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EFFECTS OF AIRCRAFT NOISE AND SONIC BOOMS ON FISH AND WILDLIFE: A RESEARCH NEEDS WORKSHOP

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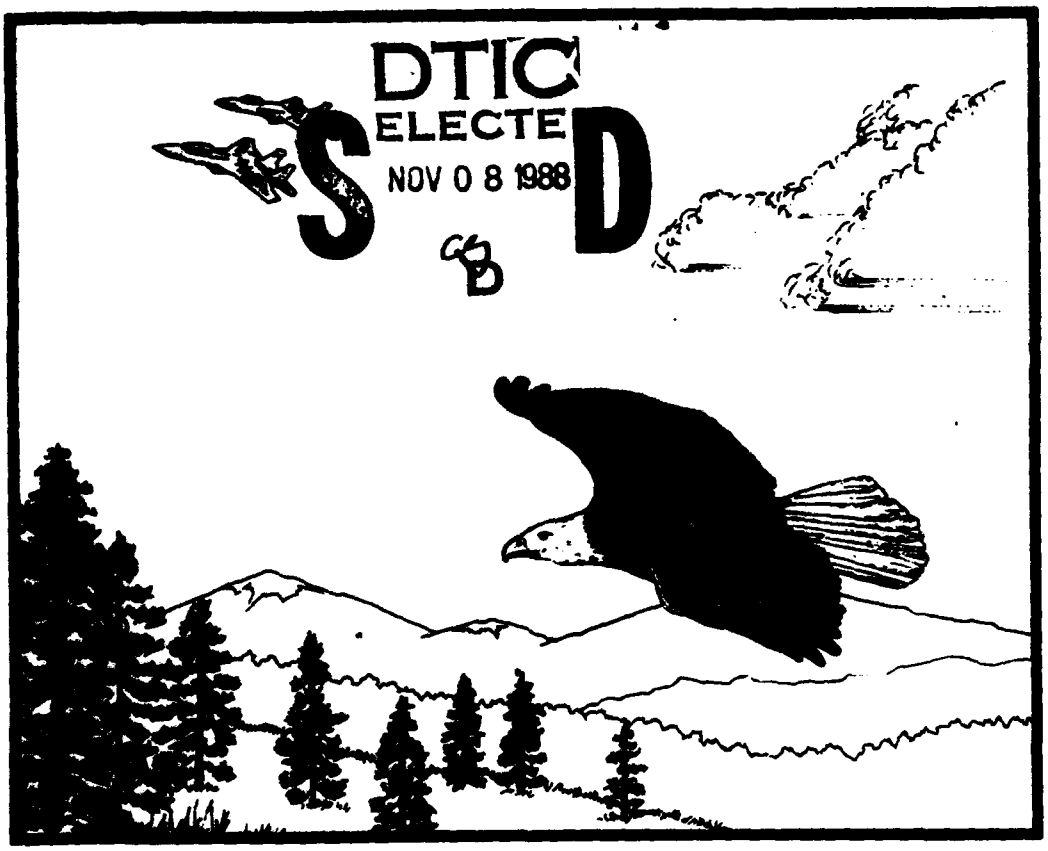

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EFFECTS OF AIRCRAFT NOISE AND SONIC BOOMS ON FISH AND WILDLIFE: A RESEARCH NEEDS WORKSHOP

April 18-21, 1988
Estes Park, CO

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EXECUTIVE SUMMARY

The U.S. Air Force conducts flight operations in assigned airspace over public and private lands to train personnel and test new technologies. One goal of the Air Force has been to make maximum use of existing aircraft operating areas, while varying military training routes to give pilots added experience. However, increasing requirements for pilot training and international agreements regarding airspace withdrawal for military use necessitate the acquisition and maintenance of additional airspace. These actions fall under the auspices of the National Environmental Policy Act (NEPA) of 1969 because of the potential impacts of aircraft noise and sonic booms on fish and wildlife.

A great deal of research was conducted during the 1960's and 1970's to determine the likely effects of commercial supersonic jet aircraft on the environment. This research focused on the potential adverse ecological impacts on humans. The knowledge gained from this research does not apply directly to wildlife on areas with low-altitude overflights by aircraft at subsonic and sometimes supersonic speeds.

Although some research on the effects of subsonic and supersonic aircraft noise on animals has been done, large data gaps exist, thus making Air Force compliance with NEPA requirements difficult in regard to its flying mission. In addition, perceived, real, or inaccurate analyses of Air Force statements on the effects of aircraft noise on wildlife by the general public have resulted in additional delays of flight operation expansion. The burden of proof that no significant adverse effects on wildlife will result if any proposed airspace use modification is implemented is on the Air Force.

On April 18-21, 1988, in cooperation with Fish and Wildlife Service Region 4, Atlanta, and the U.S. Air Force Engineering and Services Center, Panama City, Florida, the National Ecology Research Center (NERC) conducted a workshop at the YMCA Conference Center near Estes Park, Colorado, to identify and prioritize research needs on the effects of aircraft noise and sonic booms on fish and wildlife. A list of attendees is provided in Appendix A. The major objectives of the workshop were to: (1) identify gaps in the knowledge base on the effects of low-altitude aircraft operations on important wildlife species, populations, and habitat utilization; (2) identify and prioritize research needs by geographic areas; and (3) obtain recommendations for establishment of a national field research steering committee.

The workshop agenda is provided in Appendix B. The workshop started with selected presentations designed to share information on current research activities and the related topics of aircraft noise measurement and physiological measurement of stress in animals. The three workgroups (Southwest, Pacific Northwest, and Southeast/Central) then convened to begin the process of identifying general and specific research needs. Following this process, the entire group reconvened on the second day and each workgroup presented

its list of research needs. Questions and discussion followed each workgroup's presentation. On the morning of the third day, the workgroups met to: (1) modify their existing research needs in response to interactions with the other workgroups, (2) develop additional research needs, and (3) rank the top five proposed studies for their geographic region.

On the final afternoon of the workshop, each workgroup presented its five priority research needs to the entire group. These 15 research needs (five from each workgroup) are identified and detailed in the following section along with an attached ranking form. Research needs that were not in the final 15 do not have an attached ranking form. The numerical scores for study rankings are only relative within workgroups and not between workgroups because individual workgroups varied in regard to the stringency with which they assigned relative numerical values for the ranking criteria. Following the presentations, each participant was given a 3"x5" card and instructed to write down his workgroup name (to discourage partisan voting) and to identify 5 of the final 15 research needs as having the highest priority. This identification of five top priority research needs was done to assist in research decisionmaking and in response to anticipated Air Force field research funding limitations.

Tabulation of the voting results revealed that the workshop participants believed the following five research needs had the highest priority:

(1) effects of aircraft noise and ordnance on bighorn sheep in the southwestern United States (Southwest Workgroup);

(2) behavioral reactions and energetic costs of low-altitude subsonic aircraft flights on caribou (Pacific Northwest Workgroup);

(3) behavioral reaction and energetic costs of aircraft disturbance on geese in Alaska (Pacific Northwest Workgroup);

(4) impacts of helicopter and low-altitude, high-speed aircraft overflights on wintering waterfowl along the mid-Atlantic and Gulf coasts (Southeast/Central Workgroup); and

(5) effects of low-altitude subsonic airplanes and helicopters on denning bears in the Arctic (Pacific Northwest Workgroup).

Prior to the workshop closing, participants developed a list of potential candidates representing various agencies, universities, and the private sector in the United States and Canada to serve on a national field research needs steering committee to help guide and coordinate field research on the effects of aircraft noise and sonic booms on fish and wildlife (Appendix C).

Overall, the workshop was successful and objectives were met. The workshop facilitated information exchange through presentations, informal discussion, and development of a contact network on the subject. The Air Force and other entities will use the results of the workshop to help guide future research designed to fill information gaps on the effects of low-altitude aircraft operations on wildlife. The results of such research should serve to fill critical information gaps and, ultimately, to aid the Air Force in achieving its required flying mission while at the same time insuring the protection of important wildlife resources of the Nation.

WORKSHOP PRESENTATIONS

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NOISE AND SONIC BOOM IMPACT TECHNOLOGY (NSBIT) PROGRAM

Mike Thompson
U.S. Air Force

The Noise and Sonic Boom Impact Technology (NSBIT) Program is being developed by the Human Systems Division (HSD) of the Air Force Systems Command (AFSC) to assess and predict aircraft noise impacts on humans, structures, and animals. The Headquarters Air Force Engineering and Services Center (HQ AFESC), Tyndall Air Force Base, Florida, is managing the structures and animals aspects of the Program for the HSD.

Air Force mission accomplishment is dependent upon new and refined methods to describe and assess aircraft noise impacts to ensure that the National Environmental Policy Act and other legal requirements can be met without prolonged controversy. Noise exposure is a public and controversial issue; therefore, the Air Force must develop a program to assess aircraft noise impacts on the total environment.

To fill the technological gaps on aircraft noise-animal impacts, HQ AFESC proposes to conduct animal research through coordination and cooperation with other Federal agencies. Research will be conducted and data will be modeled in accordance with the NSBIT "Research Plan on the Effects of Aircraft Noise and Sonic Booms on Wild and Domestic Animals." Research areas recommended at the Air Force-Fish and Wildlife Service research design workshop will be considered to fill critical technological gaps and provide the Air Force with data for documentation required by the Environmental Impact Assessment Process.

NSBIT/animal program questions should be directed to the NSBIT/Animal Program Manager, HQ AFESC/RDV, Tyndall AFB, FL 32403, (904) 283-2942.

AIR FORCE LEGAL OBLIGATIONS INVOLVING ENVIRONMENTAL LAWS AND WILDLIFE

Doug Baur
U.S. Air Force

The Air Force is subject to all Federal environmental and general wildlife protection laws. It also must follow State law if Congress has by statute waived the U.S. Government's "Federal Supremacy" over State regulation. Congress has done so in most of the environmental laws, e.g.; Clean Air and Water Acts, Safe Drinking Water Act, and the hazardous waste laws. It has generally not done so with regard to State and local laws concerning land use planning, construction, etc. Even where Federal Supremacy has not been waived, Federal agencies extend full cooperation to, and share information with, State and local governments.

The principal legal uses to which better scientific information on the effects of aircraft noise on wildlife could be put by the Air Force would be in Environmental Impact Statements (EIS's) or Environmental Assessments (EA's) required under the National Environmental Policy Act of 1969 (NEPA), and in Section 7 consultations with the U.S. Fish and Wildlife Service (FWS) or the National Oceanographic and Atmospheric Administration (NOAA) under the Endangered Species Act.

Federal agencies must accomplish an environmental analysis under NEPA for every new proposed action. If the proposed action is one which "significantly affects the quality of the human environment," a full EIS covering the environmental effects of both the proposed action and any reasonable alternatives to it must be prepared and presented to the public and other reviewers before the proponent agency can proceed with the action. If the action involves flying aircraft, the effects of aircraft noise on both humans and wildlife nearby must be detailed in the EIS. An EIS that has legal shortcomings, or inadequate or erroneous scientific data, can result in a court injunction against the project until the EIS's deficiencies are cured in a rewritten and republicized version. Thus, the Air Force wants its EIS's to contain accurate and complete scientific information on all the effects of aircraft noise.

