

# **REGULATORY IMPACT ANALYSIS OF THE MIGRATORY BIRD HUNTING REGULATIONS FOR THE 2004-2005 SEASON**

## **Economic Background and Significance**

The purpose of this Regulatory Impact analysis is to determine the economic effects of Federal regulatory alternatives for the 2004-2005 hunting season for migratory birds. This analysis centers on changing daily bag limits and season lengths, the two most important policy variables in the Federal framework. The analysis will show that differences in those key variables between alternatives result in measurable changes in the number of hunters, how often they hunt, and the amount of consumer surplus they enjoy as well as the amount of money they spend in pursuit of their sport. There are two components to this analysis: first, each of the regulatory alternatives will be evaluated for their effects on consumer surplus and second, each alternative will be evaluated for their effects on hunter expenditures. The results of this analysis are one component in the overall decision making process for the final framework for the 2004-2005 migratory bird hunting season.

Migratory birds are a renewable, international, common property resource. Each consumer has an incentive to take as much of the resource as they can capture, so all consumers together can overexploit the resource. This type of market failure is termed an externality in that the actions of one party impose costs on others that cannot be captured by a market transaction. Over harvesting at the turn of the century resulted in depleted bird populations and inspired the Migratory Bird Treaties between the United States, Great Britain (Canada), Mexico, Japan, and the Soviet Union. The Act implementing the treaties authorizes the Secretary of the Interior to establish national frameworks within which States may establish migratory bird hunting regulations. The Act is permissive. Without the national frameworks, the states cannot establish hunting seasons and hunting is prohibited. The national framework indirectly regulates migratory bird hunting in the United States by setting maximums for season length and bag limits under which the States can set hunting regulations. The States can be more restrictive than the Federal framework but not more lenient (e.g. the States can set shorter seasons and/or lower bag limits).

Government policies generate economic effects by changing the use of resources in the economy. Alternative resource allocations may increase the efficiency of the national economy and generate greater welfare for its citizens, or policies may redistribute resources from one region or industry to another. The former are national economic development effects. The latter are regional economic development effects. By permitting hunting, the migratory bird hunting framework regulations generate both types of effects.

Approximately 1.6 million people reported hunting ducks or geese in the United States (U.S. Department of the Interior 2002). This analysis looks at duck hunting and the economic effects of regulatory alternatives on that major component of all migratory bird hunting. Sufficient data exists for duck hunting to generate an analysis of hunter

behavior in response to regulatory alternatives. The analysis for all migratory bird hunting is not possible because of data limitations but can be inferred from the results of the duck hunting analysis presented here.

Evidently, hunters derive more pleasure from duck hunting than from their next most preferred option for spending that time and money. The increment in their welfare versus the next most preferred activity and the increment in producer surplus versus the next most productive use of the resources are the national welfare benefits of duck hunting. The Fish and Wildlife Service believes that the migratory bird hunting frameworks constitute an economically significant rule, under the definition of Executive Order 12866.

### **Effects of Allowing Hunting of the Migratory Bird Population**

The annual Environmental Assessment of the migratory bird hunting regulations provides detailed descriptions of four alternative frameworks for the annual duck hunting season:

Alternative 1. Close the season on ducks. This would be a complete closure of all seasons on migratory birds.

Alternative 2. Issue restrictive regulations allowing a limited number of days.

Alternative 3. Issue moderate regulations allowing more days than those in alternative 2.

Alternative 4. Issue liberal regulations identical to the regulations in the 2003-2004 season.

The Service proposes to issue liberal migratory bird hunting regulations in 2004-2005 (Alternative 4). A final determination of which alternative to promulgate will be made when the analysis of the bird population status, due to be completed in the summer of 2004, is available.

### **Theoretical Model**

Two approaches for looking at participant behavior are the Random Utility Model (RUM) and conjoint analysis. The RUM model is a discrete choice model that uses an individual's utility function to explain an individual's choice among recreational sites. By incorporating recreational site attributes into the model, it is possible to measure the impact on welfare due to changes in site attributes.

The  $k^{th}$  hunter's utility function from a visit to site  $j$  for  $i$  days can be described as:

$$U_{ijk} = V_k(T_{jk}, A_j, S_k) + \epsilon_{ijk}$$

where  $T_{jk}$  = vector of travel costs for hunter  $k$  to site  $j$   
 $A_j$  = vector of attributes for site  $j$   
 $S_k$  = vector of socioeconomic attributes for hunter  $k$   
 $u_{ijk}$  = unobservable utility for hunter  $k$  at site  $j$  for  $i$  days.

The hunter will choose to hunt ducks at a particular site for a number of days if his utility from hunting ducks at a particular site is greater than his utility of hunting for another animal at another site. The probability that a hunter will choose to participate in duck hunting at site  $j$  for  $i$  days is given as:

$$P(ijk) = P(i|j)P(j|k)P(k)$$

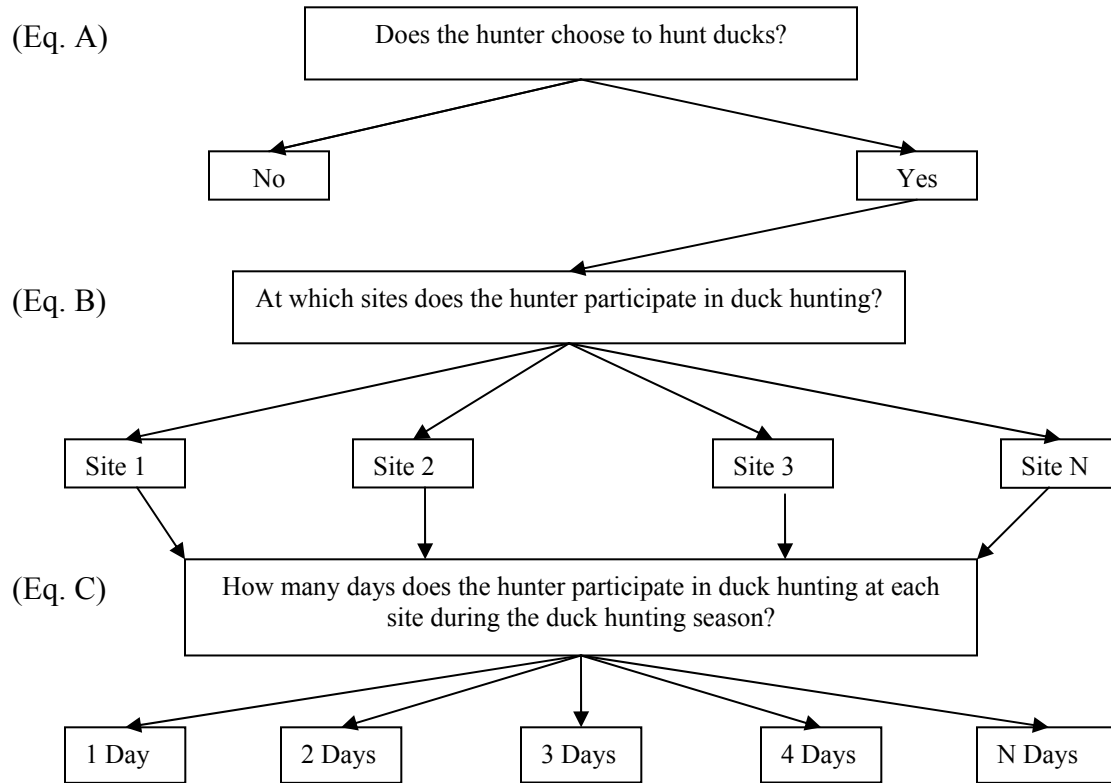
where  $P(k)$  is the marginal probability of choosing to duck hunt,  $P(j|k)$  is the conditional probability of choosing site  $j$  given that the hunter chooses to duck hunt, and  $P(i|j)$  is the conditional probability of duck hunting for  $i$  days given that site  $j$  is chosen.

For the migratory bird harvest regulation, the random utility model would have a nested logit specification with three sequential decision-making levels. The Independence of Irrelevant Alternatives (IIA) property assumes that the probability of choosing one alternative among two or more different types of recreational activities/sites is independent of the probability of choosing another alternative. By nesting together similar decisions, the IIA property holds true. **Figure 1** diagrams the hunter's decision making process for duck hunting.

The RUM is a good model to use to estimate the change in hunters' welfare as a result of a policy that changes duck hunting season length or bag limit. However, the migratory bird harvest regulation is a nationwide regulation covering 4 migratory bird flyways and 49 States with a vast number of site options for the duck hunter (equation B in Figure 1). To perform a valid RUM would require detailed information for each possible duck hunting site within the regulated 49 States. Thus, the data necessary to conduct a RUM would be prohibitively expensive to collect. The current national survey of Fishing, Hunting, and Wildlife Associated Recreation collects data on hunters by state of residence and activity but the state level of specificity would make the application of a RUM model nearly impossible.

Conjoint analysis is a modeling technique more suited to household surveys. The model consists of a series of scenarios that are framed as possible choices for the respondent. For each scenario, key variables are given different values along with other variables that don't change and the respondent is asked to pick the preferred scenario. This approach holds promise to model hunting behavior as the scenarios could be specified to include alternative sites and activities. This approach has not been used for migratory bird hunting nationwide, and as a result this approach cannot be implemented for the current analysis.

**Figure 1. The duck hunter's sequential decision-making process.**



A model of duck hunting economics to compare the impact of each of the four alternatives was developed and is described in Appendix A. Current economic effects were determined by comparisons with the base case. For purposes of analysis the base case was set as the absence of a Federal framework, i.e., no migratory bird hunting permitted. This is referred to as alternative 1. Alternatives 2 and 3 result in increasing hunting days reflecting an increase in consumer surplus when compared to the baseline (alternative 1). The estimated economic benefits resulting from liberal regulations (alternative 4) are the maximum achievable with the proposed framework.

