APPENDIX B

WHMP EVALUATIONS SUPPORTING DOCUMENTATION

This appendix contains two sections documenting efforts taken to develop more informed and practicable alternatives for wildlife hazard management at Juneau International Airport. The first, Section B.1, includes the text of independent peer reviews conducted of a draft wildlife hazard risk assessment, the revised version and text of which is found in Section 2.5.4 of the EIS. The second section, B.2, contains the results of surveys distributed to a number of airports to develop information on the benefits and drawbacks of various wildlife hazard control technologies.

B.1 WILDLIFE HAZARD RISK REVIEWS: COMMENTS AND CRITIQUES

B.1.1. INTRODUCTION

In preparing the assessment of bird and wildlife hazards at Juneau International Airport (JNU) we developed an operational risk model to assist in ranking species of concern at the Airport and to further weigh the impact of proposed actions at the facility that would result in modification of habitats on or near the Airport. Since no standard methodology for operational risk is currently available for assessing bird and wildlife hazards at airports, we developed a risk matrix that attempted to rank the species of birds that had been identified during a yearlong survey conducted by a USDA-Wildlife Services biologist as part of a formal wildlife hazard assessment. Operational risk is generally defined as a function between the probability of occurrence and the severity of the outcome. Several variables can be arrayed to calculate operational risk associated with birds and wildlife hazards at airports. The purpose of our matrix was to include a measure of severity from the FAA bird strike database and apply that to site-specific abundance data. Additionally, we attempted to weigh the model to reflect reported strike events. To confirm the validity of this approach, copies of the EIS risk model were sent to several scientists in the United States, England, and Canada for comment.

B.1.2 METHODOLOGY

The original methodology developed for the EIS included calculations for each species identified in the on-site surveys. The risk value for each species included:

- Species abundance (a measure of probability of occurrence)
- Mean flock size (an additional measure of probability of occurrence)
- Average species weight (a measure of severity of outcome)
- The percentage of strikes causing damage from the FAA strike database (an additional measure of severity of outcome)
- A penalty for actual strike events at JNU

These values were multiplied, ranked, scaled to a max score of 100, and the local penalty added. Some apparent anomalies were clear from this method. Some species, such as Trumpeter Swans, showed no risk. While these heavy-bodied birds would likely cause damage if struck by an aircraft, there is no historical record of such a strike occurring and subsequently, there is no value for the severity of damage. These apparent anomalies generated some questions as to the general validity of the model. To address these concerns we applied a ranking scheme reported by Dolbeer et al. (2000) and then developed some alternative models using those rankings. Finally we conducted correlation analyses to determine the relationships among the variables used in each model.

B.1.3 FAA RANKINGS

Using the FAA wildlife strike database, a method for ranking hazard level of wildlife species was developed (Dolbeer et al. 2000). This model (hence forth identified as the "FAA Rankings") included ranking variables such as damage and effect on flight for various bird and wildlife species. The final ranking was derived from a composite of rankings for each variable. This model provides a useful tool for prioritization of management strategies. One concern with this model, however, is that it includes general groups of animals (i.e., gulls, ducks, herons, etc.) rather than individual species. Using the FAA Rankings, we assigned birds to species groups. Since the EIS analysis addressed primarily birds, we removed mammals from the list and adjusted the relative hazard score of the highest-ranking species group to 100. Some latitude was used in assigning birds to species group since some species (such as Trumpeter Swans) were not represented by a species group. A simple ranking of bird species surveyed at JNU is provided in Appendix 2. The concern with using only the relative rankings from this model are that is does not include any measure of occurrence in the local area. That is, this model lacks a site-specific variable.

B.1.4 MODIFIED FAA METHODOLOGY

A simple adjustment to the FAA ranking was to weigh each species by abundance. This calculation resulted in a variable (Score/Abundance) that is the product of the FAA relative Hazard Ranking and the abundance (Appendix 3). This value was scaled to a maximum value of 100 and the species list ranked on that variable. To include additional weight to the species of birds that have been struck by aircraft at JNU and have caused damage, the local penalty (calculated for the original EIS model) was added after scaling and the entire species list was ranked on the "scale + penalty" variable (Appendix 4).

B.1.5 MODIFIED EIS METHODOLOGY

To assess the EIS methodology using similar groupings as provided in the FAA Rankings, we assigned species observed during the JNU surveys into the FAA groups. For each group, values were calculated from the species assigned (total abundance, average weight, and average percent of damage). This modification allowed the two risk models (FAA and EIS) to be compared. These values are summarized in Appendix 5.

B.1.6 STATISTICAL ANALYSIS

To compare the EIS rankings with the FAA rankings a series of correlation analyses were performed using Excel correlation analysis procedures. The first correlation was to determine which model showed the strongest relationship to the average weight of each species group. This comparison was continued with the percent of damage, the abundance of individuals and the weight x abundance variables. Finally, a comparison between the FAA ranking and the EIS Rankings was performed. The results are provided below:

0.82	Correlation between Average Weight and FAA Score
0.63	Correlation between Average Weight and EIS Score
0.88	Correlation between % damage and FAA Score
0.84	Correlation between % damage and EIS Score
0.15	Correlation between abundance and FAA Score
0.35	Correlation between abundance and EIS Score
0.77	Correlation between abundance x weight and FAA Score
0.94	Correlation between abundance x weight and EIS Score
0.84	Correlation between FAA Score and EIS Score

B.1.7 RESULTS

The EIS model and the FAA model have strengths and weaknesses. The FAA scoring model has a stronger relationship to the average weight of the group (r = 82). The weakness in the EIS model (r = 63) may be accounted for by heavy birds (like Trumpeter Swans) that have little or no history of damaging strikes. When comparing the risk scores of with % damage both models show strong correlations. The FAA model is poorly correlated with abundance (r =15), while the EIS model performs slightly better (r = 35). This only indicates that there is more contribution to the risk assessment model by the site-specific EIS model. Comparing models for the combined abundance*weight variable, the EIS model shows a much stronger relationship (r = 94) than does the FAA model (r = 77). Finally, a comparison between the two models showed a positive correlation of 84%.