Whenever the possibility exists that a threatened or endangered species which is on the Federal list may be adversely affected by a Federal agency's activities, the agency must cease the harmful activity while it undertakes a Section 7 consultation with the FWS or NOAA. The agency needs to submit, with its request for formal consultations, a risk assessment on the expected effect of its project on the species and/or habitat. If FWS or NOAA make a "may affect" determination based on risk assessment, the agency then issues a biological opinion on the issue, with a jeopardy or no jeopardy decision. If a jeopardy decision is made, FWS or NOAA will suggest reasonable and prudent alternatives that <u>must</u> be implemented by the proponent agency in order to avoid the jeopardy decision. If no reasonable and prudent alternatives to the jeopardy decision exist, the proposed project stops.

NEVADA ACTIVITIES

Rory E. Lamp
Nevada Department of Wildlife

As a result of the U.S. Navy's decision to initiate a supersonic operating area in central Nevada, the State of Nevada, through the Department of Wildlife, began a project designed to monitor the effects of supersonic and subsonic aircraft disturbances on big game, upland game, waterfowl, and nongame species. The project design was to include a literature search and a questionnaire to address the impacts of Navy aircraft activity on public recreation. One hundred and nine days were spent in the field observing wildlife reactions to noise disturbances resulting from normal U.S. Navy aircraft training activities. Initial observations indicated that big game species react to aircraft noise with minor startle reactions. Data on reactions by upland game species to noise were too few for conclusions. Waterfowl were the most sensitive of all groups observed, particularly to low-level subsonic overflights. Raptors and shorebirds appeared to be sensitive to low-level aircraft disturbances as well. Thirty-nine percent of the public recreationists were found to respond to aircraft disturbances with annoyance or extreme annoyance.

In conclusion, the results of the study support the conclusions of similar studies on the subject of aircraft disturbances to domestic animals and wildlife. More data are needed for big game and upland game species before conclusions can be drawn. More data on long-term effects of aircraft disturbances will be needed to conclusively resolve this wildlife issue.

RESPONSE OF STAGING AND MOLTING PACIFIC BLACK BRANT AND OTHER GEESE TO AIRCRAFT DISTURBANCES IN ALASKA

David H. Ward and Dirk V. Derksen
Alaska Fish and Wildlife Research Center

Effects of aircraft overflights on staging Pacific black brant and other geese are currently being studied on the Alaska Peninsula at Izembek Lagoon. Similarly, a new study of molting brant was initiated on the North Slope of Alaska near Teshepuk Lake in summer 1987. The objectives of these two research projects are to: (1) determine the effect of aircraft overflights and other human activity on the behavior, distribution, and habitat use of brant; (2) evaluate the expected impact of disturbance on the energetics of migration; (3) record and examine noise associated with incidental and experimental aircraft overflights; and (4) provide recommendations to government agencies for reduction or mitigation of any adverse impacts.

Aircraft (54%) and hunters (6%) were the most frequent human-related disturbance, and bald eagles (24%) were the most important natural disturbance during fall staging of brant at Izembek Lagoon between 1985 and 1987. Potential incidental disturbances were few, occurring at a rate of 1.4/h of observation. Preliminary results indicate that the response of brant to single- and multi-engine airplanes decreased with both greater altitude and greater lateral distance during experimental overflights. Response to helicopters also decreased with greater lateral distance, but response was either slightly influenced (Bell 206-B helicopter) or actually increased (Bell 205 helicopter) with greater altitude. The response of brant was greatest for the Bell 205 helicopter and, unlike other aircraft types, the intensity of the response by brant did not decrease as altitude of the Bell 205 increased up to 762 m (2,500 ft). The Bell 205 caused brant to initially respond from a farther distance, and the magnitude of the response was correlated with the measured intensity of noise.

OVERVIEW OF THE DESERT NATIONAL WILDLIFE RANGE AND ITS USE BY THE U.S. AIR FORCE

Dave Brown
Desert National Wildlife Range

Research studies to assess the impacts of airplane noise and ordnance on desert bighorn sheep on the Desert National Wildlife Range (NWR) have not been conducted. From our perspective, there is a need for this type of research, and the NWR is a logical study site because of the high level of use by military planes in close proximity to desert bighorn sheep. The following is a brief description of the existing situation.

The Desert National Wildlife Range was established by an Executive Order in 1936 for the conservation of desert bighorn sheep and their habitat. It encompasses 1.5 million acres located in the Mohave Desert region of southern Nevada just north of the City of Las Vegas. The area consists of six mountain ranges with elevations of 2,500 ft in the valleys, rising to nearly 10,000 ft at the highest point in the mountains. Vegetation zones include desert shrub communities with creosote bush and bursage at the lowest elevations. Several thousand feet above the valleys, Mohave yucca, cactus, and Joshua trees become abundant. Above 6,000 ft, there is a zone of pinyon and juniper, which is replaced at 7,000 to 9,000 ft by ponderosa pine and white fir. Near 10,000 ft, the only trees are bristlecone pine. Distribution of bighorn sheep varies by season of the year but generally occurs in the middle elevations. The current bighorn sheep population comprises 1,500 to 1,600 individuals.

Under the terms of a Military Land Withdrawal and a Memorandum of Understanding between the U.S. Air Force and the U.S. Fish and Wildlife Service, the Air Force is authorized to use the western portion of Desert NWR (approximately 860,000 acres) to train pilots and evaluate weapon systems. This use includes air-to-air gunnery practice and air-to-ground firing of ordnance into specific target areas. Air Force fighter jet planes involved in these exercises are primarily from Nellis Air Force Base, located near Las Vegas. Almost all of the air space over Desert NWR is restricted to military use. The most current figures for the level of use are for 1985, which indicate about 15,500 training sorties (each sortie includes one take-off and landing) over Desert NWR for the year.

When the Military Land Withdrawal Act of 1986 was passed, Congress mandated that an evaluation of the cumulative effects of the military activities, including those on fish and wildlife, be completed. Little in-depth research has been conducted on the effects of military activities on desert bighorn sheep or other wildlife species.

NATIONAL PARK SERVICE AIRCRAFT EXTERNAL AVIATION MANAGEMENT ACTIVITIES

Steve Hodapp
National Park Service

Impacts of aircraft sound in National Park Service (NPS) areas have been identified as a concern by the Department of the Interior since the early 1970's. In the 1980's, there was significant controversy regarding aircraft operations at Grand Teton National Park concerning expanded use of the Jackson Hole Airport and at Grand Canyon National Park concerning the sightseeing tour industry.

In the 1975 Grand Canyon Enlargement Act, Congress directed the Secretary of the Interior to provide recommendations to the Federal Aviation Administration (FAA) to mitigate aircraft impacts if it was determined that aircraft sound was causing a significant adverse effect on the natural quiet and experience of the park. By the early 1980's, the number of tour flights had increased to over 45,000 annually and the NPS initiated a data gathering and planning process designed to quantify impacts and develop recommendations for mitigation. In May 1986, the NPS released its environmental assessment for aircraft management at Grand Canyon National Park. Interest in this issue intensified following a June 1986 mid-air collision between two tour aircraft, which resulted in the deaths of 26 persons. Shortly after this accident, a law was introduced in Congress to address Grand Canyon overflights, and the FAA began development of regulations to control flights at Grand Canyon National Park.

Special Federal Aviation Regulation (SFAR) 50-1 was adopted June 15, 1987. This regulation did not significantly restrict existing tour operations, but did require that all air tour operators meet Part 135 specifications, fly fixed routes and altitudes, fly no closer than 500 ft from the surface, and use appropriate radio call frequencies. Altitude/route restrictions were also placed on general aviation aircraft.

Congress found SFAR 50-1 inadequate to protect Grand Canyon National Park and, in August 1987, passed Public Law 100-91 based on a determination that aircraft activity over the Park had a significant adverse effect on the Park's natural quiet. Further, the law required establishment of flight-free zones (areas large enough to ensure that sound from aircraft traveling adjacent to the area is not detectable by most visitors) and a prohibition on below-rim flights. The law also required a Servicewide study of aircraft impacts.

The Department of the Interior recommendation for Grand Canyon airspace management calls for designation of flight-free zones over 530,000 acres or 44% of the Park area. No flights (except for emergency/administrative flights) would be permitted below an elevation of 14,500 ft mean sea level in these zones. This would be the largest airspace reservation for resource conservation purposes in the country. The recommendation has been forwarded to the FAA, and the final ruling should be completed in June 1988.

The Servicewide studies will be completed cooperatively with the U.S. Forest Service. The basic project outline calls for development of major contracts to gather sociological information from visitors and acoustical data quantifying aircraft/ambient sound levels from a cross-section of Park areas. A study to determine the appropriate noise measurement techniques for gathering the acoustical data is already underway. A report to Congress summarizing the data results and including recommendations for legislative/regulatory action is scheduled for completion by August 1990.

MEASUREMENT AND MODELING OF PHYSIOLOGICAL RESPONSES TO STRESS

James C. Ha
Biology Department
Colorado State University

Any discussion of the current status of physiological measurement of stress raises two questions: (1) What can be measured?, and (2) What should be measured? My presentation restricts itself to those parameters which can be reliably obtained from unrestrained wild animals through the use of telemetry.

What can be Measured?

Telemetry can provide several types of information besides animal location. Activity is now routinely telemetered. Body temperature also is easily measured by telemetry but, while it provides a good index to metabolic rate in ectotherms, its usefulness as a measure of stress is questionable.

A better measure of many physiological events is heart rate. The technology to measure heart rate is now available in larger packages and can be used in smaller species (e.g., ducks) if short transmitter life-span is tolerable. Good studies of behavior, stress, and heart rate have been performed by MacArthur at the University of Calgary. Other physiological measures that have been telemetered, primarily in the laboratory, include blood flow rate and respiration rate. These measures are not reliably available for free-ranging animals.

Problems in using telemeters for free-ranging animals include restricted range (generally short distances in animals smaller than ungulates), the relatively large size, difficulty in implantation and placing of electrodes, and high rates of mechanical failure due to high levels of instrumentation and electrode movement and damage.

What Should be Measured?

In order to decide on modeling needs and methods, physiological stress must be defined. Most definitions of stress are very general and, therefore, difficult to apply in practical situations. Two definitions are generally accepted: physiological and energetic.

The physiological definition suggests that chronic stress results in an increase in glucocorticoids (cortisols), and acute stress results in increased epinephrine. Epinephrine release results in increased blood glucose levels and heart action, including heart rate, thus providing a possible link between measurable parameters and important physiological changes. Several studies have linked heart rate to raised cortisol levels in domestic animals.

The energetic definition states that any increased energetic demand which occurs <u>when energy is limiting</u> is a stress on an animal. While attempts have been made to correlate energy expenditure with various telemetered parameters

(e.g., body temperature and heart rate), little success has been achieved. Currently, two other techniques provide the best results: (1) time and energy budgets, combining behavioral observations and laboratory or literature energy estimates; and (2) radio-isotopes.

In summary, raised epinephrine levels may be measured by heart rate telemetry if appropriate baseline studies become available to provide the model, while no accurate telemetry measure of energetic demand is available. The suggestion is that time and energy budgets or radio-isotopes be used to evaluate energy demand.

MODELING THE EFFECTS OF NOISE

Ann E. Bowles and Frank T. Awbrey
Sea World Research Institute

The world is so complex that no one can ever have all possible information that would be useful for making decisions about human impacts on nature. Instead, we use models to improve our understanding of situations and to help us make good decisions. The process begins with some simple assumptions and moves on to more and more complicated ones as we learn more. The model we are building organizes information so that we have a clear view of what is known and can use it to make predictions that can be tested. The framework that results then helps to guide decisions and make them consistent and more likely to be correct.