### Estimating Consumer Surplus

Estimates of individual's willingness to pay for duck hunting provides some insight into the size of the consumer surplus derived from this activity. Willingness to pay for migratory waterfowl hunting (which includes both ducks and geese) averaged \$58 per day (2003\$) (Walsh, Johnson, and McKean 1990). This is the average of 17 estimates the authors found in the research literature. In order to account for regional differences in consumer surplus estimates, data for estimating consumer surplus of waterfowl hunting by flyway are needed. The existing literature has two studies where sufficient data were collected to derive consumer surplus estimates by flyway. Charbonneau and Hay (1978),

and Hay (1988) are the only studies found that estimated values for each of the four flyways. Average consumer surplus estimates are required to evaluate the alternative duck hunting frameworks, which are specified by flyway. In this report, the average consumer surplus is presented as a range taken from the Hay and Walsh, Johnson, and McKean studies. The daily consumer surplus estimates are used to determine the economic value of the baseline (no migratory bird hunting regulations) and the estimated effects of changes brought about by different frameworks. The estimates from the Hay study and the average consumer surplus per day reported in Walsh, Johnson, and McKean study form the range in estimates used in this analysis. The estimates range from \$38 to \$67 per hunting day. The days of duck hunting reported in the 2001 National Survey of Fishing, Hunting and Wildlife Associated Recreation were used to estimate the consumer surplus effects in the baseline. The results are shown in Table 1 below. This is the estimate for the consumer surplus loss if no migratory bird hunting regulations were issued for the 2004-2005 season.

**Table 1. Consumer Surplus Loss for the Baseline for Duck Hunting**

<u>Flyway</u>	<u>Duck Hunting Days</u>	<u>Consumer Surplus Per Day (2003 \$)</u>	<u>Base Year Consumer Surplus</u>
Atlantic	3,599,553	\$38 - \$67	\$137 - \$240 million
Mississippi	6,760,757	\$41 - \$59	\$277 - \$399 million
Central	5,333,260	\$39 - \$52	\$208 - \$279 million
Pacific	2,596,430	\$43 - \$56	\$112 - \$145 million
Total	18,290,180		\$734 - \$1,064 million

The national estimate of the consumer surplus lost without duck hunting regulations ranges from \$734 million and \$1.1 billion (2003\$) annually, with a mid-point estimate of \$899 million. This loss would be suffered by the approximately 1.6 million people who reported they hunted ducks in 2001.

#### Estimating Producer Surplus: Alternative 1/Baseline

The estimation of producer surplus is the missing value for a complete analysis of the economic benefits generated by the migratory bird framework. Producer surplus (sometimes called economic rent) is that portion of the profits that is over and above what is required to keep the company in business. Producer surplus is more difficult to quantify in the case of a natural resource. There may be some producer surplus associated with land leases for access to waterfowl hunting as well as habitat leases to provide primary constituent elements needed to allow waterfowl to reproduce. Any producer surplus associated with the sale of equipment and services to hunters is not easily estimated since the data on profits margins for all these items are not known. Also, the large numbers of suppliers of services and equipment would tend to eliminate excess profits through competition. Since most, if not all, the services and equipment have non-duck hunting applications, producers would tend to not be able to set a price that would

include excess profits. Data to estimate producer surplus are not available and most likely producer surplus is minimal compared to consumer surplus.

### Consumer Surplus Effects of Alternative Frameworks

An economic model of duck hunting was developed and estimated to evaluate the alternative duck hunting frameworks (Appendix A). This model is used to estimate changes in annual duck hunting days and the resulting consumer surplus. An analysis of the alternative frameworks shows that the proposed framework for the 2004-2005 hunting season would maximize consumer surplus and therefore, public benefits. Producer surplus, which is not estimated, should also be maximized, if it exists. For all the alternative frameworks that allow hunting regulations to be established, there is a positive consumer surplus when compared to the base case (no hunting regulations). The net effect of alternative frameworks results in relatively small increases in consumer surplus primarily reflecting the fact that the frameworks are not severely binding on duck hunters decisions on how many days to hunt. The differences between season length and days afield and bag limits and actual harvest are large enough that only marginal changes in hunter behavior are expected from alternative frameworks. The result of using the model in Appendix A to evaluate the alternatives is given in **Table 2** below. The mid-point of the consumer surplus per day values were used to develop the **Table 2** estimates.

**Table 2. Estimated Consumer Surplus for Alternative Frameworks for the 2004-2005 Duck Hunting Season.**

Consumer Surplus Estimates by Framework			
Flyway	Alternative 2 Restrictive	Alternative 3 Moderate	Alternative 4 Liberal
	(000\$)	(000\$)	(000\$)
Atlantic	\$187,427	\$187,933	\$188,500
Mississippi	\$335,912	\$336,911	\$338,000
Central	\$242,611	\$243,119	\$243,500
Pacific	\$128,016	\$128,264	\$128,500
Total	\$893,966	\$896,227	\$898,500

The frameworks safeguard the efficient use of the resource over time by imposing limits on its exploitation. Overexploitation when access to the resource was unconstrained threatened its sustainability. Limiting resource consumption ensures future hunting opportunities and the resulting benefits to hunters.

The frameworks have little direct effect on other agencies' actions nor any material budgetary impact. As the framework procedure has been in place for over 20 years, no novel legal or policy issues are raised by these regulations.

## Economic Effects of Alternative Frameworks

**Table 2** shows the estimated increases in consumer surplus from duck hunting of the alternative frameworks when compared to the base case for each flyway. The total increases in consumer surplus ranges from \$893 million for the restrictive framework to \$899 million for the liberal framework.

- Alternative 1 This alternative is a closed season on all migratory birds. Closing the migratory bird season on all flyways will result in zero duck hunting days and so no consumer surplus. This is usually slightly over half of migratory bird hunting consumer surplus. Adoption of a closed season would have the longer lasting effect of discouraging people from pursuing the sport. The scale of the consumer surplus loss is between \$734 and \$1,064 million dollars per year for duck hunting, with a mid-point estimate of \$899 million.
- Alternative 2 This alternative includes restrictive regulations allowing significantly fewer days than those issued in 2003-2004. Bag limits are 3 ducks below the 2003 levels and seasons are 30 to 47 days shorter. Total hunting days falls by 120,000 days. The reduced bag limit reduces the probability of hunting resulting in 11,700 fewer hunters. Duck hunter consumer surplus would be an estimated \$894 million (2003\$).
- Alternative 3 Bag limits under this alternative are the same as under the liberal base case but season lengths are 14 to 21 days shorter. Duck hunters would spend fewer days afield. The reduced bag limit reduces the probability of hunting resulting in 5,500 fewer hunters. Estimated consumer surplus would be \$896 million (2003\$).
- Alternative 4 The liberal regulations similar to the 2003-2004 regulations have the opposite economic effect when compared to the base case used in this analysis. The estimated consumer surplus ranges from \$734 to \$1,064 million with a mid-point estimate of \$899 million. The liberal bag limits and season lengths results in an estimated 1.6 million duck hunters. This alternative is the preferred alternative and also maximizes hunters' welfare benefits which are related to bag and days afield.

The differences between alternatives are relatively small. This reflects the fact that there is only a small influence of the national frameworks to changing the actual days afield and hunter bag.

Duck hunting accounted for 62 percent of all migratory bird hunting days in 2001. This analysis of duck hunting benefits, if extrapolated to all migratory bird hunting, would be 38 percent higher than the current estimate. There is no data to support this extrapolation so it is not performed and assumed to represent total migratory bird hunting benefits.

### **State Costs of the Rule**

The framework regulations for migratory bird hunting impose some costs of administration and enforcement on the States. If there were no migratory bird hunting, the States could apply their resources to different ends. As the States also derive revenue from licenses and sales taxes on hunting supplies, the net effect on State resources is uncertain.

If States were free to set hunting seasons and bag limits (abrogating the Migratory Bird Treaty Act), some might opt for longer seasons and higher bag limits without regard to the health of the waterfowl populations. To the extent the frameworks constrain the regulatory regime these States may impose, the framework imposes an opportunity cost on the States. The opportunity cost is the lost revenue and hunter expenditures the State cannot recover because it is constrained by the framework in its hunting regulations. There is no way to quantify this cost. In particular, the long run impact of over harvesting the population would be difficult to estimate and value.

### **Public Comment Solicitation**

We sought public comments on our initial analysis issued March 22, 2004. Comments were accepted until May 15, 2004. We received no comments on the initial analysis.



## **SMALL ENTITY ANALYSIS – INITIAL REGULATORY FLEXIBILITY ACT**

### **Regional Benefits of the Rule**

This rule will have national economic development benefits in excess of \$100 million. This rule will set in place the proposed national framework for the establishment of migratory bird hunting for the 2004-2005 season. While the national framework is aimed at regulating hunter behavior, it has indirect effects in the form of hunter expenditures that affect small businesses nationwide. Because of the magnitude of direct expenditures (\$1.4billion), with some portion going to small entities, the Fish and Wildlife Service (Service) estimates that this regulation is a major rule under the Small Business Regulatory Enforcement Fairness Act. Consequently, the Service believes the rule will have a significant beneficial economic effect on a substantial number of small entities. This impact will be focused on regions with high migratory bird hunting activity. As a result, this initial Regulatory Flexibility Act analysis is being made available for public comment.

### Major categories of Hunter Expenditures

Waterfowl and other migratory bird hunting represent an important part of the total economic activity generated by fishing and hunting in the United States. The National Survey of Fishing, Hunting and Wildlife Associated Recreation (Survey) indicates that migratory bird hunter expenditures, exclusive of licenses, stamps, tags and permits, totaled over \$1.4 billion in 2001(2003\$).

This analysis looks at duck hunting and the economic effects of regulatory alternatives on that major component of migratory bird hunting. Expenditure data specific to duck hunters are not directly available from the Survey. An estimate of duck hunter expenditures was obtained by using the numbers of active duck hunters and hunter days reported in the 2002 Waterfowl Harvest and Hunter Activity Administrative Report and the per capita and per day expenditure data reported in the 2001 Survey. Resulting expenditures for the four flyways totaled \$725 million (2003\$). Equipment and daily spending were estimated for each flyway. Equipment expenditures are calculated as per hunter equipment spending in the 2001 Survey times the number of duck hunters reported in the Administrative Report. Daily expenditures are calculated as variable expenditures (food, travel, and lodging) per day from the 2001 Survey multiplied by waterfowl hunter days from the Administrative Report. (All dollar figures in this section are constant 2003 dollars.)