B.1.8 CONCLUSIONS

The use of the FAA model was sufficient to rank the species into a reasonable array for prioritizing management objectives at airports nationwide. However, to weigh the rankings for local conditions it may be desirable to include site-specific survey data and local bird strike reports. Comparisons of the FAA model to the EIS models suggest that the results from the site-specific adjustments remain reasonably aligned with the FAA hazard rankings. Future site-specific models will require standardized survey data methodologies as well as development of industry standards in arraying variables such as: abundance, movement patterns, behaviors, and damage.

B.1.9 REVIEWER COMMENTS

Review packages were sent on December 18, 2003, to the following individuals: Dr. Russ DeFusco, Dr. John Allen, Dr. Richard Dolbeer, Mr. Bruce MacKinnon, Col (USAF Ret) Jeffery J. Short, and Mr. Ed Cleary. From the responses received we conclude that the original EIS risk model is a reasonable empirical approach to ranking the bird species at JNU by risk. The comments identify areas of concern as well as suggestions for future improvements in development of standard methodologies that may be applied to site-specific surveys. The following responses were compiled:

DR. DEFUSCO

Thanks for the opportunity to review your protocol at Juneau. Let me first say that your methodology is certainly defensible and thus serves its purpose nicely. Any objections to the approach can be addressed and supported by the scientific approach you have taken and thus should pass legal muster as well (though I'm sure there could be some challenges offered by groups bent on defeating such projects). That said, I really can only offer some minor comments that specifically address your approach at Juneau. I have much greater concerns (as we all should) about the precedence this may set for other locations. As there is no accepted protocol for conducting such studies that have been established by the regulatory agencies at either the state of federal level, I realize that you are left to your own devices. We desperately need to address this as a community so that we can standardize methods for future projects that will undoubtedly follow. I offer the following comments that should be taken in a larger context that may extend well beyond Juneau:

Technical questions about this location:

1. Frequency of damaged. How defined? Proportion of total strikes/species that caused damage or total number of strikes that caused damage?
2. Scaling used to maximize risk at 100, yet with local penalty may exceed this value?
3. Low, Moderate, and Severe damage. How defined? By whom?
4. Local penalty assigned by strikes at Juneau. Small sample size skews data (intentionally, I realize, but perhaps too much so) toward those in the FAA database struck at the location. We all know that it can be a matter of luck and must be acknowledged as such. Recognizing the need to address actual strike records for the location, is there a way to do so without the problem of small sample sizes unfairly skewing the data?
5. Scaled risk for zones A-E. How derived? By whom? Could be seen as arbitrary.

In the larger context, I am concerned that the protocol you use here may establish a precedent for how future work is conducted at other locations. Your approach may very well be the best one available (or for that matter, the only one available). It is a bit complex as well. The question is whether it is repeatable at other locations. For example, USDA has obviously done some fairly extensive survey work here that may not be available elsewhere and your risk matrix is highly dependent on such data. There data collection methodology also may not be standardized for other locations. Some of their data is curious to me from an ornithological standpoint. Let me just

point out one example that jumped out to me. The "frequency of occurrence" side of your risk model is dependent on abundance and flock size counts from USDA. The result of this drives your ranking to a large degree. Take a look at the American Wigeon as my example. The mean flock size of 26 seems awfully high (I do not question the field data from the USDA, as I'm sure it is accurate, but could be driven by a small number of observations). Twenty six wigeons may commonly be seen in feeding groups on the water, or possibly one large migratory flock could drive this number. Rarely however, will you see local movements with this number of birds in a tight flock, and these birds have never been reported struck in the records for Juneau, yet they are number two on your list of hazards for the EIS (and admittedly high in the other ranking schemes as well). If you look closely at other such "anomalies" in the ranking, I think you will see that the list does not seem to make logical/biological sense in some instances. Are there other sources of data you could use to address these inconsistencies and provide larger regional sample sizes? Did you examine the literature for data on average flock sizes for example? If so, would such data be preferable so that it could also be used at other locations? [Other points to ponder from your list: Duck species seem to be scattered through your list somewhat randomly (less so in the other two ranking lists) and logically makes it difficult to follow. The Caspian Tern is listed as number 19 on the FAA Rank list (this species does not occur in Alaska, or if so, in extremely low numbers).] I like the fact that you performed the statistical analyses to correlate the different variables with the different ranking schemes. While your approach provided the best fit specific to Juneau, is the FAA list "good enough" so that it could be used as the standard to be applied throughout the country and also greatly simplify the procedure?

There are some other areas that would perhaps be best to discuss over the phone if you wish. Give me a call if so and we can brainstorm this a bit. I agree with you that this would be a good discussion item for BSC-USA/Canada. It would be nice to establish a simple protocol that we could all emulate when these situations arise in the future.

COL (RET) JEFFREY J. SHORT

At first blush, the model will be very beneficial and give a pretty good picture of the bird hazards and management options. I like the S, M, L, XL vice goose, duck, heron, etc. However, I would keep the individual species separate instead of lumping them together. This will allow future management decisions based on changes in bird abundance, habitat distribution, etc. which is species-specific, not size-/category-specific.

The issue of altitude is adequately covered; i.e., movement to adjacent areas around the airfield would skew the probability of hitting a waterfowl versus the less dangerous shorebirds.

My concerns with the model deal more with the susceptibility of various aircraft or configurations to damage. I'm not sure the penalty fully reflects the damage potential. In the original BAM, probability of bird strike is dependent of the frontal area swept by the aircraft through the distribution of birds. However, the probability of damage is more a function of airspeed and susceptibility of the aircraft component--or what's behind it--to damage. The former relates to birds, their populations, and behaviors; the latter relates to the type of aircraft, the flightpath(s) and number of sorties, and behaviors (fast, low).

The model might better reflect the experiential penalty at JNU if you could factor-in the type of aircraft--perhaps prop, turbo-prop, jet--so not to be too specific). It may be too difficult to "tease"-out this type of information from the reports but this type of improvement may help with the decisions about what management decisions are most important.

~jjs

MR. BRUCE MCKINNON

Good day Ron. Regarding our conversation this morning, the following are my thoughts on species ranking. Please bear in mind that I'm not entirely comfortable with the concept of quantifying risk associated with a subject area where there are so few absolutes. Furthermore, although we may have a better bird strike reporting rate than many of us assume, I think there are still a great number of incidents that go unreported. Perhaps even more important, many near-misses are not reported. I am also uncomfortable with the notion that we should be able to quantify risk in order to predict incidents or accidents. It bothers and surprises me to examine the data and see that it provided little or no advance warning for the Elmendorf accident or the Air France Concorde incident at JFK. Both you and I could easily find many airports in North America today that have the same conditions that prevailed prior to both events.