The initial, very important part of the process will be to explain and resolve, as much as possible, the contradictions in published reports. The literature synthesis that precedes the model must identify and eliminate anecdotal and possibly flawed reports. Any conclusions must be supported by data. The consensus of the reports that survive expert review will go into a synthesis that is the basis for the model.

The model will be a tool for providing planners with objective information for assessing potential impacts of aircraft noise and sonic booms on animals. It is not a substitute for good judgement or research. Research will be necessary to make the model more rigorous in its predictions and to establish its limits. Properly done, the model(s) will replace speculation about what might happen with reasoned predictions.

The model itself must include as much biological information as possible about a species. It should be conservative and assume the reasonable worst case in making predictions about how noise will affect animals. It should predict the ecological effects of noise on animal populations because that is the issue of real concern here. Whether a few individuals die because of noise or from some other cause can be very difficult to determine. A more important point is whether stress or even deaths due to noise are significant to the health of the population.

All impact predictions implicitly assume that there is some relationship between the intensity and amount of a stimulus and the response of the animal. An animal's perception is important. Estimating dosage requires that we know how much of a stimulus animals can perceive. Stimuli that animals cannot perceive are not likely to have much effect on them. Responses also are modified by other factors, such as context and experience. Responses of individual animals will vary widely, and the model must account for these variations.

If the model is to be of real utility, it will have to predict not only short-term effects of noise but also medium and long-term effects. Studies will have to be well designed and carried on long enough to show whether apparent effects are truly adverse to the population. Quality control panels and peer review of all work will help ensure that the effort put into this research yields the most valid results possible.

RESEARCH NEEDS IDENTIFIED

This part of the workshop record identifies the specific research needs that the three workgroups developed. First, the top five research needs and their associated ranking scores are reported for each workgroup, and then the remaining research needs that participants did not score into the top five are listed in the last section. These other research needs do not have ranking scores developed for them.

Participants were asked to vote for the 5 research needs of the final 15 research needs (5 from each workgroup) that they believed were the highest priority. The following listing shows the final 15 research needs considered the highest priority by the workshop participants and the relative number of votes that each research need received. This vote value should not be confused with the ranking scores that were developed for each of the final 15 research needs and which are reported with each research need description.

Voting Results - Top 15

Final 15 Research Needs	Number of Votes
1. Effects of aircraft noise and ordnance on bighorn sheep in the southwestern United States (Southwest Workgroup).	19
2. Behavioral reactions and energetic costs of low-altitude subsonic aircraft flights on caribou (Pacific Northwest Workgroup).	19
3. Behavioral reaction and energetic costs of aircraft disturbance on geese in Alaska (Pacific Northwest Workgroup).	19
4. Impacts of helicopter and low-altitude, high-speed aircraft overflights on wintering waterfowl along the mid-Atlantic and Gulf coasts (Southeast/Central Workgroup).	18
5. Effects of low-altitude subsonic airplanes and helicopters on denning bears in the Arctic (Pacific Northwest Workgroup).	14
6. Effects of low-altitude military overflights on distribution and nesting success of wading birds in the Everglades (Southeast/Central Workgroup).	13
7. Physiological and behavioral effects of sonic booms on domestic animals and wildlife (Southeast/Central Workgroup).	13

8. Effects of aircraft disturbance on Sonoran pronghorn behavior (Southwest Workgroup). 11

9. Short- and long-term impacts of aircraft noise on the histology of the inner ear of birds (Southwest Workgroup). 11

10. Effects of aircraft noise on reproductive success of waterfowl in the Prairie Pothole region (Southeast/CentralWorkgroup). 9

11. Effects of aircraft noise and visual disturbance on colonial cliff-nesting seabirds (Pacific Northwest Workgroup). 8

12. Feasibility of continuously monitoring noise exposure levels to free ranging animals to determine realistic noise exposures over prolonged periods (Pacific Northwest). 8

13. The effects of aircraft noise on feeding rates and nesting success of osprey (Southeast/Central Workgroup). 7

14. Impacts of aircraft overflight noise on burrowing animal communities of the West (Southwest Workgroup). 7

15. Impacts of overflights on nesting bald eagles (Southwest Workgroup). 4

NOTE:

The Pacific Northwest Workgroup identified a study entitled "Long-term effects of low-altitude aircraft flights on nesting and reproduction of peregrine falcons and associated raptors" that would have been one of the 5 most important studies in the final 15 research needs. However, it was removed for ranking and voting purposes because of the high probability that the Air Force in Alaska will fund the study (see page 74 for this research need summary).

Southeast/Central Workgroup - Top Five

Five highest priority research needs.

		Page
1.	Effects of low-altitude military overflights on distribution and nesting success of wading birds in the Everglades (Total rank score = 48)	17
2.	Impacts of helicopters and low-altitude, high-speed military aircraft on wintering waterfowl (Total rank score = 46)	19
3.	Physiological and behavioral effects of sonic booms on domestic animals and wildlife (Total rank score = 36)	22
4.	Effects of aircraft noise on feeding rates and nesting success of osprey (Total rank score = 34)	24
5.	Effects of aircraft noise on reproductive success of waterfowl in the Prairie Pothole region (Total rank score = 30)	26

RESEARCH NEED SUMMARY

Workgroup: Southeast/Central Need No. 1

1. Descriptive title for proposed study: Effects of low-altitude military overflights on distribution and nesting success of wading birds in the Everglades.

2. Species or group of species/population(s)/habitat(s): Mixed species colonies of wading birds, including white ibis, great egret, snowy egret, little blue heron, and tricolored heron.

3. Geographic area(s): Everglades.

4. Study objective(s): The objectives would be to: (1) measure aircraft noise at selected testing colonies, and (2) determine impacts of overflights on parental behavior and nesting success.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would be to use historical data on distribution of nesting colonies to select control and experimental sites and then to conduct field measurements of scheduled low-level [<500 ft above ground level (agl)] overflights of fixed-wing aircraft and helicopters and quantify responses of wading birds.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The results should be useful in modeling potential impacts to other wading bird colonies.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): Research results would fill in a gap in our current knowledge on the effects of low-altitude flights (<500 ft agl) on wading bird populations.

8. Estimated study time and cost requirements: The study would last from October 1988 to December 1990 at an estimated cost of $140,000.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): The likely risks would include: (1) the ability to schedule low-altitude flights (<500 ft agl), and (2) the distribution of colonies in and out of flight corridors.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): There is good background information on wading bird colonies in the Everglades, and methodologies are already developed to conduct the study of impacts of overflights on wading birds. The species group is of high public interest and, generally, the populations are rapidly declining.

STUDY RANKING

Workgroup: Southeast/Central

Short Title: Effects of low-altitude military overflights on distribution and nesting success of wading birds in the Everglades.

	Criterion	Definition	Scaling
1.	Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30* Medium.....20 Low.....10
2.	Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1 Medium.....3 Low.....5*
3.	Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5* Medium.....3 Low.....1
4.	Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5 2-4 years.....3* >4 years.....1
5.	Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5* Medium.....3 Low.....1

Total score 48

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

RESEARCH NEED SUMMARY

Workgroup: Southeast/Central Need No. 2 - Phase I

1. Descriptive title for proposed study: Impacts of helicopters and low-altitude, high-speed military aircraft on wintering waterfowl.

2. Species or group of species/population(s)/habitat(s): Wintering waterfowl.

3. Geographic area(s): Gulf coast.

4. Study objective(s): The study would seek to identify the interspecific range of sensitivities to overflights.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would be to measure response of bird behavior and relocation to aircraft altitude, frequency of flights, and time of day using 5-person ground teams and aircraft surveys.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: This would be the first step in a multistep process. The first step is to identify species where there is greatest response to aircraft overflights for follow-up research. Species with no or little response can be assumed to be unaffected.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The study results should fill in gaps in information on bird species' behavioral response to overflights for species not yet studied.

8. Estimated study time and cost requirements: The duration is estimated to be 1 to 2 years, and to cost $20,000 to $30,000 (FWS personnel) per location (each location will have control(s) and treatment area(s).

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There should be low risk of adverse impacts.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): Results should be applicable across the southeast. The research would provide data on ducks, which have large public following. There is the potential for interagency cost-sharing.

RESEARCH NEED SUMMARY

Workgroup: Southeast/Central Need No. 2 - Phase II

1. Descriptive title for proposed study: Impacts of helicopters and low-altitude, high-speed military aircraft on wintering waterfowl.

2. Species or group of species/population(s)/habitat(s): Species targeted in Phase I as sensitive to noise.

3. Geographic area(s): Mid-Atlantic coast, Mississippi basin (includes both Mississippi and Atlantic flyways). Helicopters in Mississippi and central flyways, jets in Atlantic flyway.

4. Study objective(s): The objective would be to identify and measure adverse impacts to the waterfowl population(s) at risk.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): Field study would involve quantifiable behavioral observation to develop activity/energy budgets in disturbed and control situations. The research would include night observations. The lab portion of this study could be closely coordinated with Research Need No. 1 from the Pacific Northwest workgroup and Research Needs 5 and 9 from the Southeast/Central workgroup, to increase cost-effectiveness. The research would attempt to relate success on summer breeding grounds to winter habitat utilization.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: One goal would be to apply physiological measurements to determine bird health and condition for return to breeding grounds.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The benefits would include determination of suitable mitigation of impacts through time-of-year use restrictions and time-of-year flight path relocation.

8. Estimated study time and cost requirements: The duration would be 3-4 years. The cost is unknown.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There would be minimal adverse effects from the study since the waterfowl will be subjected to the noise from increased military operations regardless of whether the study is conducted or not.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): Waterfowl species overlap between flyways. There is a large hunting lobby and public interest is high. The potential for interagency cost sharing could be high.

STUDY RANKING

Workgroup: Southeast/Central

Short Title: Impacts of helicopters and low-altitude, high-speed military aircraft on wintering waterfowl, Phases I and II.

	Criterion	Definition	Scaling
1.	Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30* Medium.....20 Low.....10
2.	Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1 Medium.....3* Low.....5
3.	Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5* Medium.....3 Low.....1
4.	Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5 2-4 years.....3* >4 years.....1
5.	Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5* Medium.....3 Low.....1

Total score 46

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

RESEARCH NEED SUMMARY

Workgroup: Southeast/Central Need No. 3

1. Descriptive title for proposed study: Physiological and behavioral effects of sonic booms on domestic animals and wildlife.

2. Species or group of species/population(s)/habitat(s): Eggs, fledglings, domestic livestock, large and small mammals, reptiles, and adult birds.

3. Geographic area(s): Edwards Air Force Base, California.

4. Study objective(s): The study would attempt to: (1) determine the physiological effects of low-altitude sonic booms on animals resulting from supersonic overflights, and (2) determine the tolerance levels of shock vibration and frequency of sonic booms on wildlife.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The field study would: (1) confine a variety of species and conduct supersonic low-altitude [up to 1,000 ft above ground level (agl)] overflights and produce sonic booms, and (2) conduct a study on effects of one overflight versus two or more. The laboratory portion of the study would research the study effects of species orientation/recovery and temporary or permanent hearing loss. A representative cross-section of southeastern and southcentral U.S. species would be used.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: Unknown.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): As supersonic overflights are expected to increase, more data are needed to substantiate and document the effects of sonic booms on the environment. Focus would be on a worst-case analysis.