Assuming that duck hunters distributed their spending among the Survey's travel expenditure categories in the same way as did other migratory bird hunters in 2001, duck hunters spending would have been as follows:

CATEGORY	PERCENT	EXPENDITURES
Equipment	52.7%	\$731.6 million
Food	16.4	227.9
Transportation	17.8	246.5
Lodging	3.8	52.4
Other	9.4	130.0
<b>Total</b>	<b>100.0%</b>	<b>\$1,388.6 million</b>

Migratory bird hunters spent \$1.25 billion for guns, ammunition, travel, and recreational services in 2001 (2003\$, U.S. Department of the Interior 2002). These resources would have been spent on other activities if migratory bird hunting had not been possible so they do not represent a change in national economic efficiency or welfare. Nevertheless, this spending is important for the industries and regions where the money is spent. If items like hunting camps, off-road vehicles, and land are included, 2003 spending for migratory bird hunting increases to \$2.7 billion. As this spending flowed through the national economy, it generated \$7.4 billion of economic output and 66,274 jobs (Southwick Associates 2002).

#### Beneficiaries of the Rule

There were an estimated 1.6 million active duck hunters in the U.S. in 2001 (U.S. Department of the Interior 2002). The number of duck hunters in the U.S. has increased in the last ten years going from approximately 1 million in 1991 to 1.6 million in 2001. In addition to hunters, a wide range of businesses and individuals benefit economically from the establishment of the annual migratory bird hunting regulations. A partial list of migratory bird hunter expenditure categories and the types of businesses that benefit from those expenditures are shown below.

Migratory bird hunting regulations generate significant economic activity for small businesses. Nationwide, migratory bird hunters spent between \$481 million and \$1.2 billion at small businesses in 2003 (**Table 3**). As many as 742,380 small businesses will share in these sales. All but five of the States derive, as a minimum, an excess of \$2 million in small business sales from migratory bird hunting.

<b>Expenditure Item</b>	<b>Examples</b>	<b>Beneficiaries</b>
Equipment and Supplies	Guns, ammunition, boats	Sporting goods stores, department stores, boat dealers
Transportation	Gasoline, oil, repairs, air travel, vehicles	Service stations, vehicle dealers and rental agencies
Lodging		Motels, campgrounds
Food and Beverages		Restaurants, grocery stores

Lands and Leases	Club memberships, daily and seasonal hunting fees	Hunting clubs, private land owners
Clothing	Specialized clothing, waders, boots	Retail clothing stores, mail order firms

Limited information is available on the number of businesses and individuals in the various categories who benefit from duck hunter expenditures. This is not surprising considering that those who provide equipment, supplies and services to duck hunters often provide identical or similar items to non-hunters. For example:

1. A motel in a duck hunting area may obtain a portion of its income from duck hunters. Registrants are not requested to indicate the nature of their travel. The same situation prevails for food service establishments, gasoline stations, etc.
2. The number of sporting goods stores in the United States is obtainable. However, such stores may cater to fishermen, bowlers, skiers, joggers, etc., in addition to hunters. Without knowledge of their specialty, knowing the number of sporting goods stores is not sufficient.
3. Considerable leasing of lands for hunting and other purposes is accomplished informally without record keeping, and the payment is often in cash or otherwise undocumented.

## Methods

This analysis combines information from the 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (Survey), the U.S. Department of Commerce County Business Patterns 1993 database, and the fisher library web site at the University of Virginia to develop two estimates of migratory bird hunters' expenditures at small businesses. The Survey provides excellent information about hunters and anglers expenditures for sporting trips and equipment. Trip expenditures are categorized as food, lodging, transportation, and other travel items (e.g., guide fees, access fees, and rentals). Equipment expenditures include guns, ammunition, decoys, and other hunting related equipment. Expenditures for magazines, memberships, vehicles, cabins, land, and dogs are excluded from this analysis. As very few respondents purchased these items, the data are considered unreliable. A recent study by Southwick Associates included these large items and so reports higher total expenditures by migratory bird hunters. In addition, the Southwick study applied economic multipliers to the expenditure figures to determine the indirect and induced economic activity from hunting. Such extensive economic analysis is beyond the scope of this small entity impact analysis.

The Survey does not collect information about vendors. Therefore, another method is necessary to find the proportion of total expenditures that can be attributed to small businesses. The U.S. Department of Commerce publishes the County Business Patterns

database that includes the number of enterprises and employment by county, Standard Industrial Classification (SIC), and number of employees. For this analysis, a small business is defined as any business having less than 50 employees. The County Business Patterns information permits calculation of small business' share of establishments and employees but not their share of sales. Two alternative methods are used to allocate sales to small businesses from establishment and employment information for each State. If all businesses sell about the same amount, the share of expenditures spent at small businesses will be the proportion small business *establishments* are to the total number of establishments. This proportion probably overstates small business' share. A large discount department store probably sells more guns and ammunition than a small neighborhood gun shop. Alternatively, if sales per employee are about the same, whatever the size of the business, the share of expenditures spent at small businesses will be the proportion small business *employment* is of total employment. This proportion may understate small business' share. While each gun shop employee sells a high cost item, a large discount department store employee sells a variety of goods including many low cost items. Of course, the department store employee sells a larger volume of goods. Using both methods generates high and low estimates of expenditures by migratory bird hunters at small businesses. The actual expenditures are likely to fall between the two extreme estimates. To illustrate the State level of benefits, the following tables have been developed based on the 2001 national Survey. These ranges are summarized by State and expenditure category in **Table 3**. All expenditures in this section are reported in thousands of 2003 dollars.

**Table 4**, Estimated Migratory Bird Hunters' Expenditures on Food, illustrates the calculations for each of the expenditure categories shown on **Tables 5 - 8**. The first column contains State totals of the amounts respondents to the Survey reported they spent for food while on trips whose primary purpose was to hunt migratory birds. Food may be bought at a restaurant (SIC 5812) or grocery store (SIC 5410) so both types of establishments were combined. The second column shows the number of establishments in SIC 5812 or 5410 in each State. The third column shows the number of establishments with less than 50 employees in these SIC codes in each State. The proportion small business establishments are of the total is the first method used to allocate expenditures to small businesses. This allocation is shown in the fifth column. The sixth through ninth columns repeat the process using employment as the allocation basis. The fifth and ninth columns were transferred to the summary table (table 3).

Although more than 25,000 hunters and anglers were interviewed for the Survey, these expenditure estimates are based on only those who actually hunted during 2001 and stated that the primary purpose of their trip or equipment purchase was hunting migratory birds. Only a small subset of hunters in each State meets both criteria so the expenditures are quite sensitive to individual responses. For example, the Connecticut results are based on a sample of only 9 people, none of whom purchased lodging on hunting trips. Other zero totals are based on similar small sample sizes. Small samples may also inflate expenditure estimates. An asterisk by the state name indicates a small sample size.

County business pattern information may also introduce errors. To avoid disclosure of private information, the Census Bureau withholds employment information when there are few establishments in a geographic area. Exclusion of a single large employer can greatly affect the proportion attributed to small business. In addition, entry of enough firms into an area results in all of the establishments appearing in the statistics. This exacerbates the instability of the published series. No effort was made to compensate for unreported firms in this analysis.

Surveys of a wide range of businesses would be required to obtain the necessary detailed data. The Small Entity Analysis included in this section overcomes the first two examples by assuming all spending by migratory bird hunters is spread across all beneficiary businesses in proportion to the number of establishments or number of employees. The third example is insuperable.

The direct expenditures described above cycle through the economy generating additional income and sales. Analysis of this multiplier effect is beyond the scope of this report but clearly \$1.4 billion is the minimum benefit from the migratory bird regulations.

## **Results**

Migratory bird hunting generates considerable revenue for small businesses. In California and Michigan, migratory bird hunting would be considered a significant industry generating over \$100 million in expenditures in each state. The multiplier effect in each of these regions generates significantly more economic activity. Nationwide, migratory bird hunters will spend between \$481 million and \$1.2 billion at thousands of small businesses in 2003. Some of this economic activity would occur without the annual promulgation of hunting regulations. Since much of the equipment and services used in migratory bird hunting can be used for other purposes, some of the annual sales would continue even if migratory bird hunting were prohibited. Much, if not all of this business activity would be redirected to alternative pursuits.

## **Evaluation of Alternatives**

Each alternative outlined above results in a different level of economic stimulus generated from duck hunter spending. State expenditures for enforcement of duck hunting regulations are not affected by any of the proposed alternatives. In each case, the States would be required to field about the same enforcement effort. Only if the frameworks greatly relaxed bag limits and seasons would the States be able to reduce enforcement effort significantly. Alternatives 1 through 3 will reduce State license sales and sales taxes on hunting goods compared to the preferred Alternative 4. These revenue losses would be in addition to the lost benefits of expenditures in local economies.

Although reduced hunting now may result in more ducks to hunt next year, higher populations also increase the risk of disease outbreaks and unhealthy competition, in the absence of adequate natural predation. The opportunity cost of duck hunting, ignoring long run effects, is minimized by the most liberal frameworks, Alternative 4.

**Table 3. Estimated Expenditures by Migratory Bird Hunters at Small Businesses - Summary**

(Thousands of 2003 dollars. Asterisk (\*) indicates small sample size.)