Having said this, I think your species ranking system makes sense, particularly given the terms of reference that you are working to. Although I prefer the more simple approach that was developed by Dr. Dolbeer, which in modified format is included in our new Standards to the CAR on Wildlife Planning and Management, you have enhanced your protocol by including a factor related to whether a particular species has in fact been struck at a given airport. Even though our reporting system is far from perfect, I suspect there is sufficient historical damaging incident data for most airports to identify those species we should be most concerned with. We also have sufficient data on aircraft certification standards and the damage record to be able to assess within reason whether we should be concerned about a particular species.

At the end of the day, I think most of us who have been involved in the birdstrike business for as long as you and I can subjectively assess the risk associated with bird strikes at most airports we visit. Given that you have as much credibility and experience as anyone in this business, I feel comfortable endorsing a protocol that you have established. Cheers, and if you need additional information, please feel free to contact me. Bruce.

DR. JOHN ALLEN

Further to your e-mail and our telephone conversation, I have the following thoughts on the risk assessment model.

Risk is basically frequency times severity, i.e., the number of strikes multiplied by the probability of damage or an accident. We know the latter quite well based on the FAA database but, from looking at the JNU bird strike data, the reporting rate at the Airport is poor to say the least. Given that we have no reliable measure of strike frequency from the reported data we need to find another measure of probability. The easiest to use is simple bird abundance, and you have good

count data for the Airport. However, we know that some birds, because of their behavior, are more prone to be struck than others, presumably either because they move through the operational airspace more often or because they are poor at detecting and avoiding aircraft. One can therefore modify bird abundance by a factor that one could describe as 'strike proneness' to arrive at a better probability measure and hence risk measure, for each species.

Unfortunately, this 'strike proneness' measure is based on experience at a large number of airports around the USA and may not necessarily apply to the situation in JNU as it may well be 'different up there' and each airport, wherever it is located, has its own unique set of circumstances (locations of feeding, roosting and nesting sites relative to the runways for example) that influence the probability of a species being struck. This can be overcome if a real world probability measure is used (as opposed to a subjective factor) that integrates numbers and behavior. The best way to do this is to make a count of birds moving through the operational airspace, as this is the only time when birds are actually at risk of being struck. If you do not have these data, and you are not confident that adding a factor of 'strike proneness' to the count data for the airport is valid for JNU then the method that you have used, combining abundance with damage probability and adding a factor for those strikes that have been reported, is as valid as any that I can conceive. There will always be anomalies in any scoring system, and it is important to ensure that species that do not feature high in the list, but which common sense suggests may be hazardous, if only for a short time each year, are included in the assessment.

I trust that the above is of use. We should certainly discuss this in Baltimore.

RICHARD A. DOLBEER

The BSRM used by Detect was developed from a ranking system developed by Dolbeer et al. 2000 using strike statistics from the National Wildlife Strike Database. I am pleased to see this approach being used at Juneau to get a better handle on where priorities should be focused in reducing the risk due to bird strikes. I published this ranking system as an initial approach to get people thinking about which species were the most hazardous. Then by multiplying the hazard value of a species or species group by the frequency or probability of a strike at an airport, you could calculate risk at the airport. I commend Detect for taking this approach. Having said that, I think the BSRM developed by Detect has some major shortcomings that should be factored in when using the model in decision making. My concerns were also concerns mentioned by Drs. Defusco and Allen in their comments on the model. When I developed the initial ranking model (Dolbeer 2000), I used species groups (e.g., ducks, vultures, geese, swallows) instead of individual species (e.g., gadwall) because sample sizes were simply too small for most individual species. For example, from1990-2002 there were 503 "ducks" (unidentified to species) reported in the database compared to only 6 gadwalls and 2 canvasbacks. I am sure that a number of the 503 "ducks" were gadwalls and canvasbacks but just never identified to species. Thus, to develop a robust ranking system based on sufficient sample size, I used species groups in most cases, I think the BSRM presents some spurious results because of the very low sample sizes(e.g., pintail, scaup, canvasback, mew gull, GWF goose, RN duck, gadwall, gw teal all with only 1 or 2 strikes in USA database). I think the BSRM would be far more instructive if it used the aggregate strike data for all ducks and applied those to the ducks at Juneau (ditto for gulls, crows etc). Also, I wonder why species such as swans are not even considered when we know they are quite haz-

ardous because of their size (e.g., the second deadliest commercial bird strike in USA was caused by swans in1962-17 people died). Even if there have not been swan strikes at Juneau, since swans are in the area they should be considered in the BSRM. Dr. Allen also made this point in his comments on the BSRM. In summary, I like the idea of developing BSRMs as an aid to focusing our efforts most productively in Wildlife Hazard Management Plans (WHMPs) at airports. But the BSRMs must be based on sufficient data to provide realistic rankings, and I feel there are some spurious results in the current BSRM as applied to Juneau because of very small sample sizes for individual species. Also, it is important to recognize that given the complexity of biological systems and the limited nature of our data, a BSRM, no matter how well formulated, should be considered as a supportive guide for an airport's WHMP and not the driving force. You still must factor in the observations and experience of the biologists and airport personnel on the ground who observe wildlife at the airport on a daily basis throughout the annual cycle.

Finally, I would note that on page 14 of the Draft EIS section 2.5.3, the statement is made that "this approach [BSRM] has been reviewed by an international group of six bird-air-strike hazard specialists, all of whom agreed that it was an appropriate methodology for the purposes of this EIS". I was one of the six people sent the material to review by Detect last December, but I must apologize that I have not reviewed it until now. Thus, that statement is not correct. Also, I note that the four people who did respond had some criticism or concern about the specific BSRM, even though we are all supportive of the approach.

I emphasize that I am delighted to see consultants such as Detect using this approach to aid in developing and evaluating WHMPs and I expect and encourage people to modify the initial ranking system I developed. But I do think the concerns that the other reviewers and I have expressed (and I acknowledge mine have been given very belatedly) should be incorporated before this BSRM becomes a part of the EIS. Also, in the words of Dr. Allen in his review of the BSRM, "it is important to ensure that species that do not feature high in the list, but which common sense suggests maybe hazardous, if only for a short time each year, are included in the assessment".