8. Estimated study time and cost requirements: The study duration is estimated to be 6-8 months at a cost of $60,000.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): The risks could be high due to possible destruction of test animals and potential adverse public reaction.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): Based on the study results, future experiments related to long-term impacts on wildlife should be conducted. A major advantage to this study is that it would be conducted under readily controlled experimental conditions and could lay the foundation for future applied field research projects, such as studies on marine mammals and fish. This study could be "dove-tailed" with goose, ungulate, or waterfowl studies in the southeast as well as with studies in Alaska and possibly with similar studies in the southwest.

STUDY RANKING

Workgroup: Southeast/Central

Short Title: Physiological and behavioral effects of sonic booms on domestic animals and wildlife.

	Criterion	Definition	Scaling
1.	Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30 Medium.....20* Low.....10
2.	Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1 Medium.....3* Low.....5
3.	Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5* Medium.....3 Low.....1
4.	Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5 2-4 years.....3* >4 years.....1
5.	Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5* Medium.....3 Low.....1

Total score 36

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

RESEARCH NEED SUMMARY

Workgroup: Southeast/Central Need No. 4

1. Descriptive title for proposed study: Effects of aircraft noise on feeding rates and nesting success of osprey.

2. Species or group of species/population(s)/habitat(s): Osprey.

3. Geographic area(s): Central Florida lakes.

4. Study objective(s): The study objectives would be to: (1) measure aircraft (fixed-wing and helicopter) noise, (2) identify behavioral responses to noise, and (3) evaluate/identify differences in feeding rates/consumption and nesting success between noise/no noise populations.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would be to make field noise measurements and observations of responses to overflights, comparing activity to control populations.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The results could be applied to other populations.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The study results should enhance knowledge about aircraft effects on birds of prey.

8. Estimated study time and cost requirements: The research duration is estimated to be from August 1988 to December 1990 at a cost of $120,000 (including $30,000 for noise monitoring equipment).

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There should be a high probability of success with a low probability of adverse effects.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): The osprey is a high-interest species worldwide and there are large populations in Florida, which would facilitate the study. The disadvantage is that raptors in general seem quite tolerant to overflight disturbance.

STUDY RANKING

Workgroup: Southeast/Central

Short Title: Effects of aircraft noise on feeding rates and nesting success of osprey.

	Criterion	Definition	Scaling
1.	Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30 Medium.....20* Low.....10
2.	Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1 Medium.....3* Low.....5
3.	Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5 Medium.....3* Low.....1
4.	Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5 2-4 years.....3* >4 years.....1
5.	Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5* Medium.....3 Low.....1

Total score 34

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

RESEARCH NEED SUMMARY

Workgroup: Southeast/Central Need No. 5

1. Descriptive title for proposed study: Effects of aircraft noise on reproductive success of waterfowl in the Prairie Pothole region.

2. Species or group of species/population(s)/habitat(s): Nesting waterfowl.

3. Geographic area(s): Prairie Pothole region of the U.S. (North Dakota, South Dakota, Montana).

4. Study objective(s): The objective would be to determine the effects of aircraft noise on the reproductive success of the most characteristic species of waterfowl nesting in the Prairie Pothole region of the U.S.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would be to: (1) characterize aircraft noise (amplitude, modulation, frequency of occurrence, approach angle, duration); (2) describe waterfowl behavioral reaction by species; (3) determine effects on reproductive success; and (4) estimate effects on species population size (fall migration). Study areas are readily available, and new aircraft flight corridors are planned in the region. A large amount of background data on waterfowl production in the Prairie Potholes is available at the USFWS Northern Prairie Wildlife Research Center.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: Steps 3 and 4 above would likely require models.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The findings should identify those characteristics of aircraft noise that do or do not affect breeding waterfowl and should indicate the degree of impacts. This should facilitate the design of flight corridors that best serve training needs with a minimum impact to breeding waterfowl.

8. Estimated study time and cost requirements: The time required is estimated at 12 months spread over 3 years. The cost is estimated at $65,000 (not including audio equipment).

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): The probability of success is high due to the usefulness of any information developed and the existence of needed techniques. There should be no major stresses on waterfowl other than that associated with searches for nests. Widely dispersed waterfowl during the breeding season will increase study difficulty.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): To a large degree, the findings can be extrapolated to the same species breeding elsewhere. There is high public interest in waterfowl nationally. Local interest could also be high because of the study area's proximity to a B-52 base in the northern Great Plains.

STUDY RANKING

Workgroup: Southeast/Central

Short Title: Effects of aircraft noise on reproductive success of waterfowl in the Prairie Pothole region.

	Criterion	Definition	Scaling
1.	Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30 Medium.....20* Low.....10
2.	Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1 Medium.....3* Low.....5
3.	Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5 Medium.....3 Low.....1*
4.	Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5 2-4 years.....3* >4 years.....1
5.	Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5 Medium.....3* Low.....1

Total score 30

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

Southwest Workgroup - Top Five

Five highest priority research needs.

		Page
1.	Short- and long-term impacts of aircraft noise on the histology of the inner ear of birds (Total rank score = 50)	30
2.	Effects of aircraft noise and ordnance on desert bighorn sheep in the southwestern United States (Total rank score = 48)	33
3.	Effects of aircraft disturbance on Sonoran pronghorn behavior (Total rank score = 46)	36
4.	Impacts of aircraft overflight noise on burrowing animal communities of the West (Total rank score = 40)	38
5.	Impacts of aircraft overflights on nesting bald eagles (Total rank score = 36)	40

RESEARCH NEED SUMMARY

Workgroup: Southwest Need No. 1

1. Descriptive title for proposed study: Short- and long-term impacts of aircraft noise on the histology of the inner ear of birds.

2. Species or group of species/population(s)/habitat(s): Waterfowl (suggested species: mallard) and songbirds (suggested species: starling).

3. Geographic area(s): Laboratory study.

4. Study objective(s): The objectives would be to determine if aircraft-generated noise causes physical damage to the hearing organ of birds and, if so, the extent to which damage is permanent or temporary and to determine the auditory effects of many types of subsonic and supersonic aircraft, and of sonic booms, at varying noise intensities and durations. The research would examine cumulative effects of noise over time.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would be to mimic noise levels, frequencies, and durations likely to occur from actual training operations and examine the effect of many flights over a short period of time vs. a few flights over a long period of time. Behavioral studies on impacted birds to determine reactions to song and vocalizations of own species and ability to detect predators would also be conducted.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The results should be highly applicable since they would lead to understanding of actual causes of behavioral responses to noise. It is highly probable that a model could be developed showing the relationship between noise and degree of hearing loss.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): This study could be critical to understanding the effects of aircraft noise and sonic booms on birds. Loss in hearing ability of birds is likely to affect ability to detect a mate, of young to learn species' song, ability to detect own young, predators, and some prey. Also, hearing loss is likely to reduce longevity and reproductive success and therefore population numbers.

8. Estimated study time and cost requirements: The research is expected to require 1-2 years at a maximum cost of $150,000. The study would use two researchers and require minimal equipment purchase if they use a lab already set up for this type of experimentation.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): The probability of accomplishing the study objectives should be high. Laboratory animals (at least some) would have to be sacrificed.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): The study results would probably be applicable to most waterfowl and passerine species in all areas and over a wide range of habitats. The experimental species are common, but the research results should be applicable to endangered and threatened avian species.

STUDY RANKING

Workgroup: Southwest

Short Title: Short- and long-term impacts of aircraft noise on the histology of the inner ear of birds.

	Criterion	Definition	Scaling
1.	Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30* Medium.....20 Low.....10
2.	Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1 Medium.....3 Low.....5*
3.	Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5* Medium.....3 Low.....1
4.	Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5* 2-4 years.....3 >4 years.....1
5.	Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5* Medium.....3 Low.....1

Total score 50

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

RESEARCH NEED SUMMARY

Workgroup: Southwest Need No. 2

1. Descriptive title for proposed study: Effects of aircraft noise and ordnance on desert bighorn sheep in the southwestern United States.

2. Species or group of species/population(s)/habitat(s): Desert bighorn sheep.

3. Geographic area(s): Southwestern United States (suggested areas are Cabeza Prieta National Wildlife Refuge, Desert National Wildlife Range, Goldwater Air Force Range, Fallon area (Utah), and Utah Test and Training Range).

4. Study objective(s): The objective would be to determine the effects of aircraft noise and ordnance on desert bighorn sheep population dynamics, physiology, habitat utilization, disease, and behavior.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would be to obtain baseline population data, establish a monitoring program (physiology, behavioral, habitat, and reproductive success) and include seasonal, time of day, weather, and sound exposure data. Monitoring of sheep populations not subject to aircraft noise is recommended in order to establish a norm for behavior.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The information developed should be applicable for impact prediction.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): It should be possible to use study results to predict impacts and recommend alternatives or mitigation.

8. Estimated study time and cost requirements: The research is estimated to take 2-4 years. Six animals would be monitored. The costs are estimated at $80,000 for the first year and $50,000/yr for the next 3 years. $40,000 sound monitoring equipment is expected to be required.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There should be a good probability of accomplishing study objectives with minimum risk to bighorn sheep. There may be a potential problem with the military allowing access to study areas. Access to areas of low-flying aircraft may be more liberal on Cabeza Prieta and Goldwater Range than Desert Range. However, population estimates on Desert are approximately 1,800 sheep, whereas the population for the Cabeza Prieta and Goldwater Range combined is approximately 500 sheep. Desert Range would allow for more frequent observations.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): The study results should be applicable to other sheep populations. The species is of high interest to the military and the public.

STUDY RANKING

Workgroup: Southwest

Short Title: Effects of aircraft noise and ordnance on desert bighorn sheep in the southwestern United States.

	Criterion	Definition	Scaling
1.	Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30* Medium.....20 Low.....10
2.	Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1 Medium.....3 Low.....5*
3.	Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5* Medium.....3 Low.....1
4.	Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5 2-4 years.....3* >4 years.....1
5.	Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5* Medium.....3 Low.....1
			Total score 48

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

RESEARCH NEED SUMMARY

Workgroup: Southwest Need No. 3

1. Descriptive title for proposed study: Effects of aircraft disturbance on Sonoran pronghorn behavior.

2. Species or group of species/population(s)/habitat(s): Sonoran pronghorn.

3. Geographic area(s): Cabeza Prieta National Wildlife Refuge and Goldwater Air Force Range (Arizona).

4. Study objective(s): The research would attempt to document, quantify, and interpret behavioral responses to aircraft disturbance and conduct a complete aerial survey of the herd in the U.S.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The study would involve using field observers and automatically monitored radio-collared pronghorn. Two months each in spring and fall in the field would be required. Day and night observations would be included as would all types of aircraft disturbance and ordnance.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The research should result in some ability to model behavioral responses and to recommend altitudes and types of aircraft having minimal impacts.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The study should result in solid data for analyzing Marine and Air Force activities in the area and identifying specific problems and add to the overall data base and literature used in the EA and EIS review process.

8. Estimated study time and cost requirements: The study is estimated to require 2 years at a cost of $150,000.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There are risks associated with capturing pronghorn. There could be difficulties with obtaining good repeatable field observations due to the wilderness status of most of the Sonoran pronghorns range and the limitations placed on methods of access and travel by researchers.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): The subspecies is Federally listed as endangered and in the U.S. is restricted to this area. The subspecies is currently subject to interagency agreements and complementary studies of habitat use and herd productivity. The study results may have some cross application to other arid land pronghorn, such as those populations in west Texas.