State	<i>Food</i>		<i>Lodging</i>		<i>Transportation</i>		<i>Other Travel Items</i>		<i>Equipment</i>		<i>Total</i>	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
Alabama*	\$4,213	\$2,835	\$0	\$0	\$2,658	\$1,922	\$9,239	\$6,345	\$4,955	\$873	\$21,545	\$11,975
Alaska	\$1,483	\$950	\$374	\$164	\$938	\$394	\$3,398	\$1,884	\$2,428	\$763	\$8,816	\$4,155
Arizona	\$3,427	\$2,133	\$0	\$0	\$4,044	\$1,483	\$597	\$439	\$3,835	\$634	\$12,175	\$4,689
Arkansas	\$6,931	\$5,007	\$356	\$229	\$7,360	\$6,667	\$3,497	\$2,713	\$17,059	\$2,593	\$36,005	\$17,208
California	\$43,061	\$27,864	\$2,294	\$638	\$27,626	\$12,035	\$37,647	\$17,197	\$82,286	\$14,100	\$197,310	\$71,834
Colorado*	\$2,229	\$1,408	\$331	\$90	\$3,162	\$1,100	\$417	\$92	\$8,552	\$2,191	\$15,025	\$4,880
Connecticut*	\$73	\$44	\$0	\$0	\$61	\$32	\$0	\$0	\$2,536	\$453	\$2,731	\$528
Delaware	\$1,700	\$1,076	\$1,402	\$653	\$1,079	\$768	\$500	\$217	\$1,727	\$277	\$6,554	\$2,991
DC*	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Florida*	\$6,577	\$3,593	\$472	\$126	\$1,352	\$793	\$2,222	\$1,695	\$5,239	\$835	\$16,223	\$7,042
Georgia	\$4,224	\$2,699	\$641	\$230	\$3,479	\$1,514	\$2,251	\$2,107	\$22,245	\$3,633	\$33,589	\$10,183
Hawaii*	\$93	\$60	\$0	\$0	\$142	\$35	\$0	\$0	\$33	\$6	\$273	\$102
Idaho*	\$1,889	\$1,345	\$3	\$1	\$2,389	\$1,523	\$610	\$464	\$6,352	\$1,753	\$11,499	\$5,085
Illinois*	\$8,935	\$5,553	\$2,050	\$549	\$6,824	\$2,763	\$10,399	\$2,920	\$21,604	\$2,894	\$50,946	\$14,679
Indiana*	\$1,308	\$870	\$0	\$0	\$1,163	\$767	\$541	\$362	\$1,870	\$369	\$4,993	\$2,368
Iowa*	\$1,413	\$957	\$361	\$155	\$944	\$747	\$344	\$98	\$1,882	\$412	\$5,057	\$2,370
Kansas*	\$2,514	\$1,777	\$470	\$240	\$3,485	\$2,516	\$34	\$17	\$8,488	\$1,461	\$15,332	\$6,011
Kentucky	\$5,826	\$3,827	\$376	\$171	\$3,704	\$1,691	\$1,673	\$1,221	\$16,189	\$3,258	\$28,401	\$10,166
Louisiana	\$9,080	\$5,434	\$340	\$107	\$12,769	\$7,871	\$4,683	\$2,970	\$21,485	\$3,219	\$49,458	\$19,600
Maine*	\$4,958	\$3,466	\$2,738	\$1,406	\$4,874	\$4,291	\$3,420	\$684	\$499	\$138	\$16,865	\$9,986
Maryland*	\$2,961	\$1,851	\$1,431	\$539	\$2,773	\$2,326	\$2,880	\$2,281	\$10,900	\$2,200	\$21,423	\$9,196
Massachusetts*	\$522	\$310	\$0	\$0	\$1,134	\$593	\$23	\$11	\$7,859	\$1,242	\$9,755	\$2,156
Michigan*	\$12,188	\$8,066	\$7,852	\$3,126	\$11,798	\$7,291	\$7,628	\$3,937	\$74,624	\$11,746	\$116,690	\$34,166
Minnesota	\$8,331	\$5,308	\$231	\$79	\$8,248	\$4,147	\$315	\$78	\$29,592	\$5,403	\$47,782	\$15,014
Mississippi	\$5,410	\$3,823	\$844	\$349	\$6,077	\$4,498	\$3,614	\$363	\$28,207	\$5,558	\$45,159	\$14,591
Missouri*	\$4,147	\$2,739	\$1,567	\$600	\$6,518	\$2,924	\$691	\$593	\$12,483	\$1,790	\$25,984	\$8,646

Table 3 continued

	<i>Food</i>		<i>Lodging</i>		<i>Transportation</i>		<i>Other Travel Items</i>		<i>Equipment</i>		<i>Total</i>	
State	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
Montana*	\$12,747	\$9,814	\$0	\$0	\$9,739	\$6,327	\$33	\$17	\$4,930	\$1,532	\$28,073	\$17,689
Nebraska	\$4,975	\$3,240	\$1,305	\$657	\$5,904	\$4,569	\$570	\$203	\$14,931	\$3,810	\$28,317	\$12,479
Nevada*	\$1,702	\$1,080	\$609	\$19	\$1,592	\$519	\$105	\$16	\$3,437	\$428	\$7,614	\$2,062
New Hampshire*	\$402	\$256	\$132	\$17	\$280	\$196	\$42	\$8	\$1,501	\$352	\$2,410	\$828
New Jersey*	\$2,202	\$1,292	\$0	\$0	\$2,424	\$897	\$873	\$482	\$6,559	\$1,163	\$12,333	\$3,834
New Mexico*	\$554	\$374	\$19	\$8	\$879	\$534	\$31	\$11	\$897	\$219	\$2,435	\$1,147
New York*	\$1,265	\$821	\$0	\$0	\$2,983	\$1,065	\$2,849	\$1,676	\$3,591	\$799	\$10,932	\$4,361
North Carolina*	\$6,135	\$4,194	\$651	\$339	\$5,873	\$2,634	\$1,016	\$741	\$4,921	\$1,141	\$19,020	\$9,050
North Dakota	\$1,893	\$1,243	\$232	\$13	\$2,057	\$1,923	\$19	\$14	\$1,966	\$382	\$6,307	\$3,574
Ohio*	\$2,069	\$1,321	\$0	\$0	\$1,419	\$992	\$58	\$46	\$1,101	\$213	\$4,753	\$2,571
Oklahoma*	\$3,054	\$2,305	\$737	\$415	\$1,791	\$1,550	\$34	\$18	\$6,450	\$1,017	\$12,341	\$5,303
Oregon*	\$5,586	\$4,211	\$540	\$259	\$5,526	\$3,331	\$10,163	\$4,777	\$11,534	\$1,968	\$34,109	\$14,547
Pennsylvania*	\$1,891	\$1,134	\$0	\$0	\$1,153	\$611	\$103	\$63	\$309	\$56	\$3,535	\$1,864
Rhode Island*	\$168	\$101	\$15	\$5	\$72	\$46	\$70	\$27	\$146	\$19	\$481	\$198
South Carolina	\$5,173	\$3,450	\$2,064	\$975	\$5,365	\$4,489	\$4,300	\$3,483	\$23,073	\$4,813	\$40,885	\$17,210
South Dakota	\$2,661	\$1,866	\$140	\$81	\$5,812	\$5,269	\$154	\$69	\$4,856	\$1,214	\$13,933	\$8,498
Tennessee*	\$3,791	\$2,494	\$0	\$0	\$3,478	\$2,120	\$691	\$436	\$7,581	\$1,445	\$15,896	\$6,495
Texas	\$21,934	\$13,705	\$4,204	\$1,439	\$13,743	\$6,306	\$10,150	\$7,472	\$50,489	\$8,349	\$102,811	\$37,271
Utah*	\$1,335	\$821	\$0	\$0	\$1,683	\$763	\$107	\$31	\$6,202	\$1,228	\$9,540	\$2,843
Vermont*	\$601	\$443	\$259	\$105	\$520	\$422	\$61	\$6	\$1,720	\$743	\$3,233	\$1,718
Virginia*	\$1,086	\$696	\$133	\$51	\$1,268	\$784	\$873	\$667	\$4,416	\$1,037	\$7,953	\$3,235
Washington*	\$6,595	\$4,552	\$388	\$156	\$8,860	\$3,734	\$762	\$336	\$16,347	\$3,104	\$33,703	\$11,882
West Virginia*	\$79	\$56	\$0	\$0	\$143	\$111	\$0	\$0	\$63	\$16	\$291	\$184
Wisconsin*	\$5,073	\$3,407	\$2,029	\$885	\$4,892	\$3,541	\$1,361	\$368	\$15,847	\$2,347	\$29,867	\$10,548
Wyoming*	\$5,219	\$3,840	\$37	\$13	\$9,010	\$7,549	\$18	\$6	\$2,854	\$801	\$17,529	\$12,209
<b>TOTAL</b>	<b>\$241,680</b>	<b>\$159,710</b>	<b>\$37,624</b>	<b>\$14,889</b>	<b>\$221,066</b>	<b>\$130,972</b>	<b>\$131,064</b>	<b>\$69,658</b>	<b>\$588,649</b>	<b>\$105,994</b>	<b>\$1,247,890</b>	<b>\$481,223</b>

**Table 4. Estimated Migratory Bird Hunters' Expenditures on Food**  
(Expenditures in thousands of 2003 dollars. Asterisk (\*) indicates small sample size.)

<i>State</i>	<i>Total MB Hunter Expenditures on Food</i>	<b>Establishments</b>				<b>Employment</b>			
		<i>Total Number of Establishments</i>	<i>Number of Small Businesses</i>	<i>Percent Small Businesses</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>	<i>Total Employed</i>	<i>Employed at Small Businesses</i>	<i>Percent Small Businesses of Total</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>
Alabama*	\$4,602	7,840	7,178	91.6%	\$4,213	137,914	84,976	61.6%	\$2,835
Alaska	\$1,587	1,276	1,192	93.4%	\$1,483	19,400	11,609	59.8%	\$950
Arizona	\$3,829	7,636	6,836	89.5%	\$3,427	157,707	87,874	55.7%	\$2,133
Arkansas	\$7,395	5,098	4,778	93.7%	\$6,931	76,287	51,647	67.7%	\$5,007
California	\$46,931	62,395	57,249	91.8%	\$43,061	1,030,623	611,905	59.4%	\$27,864
Colorado*	\$2,465	7,568	6,842	90.4%	\$2,229	154,860	88,428	57.1%	\$1,408
Connecticut*	\$79	7,274	6,767	93.0%	\$73	116,877	65,320	55.9%	\$44
Delaware	\$1,859	1,627	1,488	91.5%	\$1,700	28,440	16,468	57.9%	\$1,076
DC*	\$0	1,759	1,627	92.5%	\$0	29,741	17,205	57.8%	\$0
Florida*	\$7,405	29,098	25,844	88.8%	\$6,577	589,905	286,232	48.5%	\$3,593
Georgia	\$4,650	14,209	12,907	90.8%	\$4,224	276,071	160,257	58.0%	\$2,699
Hawaii*	\$102	3,015	2,726	90.4%	\$93	58,960	34,715	58.9%	\$60
Idaho*	\$2,029	2,273	2,117	93.1%	\$1,889	38,511	25,532	66.3%	\$1,345
Illinois*	\$9,772	22,955	20,987	91.4%	\$8,935	414,480	235,527	56.8%	\$5,553
Indiana*	\$1,456	11,016	9,897	89.8%	\$1,308	228,228	136,358	59.7%	\$870
Iowa*	\$1,529	6,281	5,803	92.4%	\$1,413	114,097	71,430	62.6%	\$957
Kansas*	\$2,693	5,483	5,117	93.3%	\$2,514	98,546	65,000	66.0%	\$1,777
Kentucky	\$6,401	7,515	6,841	91.0%	\$5,826	141,432	84,559	59.8%	\$3,827
Louisiana	\$10,022	8,336	7,552	90.6%	\$9,080	151,563	82,175	54.2%	\$5,434
Maine*	\$5,192	3,566	3,405	95.5%	\$4,958	45,596	30,438	66.8%	\$3,466