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B.2 Review of Wildlife Control Methods

B.2.1 Introduction

The proposed Wildlife Hazard Management Plan for the Juneau International Airport (JNU) includes the use of several methods. To determine which methods are efficacious in controlling wildlife a survey was sent to staff at 12 airports across the country. Nine responses were received and the results tabulated below.

B.2.2 SURVEY SUMMARY

The following airports responded to the survey request (Appendix 1a includes survey forms returned for each facility):

- Portland International Airport (PDX)
- Sacramento Metropolitan (SAC)
- Dallas – Fort Worth International Airport (DFW)
- Nashville International Airport (BNA)
- Vancouver International Airport (YVR)
- New Orleans International Airport (MSY)
- Panama City-Bay County International Airport (PFN)
- Augusta Regional Airport (AUG)
- Tallahassee Regional Airport (TLH)

These airports range from very busy hub airports (Dallas-Fort Worth IAP, Vancouver IAP, and Nashville IAP) to smaller regional airports (Panama City- Bay County IAP and Augusta Regional Airport). Additionally, the area of each airport varied widely from 18,000 acres at DFW to approximately 1,000 acres at Panama City. This array of airports allows for a reasonable review of the methods used in bird and wildlife control.

B.2.3 DEDICATED CONTROL STAFF

Smaller, regional airports have limited resources to dedicate to bird control activities. These airports typically do not have a dedicated wildlife control specialist and conduct wildlife control activities "in-house" using operations specialists or fire/rescue staff to assist in control programs. Dedicated staff ranged from a high of 14 (contracted at Vancouver IAP) to 0 at Panama City and Nashville. Airports that did not have full-time contract support typically dedicated only 1 person to wildlife control.

B.2.4 DESIGNATED CONTROL STAFF

In addition to dedicated staff, most airports supplement control programs with individuals trained in wildlife control, but who have other duties at the airport. Airports without fulltime contract support often train a wide range of airport staff to assist including: Operations specialists, fire/ rescue, and security forces. A summary by airport is provided in Table B-1.

Table B-1. Manpower Summary

Staff	DFW	YVR	TLH	AUG	PFN	PDX	MSY	SAC	BNA	Total	Average
Dedicated	1		1	1	0	3.5	1	3	0	10.5	
Designated	16		5	4	5	8	6	30	8	82	
Contract		14				1			1	16	
Totals	**17**	**14**	**6**	**5**	**5**	**12.5**	**7**	**33**	**9**	**108.5**	**12.5**

B.2.5 CONTRACT VS. IN-HOUSE SUPPORT

Vancouver IAP had the most aggressive program with 14 fulltime contract wildlife control specialists. Sacramento Metropolitan Airport has contract support from USDA Wildlife Services and augments that effort with trained airport employees.

Contractors are often used part time for specific problems such as raptor relocation at Portland and raptor control at Nashville.

B.2.6 HABITAT MANAGEMENT

Habitat management programs are integral to every airport program and only 1 airport (representing 11% of those airports responding) reported not having any habitat management efforts in the past 5 years. Habitat alterations included removal of wetland habitat (DFW) and large-scale tree thinning (Nashville); clearing of vegetation (Tallahassee, New Orleans, Panama City, and Vancouver), and turf management (Portland). Each airport has unique habitat and site-specific land uses in the vicinity of the airport that drives the level of effort at each facility. Habitat management programs are required in wildlife management plans approved by the FAA.

B.2.7 CONTROL METHODS

In addition to habitat management, all airports surveyed used some type of control program. A summary is provided in Table B-2.

.22 Caliber Pistol. The most commonly used control method was the .22 cal pistol (also known as 15mm pistol) that was used at 8 of the 9 airports surveyed. The .22 cal pyrotechnic pistol was determined to be effective at 7 of 9 airports and rated as inexpensive by 7 of 9 airports as well.

Pyrotechnics (12 gauge). The 12 gauge pyrotechnic round was used at 7 of the 9 airports surveyed. The 12 gauge round cost approximately three times more than the .22 cal round, but was still considered any more expensive than the .22 cal. The 12 gauge round has a longer range and was identified as more effective than the .22 cal round.

Long-range Pyrotechnic Rounds. These rounds are represented by the Capa rounds that cost approximately $5-10 per round (depending on quantity and exchange rates). These rounds are advertised as having a longer reach (out to 1,200 feet) than other pyrotechnics. Most airports

Table B-2. Summary of Control Methods

	Commonly Used %	Occasion-ally Used %	Never Used %	Not Effective %	Effective %	Very Effective %	Not Expensive	Expensive	Very Expensive
.22 Caliber Pistol	56	33	11	11	78	0	78	11	0
12 Gauge	56	22	22	11	33	44	78	56	0
Capa Rounds	11	22	67	0	33	11	0	22	22
Propane Cannons	33	33	33	11	78	0	11	78	0
Bio-acoustics	22	0	78	11	11	0	11	22	0
Other Sonic Devices	11	0	89	22	0	0	11	0	0
Dogs	22	0	78	0	11	11	11	11	0
Falconry	0	0	100	0	0	0	0	0	22
Perch Excluders	22	11	67	11	22	11	11	11	11
Trap and Remove	11	22	67	0	22	0	11	11	11
Habitat Alteration	22	67	11	0	67	0	11	44	33

(67%) do not use these with only 1 airport (11%) using them commonly. The airport that commonly uses Capa rounds rated them very effective, while the other airports using them rated them effective. Cost is a major consideration in the use of this product, with 4 airports considering them expensive (22%) or very expensive (22%).

Propane Cannons. Propane cannons are used at 6 (67%) of the airports responding to the survey. Of the airports using propane cannons only one reported them as not effective. Cost appears to be a factor in the use of propane cannons, with the initial costs ranging from $250 to $2,500 depending on options. Effectiveness of propane cannons is highly dependent on the species being controlled as well as the experience of the control officer in implementing this program.

Bioacoustics. Bioacoustics includes recorded distress calls, alarm calls, and predator calls projected over a loudspeaker system either permanently mounted or mobile systems mounted on vehicles. The effective use of bioacoustics requires a good understanding of the bird species being controlled as well as local movement patterns. This is often referred to as a "finesse" tool. Only 2 (22%) of the responding airports use bioacoustics systems. Of the two airports using bioacoustics, only one determined the system to be effective. No airport considered the method very expensive.