STUDY RANKING

Workgroup: Southwest

Short Title: Effects of aircraft disturbance on Sonoran pronghorn behavior.

	Criterion	Definition	Scaling
1.	Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30* Medium.....20 Low.....10
2.	Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1 Medium.....3* Low.....5
3.	Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5 Medium.....3* Low.....1
4.	Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5* 2-4 years.....3 >4 years.....1
5.	Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5* Medium.....3 Low.....1
			Total score 46

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

RESEARCH NEED SUMMARY

Workgroup: Southwest Need No. 4

1. Descriptive title for proposed study: Impacts of aircraft overflight noise on burrowing animal communities of the West.

2. Species or group of species/population(s)/habitat(s): Obligate burrow-dwelling species, including desert tortoise, burrowing owl, kit fox, and kangaroo rat.

3. Geographic area(s): Cabeza Prieta National Wildlife Refuge and Naval Air Station Fallon.

4. Study objective(s): The research would seek to determine use by appropriate species in available habitats and evaluate impacts on reproductive success caused by overflight disturbances.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): Basic field study would include: (1) determining whether distribution and habitat use appears to be affected by overflight activity; and (2) if Phase 1 is completed on time, determining more detailed effects on distribution and reproductive success.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: If population density and/or reproductive differences are found, results would provide needed data for modeling/predicting impacts on such populations.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): At the current time, there are no data on the effects of overflights on this ecological community.

8. Estimated study time and cost requirements: The study would require 2 years or less, depending upon results of Phase 1 and cost $95,000 for year 1 (including all equipment) and $60,000 for year 2.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There should be a low risk and high probability of successful study completion.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): The results should be broadly applicable to a significant number of wildlife communities.

STUDY RANKING

Workgroup: Southwest

Short Title: Impacts of aircraft overflight noise on burrowing animal communities of the West.

	Criterion	Definition	Scaling
1.	Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30 Medium.....20* Low.....10
2.	Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1 Medium.....3 Low.....5*
3.	Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5* Medium.....3 Low.....1
4.	Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5* 2-4 years.....3 >4 years.....1
5.	Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5* Medium.....3 Low.....1
			Total score 40

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

RESEARCH NEED SUMMARY

Workgroup: Southwest Need No. 5

1. Descriptive title for proposed study: Impacts of aircraft overflights on nesting bald eagles.

2. Species or group of species/population(s)/habitat(s): Southern bald eagle.

3. Geographic area(s): Arizona - Salt, Verde, and Bill Williams Rivers, and Gladden/Bagdad Military Operations Areas.

4. Study objective(s): The objective would be to determine effects of aircraft on bald eagle nesting success, behavior, and habitat utilization.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The research would involve: (1) field observations of eagle reaction to aircraft, (2) documentation of other ill effects, (3) quantification of overflight noise levels, and (4) standardization of overflight level with noise.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: It should be possible to predict minimum aircraft altitudes at which nesting is not impacted.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The research results should be useful for planning military training routes and exercises and for conducting environmental assessments for military operations areas and other proposed actions.

8. Estimated study time and cost requirements: The research is expected to require 2 years at a total cost of $100,000

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There are already nest watchers at 23 bald eagle nests in Arizona. There should be a good probability of success with little additional adverse effects on eagles.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): If research results could be applicable to proposed changes in military training routes in the Gladden-Bagdad airspace. The study can be "piggy-backed" with present nest observations being funded by several agencies.

STUDY RANKING

Workgroup: Southwest

Short Title: Impacts of aircraft overflights on nesting bald eagles.

	Criterion	Definition	Scaling
1.	Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30 Medium.....20* Low.....10
2.	Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1* Medium.....3 Low.....5
3.	Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5* Medium.....3 Low.....1
4.	Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5* 2-4 years.....3 >4 years.....1
5.	Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5* Medium.....3 Low.....1
			Total score 36

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

Pacific Northwest Workgroup - Top Five

Five highest priority research needs.

		Page
1.	Behavioral reaction and energetic costs of aircraft disturbance on geese in Alaska (Total rank score = 48)	43
2.	Effects of low-altitude subsonic airplanes and helicopters on denning bears in the Arctic (Total rank score = 48)	46
3.	Behavioral reactions and energetic costs of low-altitude subsonic aircraft overflights on caribou (Total rank score = 46)	49
4.	The feasibility of continuously monitoring noise exposure levels to free-ranging animals to determine realistic noise exposures over prolonged periods (Total rank score = 46)	52
5.	Effects of aircraft noise and visual disturbances on colonial cliff-nesting seabirds (Total rank score = 44)	55

RESEARCH NEED SUMMARY

Workgroup: Pacific Northwest Need No. 1

1. Descriptive title for proposed study: Behavioral reaction and energetic costs of aircraft disturbance on geese in Alaska.

2. Species or group of species/population(s)/habitat(s): Brant and snow geese.

3. Geographic area(s): Alaska.

4. Study objective(s): The study would attempt to: (1) determine the energetic cost of stress activities resulting from aircraft noise, and (2) develop a predictive model of energetic cost due to aircraft noise disturbance.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The laboratory portion of the study would: (1) test state-of-the-art telemetric devices or methods for measuring heart-rate/respiration, (2) evaluate the energetic costs of stress of noise from sub and supersonic aircraft using telemetric devices, (3) implant laboratory-tested telemetric devices in wild geese and measure noise and behavioral responses of geese with and without overflight, and (4) develop a model to predict the energetic costs of aircraft disturbance from laboratory and field components of the study.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The applicability of the study results should be high since they would provide a model for predicting potential impacts (i.e., negative energy balance) of aircraft disturbance on population levels.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The study benefits should be high since at present, behavioral studies rely solely on observed behavioral reactions as relevant indicators of energetic stress. This study would tie the behavioral reactions to an energetic cost scale and allow a more accurate prediction of the potential impacts of aircraft disturbance on brant and geese populations. The study would further existing knowledge of telemetric devices for monitoring physiological behavior.

8. Estimated study time and cost requirements: The laboratory portion of the study is expected to require 1 year at an estimated cost of $25,000. The field portion of the study is expected to take 2 years at a cost of $100,000. It is believed that use of graduate students could lower these estimated costs.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): A medium risk is anticipated since telemetric devices have been tested but need refinement, and aircraft disturbance of geese already exists.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): This study would "dove-tail" with existing studies of brant and snow geese in Alaska. There is high public interest in waterfowl. There should be broad applicability of study results to other waterfowl species in other geographic areas. Interagency agreements are in place with the Minerals Management Service (MMS); the Bureau of Land Management (BLM); the University of Alaska, Fairbanks; Texas A&M University; and the U.S. Army Construction Engineering Research Lab.

STUDY RANKING

Workgroup: Pacific Northwest

Short Title: Behavioral reaction and energetic costs of aircraft disturbance on geese in Alaska.

	Criterion	Definition	Scaling
1.	Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30* Medium.....20 Low.....10
2.	Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1 Medium.....3* Low.....5
3.	Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5* Medium.....3 Low.....1
4.	Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5* 2-4 years.....3 >4 years.....1
5.	Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5* Medium.....3 Low.....1

Total score 48

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

RESEARCH NEED SUMMARY

Workgroup: Pacific Northwest Need No. 2

1. Descriptive title for proposed study: Effects of low-altitude subsonic airplanes and helicopters on denning bears in the Arctic.

2. Species or group of species/population(s)/habitat(s): Polar bears and grizzly bears.

3. Geographic area(s): Arctic - Alaska and Canada.

4. Study objective(s): The study would seek to: (1) determine the effects of low-altitude aircraft overflights on the behavior of denning bears, and (2) evaluate behavioral responses of bears in areas with and without overflights.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): This study would be integrated with existing studies of grizzly bears and polar bears in Alaska by the U.S. Fish and Wildlife Service (USFWS) and Alaska Department of Fish and Game. Bears are currently being studied with satellite and conventional radio collars. Some den locations are known. The research would focus on early denning since this appears to be the time that bears are most sensitive to disturbance. Ideally, the study would be conducted during mid- to late-denning as well. The interior Alaska grizzly studies would be conducted by the State of Alaska. The northslope polar bear studies would be conducted by the USFWS.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The study results would be highly applicable, since the behavioral reaction of denning bears to low-altitude aircraft overflights has direct effects on the population. The research can be integrated into existing studies and modeled into population effects.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The benefits are that high-satellite, telemetry-heart rate transmitters could also be applied for black bears. Perhaps the information obtained could be applied to other denning animals (e.g., ground squirrels).

8. Estimated study time and cost requirements: The study is estimated to require 1-2 years. The cost is predicted to be low, since the research can be "dove-tailed" into existing studies, primarily in Alaska, and because the grizzly bear dens are located close to a Military Operations Area (MOA).

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): The risk is expected to be medium, since animals may be driven out of their dens early when little food is available.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): The study results should be applicable to other bear populations around the world. The species are sensitive. There is high public interest in the species. There are existing interagency and cooperative agreements.

STUDY RANKING

Workgroup: Pacific Northwest

Short Title: Effects of low-altitude subsonic airplanes and helicopters on denning bears in the Arctic.

	Criterion	Definition	Scaling
1.	Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30* Medium.....20 Low.....10
2.	Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1 Medium.....3* Low.....5
3.	Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5* Medium.....3 Low.....1
4.	Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5* 2-4 years.....3 >4 years.....1
5.	Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5* Medium.....3 Low.....1

Total score 48

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

RESEARCH NEED SUMMARY

Workgroup: Pacific Northwest Need No. 3

1. Descriptive title for proposed study: Behavioral reactions and energetic costs of low-altitude subsonic aircraft overflights on caribou.

2. Species or group of species/population(s)/habitat(s): Delta caribou herd - experimental; Denali caribou herd - control.

3. Geographic area(s): Interior Alaska, Central Alaska Range.

4. Study objective(s): The study would seek to: (1) quantify the energetic costs of stress and altered activity budgets of caribou resulting from noise; (2) evaluate the behavioral reactions of caribou exposed to low-altitude overflights and collect comparable data from undisturbed caribou; (3) quantify sound levels from aircraft that Delta herd caribou are exposed to; and (4) use the results from objectives 1, 2, and 3 to develop a predictive model of the energetic costs of aircraft disturbance.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would be to: (1) use an existing energetics model for caribou developed at the University of Alaska and perform additional experiments at the University to quantify the energetic costs of stress from noise, (2) measure noise and behavioral responses of caribou in the field in areas with and without overflights, and (3) integrate the lab and field components of the study and expand the existing model to predict the energetic costs of aircraft disturbance.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The applicability of study results to population effects should be high because the model developed should be able to predict the approximate thresholds of disturbance at which caribou will go into a negative energy balance situation.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): This study should bridge the gaps between behavioral responses, energetic costs, and demographic consequences of disturbance. This is critical for all disturbance studies using behavioral reactions because these studies assume that behavioral responses are relevant indicators of physiological responses.

8. Estimated study time and cost requirements: The laboratory portion of the study, because of the existing energetics model, could probably be done in 1 year by a graduate student at a cost of about $50,000 for data collection and modeling. The field study part of the research could probably be done in 1 year (4 seasons minimum). The cost is estimated to include $20,000 for sound equipment and $100,000 for the behavioral study, provided that the U.S. Air Force (USAF) provides aircraft overflights. Two years is the desirable timeframe for the field work.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): Disturbance of the Delta caribou herd by military aircraft already exists, so few additional adverse effects are anticipated. The study objectives should be obtainable without risk to pilots, biologists, or caribou.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): It may be possible to integrate this study with USFWS studies of the Porcupine caribou herd. This herd is not currently subjected to overflights, but is the subject of a massive research effort on energetics and modeling for predicting the effects of oilfield disturbance.