*Table 4 continued*

<i>State</i>	<i>Total MB Hunter Expenditures on Food</i>	<b>Establishments</b>				<b>Employment</b>			
		<i>Total Number of Establishments</i>	<i>Number of Small Businesses</i>	<i>Percent Small Businesses</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>	<i>Total Employed</i>	<i>Employed at Small Businesses</i>	<i>Percent Small Businesses of Total</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>
Maryland*	\$3,255	9,719	8,841	91.0%	\$2,961	173,256	98,538	56.9%	\$1,851
Massachusetts*	\$564	14,127	13,083	92.6%	\$522	239,233	131,466	55.0%	\$310
Michigan*	\$13,387	19,493	17,747	91.0%	\$12,188	343,001	206,660	60.3%	\$8,066
Minnesota	\$9,226	8,926	8,060	90.3%	\$8,331	178,224	102,540	57.5%	\$5,308
Mississippi	\$5,788	5,097	4,764	93.5%	\$5,410	76,521	50,541	66.0%	\$3,823
Missouri*	\$4,537	10,622	9,707	91.4%	\$4,147	198,958	120,110	60.4%	\$2,739
Montana*	\$13,402	2,230	2,121	95.1%	\$12,747	32,196	23,576	73.2%	\$9,814
Nebraska	\$5,399	3,692	3,402	92.1%	\$4,975	67,989	40,802	60.0%	\$3,240
Nevada*	\$1,856	2,657	2,436	91.7%	\$1,702	47,776	27,797	58.2%	\$1,080
New Hampshire*	\$428	3,090	2,903	93.9%	\$402	47,076	28,140	59.8%	\$256
New Jersey*	\$2,350	17,565	16,458	93.7%	\$2,202	241,815	132,939	55.0%	\$1,292
New Mexico*	\$605	3,301	3,023	91.6%	\$554	60,581	37,433	61.8%	\$374
New York*	\$1,325	43,335	41,371	95.5%	\$1,265	527,413	326,666	61.9%	\$821
North Carolina*	\$6,753	15,007	13,635	90.9%	\$6,135	267,161	165,929	62.1%	\$4,194
North Dakota	\$2,061	1,434	1,317	91.8%	\$1,893	24,477	14,758	60.3%	\$1,243
Ohio*	\$2,283	22,633	20,510	90.6%	\$2,069	427,736	247,432	57.8%	\$1,321
Oklahoma*	\$3,238	7,385	6,965	94.3%	\$3,054	111,820	79,588	71.2%	\$2,305
Oregon*	\$5,950	7,460	7,003	93.9%	\$5,586	117,516	83,171	70.8%	\$4,211
Pennsylvania*	\$2,065	24,434	22,384	91.6%	\$1,891	419,030	230,125	54.9%	\$1,134
Rhode Island*	\$179	2,498	2,345	93.9%	\$168	35,438	20,062	56.6%	\$101
South Carolina	\$5,707	7,580	6,870	90.6%	\$5,173	138,376	83,646	60.4%	\$3,450

*Table 4 continued*

<i>State</i>	<i>Total MB Hunter Expenditures on Food</i>	<b>Establishments</b>				<b>Employment</b>			
		<i>Total Number of Establishments</i>	<i>Number of Small Businesses</i>	<i>Percent Small Businesses</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>	<i>Total Employed</i>	<i>Employed at Small Businesses</i>	<i>Percent Small Businesses of Total</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>
South Dakota	\$2,834	1,748	1,641	93.9%	\$2,661	28,452	18,738	65.9%	\$1,866
Tennessee*	\$4,146	10,516	9,617	91.5%	\$3,791	191,537	115,244	60.2%	\$2,494
Texas	\$23,965	35,784	32,751	91.5%	\$21,934	658,784	376,731	57.2%	\$13,705
Utah*	\$1,492	3,239	2,899	89.5%	\$1,335	69,331	38,148	55.0%	\$821
Vermont*	\$632	1,874	1,781	95.0%	\$601	25,290	17,703	70.0%	\$443
Virginia*	\$1,195	13,857	12,594	90.9%	\$1,086	244,137	142,210	58.3%	\$696
Washington*	\$7,135	11,818	10,924	92.4%	\$6,595	200,260	127,772	63.8%	\$4,552
West Virginia*	\$84	3,691	3,442	93.3%	\$79	54,983	36,606	66.6%	\$56
Wisconsin*	\$5,605	9,926	8,983	90.5%	\$5,073	197,159	119,831	60.8%	\$3,407
Wyoming*	\$5,578	1,104	1,033	93.6%	\$5,219	19,043	13,109	68.8%	\$3,840
<b>TOTAL</b>	<b>\$263,023</b>	<b>542,062</b>	<b>497,763</b>		<b>\$241,680</b>	<b>9,373,807</b>	<b>5,505,666</b>		<b>\$159,710</b>

**Table 5. Estimated Migratory Bird Hunters' Expenditures on Lodging**  
(Expenditures in thousands of 2003 dollars. Asterisk (\*) indicates small sample size.)

<i>State</i>	<i>Total MB Hunter Expenditures on Lodging</i>	<b>Establishments</b>				<b>Employment</b>			
		<i>Total Number of Establishments</i>	<i>Number of Small Businesses</i>	<i>Percent Small Businesses</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>	<i>Total Employed</i>	<i>Employed at Small Businesses</i>	<i>Percent Small Businesses of Total</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>
Alabama*	\$0	636	570	89.6%	\$0	12,907	6,149	47.6%	\$0
Alaska	\$401	342	319	93.3%	\$374	4,888	2,007	41.1%	\$164
Arizona	\$0	988	847	85.7%	\$0	35,658	8,739	24.5%	\$0
Arkansas	\$378	613	578	94.3%	\$356	8,780	5,318	60.6%	\$229
California	\$2,579	6,018	5,353	88.9%	\$2,294	177,862	44,008	24.7%	\$638
Colorado*	\$374	1,287	1,139	88.5%	\$331	35,251	8,487	24.1%	\$90
Connecticut*	\$0	379	319	84.2%	\$0	10,910	3,324	30.5%	\$0
Delaware	\$1,501	136	127	93.4%	\$1,402	2,516	1,094	43.5%	\$653
DC*	\$0	114	57	50.0%	\$0	14,577	1,010	6.9%	\$0
Florida*	\$558	3,697	3,125	84.5%	\$472	135,814	30,556	22.5%	\$126
Georgia	\$740	1,254	1,085	86.5%	\$641	38,372	11,903	31.0%	\$230
Hawaii*	\$0	279	173	62.0%	\$0	37,558	2,360	6.3%	\$0
Idaho*	\$3	373	343	92.0%	\$3	8,029	2,448	30.5%	\$1
Illinois*	\$2,365	1,382	1,198	86.7%	\$2,050	49,610	11,521	23.2%	\$549
Indiana*	\$0	882	786	89.1%	\$0	19,173	6,830	35.6%	\$0
Iowa*	\$403	692	621	89.7%	\$361	13,308	5,133	38.6%	\$155
Kansas*	\$501	587	551	93.9%	\$470	9,674	4,632	47.9%	\$240
Kentucky	\$407	586	541	92.3%	\$376	13,441	5,634	41.9%	\$171
Louisiana	\$396	578	496	85.8%	\$340	20,541	5,554	27.0%	\$107

*Table 5 continued*

<i>State</i>	<i>Total MB Hunter Expenditures on Lodging</i>	<b>Establishments</b>				<b>Employment</b>			
		<i>Total Number of Establishments</i>	<i>Number of Small Businesses</i>	<i>Percent Small Businesses</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>	<i>Total Employed</i>	<i>Employed at Small Businesses</i>	<i>Percent Small Businesses of Total</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>
Maine*	\$2,834	942	910	96.6%	\$2,738	7,918	3,929	49.6%	\$1,406
Maryland*	\$1,677	600	512	85.3%	\$1,431	17,128	5,501	32.1%	\$539
Massachusetts*	\$0	1,083	955	88.2%	\$0	29,469	6,458	21.9%	\$0
Michigan*	\$8,579	1,688	1,545	91.5%	\$7,852	32,279	11,764	36.4%	\$3,126
Minnesota	\$255	1,248	1,128	90.4%	\$231	23,245	7,203	31.0%	\$79
Mississippi	\$934	449	406	90.4%	\$844	7,813	2,919	37.4%	\$349
Missouri*	\$1,701	1,254	1,155	92.1%	\$1,567	25,101	8,860	35.3%	\$600
Montana*	\$0	623	591	94.9%	\$0	7,510	3,928	52.3%	\$0
Nebraska	\$1,416	418	385	92.1%	\$1,305	6,586	3,054	46.4%	\$657
Nevada*	\$838	603	438	72.6%	\$609	160,476	3,600	2.2%	\$19
New Hampshire*	\$140	561	530	94.5%	\$132	6,613	817	12.4%	\$17
New Jersey*	\$0	1,335	1,179	88.3%	\$0	70,105	7,235	10.3%	\$0
New Mexico*	\$21	664	602	90.7%	\$19	12,865	4,982	38.7%	\$8
New York*	\$0	2,578	2,317	89.9%	\$0	72,673	16,187	22.3%	\$0
North Carolina*	\$705	1,551	1,431	92.3%	\$651	28,810	13,852	48.1%	\$339
North Dakota	\$250	299	278	93.0%	\$232	4,537	228	5.0%	\$13
Ohio*	\$0	1,403	1,235	88.0%	\$0	33,748	11,503	34.1%	\$0
Oklahoma*	\$789	583	545	93.5%	\$737	9,707	5,103	52.6%	\$415
Oregon*	\$576	999	936	93.7%	\$540	16,232	7,289	44.9%	\$259
Pennsylvania*	\$0	1,773	1,541	86.9%	\$0	46,969	11,337	24.1%	\$0