Other Sonic Devices. This category includes the stationary and mobile "noise makers" such as sirens, wailers, horns, etc. Only one airport commonly uses this method. Two airports reported them as not effective, and no airport reported them as effective. Cost is not a factor, as the only airport responding to this question evaluated them as not expensive.

Dogs/Border Collies. Trained Dogs have seen a great increase in use over the past decade. Two airports surveyed commonly use dogs to assist in their control programs. Of these two airports, one reports them as effective and the other as very effective. Cost appears to be a major factor in implementing a program that uses dogs.

Falconry. No airports surveyed use falconry. Two airports sited the extremely high cost of this technique.

Perch Excluders. This method includes a range of products designed to prevent birds from perching on a structure. These range from wires to barbs and nets. Most airports did not indicate that they use these devices (67%). The effectiveness of this method is highly variable due to the wide range of products and the methods of installation. Cost are also highly variable depending on the type of product (spikes are less expensive than netting).

Trap and Remove. Only one airport commonly traps and removes birds from the airport. Two other airports occasionally trap and remove birds. All bird trapping and removal is done with contract support. Two airports reports trapping as effective, but no airport reports trapping as very effective. The cost of this process will range with the level of effort expended and survey results are evenly split from not expensive to very expensive.

Habitat Alterations. Almost all airports responding to the surveys have used habitat alterations as a method to control wildlife hazards. Most of the airports that have modified habitat believe it is an effective hazard control technology. However, half of the airports have determined that it is an expensive control technology, and three of the eight respondents characterize habitat alteration as very expensive.

B.2.8 SUMMARY AND CONCLUSIONS

Airports across the country use a wide range of strategies to manage wildlife hazards. With each airport situated in a different environmental setting and with different types of aviation activities, the level of control effort will vary accordingly. The wide range in manpower allocation underscores this concern. For example, DFW IAP, in north central Texas, is located on 18,000 acres of land and supports over three quarter of a million operations each year. DFW has only one dedicated wildlife control specialist. Vancouver IAP has approximately 337,000 operations annually, but is located on the Pacific Northwest coast. This is a major migratory route for a wide range of bird species. Vancouver IAP has 14 dedicated (contract) wildlife control staff.

The value of this review is identifying products that are commonly used in most settings that are both effective and affordable. The tools common to most airports are the .22 cal and 12 gauge pyrotechnic rounds. These devices are inexpensive and effective in controlling many species of birds. Propane cannons are also generally effective when properly used and not considered very expensive, especially when used over a long period of time, probably because birds learn to stay away from areas where they are commonly employed. Bioacoustics are not commonly used and have shown to be somewhat difficult to use without some level of expertise.

The use of dogs and falconry are considered expensive. Even though both control techniques are generally considered effective, neither is commonly used. For example, Sacramento Airport has used falcons but found they would stray into designated airspace. At SAC the falcons are very effective for pigeons, ducks stayed on the water (presumably away from the falcons) and gulls towered above the falcons, creating a worse hazard. Only airports with extraordinary bird strike issues warrant the time investment and expense associated with these methods. Perch excluders are effective when properly designed and installed.

The bird strike risk at JUN warrants the continued use of pyrotechnics and propane cannons. The use of falconry and dogs is not apparently justified in economic terms, at least during periods of much reduced operations in the winter months (in particular, dogs used to haze wildlife need to be kept busy and on-the-job; the flight frequency at JNU is much reduced during winter). Perch excluders to limit raptors on structures around the airport are also of value, while trapping would not be recommended.

B.3 SURVEY FORMS

AIRPORT NAME (optional but desired)	**Vancouver International Airport Authority (YVRAA)**	
Operations per year:	24/7	
Number of staff positions dedicated to wildlife control	14	
Number of staff positions designated for wildlife control	14	
Wildlife control is conducted (circle one):	in house	by contract
What habitat alterations have you made in the past five year?	Drainage, field leveling and brush removal	

YVRAA Survey

Please identify the methods you use at your airport.

Method	Commonly Used	Occasionally Used	Never Used	Comments (which species respond best)
1. Pyrotechnics (.22 cal)		X		
2. Pyrotechnics (12 ga.)	X			
3. Long Range Pyros (Capa)	X			
4. Propane cannons	X			
5. Bioacoustics	X			
6. Other Sonic devices			X	
7. Dogs/Border collies	X			
8. Falconry			X	
9. Perch excluders	X			
10. Trap and remove			X	
11. Habitat Alterations	X			

YVRAA Survey, continued

Please rate these methods from Very Effective to Not Effective.

Method	Not Effective	Effective	Very Effective	Comments
1. Pyrotechnics (.22 cal)				
2. Pyrotechnics (12 ga.)		X		Overuse of all pyro reduce their effectiveness
3. Long Range Pyros (Capa)		X		
4. Propane cannons		X		
5. Bioacoustics		X		
6. Other Sonic devices	X			
7. Dogs/Border collies		X		
8. Falconry				
9. Perch excluders		X		
10. Trap and remove				
11. Habitat Alterations			X	

YVRAA Survey, continued

Please rate these methods from Very Expensive to Not Expensive.

Method	Not Expensive	Expensive	Very Expensive	Comments
1. Pyrotechnics (.22 cal)				
2. Pyrotechnics (12 ga.)	X			Costs can be controlled through proper training on when to use and when not to.
3. Long Range Pyros (Capa)		X		
4. Propane cannons	X			
5. Bioacoustics	X			
6. Other Sonic devices				
7. Dogs/Border collies	X			
8. Falconry				
9. Perch excluders		X		
10. Trap and remove				
11. Habitat Alterations		X		Construction on major project can cost a lot of money; there is no way around it. Proper planning and the right people return huge gains in years to come.

YVRAA Survey, continued

AIRPORT NAME (optional but desired)	**DFW International Airport**	
Operations per year:	745,000 total as of December 22, 2003 (should be close to 758,000 total for calendar year 2003)	
Number of staff positions dedicated to wildlife control	none* (one person has primary duties involved with wildlife control; however, that is not their sole function.)	
Number of staff positions designated for wildlife control	17* (all Airfield Operations Officers and Assistant Officers conduct wildlife control duties during the course of their assigned shifts).	
Wildlife control is conducted (circle one):	**in house**	**by contract**
	Airfield Operations personnel and Energy and Asset management personnel (formerly Airport Maintenance)	
What habitat alterations have you made in the past five year?	Removal of wetlands associated with Runway 17L; recently reduced the height of grass on the airfield; programs are being established to control and reduce the amount of vegetation in and around the open drainage ditches on the airport (initial plans indicate a five to six year project for this program).	