STUDY RANKING

Workgroup: Pacific Northwest

Short Title: Behavioral reactions and energetic costs of low-altitude subsonic aircraft overflights on caribou.

Criterion	Definition	Scaling
1. Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30* Medium.....20 Low.....10
2. Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1 Medium.....3* Low.....5
3. Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5 Medium.....3* Low.....1
4. Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5* 2-4 years.....3 >4 years.....1
5. Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5* Medium.....3 Low.....1
		Total score 46

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

RESEARCH NEED SUMMARY

Workgroup: Pacific Northwest Need No. 4

1. Descriptive title for proposed study: The feasibility of continuously monitoring noise exposure levels to free-ranging animals to determine realistic noise exposures over prolonged periods.

2. Species or group of species/population(s)/habitat(s): Ungulates (species large enough to carry instrumentation, e.g., sheep or caribou).

3. Geographic area(s): Any area exposed to overflights plus a similar "quiet" control area.

4. Study objective(s): The study would seek to: (1) determine the significance of aircraft noise relative to other noise sources in the wilderness, (2) quantify long-term noise exposure leading to lab assessments of hearing damage risk, and (3) correlate individual noise events with energy expenditure (using telemetric sensors).

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would involve field monitoring of noise exposure and, simultaneously, animal activity and location via telemetry (including satellites), with possible follow-up in the laboratory on hearing damage risk. The initial step would be to develop a prototype acoustic monitor.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The possibility exists of developing information enabling correlation between noise exposure and abandonment of habitat or between noise exposure and energy expenditure.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The benefits are that the effects of real-life noise exposure on hearing, energy expenditure, and habitat avoidance could be determined. The technique should be widely applicable to many noise effects studies.

8. Estimated study time and cost requirements: It is estimated that it would require up to 1 year to develop the equipment, 2 months to 1 year to collect and analyze preliminary data, and $75,000 to get prototypes into the field.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There is the potential problem with verifying validity of noise data unless the monitors are recovered at the end of the study period. Unless complete noise spectral information can be transmitted, it would not be possible to distinguish aircraft noise from other noise sources.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): Presently, the definition of the aircraft noise exposure environment is a "weak link" in most studies. If more realistic noise exposure data could be obtained, it would be very useful, even if there are certain limitations with respect to accuracy and reliability. The measured data would also serve as a check on predicted noise data.

STUDY RANKING

Workgroup: Pacific Northwest

Short Title: The feasibility of continuously monitoring noise exposure levels to free-ranging animals to determine realistic noise exposures over prolonged periods.

	Criterion	Definition	Scaling
1.	Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30* Medium.....20 Low.....10
2.	Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1 Medium.....3 Low.....5*
3.	Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5* Medium.....3 Low.....1
4.	Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5 2-4 years.....3 >4 years.....1*
5.	Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5* Medium.....3 Low.....1
			Total score 46

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

RESEARCH NEED SUMMARY

Workgroup: Pacific Northwest Need No. 5

1. Descriptive title for proposed study: Effects of aircraft noise and visual disturbances on colonial cliff-nesting seabirds.

2. Species or group of species/population(s)/habitat(s): Colonial nesting seabirds - (murres, auklets, kittiwakes, puffins).

3. Geographic area(s): St. George Island of the Pribilof Islands in the Bering Sea, Alaska.

4. Study objective(s): This research would attempt to: (1) collect pre-disturbance data on species distribution, numbers, existing noise levels, nesting success, predator/prey relationships, and behavior; (2) compare the "baseline" data with airport construction/operation periods; (3) provide aircraft operation recommendations and future mitigation needs; and (4) monitor the effectiveness of implemented mitigation measures.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The study would involve data collection on undisturbed seabird colonies and the resultant changes due to airport construction and operation. The study area cliffs are located under planned approach and takeoff patterns of commercial helicopter, turbine, and jet aircraft. Field monitoring would be conducted during April-October. Control plots will be established on undisturbed cliffs on other parts of the island.

6. Applicability of physiological and behavioral study results through modelign to reproductive/population impact prediction: Pre- and post-disturbance data on colonial cliff-nesting seabird populations would show short- and long-term demographic changes and could be implemented on-site and projected to additional areas along the east and west coast ranges of these species.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The research results can be compared to past work on historically disturbed cliff-nesting seabird colonies of Oregon, Washington, and California. The information could be expanded for comparison/habituation studies. Future mitigation measures can be dictated for comparable government projects (e.g., airports, MOA's).

8. Estimated study time and cost requirements: Four field seasons (April through October) would be required: (1) one pre-construction, (2) one season during construction, and (3) two airport operation seasons. Additional years of research could study habituation.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): The study would not affect bird populations, since the airport may well be constructed and disturb the birds anyway. A high probability of success is anticipated if the airport opponents do not halt airport construction.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): The project could compliment possible work and funding by the Federal Aviation Administration and the Alaska Department of Transportation. The species are of high public interest and wide geographic range. The research results should be applicable to future airport and military airspace assessment projects. The research results should be applicable to other similar colonies throughout North America.

STUDY RANKING

Workgroup: Pacific Northwest

Short Title: Effects of aircraft noise and visual disturbances on colonial cliff-nesting seabirds.

	Criterion	Definition	Scaling
1.	Scientific Value	The degree to which successful completion of the study would contribute to the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife species, populations, and habitats, and the degree to which the species/population/habitat is considered important due to its rarity, legal status, or uniqueness.	High.....30* Medium.....20 Low.....10
2.	Technical Risk	The degree of risk associated with accomplishing the study objectives. High risk means there is a high chance of failure.	High.....1 Medium.....3* Low.....5
3.	Application of Study Results	The degree to which the results of the study would be directly applicable to other species/populations/habitats and geographic areas.	High.....5* Medium.....3 Low.....1
4.	Duration	The elapsed time from initial project planning, to data gathering and analysis, to preparation of final report(s).	2 years or less...5 2-4 years.....3* >4 years.....1
5.	Cost Effectiveness	The degree to which it is believed that the study results would justify the anticipated personnel, equipment, and other costs required.	High.....5 Medium.....3* Low.....1

Total score 44

*Asterisks indicate the assigned rankings, which are added to obtain the total score.

Other Research Needs

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RESEARCH NEED SUMMARY

Workgroup: Southeast/Central Need No. 6

1. Descriptive title for proposed study: Effects of sonic booms and aircraft noise on nesting success of sooty terns.

2. Species or group of species/population(s)/habitat(s): Sooty terns.

3. Geographic area(s): Garden Key, Florida.

4. Study objective(s): The study would attempt to measure and evaluate the effects of subsonic and supersonic aircraft noise on the behavior and reproductive success of sooty terns.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The basic approach would be to: (1) review 30 years of historical data on nesting activity, (2) investigate existence of available data on levels of aircraft activity in the area, (3) measure noise levels in the field, and (4) observe behavioral and reproductive responses.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: There is an opportunity to use an existing 30-year dataset to model natural variability of nesting success. This variation can be used as a basis for interpreting adverse effects of aircraft noise and sonic booms.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The results of the study should increase knowledge of effects of aircraft noise and sonic booms on nesting shorebirds.

8. Estimated study time and cost requirements: The duration of the study is estimated to be 27 months (1 October 1988-30 December 1990). The cost is projected to be $92,000 (including $30,000 for noise monitoring equipment).

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There should be a high probability of success and minimal adverse effects on the population.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): Sooty terns are a State species of special concern. The study results should be applicable to other nesting shorebirds. The National Park Service may have acoustical equipment available from studies at Fort Jefferson. The study area has high public interest. Noise complaints currently exist.

RESEARCH NEED SUMMARY

Workgroup: Southeast/Central Need No. 7

1. Descriptive title for proposed study: Identifying differential noise effects of tactical flying and straight and level flights on wildlife species.

2. Species or group of species/population(s)/habitat(s): To be determined based upon those found where flight patterns vary.

3. Geographic area(s): To be determined based on those areas of flight variations.

4. Study objective(s): The objectives would be to determine if: (1) different types of flight maneuvers generate different noise patterns, and (2) these different patterns create different effects on wildlife.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would involve field and/or laboratory (simulation) measurements of flight noise patterns and field observations of wildlife.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: Unknown.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): Study results should determine if different types of flights generate different effects on animals.

8. Estimated study time and cost requirements: The required duration of the study is estimated to be 1 year at a cost of $75,000.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): Determining different flight patterns may be difficult. There should be a high probability of success in observing animal behavioral reactions.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): Unknown.

RESEARCH NEED SUMMARY

Workgroup: Southeast/Central Need No. 8

1. Descriptive title for proposed study: Effects of low-altitude overflights on the behavior and nesting success of magnificent frigatebirds.

2. Species or group of species/population(s)/habitat(s): Magnificent frigatebirds.

3. Geographic area(s): Key West National Wildlife Refuge, Florida.

4. Study objective(s): The study would seek to: (1) measure the aircraft noise at the colony site, and (2) determine the behavioral response to overflights and impacts to feeding rates and nesting success.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): This would be a field study with direct measurement of noise levels, behavior, and reproductive performance.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The research results should provide critical data on the only nesting colony of frigatebirds in North America and document response and impacts of aircraft noise to colonial nesting species.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The study results should be beneficial, since little is known of the effects of low-altitude aircraft overflights on colonial nesting birds, particularly frigatebirds.

8. Estimated study time and cost requirements: The study duration is estimated to be from October 1988 to December 1990 at an estimated cost of $95,000.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): The study risks are expected to be minimal. The quality of data and sample sizes will be enhanced if overflights can be scheduled to facilitate measurements.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): This is the only colony of nesting frigatebirds in the United States. As such, its protection is essential.

RESEARCH NEED SUMMARY

Workgroup: Southeast/Central Need No. 9

1. Descriptive title for proposed study: Aircraft noise impacts on migrating cranes in the central flyway.

2. Species or group of species/population(s)/habitat(s): Sandhill cranes and whooping cranes using the central flyway.

3. Geographic area(s): Texas to Canada via Kansas and North Dakota.

4. Study objective(s): The objective would be to determine the effects of aircraft noise on cranes in flight, roosting, resting, and feeding.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would be to monitor the behavior of cranes involved in various activities (feeding, migrating, etc.) subjected to a variety of aircraft-generated noises (sonic booms, helicopters, jets). The study would involve radio-tracking birds and will be most intense in staging and resting areas (Aransas National Wildlife Refuge, Texas; Platte River, Nebraska).

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The study results should be very applicable for whooping cranes, less so for sandhill cranes.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): Except for whooping cranes on Aransas National Wildlife Refuge, very little is known of their reaction to aircraft noise, especially in migration.

8. Estimated study time and cost requirements: Meaningful findings should require 2 years, although 1 year's findings should help. The cost is estimated at $60,000 for year 1 and $50,000 for year 2.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There should be no increased hazards to cranes, provided whooping cranes are not radio-tagged.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): The study is very important because: (1) cranes are large and fly high, thus increasing aircraft collision probability; and (2) endangered whooping cranes, which usually fly in groups of 1-5, are involved.