*Table 5 continued*

<i>State</i>	<i>Total MB Hunter Expenditures on Lodging</i>	<b>Establishments</b>				<b>Employment</b>			
		<i>Total Number of Establishments</i>	<i>Number of Small Businesses</i>	<i>Percent Small Businesses</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>	<i>Total Employed</i>	<i>Employed at Small Businesses</i>	<i>Percent Small Businesses of Total</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>
Rhode Island*	\$16	162	150	92.6%	\$15	2,744	945	34.4%	\$5
South Carolina	\$2,283	979	885	90.4%	\$2,064	21,557	9,204	42.7%	\$975
South Dakota	\$147	478	455	95.2%	\$140	5,886	3,216	54.6%	\$81
Tennessee*	\$0	1,156	1,053	91.1%	\$0	25,906	4,885	18.9%	\$0
Texas	\$4,704	2,803	2,505	89.4%	\$4,204	79,103	24,207	30.6%	\$1,439
Utah*	\$0	480	430	89.6%	\$0	13,040	3,954	30.3%	\$0
Vermont*	\$273	507	480	94.7%	\$259	9,047	3,463	38.3%	\$105
Virginia*	\$152	1,334	1,169	87.6%	\$133	38,393	12,930	33.7%	\$51
Washington*	\$421	1,279	1,179	92.2%	\$388	26,337	9,774	37.1%	\$156
West Virginia*	\$0	328	294	89.6%	\$0	8,034	1,466	18.2%	\$0
Wisconsin*	\$2,202	1,388	1,279	92.1%	\$2,029	22,574	9,074	40.2%	\$885
Wyoming*	\$39	503	474	94.2%	\$37	5,852	1,942	33.2%	\$13
<b>TOTAL</b>	<b>\$41,558</b>	<b>52,874</b>	<b>47,200</b>		<b>\$37,624</b>	<b>1,527,126</b>	<b>387,516</b>		<b>\$14,889</b>

**Table 6. Estimated Migratory Bird Hunters' Expenditures on Transportation**  
(Expenditures in thousands of 2003 dollars. Asterisk (\*) indicates small sample size.)

<i>State</i>	<i>Total MB Hunter Expenditures on Transportation</i>	<b>Establishments</b>				<b>Employment</b>			
		<i>Total Number of Establishments</i>	<i>Number of Small Businesses</i>	<i>Percent Small Businesses</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>	<i>Total Employed</i>	<i>Employed at Small Businesses</i>	<i>Percent Small Businesses of Total</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>
Alabama*	\$2,697	2,293	2,260	98.6%	\$2,658	16,017	11,415	71.3%	\$1,922
Alaska	\$980	469	449	95.7%	\$938	8,186	3,290	40.2%	\$394
Arizona	\$4,207	1,448	1,392	96.1%	\$4,044	32,423	11,433	35.3%	\$1,483
Arkansas	\$7,427	1,440	1,427	99.1%	\$7,360	11,168	10,026	89.8%	\$6,667
California	\$28,815	10,320	9,894	95.9%	\$27,626	179,552	74,990	41.8%	\$12,035
Colorado*	\$3,269	1,727	1,670	96.7%	\$3,162	32,343	10,879	33.6%	\$1,100
Connecticut*	\$64	1,836	1,745	95.0%	\$61	23,827	11,777	49.4%	\$32
Delaware	\$1,107	441	430	97.5%	\$1,079	3,719	2,580	69.4%	\$768
DC*	\$0	236	227	96.2%	\$0	2,924	1,115	38.1%	\$0
Florida*	\$1,388	6,565	6,395	97.4%	\$1,352	70,506	40,280	57.1%	\$793
Georgia	\$3,542	3,637	3,573	98.2%	\$3,479	49,413	21,120	42.7%	\$1,514
Hawaii*	\$155	505	461	91.3%	\$142	18,325	4,186	22.8%	\$35
Idaho*	\$2,438	640	627	98.0%	\$2,389	6,160	3,847	62.5%	\$1,523
Illinois*	\$7,100	5,233	5,029	96.1%	\$6,824	91,030	35,429	38.9%	\$2,763
Indiana*	\$1,194	3,003	2,925	97.4%	\$1,163	33,411	21,475	64.3%	\$767
Iowa*	\$954	1,942	1,922	99.0%	\$944	15,502	12,141	78.3%	\$747
Kansas*	\$3,528	1,634	1,614	98.8%	\$3,485	12,789	9,121	71.3%	\$2,516
Kentucky	\$3,763	2,150	2,116	98.4%	\$3,704	31,989	14,371	44.9%	\$1,691
Louisiana	\$13,040	2,120	2,076	97.9%	\$12,769	19,480	11,758	60.4%	\$7,871

*Table 6 continued*

<i>State</i>	<i>Total MB Hunter Expenditures on Transportation</i>	<b>Establishments</b>				<b>Employment</b>			
		<i>Total Number of Establishments</i>	<i>Number of Small Businesses</i>	<i>Percent Small Businesses</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>	<i>Total Employed</i>	<i>Employed at Small Businesses</i>	<i>Percent Small Businesses of Total</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>
Maine*	\$4,949	795	783	98.5%	\$4,874	6,515	5,649	86.7%	\$4,291
Maryland*	\$2,840	2,392	2,336	97.7%	\$2,773	18,695	15,310	81.9%	\$2,326
Massachusetts*	\$1,176	3,329	3,210	96.4%	\$1,134	41,187	20,770	50.4%	\$593
Michigan*	\$12,029	4,312	4,229	98.1%	\$11,798	45,965	27,860	60.6%	\$7,291
Minnesota	\$8,471	2,858	2,783	97.4%	\$8,248	51,203	25,066	49.0%	\$4,147
Mississippi	\$6,123	1,334	1,324	99.3%	\$6,077	8,435	6,197	73.5%	\$4,498
Missouri*	\$6,727	3,261	3,160	96.9%	\$6,518	44,849	19,492	43.5%	\$2,924
Montana*	\$9,941	638	625	98.0%	\$9,739	5,806	3,695	63.6%	\$6,327
Nebraska	\$5,999	1,080	1,063	98.4%	\$5,904	9,031	6,879	76.2%	\$4,569
Nevada*	\$1,776	511	458	89.6%	\$1,592	12,913	3,773	29.2%	\$519
New Hampshire*	\$288	674	656	97.3%	\$280	6,432	4,370	67.9%	\$196
New Jersey*	\$2,526	4,492	4,311	96.0%	\$2,424	66,100	23,485	35.5%	\$897
New Mexico*	\$910	880	850	96.6%	\$879	8,749	5,137	58.7%	\$534
New York*	\$3,122	8,654	8,268	95.5%	\$2,983	123,626	42,173	34.1%	\$1,065
North Carolina*	\$5,955	3,796	3,744	98.6%	\$5,873	40,825	18,059	44.2%	\$2,634
North Dakota	\$2,081	503	497	98.8%	\$2,057	3,126	2,888	92.4%	\$1,923
Ohio*	\$1,456	5,134	5,005	97.5%	\$1,419	50,585	34,454	68.1%	\$992
Oklahoma*	\$1,817	1,671	1,647	98.6%	\$1,791	10,298	8,782	85.3%	\$1,550
Oregon*	\$5,768	1,286	1,232	95.8%	\$5,526	18,114	10,461	57.8%	\$3,331
Pennsylvania*	\$1,196	6,139	5,917	96.4%	\$1,153	83,135	42,480	51.1%	\$611
Rhode Island*	\$74	541	526	97.2%	\$72	5,065	3,106	61.3%	\$46

*Table 6 continued*

<i>State</i>	<i>Total MB Hunter Expenditures on Transportation</i>	<b>Establishments</b>				<b>Employment</b>			
		<i>Total Number of Establishments</i>	<i>Number of Small Businesses</i>	<i>Percent Small Businesses</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>	<i>Total Employed</i>	<i>Employed at Small Businesses</i>	<i>Percent Small Businesses of Total</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>
South Carolina	\$5,410	1,885	1,869	99.2%	\$5,365	13,187	10,942	83.0%	\$4,489
South Dakota	\$5,876	638	631	98.9%	\$5,812	4,710	4,223	89.7%	\$5,269
Tennessee*	\$3,552	2,786	2,728	97.9%	\$3,478	29,304	17,488	59.7%	\$2,120
Texas	\$14,027	8,247	8,080	98.0%	\$13,743	105,301	47,336	45.0%	\$6,306
Utah*	\$1,721	899	879	97.8%	\$1,683	14,476	6,417	44.3%	\$763
Vermont*	\$528	417	411	98.6%	\$520	3,542	2,831	79.9%	\$422
Virginia*	\$1,295	3,034	2,970	97.9%	\$1,268	35,684	21,616	60.6%	\$784
Washington*	\$9,131	1,787	1,734	97.0%	\$8,860	29,979	12,258	40.9%	\$3,734
West Virginia*	\$144	1,037	1,028	99.1%	\$143	7,427	5,745	77.4%	\$111
Wisconsin*	\$5,052	3,168	3,068	96.8%	\$4,892	36,832	25,816	70.1%	\$3,541
Wyoming*	\$9,069	458	455	99.3%	\$9,010	3,127	2,603	83.2%	\$7,549
<b>TOTAL</b>	<b>\$226,698</b>	<b>126,275</b>	<b>122,709</b>		<b>\$221,066</b>	<b>1,602,987</b>	<b>798,594</b>		<b>\$130,972</b>



**Table 7. Estimated Migratory Bird Hunters' Expenditures on Other Travel**  
(Expenditures in thousands of 2003 dollars. Asterisk (\*) indicates small sample size.)