DFW International Airport Survey

Please identify the methods you use at your airport.

Method	Commonly Used	Occasionally Used	Never Used	Comments (which species respond best)
1. Pyrotechnics (.22 cal)		X		Grackles, starlings, pigeons
2. Pyrotechnics (12 ga.)	X			Grackles, starlings, pigeons, hawks and coyotes on occasion
3. Long Range Pyros (Capa)		X		Red-tailed Hawks (used infrequently – supplies are stored in the Airfield Office)
4. Propane cannons	X			Used in and around the terminals for grackles and starlings
5. Bioacoustics			X	
6. Other Sonic devices	X			Vehicle horns, sirens – grackles, starlings, pigeons, etc
7. Dogs/Border collies			X	
8. Falconry			X	
9. Perch excluders		X		Limited success in the terminal parking garages
10. Trap and remove			X	
11. Habitat Alterations		X		Removal of 17L wetlands, reducing the height of the grass on the airfield

DFW International Airport Survey, continued

Please rate these methods from Very Effective to Not Effective.

Method	Not Effective	Effective	Very Effective	Comments
1. Pyrotechnics (.22 cal)		X		
2. Pyrotechnics (12 ga.)			X	
3. Long Range Pyros (Capa)		X		
4. Propane cannons		X		
5. Bioacoustics				Not applicable
6. Other Sonic devices				Vehicle horns, sirens
7. Dogs/Border collies				Not applicable
8. Falconry				Not applicable
9. Perch excluders	X			Some positive effects were noted, however, the overall problem still remains.
10. Trap and remove				Not applicable
11. Habitat Alterations		X		Too soon to tell if the shortened grass height on airfield is a permanent fix or not.

DFW International Airport Survey, continued

Please rate these methods from Very Expensive to Not Expensive.

Method	Not Expensive	Expensive	Very Expensive	Comments
1. Pyrotechnics (.22 cal)	X			
2. Pyrotechnics (12 ga.)		X		
3. Long Range Pyros (Capa)		X		Can become very expensive if frequent use is needed to disperse certain types of wildlife
4. Propane cannons		X		
5. Bioacoustics				Not applicable
6. Other Sonic devices	X			
7. Dogs/Border collies				Not applicable
8. Falconry				Not applicable
9. Perch excluders	X			
10. Trap and remove				Not applicable
11. Habitat Alterations			X	Can be expensive and time consuming, such as wetlands mitigation.

DFW International Airport Survey, continued

AIRPORT NAME (optional but desired)	Tallahassee Regional Airport	
Operations per year:	77,149	
Number of staff positions dedicated to wildlife control	1	
Number of staff positions designated for wildlife control	5	
Wildlife control is conducted (circle one):	**in house**	**by contract**
What habitat alterations have you made in the past five year?	Clearing wooded areas on south side of the airport. New fencing and gates	

Tallahassee Regional Airport Survey

Please identify the methods you use at your airport.

Method	Commonly Used	Occasionally Used	Never Used	Comments (which species respond best)
1. Pyrotechnics (.22 cal)	X			
2. Pyrotechnics (12 ga.)	X			
3. Long Range Pyros (Capa)			X	
4. Propane cannons		X		
5. Bioacoustics			X	
6. Other Sonic devices			X	
7. Dogs/Border collies			X	
8. Falconry			X	
9. Perch excluders			X	
10. Trap and remove			X	
11. Habitat Alterations		X		

Tallahassee Regional Airport Survey, continued

Please rate these methods from Very Effective to Not Effective.

Method	Not Effective	Effective	Very Effective	Comments
1. Pyrotechnics (.22 cal)		X		
2. Pyrotechnics (12 ga.)			X	
3. Long Range Pyros (Capa)				NA
4. Propane cannons		X		
5. Bioacoustics				NA
6. Other Sonic devices				NA
7. Dogs/Border collies				NA
8. Falconry				NA
9. Perch excluders				NA
10. Trap and remove				NA
11. Habitat Alterations		X		

Tallahassee Regional Airport Survey, continued

Please rate these methods from Very Expensive to Not Expensive.

Method	Not Expensive	Expensive	Very Expensive	Comments
1. Pyrotechnics (.22 cal)	X			
2. Pyrotechnics (12 ga.)		X		
3. Long Range Pyros (Capa)				NA
4. Propane cannons		X		
5. Bioacoustics				NA
6. Other Sonic devices				NA
7. Dogs/Border collies				NA
8. Falconry			X	We don't use it...but it is expensive
9. Perch excluders				NA
10. Trap and remove				NA
11. Habitat Alterations		X		

Tallahassee Regional Airport Survey, continued

AIRPORT NAME (optional but desired)	**Sacramento International Airport**
Operations per year:	159,999
Number of staff positions dedicated to wildlife control	3
Number of staff positions designated for wildlife control	30
Wildlife control is conducted (circle one):	**in house** / **by contract**
	In house and USDA-WS contract
What habitat alterations have you made in the past five year?	Reduced the variety of crops that can be grown on airport property and will discontinue agriculture altogether this year.

Sacramento International Airport Survey

Please identify the methods you use at your airport.

Method	Commonly Used	Occasionally Used	Never Used	Comments (which species respond best)
1. Pyrotechnics (.22 cal)	X			Mallards, Egrets\Herons
2. Pyrotechnics (12 ga.)	X			Waterfowl, Egrets\Herons, some raptors
3. Long Range Pyros (Capa)		X		Raptors (if cartridge explodes right next to them)
4. Propane cannons	X			Mallards, Egrets\Herons
5. Bioacoustics	X			Unknown if they work at all.
6. Other Sonic devices			X	
7. Dogs/Border collies			X	
8. Falconry		X		Falcon kept flying into departure airspace
9. Perch excluders		X		Pigeons and blackbirds but they just go someplace you don't have treated.
10. Trap and remove			X	
11. Habitat Alterations	X			Blackbird roosting trees removed

Sacramento International Airport Survey, continued

Please rate these methods from Very Effective to Not Effective.