RESEARCH NEED SUMMARY

Workgroup: Southeast/Central Need No. 10

1. Descriptive title for proposed study: Effects of low-altitude military aircraft flights on the Federally threatened Florida scrub jay.

2. Species or group of species/population(s)/habitat(s): Florida scrub jay.

3. Geographic area(s): Central Florida.

4. Study objective(s): The objective would be to determine the sound levels from low-altitude military overflights in scrub jay habitats and evaluate impacts on their reproductive success.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would involve noise measurement and monitoring of reproductive success in control and experimental scrub jay populations.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The study results could be used in modeling reproductive impacts throughout the species' range.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The study results would provide information to evaluate sensitivity of this Federally threatened species to aircraft noise and could be applied to other corvids or passerines.

8. Estimated study time and cost requirements: The duration of the study is estimated at 30 months (FY 89-91) at a cost of $75,000.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There should be a high probability of achieving objectives, with little adverse effect anticipated on scrub jays.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): Over a decade of background reproductive data is available from the population at Archbold Biological Station, which could serve as the control. Experimental populations can be located in areas of high military aircraft use.

RESEARCH NEED SUMMARY

Workgroup: Southeast/Central Need No. 11

1. Descriptive title for proposed study: Assessment of the 2,000 ft above ground level (agl) recommendation by the Federal Aviation Administration (FAA) for refuge overflights.

2. Species or group of species/population(s)/habitat(s): Primary management species of the national wildlife refuges.

3. Geographic area(s): Nationwide.

4. Study objective(s): The study would attempt to determine the adequacy of the 2,000 ft above ground level (agl) FAA recommendation. Potential impacts to key management species will be assessed: large mammals, waterfowl (breeding and wintering), and endangered species.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): Field study would involve observation during overflights by military, commercial, and private aircraft. Reproductive success measurements would also be made.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The observational field data would be correlated to the physiological data derived from other ongoing studies of these species.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The major study benefits would be (1) designation of appropriate corridors and buffer zones around Refuges, and (2) mitigation.

8. Estimated study time and cost requirements: The research is expected to take 3-4 years at a cost of $200,000. Much of this information can be pulled from other studies (proposed and ongoing). Some scheduled overflights would be required.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): Adverse effects are expected to be low to none; refuges are being overflown now at low altitudes.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): A joint Department of the Interior (DOI)/FAA/Department of Defense (DOD) approach is preferred. Results from ongoing studies can be applied.

RESEARCH NEED SUMMARY

Workgroup: Southwest Need No. 6

1. Descriptive title for proposed study: Feasibility of assembling and digitizing spatial/temporal data to be used by the U.S. Air Force Assessment System for Aircraft Noise and other computer applications.

2. Species or group of species/population(s)/habitat(s): All.

3. Geographic area(s): 50 U.S. States, Canada, and Mexico.

4. Study objective(s): The study would seek to explore methods to: (1) digitize or obtain existing digital maps of species-sensitive areas for all natural resource management agencies, (2) develop digitized sensitivity models for species of concern, and (3) support the USAF bird-aircraft strike hazard program.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would be to: (1) establish a lead agency (DOI), (2) identify the common denominator data base format, (3) identify participating agencies, and (4) identify data conversion contract costs.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The results would be directly applicable to the NEPA process.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): There should be broad based applicability that supports numerous programs and future studies. The study results would provide a significant reduction of time and labor in preparing NEPA studies and documents.

8. Estimated study time and cost requirements: The duration of the feasibility study is estimated to be 2 years with a cost of $75,000. The total cost is unknown.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): None.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): When the data base concept is determined to be feasible, the potential benefits will support numerous programs, including present and future research, airspace management actions, and surface management programs.

RESEARCH NEED SUMMARY

Workgroup: Southwest Need No. 7

1. Descriptive title for proposed study: Quantifying and characterizing propagation of sonic booms over varied terrain.

2. Species or group of species/population(s)/habitat(s): To be determined.

3. Geographic area(s): Western United States.

4. Study objective(s): The research would attempt to determine what attenuation or amplification effects result from geomorphic features such as abrupt escarpments, isolated hills in valleys, or canyons in mountains.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would be to set up sound monitoring equipment in appropriate geomorphic situations and then overfly at supersonic speeds.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The data obtained should be applicable to understanding the potential for impacts on animals in relation to specific characteristics of certain geomorphic features.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): We currently do not know what effect geomorphic features have in attentuating or amplifying sonic booms. Any data should be useful.

8. Estimated study time and cost requirements: Short timeframe; expense unknown.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There would be fairly minimal risks, and the probability of obtaining useful results should be high.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): The study results should be broadly applicable geographically.

RESEARCH NEED SUMMARY

Workgroup: Southwest Need No. 8

1. Descriptive title for proposed study: Time and energy budgets of exposed vs. control populations.

2. Species or group of species/population(s)/habitat(s): Waterfowl, pronghorn, bighorn sheep, lizards.

3. Geographic area(s): Nevada (Naval Air Station Fallon and/or Desert National Wildlife Range).

4. Study objective(s): The objective would be to determine whether species population energetics are being influenced by military overflights.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would be to determine by observation what the normal, detailed activities of each species on an area are and, using available literature, develop energy budgets for the observed populations. The study would then compare the budgets of exposed vs. control populations.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The results should be directly applicable to population effects models. If study species are carefully chosen, the research results should have relatively broad applicability across species groups (guilds).

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The research results should allow reasonable prediction of effects of noise exposure and could allow determination of whether or not habituation occurs.

8. Estimated study time and cost requirements: The study is estimated to cost $95,000 the first year and $65,000 the second year. The research would require at least 1 year of observational data, ideally under the normal range of biological environmental/locational conditions. It probably would require 6 months to 1 year to develop energetic models of observational data.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There should be 100% probability of success. The study results could show effect or no effect, and either answer is useful and applicable. There should be no risk to wildlife.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): The study should provide broadly useful, scientifically interesting data, since there are relatively few species for whicn time/energy budgets have been developed.

RESEARCH NEED SUMMARY

Workgroup: Southwest Need No. 9

1. Descriptive title for proposed study: Data base analysis of Military Operations Area (MOA) and Military Training Route (MTR) use.

2. Species or group of species/population(s)/habitat(s): All.

3. Geographic area(s): Continental U.S., Alaska, and Hawaii.

4. Study objective(s): The objective would be to determine the frequency of use and the hours and dates of use to determine scheduling economies and combined use possibilities.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The study would involve airspace utilization data-gathering and conversion to a computerized data base.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The study could possibly facilitate closure of unused or excess-capacity routes to reduce impacts on identified sensitive wildlife areas.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): There would be broad-based applications. The study results could facilitate NEPA compliance through the quantification of need for specific routes vs. continuing many routes of questionable value.

8. Estimated study time and cost requirements: Unknown.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): The risks would be minimal.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): There is high interest from the public and resource agencies to know which routes are likely to impact sensitive areas, which can be replaced, and which can be intensively used with minimal wildlife impacts. Increased airspace utilization efficiency and lessened impacts should result from the research.

RESEARCH NEED SUMMARY

Workgroup: Southwest Need No. 10

1. Descriptive title for proposed study: Physiological effects of subsonic aircraft: visual vs. nonvisual impacts.

2. Species or group of species/population(s)/habitat(s): Wild and domestic animals, with emphasis on high interest species. Bighorn sheep, threatened and endangered species, waterfowl, and domestic livestock.

3. Geographic area(s): Sheep - southern Utah, southern Nevada, and central Arizona. Waterfowl - Naval Air Station Fallon, Great Salt Lake area. Domestic livestock - Gandy area of Utah. Endangered species - where appropriate.

4. Study objective(s): The study would seek to determine the physiological effects that depress the immune system and increase susceptibility to infectious diseases, habitat abandonment, and reduction of reproductive success and behavior.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would be to make heart rate and body temperature measurements in the field on the animals being studied. This should also include behavioral observations. The research would establish a system for measuring noise levels.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: Physiological parameters for the various species being studied need to be obtained. Once obtained, data could be used in models for impact predictions.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The study benefits would be the ability to predict impacts on wildlife and recommend alternatives or mitigation.

8. Estimated study time and cost requirements: The study duration is estimated to be 5-10 years. The start-up costs would be $15,000/animal x 5 animals x 5 species = $375,000, and $100,000/year thereafter.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): The probability of accomplishing the research objectives would be high.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): At the present time, sufficient physiological information relating to the effects of subsonic aircraft overflights on wildlife is not available. This research is a step in the direction of obtaining real stress information on wildlife as caused by aircraft. This project would be acceptable to State and Federal agencies as well as the public.

RESEARCH NEED SUMMARY

Workgroup: Southwest Need No. 11

1. Descriptive title for proposed study: Effects of helicopter noise on selected fish and wildlife.

2. Species or group of species/population(s)/habitat(s): To be selected.

3. Geographic area(s): To be selected.

4. Study objective(s): The study would attempt to: (1) characterize the effects of helicopter noise on behavior, stress, breeding success, and habitat use; and (2) determine flight distance offsets needed to minimize adverse impacts of particular helicopters on identified sensitive species.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The research would be both field and laboratory and involve noise measurement, sound propagation characteristics, pitch measurement (frequency), beat measurement (cyclical or rotor generation), effects of altitude and slant range, effects of power settings, and doppler effect. All these factors would be correlated to behavior, stress, breeding success, and habitat use.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: Unknown.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): Knowledge of helicopter noise can be compared to data for sonic booms. Research results would be included in some NEPA documents as applicable.

8. Estimated study time and cost requirements: The research is anticipated to take 2 years at a cost of $200,000.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There could be potential stress to breeding wildlife populations.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): Few studies have been done on helicopter noise effects on animals.

RESEARCH NEED SUMMARY

Workgroup: Southwest Need No. 12

1. Descriptive title for proposed study: Rangewide survey of desert bighorn sheep populations and their status.

2. Species or group of species/population(s)/habitat(s): Desert bighorn sheep.

3. Geographic area(s): Rangewide.

4. Study objective(s): The objective would be to determine population status of each herd, classifying them as decreasing, increasing, or stable, and determine causative factors in declining populations.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The research would involve a literature review plus field studies of selected populations.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: None.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The benefits would be a determination if declining populations are subjected to aircraft harassment.

8. Estimated study time and cost requirements: The research is estimated to require 2 years at a cost of $150,000.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): There could be problems coordinating data from a large number of agencies and an inability to determine causative factors in declining herds.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): This study will focus attention on populations that have insufficient data. The goal is a comprehensive overview of desert bighorns, providing baseline data upon which aircraft effects can be assessed in the future.

RESEARCH NEED SUMMARY

Workgroup: Pacific Northwest Need No. 6

1. Descriptive title for proposed study: Population-level responses by dall and bighorn sheep to military aircraft (fixed-wing and helicopters) overflights.

2. Species or group of species/population(s)/habitat(s): Dall sheep and bighorn sheep (including Rocky Mountain, California, and desert subspecies).

3. Geographic area(s): Alaska, Oregon, California, Nevada, Utah, and Arizona.

4. Study objective(s): The research would attempt to: (1) determine if wild sheep habituate to military overflights and if the population parameters of exposed populations are no different from those of unexposed populations, and (2) determine if all wild sheep respond in a similar manner when exposed to military overflights.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): Field research would examine demographics, survival rates (life table), productivity, mortality, habitat utilization, and time-activity budgets. Lab and field research would look at population vigor assessment (immunosuppressions, diseases).