<i>State</i>	<i>Total MB Hunter Expenditures on Other Travel</i>	<b>Establishments</b>				<b>Employment</b>			
		<i>Total Number of Establishments</i>	<i>Number of Small Businesses</i>	<i>Percent Small Businesses</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>	<i>Total Employed</i>	<i>Employed at Small Businesses</i>	<i>Percent Small Businesses of Total</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>
Alabama*	\$9,380	384	378	98.5%	\$9,239	6,359	4,302	67.7%	\$6,345
Alaska	\$3,463	192	188	98.1%	\$3,398	2,277	1,239	54.4%	\$1,884
Arizona	\$620	500	482	96.4%	\$597	5,916	4,187	70.8%	\$439
Arkansas	\$3,551	273	269	98.5%	\$3,497	2,590	1,979	76.4%	\$2,713
California	\$39,353	4,027	3,852	95.7%	\$37,647	60,384	26,387	43.7%	\$17,197
Colorado*	\$450	437	405	92.8%	\$417	5,015	1,028	20.5%	\$92
Connecticut*	\$0	304	0	0.0%	\$0	3,200	0	0.0%	\$0
Delaware	\$511	88	86	97.8%	\$500	1,137	483	42.5%	\$217
DC*	\$0	0	0	0.0%	\$0	0	0	0.0%	\$0
Florida*	\$2,520	3,107	2,739	88.2%	\$2,222	42,576	28,644	67.3%	\$1,695
Georgia	\$2,290	964	948	98.3%	\$2,251	12,208	11,236	92.0%	\$2,107
Hawaii*	\$0	139	0	0.0%	\$0	2,521	0	0.0%	\$0
Idaho*	\$630	137	133	96.8%	\$610	838	617	73.6%	\$464
Illinois*	\$11,007	1,503	1,420	94.5%	\$10,399	21,941	5,820	26.5%	\$2,920
Indiana*	\$559	501	485	96.8%	\$541	5,608	3,633	64.8%	\$362
Iowa*	\$359	232	223	95.9%	\$344	1,908	520	27.3%	\$98
Kansas*	\$34	231	231	100.0%	\$34	3,062	1,531	50.0%	\$17
Kentucky	\$1,704	300	294	98.2%	\$1,673	4,097	2,934	71.6%	\$1,221
Louisiana	\$4,875	806	774	96.1%	\$4,683	14,437	8,796	60.9%	\$2,970
Maine*	\$3,591	139	132	95.2%	\$3,420	940	179	19.0%	\$684
Maryland*	\$2,962	522	508	97.2%	\$2,880	8,158	6,280	77.0%	\$2,281
Massachusetts*	\$27	546	455	83.3%	\$23	5,321	2,217	41.7%	\$11

*Table 7 continued*

<i>State</i>	<i>Total MB Hunter Expenditures on Other Travel</i>	<b>Establishments</b>				<b>Employment</b>			
		<i>Total Number of Establishments</i>	<i>Number of Small Businesses</i>	<i>Percent Small Businesses</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>	<i>Total Employed</i>	<i>Employed at Small Businesses</i>	<i>Percent Small Businesses of Total</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>
Michigan*	\$7,992	798	762	95.4%	\$7,628	9,452	4,655	49.3%	\$3,937
Minnesota	\$329	498	478	95.9%	\$315	4,658	1,101	23.6%	\$78
Mississippi	\$3,843	204	192	94.0%	\$3,614	3,516	332	9.5%	\$363
Missouri*	\$708	575	561	97.6%	\$691	5,329	4,465	83.8%	\$593
Montana*	\$34	106	102	96.7%	\$33	764	382	50.0%	\$17
Nebraska	\$595	142	136	95.8%	\$570	1,936	659	34.0%	\$203
Nevada*	\$129	185	150	80.9%	\$105	2,034	248	12.2%	\$16
New Hampshire*	\$44	84	80	94.9%	\$42	507	91	17.9%	\$8
New Jersey*	\$738	1,275	1,508	118.3%	\$873	19,395	12,654	65.2%	\$482
New Mexico*	\$33	153	146	95.4%	\$31	2,674	927	34.7%	\$11
New York*	\$2,917	1,531	1,495	97.6%	\$2,849	11,845	6,803	57.4%	\$1,676
North Carolina*	\$1,031	704	694	98.6%	\$1,016	4,295	3,090	71.9%	\$741
North Dakota	\$19	137	133	97.1%	\$19	1,107	804	72.6%	\$14
Ohio*	\$59	878	869	99.0%	\$58	5,354	4,212	78.7%	\$46
Oklahoma*	\$35	243	236	97.1%	\$34	2,092	1,080	51.6%	\$18
Oregon*	\$10,386	326	319	97.9%	\$10,163	3,800	1,748	46.0%	\$4,777
Pennsylvania*	\$105	960	947	98.6%	\$103	7,309	4,390	60.1%	\$63
Rhode Island*	\$71	103	101	98.1%	\$70	569	215	37.8%	\$27
South Carolina	\$4,344	397	393	99.0%	\$4,300	2,426	1,945	80.2%	\$3,483
South Dakota	\$167	146	135	92.5%	\$154	2,231	923	41.4%	\$69
Tennessee*	\$705	400	392	98.0%	\$691	3,068	1,898	61.9%	\$436
Texas	\$10,311	1,411	1,389	98.4%	\$10,150	11,429	8,282	72.5%	\$7,472
Utah*	\$113	202	193	95.5%	\$107	3,707	1,005	27.1%	\$31
Vermont*	\$65	111	104	93.7%	\$61	3,068	297	9.7%	\$6

*Table 7 continued*

<i>State</i>	<i>Total MB Hunter Expenditures on Other Travel</i>	<b>Establishments</b>				<b>Employment</b>			
		<i>Total Number of Establishments</i>	<i>Number of Small Businesses</i>	<i>Percent Small Businesses</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>	<i>Total Employed</i>	<i>Employed at Small Businesses</i>	<i>Percent Small Businesses of Total</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>
Virginia*	\$887	528	520	98.5%	\$873	3,233	2,431	75.2%	\$667
Washington*	\$806	665	629	94.6%	\$762	9,736	4,055	41.6%	\$336
West Virginia*	\$0	127	126	99.2%	\$0	568	420	73.9%	\$0
Wisconsin*	\$1,412	473	456	96.4%	\$1,361	4,997	1,303	26.1%	\$368
Wyoming*	\$18	164	162	98.8%	\$18	1,221	420	34.4%	\$6
<b>TOTAL</b>	<b>\$135,778</b>	<b>28,858</b>	<b>27,410</b>		<b>\$131,064</b>	<b>342,813</b>	<b>182,848</b>		<b>\$69,658</b>

**Table 8. Estimated Migratory Bird Hunters' Expenditures on Equipment**  
(Expenditures in thousands of 2003 dollars. Asterisk (\*) indicates small sample size.)

<i>State</i>	<i>Total MB Hunter Expenditures on Equipment</i>	<b>Establishments</b>				<b>Employment</b>			
		<i>Total Number of Establishments</i>	<i>Number of Small Businesses</i>	<i>Percent Small Businesses</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>	<i>Total Employed</i>	<i>Employed at Small Businesses</i>	<i>Percent Small Businesses of Total</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>
Alabama*	\$6,065	1,131	924	81.7%	\$4,955	37,871	5,448	14.4%	\$873
Alaska	\$2,598	229	214	93.4%	\$2,428	3,927	1,153	29.4%	\$763
Arizona	\$4,940	800	621	77.6%	\$3,835	33,058	4,243	12.8%	\$634
Arkansas	\$21,502	634	503	79.3%	\$17,059	25,063	3,022	12.1%	\$2,593
California	\$105,070	5,271	4,128	78.3%	\$82,286	243,058	32,618	13.4%	\$14,100
Colorado*	\$10,440	1,062	870	81.9%	\$8,552	36,050	7,565	21.0%	\$2,191
Connecticut*	\$3,221	705	555	78.7%	\$2,536	25,654	3,604	14.0%	\$453
Delaware	\$2,189	218	172	78.9%	\$1,727	8,731	1,106	12.7%	\$277
DC*	\$0	52	47	90.4%	\$0	1,977	280	14.2%	\$0
Florida*	\$6,701	3,313	2,590	78.2%	\$5,239	126,279	15,737	12.5%	\$835
Georgia	\$28,377	1,606	1,259	78.4%	\$22,245	62,961	8,061	12.8%	\$3,633
Hawaii*	\$38	301	257	85.4%	\$33	9,428	1,585	16.8%	\$6
Idaho*	\$7,470	394	335	85.0%	\$6,352	9,551	2,241	23.5%	\$1,753
Illinois*	\$28,658	2,405	1,813	75.4%	\$21,604	108,122	10,917	10.1%	\$2,894
Indiana*	\$2,410	1,450	1,125	77.6%	\$1,870	56,131	8,596	15.3%	\$369
Iowa*	\$2,418	794	618	77.8%	\$1,882	27,995	4,775	17.1%	\$412
Kansas*	\$10,893	625	487	77.9%	\$8,488	24,986	3,352	13.4%	\$1,461
Kentucky	\$20,075	1,028	829	80.6%	\$16,189	34,534	5,604	16.2%	\$3,258
Louisiana	\$27,863	948	731	77.1%	\$21,485	39,337	4,544	11.6%	\$3,219
Maine*	\$578	580	500	86.2%	\$499	11,057	2,641	23.9%	\$138