Method	Not Effective	Effective	Very Effective	Comments
1. Pyrotechnics (.22 cal)	X	X		Not effective with raptors or small birds. Works well with Mallards and Egrets\Herons
2. Pyrotechnics (12 ga.)		X		Effective for lethal reinforcement
3. Long Range Pyros (Capa)		X		Effective for Gulls that are already being pushed away. Sometimes if you fire a cracker shell it will actually draw them in.
4. Propane cannons		X		Effective, when used judiciously
5. Bioacoustics	X			Ours have droppings on them
6. Other Sonic devices				NA
7. Dogs/Border collies				NA
8. Falconry			X	Very effective for pigeons, ducks stayed on the water and gulls towered above the falcon creating a worse hazard.
9. Perch excluders			X	Effective to a degree, expensive
10. Trap and remove		X		Effective to a degree, it catches a lot of blackbirds but the numbers are only a drop in the bucket
11. Habitat Alterations		X		

Sacramento International Airport Survey, continued

Please rate these methods from Very Expensive to Not Expensive.

Method	Not Expensive	Expensive	Very Expensive	Comments
1. Pyrotechnics (.22 cal)		X		
2. Pyrotechnics (12 ga.)	X			
3. Long Range Pyros (Capa)			X	$5.00 a shot
4. Propane cannons		X		Initially expensive, low cost to operate
5. Bioacoustics		X		Initially expensive, low cost to operate
6. Other Sonic devices				NA
7. Dogs/Border collies				NA
8. Falconry			X	Very, very, very, expensive
9. Perch excluders			X	Very expensive to do it right
10. Trap and remove	X			Very expensive to do it right
11. Habitat Alterations			X	Very expensive

Sacramento International Airport Survey, continued

AIRPORT NAME (optional but desired)	**Panama City-Bay County International Airport**	
Operations per year:	78,523	
Number of staff positions dedicated to wildlife control	0	
Number of staff positions designated for wildlife control	8	
Wildlife control is conducted (circle one):	**in house**	**by contract**
What habitat alterations have you made in the past five year?	Turf management improvements, drainage clearance	

Panama City-Bay County International Airport Survey

Please identify the methods you use at your airport.

Method	Commonly Used	Occasionally Used	Never Used	Comments (which species respond best)
1. Pyrotechnics (.22 cal)		X		
2. Pyrotechnics (12 ga.)		X		
3. Long Range Pyros (Capa)			X	
4. Propane cannons			X	
5. Bioacoustics			X	
6. Other Sonic devices			X	
7. Dogs/Border collies			X	
8. Falconry			X	
9. Perch excluders			X	
10. Trap and remove			X	
11. Habitat Alterations		X		

Panama City-Bay County International Airport Survey, continued

Please rate these methods from Very Effective to Not Effective.

Method	Not Effective	Effective	Very Effective	Comments
1. Pyrotechnics (.22 cal)		X		
2. Pyrotechnics (12 ga.)		X		
3. Long Range Pyros (Capa)				NA
4. Propane cannons				NA
5. Bioacoustics				NA
6. Other Sonic devices				NA
7. Dogs/Border collies				NA
8. Falconry				NA
9. Perch excluders				NA
10. Trap and remove				NA
11. Habitat Alterations		X		

Panama City-Bay County International Airport Survey, continued

Please rate these methods from Very Expensive to Not Expensive.

Method	Not Expensive	Expensive	Very Expensive	Comments
1. Pyrotechnics (.22 cal)	X			
2. Pyrotechnics (12 ga.)		X		
3. Long Range Pyros (Capa)				NA
4. Propane cannons				NA
5. Bioacoustics				NA
6. Other Sonic devices				NA
7. Dogs/Border collies				NA
8. Falconry				NA
9. Perch excluders				NA
10. Trap and remove				NA
11. Habitat Alterations			X	

Panama City-Bay County International Airport Survey, continued

AIRPORT NAME (optional but desired)	**New Orleans International Airport**	
Operations per year:	149,752	
Number of staff positions dedicated to wildlife control	1	
Number of staff positions designated for wildlife control	6	
Wildlife control is conducted (circle one):	**in house**	**by contract**
	Orkin provides some assistance	
What habitat alterations have you made in the past five year?	Vegetation clearing in ditches, tree removal along drainage ditches	

New Orleans International Airport Survey

Please identify the methods you use at your airport.

Method	Commonly Used	Occasionally Used	Never Used	Comments (which species respond best)
1. Pyrotechnics (.22 cal)	X			
2. Pyrotechnics (12 ga.)	X			
3. Long Range Pyros (Capa)		X		
4. Propane cannons		X		
5. Bioacoustics			X	
6. Other Sonic devices			X	
7. Dogs/Border collies			X	
8. Falconry			X	
9. Perch excluders			X	
10. Trap and remove			X	
11. Habitat Alterations		X		

New Orleans International Airport Survey, continued

Please rate these methods from Very Effective to Not Effective.

Method	Not Effective	Effective	Very Effective	Comments
1. Pyrotechnics (.22 cal)		X		
2. Pyrotechnics (12 ga.)		X		
3. Long Range Pyros (Capa)			X	
4. Propane cannons		X		
5. Bioacoustics				Not used
6. Other Sonic devices				Not used
7. Dogs/Border collies				Not used
8. Falconry				Not used
9. Perch excluders				Not used
10. Trap and remove				Not used
11. Habitat Alterations		X		

New Orleans International Airport Survey, continued

Please rate these methods from Very Expensive to Not Expensive.

Method	Not Expensive	Expensive	Very Expensive	Comments
1. Pyrotechnics (.22 cal)	X			
2. Pyrotechnics (12 ga.)		X		
3. Long Range Pyros (Capa)			X	
4. Propane cannons		X		
5. Bioacoustics				Not used
6. Other Sonic devices				Not used
7. Dogs/Border collies				Not used
8. Falconry				Not used
9. Perch excluders				Not used
10. Trap and remove				Not used
11. Habitat Alterations			X	

New Orleans International Airport Survey, continued

AIRPORT NAME (optional but desired)	**Nashville International Airport**	
Operations per year:	233,631	
Number of staff positions dedicated to wildlife control	0	
Number of staff positions designated for wildlife control	8	
Wildlife control is conducted (circle one):	**in house**	**by contract**
	Critter Ridder, Inc	
What habitat alterations have you made in the past five year?	Tree removal on the east side of the airport	

Nashville International Airport Survey

Please identify the methods you use at your airport.