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The study should result in the ability to predict and model effects.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): The study should result in the ability to compare/contrast all North American wild sheep in that it will be possible to state that wild sheep do/do not respond in similar fashions when exposed to helicopters, fixed-wing aircraft, and sonic boom noise stimuli.

8. Estimated study time and cost requirements: It is estimated that 5 years for each study population would be required. The study populations required are: four dall sheep, four Rocky Mountain bighorn, two California bighorn, and four desert bighorn. The cost is estimated to be high.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): The study risk is likely to be low, since the experimental populations are currently exposed to military overflights.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): The species is of high public interest. There is high potential for interagency cooperation and "piggy-backing" onto other existing studies and good potential to use existing data, thus requiring research to only "fill in the gaps."

RESEARCH NEED SUMMARY

Workgroup: Pacific Northwest Need No. 7

1. Descriptive title for proposed study: Long-term effects of low-altitude aircraft flights on nesting and reproduction of peregrine falcons and associated raptors.

2. Species or group of species/population(s)/habitat(s): Peregrine falcons and rough-legged hawks.

3. Geographic area(s): Interior Alaska.

4. Study objective(s): The study would seek to: (1) compare nesting density and productivity of a nesting population within a Military Operations Area (MOA) with that of a control population, and (2) compare nesting density and productivity within the MOA to background data obtained prior to the MOA's installation.

5. Basic study approach (e.g., field or laboratory; physiological, behavioral, or reproductive; noise measurement/modeling, etc): The approach would be to perform paired comparisons of nesting density and productivity (number of young fledged) within the MOA and a nesting population in a nearby area and in similar habitat which is not subjected to low-altitude overflights. The research would also compare the parameters within the MOA with those collected before the MOA's installation. The background data have already been collected.

6. Applicability of physiological and behavioral study results through modeling to reproductive/population impact prediction: The study would provide empirical data on effects on long-term reproduction, which is very much needed for population modeling. Data could be extrapolated to other falcon species and other raptors as well.

7. Study benefits to furthering the state-of-the-art knowledge on the effects of aircraft noise and sonic booms on wildlife (NEPA benefits): Information from the study would assist in making predictions of the long-term effects of low-altitude flights on raptor reproduction and population stability, especially peregrine falcons, which are Federally endangered.

8. Estimated study time and cost requirements: The study is expected to last 10 years at a cost of $30-40,000/year.

9. Potential study risks (e.g., probability of accomplishing study objectives, potential adverse effects on wildlife species): Risks would be minimal to none.

10. Additional comments (e.g., application of study results to other species/populations/habitats, or geographic areas; species sensitivity; existing studies and/or interagency or cooperative agreements; species status; public interest, etc.): The results of the study could be expanded to other raptor species. The FWS has already collected baseline data (10 yr) on peregrines and other raptors where the MOA is to be located. The Air Force may already be funding the effort in 1988. This study will be an interagency effort and will be able to use much background data.

NOTE:

This study was one of the five most important studies proposed in the Pacific Northwest Workgroup. Because of the high probability of funding for this study from the Air Force in Alaska, it was removed from the ranking process with the other studies proposed in this workshop. However, the workshop participants support this study and recommend that the Air Force ensure that funding be provided and continued for this study. Principal contact for the study is Skip Ambrose, U.S. Fish and Wildlife Service, Fairbanks, AK.

SUMMARY

Workshop participants identified a broad range of needed research on the effects of aircraft noise and sonic booms on fish and wildlife. Proposed study areas varied from the Alaskan Arctic to Gulf Coast wetlands and the Everglades of southern Florida. Species identified as important candidates for aircraft noise impact research included bighorn and dall sheep, caribou, bears, antelope, burrowing mammals, waterfowl, seabirds, cranes, wading birds, and raptors.

Virtually all of the identified field studies called for quantification of the noise stimulus in terms of time of occurrence, number of events, and noise level and duration. The research needs also identified the necessity for quantifying animal responses to individual and cumulative noise exposures in terms of physiological, behavioral, habitat utilization, and reproductive/population effects, or some combination thereof. Participants also identified the need to include the evaluation of nighttime effects in the design of studies and to include large and small helicopters, fixed-wing propeller-driven airplanes, and small and large jets in overflight designs.

Of the 30 research needs identified at the workshop, 19 would involve only field research, while 8 others would include both laboratory and field research. One research need would be a laboratory study only (short- and long-term impacts of aircraft noise on the histology of the inner ear of birds) and two others would be of a legal-institutional nature (feasibility of assembling and digitizing spatial/temporal data to be used by the U.S. Air Force Assessment System for Aircraft Noise and other computer applications; and data base analysis of Military Operations Area (MOA) and Military Training Route (MTR) use).

Nine of the identified studies involve research on Federally listed endangered and threatened species; six others identified the possibility of including such species in aircraft noise and sonic boom research. Thirteen research needs called for research on national wildlife refuges, while 10 others indicated that the identified research, if implemented, could be conducted at selected refuges.

The following five research needs were identified by workshop participants as having the highest priority:

(1) effects of aircraft noise and ordnance on desert bighorn sheep (Southwest Workgroup);

(2) behavioral reactions and energetic costs of low-altitude subsonic aircraft overflights on caribou (Pacific Northwest Workgroup);

(3) behavioral reaction and energetic costs of aircraft disturbance on geese in Alaksa (Pacific Northwest Workgroup);

(4) impacts of helicopters and low-altitude, high-speed military aircraft on wintering waterfowl (Southeast/Central Workgroup); and

(5) effects of low-altitude subsonic airplanes and helicopters on denning bears in the Arctic (Pacific Northwest Workgroup).

Results from the field research identified here would provide new and improved data for dose-response modeling. This modeling should eventually link physiological, behavioral, or habitat utilization effects on animals to likely reproductive/population impacts. Models should relate observed animal responses to the quantified noise doses and be field tested before being used in aircraft noise impact prediction.

The overall goal of the research identified at this workshop is to develop information useful in predicting the potential adverse effects on wildlife of proposed low-altitude aircraft operations. Research should identify thresholds at which aircraft operations are likely to be detrimental to the behavior, physiology, reproduction success, or population dynamics of a wildlife species or population. Such thresholds are dependent on the fish and wildlife species involved, habitat, aircraft type(s), number of overflights, altitude(s), season, time-of-day, and other factors. Once determined, the thresholds would be applied in making recommendations designed to minimize the adverse effects of aircraft noise and sonic booms on important fish and wildlife resources.

APPENDIX A

WORKSHOP PARTICIPANTS

EFFECTS OF AIRCRAFT NOISE AND SONIC BOOMS
ON FISH AND WILDLIFE

Research Needs Workshop
April 18-21, 1988
Estes Park, Colorado

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APPENDIX B

WORKSHOP AGENDA

EFFECTS OF AIRCRAFT NOISE AND SONIC BOOMS
ON FISH AND WILDLIFE

Research Needs Workshop
April 19-21, 1988
Estes Park, Colorado

WORKSHOP AGENDA

Tuesday - April 19

8:30 am	Introduction - Duane Asherin, NERC
8:45	NSBIT Overview - Mike Thompson, USAF
9:15	Legal-Institutional Concerns - Warren Humphries, USAF
9:45	BREAK
10:00	Nevada Activities - Roy Leach, NDW
10:30	Breeding Pacific Black Brant Studies - Dave Ward, AFWRC
11:00	Staging Pacific Black Brant Studies - Dirk Derksen, AFWRC
11:30	Desert NWR Problems with Bighorn Sheep - Dave Brown, DNWK
12:00 pm	LUNCH
1:00	NPS Activities - Steve Hodapp, NPS
1:30	Noise Measurement and Modeling - Frank Awbry, HMRI
2:00	Telemetric Physiological Measurement and Modeling - ?
2:30	BREAK
2:45	Workgroups Convene for Instructions - geographic maps - flight maps - workgroup objectives - research needs summary format - ranking criteria and process
4:15	BREAK
5:30	Open Dinner
7:00	Icebreaker

Tuesday - April 20

8:30 am	Workgroups Reconvene - Identify potential wildife problems - Develop proposal summaries - Rank proposed studies
12:00 pm	LUNCH
1:00	Maingroup Reconvenes - Workshop Chairperson Announcements/Comments
1:15	Southeast Workgroup Results and Open Discussion
2:00	Central Workgroup Results and Open Discussion
2:45	BREAK
3:00	Southwest Workgroup Results and Open Discussion
3:45	Pacific Northwest Workgroup Results and Open Discussion BREAK
5:30	Open Dinner

Wednesday - April 21

8:30 am	Workgroups Reconvene - Modify potential wildlife problems - Develop/modify proposal summaries - Rank/rerank proposed studies
12:00 pm	LUNCH
1:00	Maingroup Reconvenes - Workshop Chairperson Announcements/Comments
1:15	Pacific Northwest Workgroup Results and Open Discussion
1:45	Southwest Workgroup Results and Open Discussion
2:15	BREAK
2:30	Central Workgroup Results and Open Discussion
3:00	Southeast Workgroup Results and Open Discussion
3:30	Closing Remarks and Adjourn

Evening Open Dinner in Estes Park

APPENDIX C

CANDIDATES FOR A NATIONAL FIELD RESEARCH STEERING COMMITTEE

	Name	Expertise	Affiliation or Agency
1.	Steve Kovach*	Ungulates/Carnivores	U.S. Navy
2.	Robert W. Young	Acoustical Measurement	Private consultant
3.	Paul Schomer	Acoustical Measurement	U.S. Army Corps of Engineers
4.	David Ward*	Avifauna	U.S. Fish and Wildlife Service
5.	Gary White	Biometry	Colorado State University
6.	Tony Downs	Study Coordination	Canadian Department of National Defence
7.	Steve Murphy*	Research Design, Animal Behavior	Alaska Biol. Research, Inc.
8.	Jackie Campbell*	NEPA, Endangered Species Act-Protective Measures Mitigation/Monitoring Needs	U.S. Fish and Wildlife Service
9.	Gar Workman*	Animal Life History and Behavior	Utah State University
10.	Thomas Bunch	Physiology Pathology	Utah State University
11.	Patricia Port*	Coordination	U.S. Department of the Interior
12.	Murray Sant*	Utah Wildlife	U.S. Air Force
13.	Kate Benkert*	Waterfowl, NEPA	U.S. Fish and Wildlife Service
14.	Marc Woodin*	Waterfowl	U.S. Fish and Wildlife Service
15.	Doug Gladwin*	Aircraft Effects on Animals	U.S. Fish and Wildlife Service
16.	Paul Ebersbach*	Aircraft Effects on Animals, Resource Management	U.S. Air Force
17.	Mike Collopy*	Wading Birds and Raptors Behavior	University of Florida
18.	Steve Hodapp*	Airspace Management	National Park Service

	Name	Expertise	Affiliation or Agency
19.	Brian Dean*	Airspace Management	Bureau of Land Management
20.	Mary Jo Elpers*	Bird Behavior, Wildlife Biology	U.S. Fish and Wildlife Service
21.	Evert Byington*	Systems Ecology	U.S. Air Force
22.	Dennis Skalka*	Veterinary/Animal Damage Claims	U.S. Air Force
23.	Russ Haughey*	Wildlife Biology	U.S. Air Force
24.	Dave Stanbrough*	Refuge Management	U.S. Fish and Wildlife Service
25.	Jim Kirkwood*	Wildlife Ecology	U.S. Fish and Wildlife Service

*Workshop Attendee.