Method	Commonly Used	Occasionally Used	Never Used	Comments (which species respond best)
1. Pyrotechnics (.22 cal)	X			
2. Pyrotechnics (12 ga.)		X		
3. Long Range Pyros (Capa)			X	
4. Propane cannons		X		
5. Bioacoustics			X	
6. Other Sonic devices			X	
7. Dogs/Border collies			X	
8. Falconry			X	
9. Perch excluders			X	
10. Trap and remove			X	
11. Habitat Alterations		X		

Nashville International Airport Survey, continued

Please rate these methods from Very Effective to Not Effective.

Method	Not Effective	Effective	Very Effective	Comments
1. Pyrotechnics (.22 cal)		X		
2. Pyrotechnics (12 ga.)			X	
3. Long Range Pyros (Capa)				NA
4. Propane cannons		X		
5. Bioacoustics				NA
6. Other Sonic devices				NA
7. Dogs/Border collies				NA
8. Falconry				NA
9. Perch excluders				NA
10. Trap and remove				NA
11. Habitat Alterations			X	

Nashville International Airport Survey, continued

Please rate these methods from Very Expensive to Not Expensive.

Method	Not Expensive	Expensive	Very Expensive	Comments
1. Pyrotechnics (.22 cal)	X			
2. Pyrotechnics (12 ga.)		X		
3. Long Range Pyros (Capa)				NA
4. Propane cannons		X		
5. Bioacoustics				NA
6. Other Sonic devices				NA
7. Dogs/Border collies				NA
8. Falconry				NA
9. Perch excluders				NA
10. Trap and remove				NA
11. Habitat Alterations			X	

Nashville International Airport Survey, continued

AIRPORT NAME (optional but desired)	**Portland International Airport**
Operations per year:	275,000
Number of staff positions dedicated to wildlife control	3 full time, one half time, one part time intern
Number of staff positions designated for wildlife control	Airfield Supervisors have wildlife control duties along with other duties and conduct hazing as time allows (these staff is separate from wildlife staff). One Ops person is on duty 24/7.
Wildlife control is conducted (circle one):	**in house** **by contract**
	Raptor trapping services are contracted. All other duties are done in-house.
What habitat alterations have you made in the past five year?	We have removed all open water from the airfield by improving drainage, filling all wetlands (jurisdictional and non-jurisdictional), and piping all open water ditches. We have installed perforated pipe in open fields adjacent to the airfield to remove standing water. We are currently removing all trees within 300 feet of the perimeter fence that are documented to attract wildlife species of concern. We have been baiting the airfield grass with zinc phosphide to regularly knock down the numbers of rodents in the grass that attract species of concern. A recent change to our baiting program, the inclusion of a pre-baiting, has significantly improved the effectiveness of our baiting program.

Portland International Airport Survey

Please identify the methods you use at your airport.

Method	Commonly Used	Occasionally Used	Never Used	Comments (which species respond best)
1. Pyrotechnics (.22 cal)				
2. Pyrotechnics (12 ga.)				
3. Long Range Pyros (Capa)				
4. Propane cannons				
5. Bioacoustics				
6. Other Sonic devices				
7. Dogs/Border collies				
8. Falconry				
9. Perch excluders				
10. Trap and remove				
11. Habitat Alterations				

Portland International Airport Survey, continued

Please rate these methods from Very Effective to Not Effective.

Method	Not Effective	Effective	Very Effective	Comments
1. Pyrotechnics (.22 cal)				
2. Pyrotechnics (12 ga.)				
3. Long Range Pyros (Capa)				
4. Propane cannons				
5. Bioacoustics				
6. Other Sonic devices				
7. Dogs/Border collies				
8. Falconry				
9. Perch excluders				
10. Trap and remove				
11. Habitat Alterations				
Portland International Airport Survey, continued				

Please rate these methods from Very Expensive to Not Expensive.

Method	Not Expensive	Expensive	Very Expensive	Comments
1. Pyrotechnics (.22 cal)				
2. Pyrotechnics (12 ga.)				
3. Long Range Pyros (Capa)				
4. Propane cannons				
5. Bioacoustics				
6. Other Sonic devices				
7. Dogs/Border collies				
8. Falconry				
9. Perch excluders				
10. Trap and remove				
11. Habitat Alterations				

Portland International Airport Survey, continued

AIRPORT NAME (optional but desired)	**Augusta Regional Airport**	
Operations per year:	43,537	
Number of staff positions dedicated to wildlife control	1	
Number of staff positions designated for wildlife control	4	
Wildlife control is conducted (circle one):	**in house**	**by contract**
What habitat alterations have you made in the past five year?	Cleared vegetation from drainage areas.	

Augusta Regional Airport Survey

Please identify the methods you use at your airport.

Method	Commonly Used	Occasionally Used	Never Used	Comments (which species respond best)
1. Pyrotechnics (.22 cal)	X			
2. Pyrotechnics (12 ga.)			X	
3. Long Range Pyros (Capa)			X	
4. Propane cannons		X		
5. Bioacoustics			X	
6. Other Sonic devices			X	
7. Dogs/Border collies	X			
8. Falconry			X	
9. Perch excluders			X	
10. Trap and remove			X	
11. Habitat Alterations		X		

Augusta Regional Airport Survey, continued

Please rate these methods from Very Effective to Not Effective.

Method	Not Effective	Effective	Very Effective	Comments
1. Pyrotechnics (.22 cal)		X		
2. Pyrotechnics (12 ga.)				NA
3. Long Range Pyros (Capa)				NA
4. Propane cannons		X		
5. Bioacoustics				NA
6. Other Sonic devices				NA
7. Dogs/Border collies			X	
8. Falconry				NA
9. Perch excluders				NA
10. Trap and remove				NA
11. Habitat Alterations		X		

Augusta Regional Airport Survey, continued

Please rate these methods from Very Expensive to Not Expensive.

Method	Not Expensive	Expensive	Very Expensive	Comments
1. Pyrotechnics (.22 cal)	X			
2. Pyrotechnics (12 ga.)				NA
3. Long Range Pyros (Capa)				NA
4. Propane cannons		X		
5. Bioacoustics				NA
6. Other Sonic devices				NA
7. Dogs/Border collies		X		
8. Falconry				NA
9. Perch excluders				NA
10. Trap and remove				NA
11. Habitat Alterations		X		

Augusta Regional Airport Survey, continued

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