*Table 8 continued*

<i>State</i>	<i>Total MB Hunter Expenditures on Equipment</i>	<b>Establishments</b>				<b>Employment</b>			
		<i>Total Number of Establishments</i>	<i>Number of Small Businesses</i>	<i>Percent Small Businesses</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>	<i>Total Employed</i>	<i>Employed at Small Businesses</i>	<i>Percent Small Businesses of Total</i>	<i>Estimated MB Hunters' Expenditures at Small Businesses</i>
Maryland*	\$13,432	1,114	904	81.1%	\$10,900	40,320	6,603	16.4%	\$2,200
Massachusetts*	\$9,976	1,296	1,021	78.8%	\$7,859	46,857	5,834	12.5%	\$1,242
Michigan*	\$94,104	2,140	1,697	79.3%	\$74,624	108,912	13,594	12.5%	\$11,746
Minnesota	\$37,194	1,189	946	79.6%	\$29,592	48,988	7,116	14.5%	\$5,403
Mississippi	\$33,624	807	677	83.9%	\$28,207	23,674	3,913	16.5%	\$5,558
Missouri*	\$16,104	1,294	1,003	77.5%	\$12,483	54,303	6,037	11.1%	\$1,790
Montana*	\$5,768	337	288	85.5%	\$4,930	7,764	2,062	26.6%	\$1,532
Nebraska	\$17,896	507	423	83.4%	\$14,931	16,690	3,553	21.3%	\$3,810
Nevada*	\$4,548	262	198	75.6%	\$3,437	12,298	1,158	9.4%	\$428
New Hampshire*	\$1,832	488	400	82.0%	\$1,501	13,307	2,556	19.2%	\$352
New Jersey*	\$8,055	1,529	1,245	81.4%	\$6,559	59,523	8,597	14.4%	\$1,163
New Mexico*	\$1,119	362	290	80.1%	\$897	13,397	2,616	19.5%	\$219
New York*	\$4,249	3,712	3,137	84.5%	\$3,591	123,064	23,145	18.8%	\$799
North Carolina*	\$6,167	2,010	1,604	79.8%	\$4,921	62,645	11,589	18.5%	\$1,141
North Dakota	\$2,579	202	154	76.2%	\$1,966	7,763	1,149	14.8%	\$382
Ohio*	\$1,409	2,426	1,897	78.2%	\$1,101	106,467	16,110	15.1%	\$213
Oklahoma*	\$8,509	719	545	75.8%	\$6,450	28,826	3,444	11.9%	\$1,017
Oregon*	\$14,776	775	605	78.1%	\$11,534	31,231	4,160	13.3%	\$1,968
Pennsylvania*	\$401	2,693	2,078	77.2%	\$309	107,399	15,138	14.1%	\$56
Rhode Island*	\$181	192	155	80.7%	\$146	7,024	721	10.3%	\$19

Table 8 continued

State	Total MB Hunter Expenditures on Equipment	Establishments				Employment			
		Total Number of Establishments	Number of Small Businesses	Percent Small Businesses	Estimated MB Hunters' Expenditures at Small Businesses	Total Employed	Employed at Small Businesses	Percent Small Businesses of Total	Estimated MB Hunters' Expenditures at Small Businesses
South Carolina	\$28,881	925	739	79.9%	\$23,073	30,885	5,147	16.7%	\$4,813
South Dakota	\$5,862	239	198	82.8%	\$4,856	7,142	1,479	20.7%	\$1,214
Tennessee*	\$9,735	1,297	1,010	77.9%	\$7,581	49,297	7,316	14.8%	\$1,445
Texas	\$65,562	3,858	2,971	77.0%	\$50,489	164,697	20,973	12.7%	\$8,349
Utah*	\$8,237	421	317	75.3%	\$6,202	17,526	2,614	14.9%	\$1,228
Vermont*	\$1,928	278	248	89.2%	\$1,720	3,701	1,426	38.5%	\$743
Virginia*	\$5,495	1,726	1,387	80.4%	\$4,416	55,776	10,526	18.9%	\$1,037
Washington*	\$20,167	1,135	920	81.1%	\$16,347	41,690	6,417	15.4%	\$3,104
West Virginia*	\$77	588	488	83.0%	\$63	15,502	3,236	20.9%	\$16
Wisconsin*	\$21,348	1,300	965	74.2%	\$15,847	53,595	5,892	11.0%	\$2,347
Wyoming*	\$3,235	238	210	88.2%	\$2,854	4,905	1,214	24.8%	\$801
<b>TOTAL</b>	<b>\$743,954</b>	<b>59,605</b>	<b>47,298</b>		<b>\$588,649</b>	<b>2,290,938</b>	<b>332,427</b>		<b>\$105,994</b>

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## Appendix A

### Introduction

To analyze the 2004-2005 migratory bird hunting framework, an economic model was necessary that described hunter behavior under different regulatory frameworks. Available data to apply any model efforts consisted of the 2001 National Survey of Fishing, Hunting and Wildlife-Associated Recreation and Administrative Reports for the 2001 waterfowl hunting season. The 2001 National Survey is the most current database that is comprehensive enough to allow this type of analysis. The primary research interest of this analysis is the tradeoff between season length and bag limit assuming a desired total harvest of ducks. This is not the question these alternative frameworks pose. Each framework varies both bag limit and season length in order to not overharvest the species. The present analysis seeks to quantify these relationships and apply them to changes in both season length and bag limit.

Because of the less stringent data requirements, the empirical approach employed for this analysis is a reduced form of the random utility model by bypassing the site decision equation. The hunter's decision is limited to two questions. First, does the hunter choose to hunt ducks? Second, how many total days does the hunter choose to hunt ducks during one hunting season? The methodology used to analyze the impacts of varying the season length and/or bag limit is explained in the following text.

In any season, the total harvest of ducks (K) is the product of average bag per day per hunter (B), average days afield per hunter per season (DAF), the probability that a hunter will hunt ducks (PROB), and total hunters of all game (H):

$$(1) \quad K = (B) (DAF) (PROB) H$$

The variables in the model and in the subsequent empirical analysis are defined in Table 9. The analysis was conducted under the assumption that total harvest, K, is set according to annual biological considerations. To develop the parameters of the model it was assumed that once K is determined, it remains constant under all alternative combinations of daily bag and season length. Therefore in the model, any change in K, denoted as (dK), is equated to zero.

This can be seen in the total differential of equation (1):

$$(2) \quad dK = dB \frac{\delta K}{\delta B} + dDAF \frac{\delta K}{\delta DAF} + d(PROB) \frac{\delta K}{\delta PROB} = 0$$

The differential shows that the various components of dK can be allowed to vary as long as the effects of their changes on K net out to zero. The components are the changes in duck harvest that can be attributed to changes in bag per day (dB), days afield (dDAF), and probability (dPROB). It is assumed that total number of hunters (H) remains constant. Measuring the compensating changes in these components is what ultimately



permits the determination of the tradeoffs between bag limit and season length. The magnitude of the change in harvest caused by each of the components is the product of the initial change in the component and the partial derivative of  $K$  with respect to the component. For example, the effect on  $K$  of a change in daily bag ( $dB$ ) is the product of  $dB$  and the partial derivative of harvest with respect to daily bag ( $\delta K/\delta B$ ). Thus, equation (2) summarizes the nature of the tradeoffs between daily bag limits and season length in setting the regulatory framework. It shows that any increase in daily bag ( $dB > 0$ ) must be offset by decreases in  $DAF$  and  $PROB$  such that total harvest remains the same ( $dK = 0$ ).

**Table 9. Definition of Variables**

<i>Variable</i>	<i>Definition</i>	<i>Unit of Measurement</i>
PROB	Probability of duck hunting, given that a person hunts	1 = if hunts ducks 0 = otherwise
DAF	Days afield per hunter per season	Days
SL	Season length	Days
BL	Bag limit per hunter per day	Ducks
B	Actual daily harvest per hunter	Ducks
K	Duck harvest per season	Ducks
H	Number of hunters of all species	Participants
DH	Number of duck hunters	Participants
HD	Duck hunting days ( $DAF \times DH$ )	Days
AGE	Age of individual	Years
INC	Individual's household income	Thousands of dollars
SEX	Sex of individual	1 = if male 0 = female
METRO	Urban residence	1 = if residence is in urban area 0 = otherwise
BD00	2000 average daily harvest of ducks per hunter in individual's state of residence	Ducks
WH97	Square miles of waterfowl habitat in individual's state of residence in 1997	Square miles of wetlands per square mile of total state area
AES	Average 2001 equipment expenditures of duck hunters	2003 Dollars
AVS	Average 2001 variable expenditures per day for duck hunting	2003 Dollars
E	Elasticity of season length with respect to days afield	Unitless Number

To measure those tradeoffs it is first necessary to express the components of (2) in other terms. From equation (1), the partial derivatives of total harvest with respect to daily bag (B), days afield (DAF), and probability (PROB) are:

$$(2.1) \quad \frac{\delta K}{\delta B} = \text{DAF}(\text{PROB})H$$

$$(2.2) \quad \frac{\delta K}{\delta \text{DAF}} = B(\text{PROB})H$$

$$(2.3) \quad \frac{\delta K}{\delta \text{PROB}} = B(\text{DAF})H$$

Two equations were specified to incorporate hunter behavior into the model. It is assumed that a hunter makes two decisions.

First, a hunter decides whether to hunt ducks. The decision to participate is binary; the individual either hunts ducks (PROB=1) or he does not (PROB=0). The mean of PROB is the proportion of hunters that hunts ducks, the participation rate.

As discussed in detail below, the decision to participate is influenced by a number of factors. The probability that a given hunter will hunt ducks is a function of age, sex, residence in a rural versus urban area, income, season length, and the amount of waterfowl habitat and the bag per day per hunter in the individual's home state. To simplify the discussion, all factors influencing the decision to hunt ducks except bag per day can be combined in the intercept (a), making the probability that an individual hunts ducks a function of bag per day.

$$(3) \quad \text{PROB} = a + bB$$

Second, after deciding to hunt ducks the hunter must decide how many days to hunt during the season (DAF). The days afield decision is influenced by a number of the same variables: income, availability of duck habitat, and bag per day. Once again, all factors influencing DAF except bag per day can be summarized in the intercept ©.

$$(4) \quad \text{DAF} = c + eB$$

Solving equation (4) for B and substituting into equation (3) yields:

$$(5) \quad \text{PROB} = a + \frac{b(\text{DAF} - c)}{e}$$

The derivative of (5) with respect to DAF is:

$$(6) \quad \frac{d\text{PROB}}{d\text{DAF}} = \frac{b}{e}$$

Substituting (6) and the partial derivatives (2.1, 2.2, and 2.3) into equation (2) and solving for the change in DAF results in:

$$(7) \quad d\text{DAF} = \frac{-dB(\text{DAF})(\text{PROB})H}{B(\text{PROB})H + \frac{b}{e}B(\text{DAF})H}$$

Equation (7) may be simplified by combining all factors on the right hand side except dB into a constant, J. This makes the tradeoffs between changes in DAF and B apparent, in equation (8).

$$(7.1) \quad J = \frac{(\text{DAF})(\text{PROB})H}{B(\text{PROB})H + \frac{b}{e}B(\text{DAF})H}$$

$$(8) \quad d\text{DAF} = -dB(J)$$

Note that B in the model is actual bag whereas the policy variable set in the regulations is bag limit (BL), a maximum number of ducks per day attained by relatively few hunters. The estimated relationship between changes in B and BL for each flyway is shown in Table 10. When dBL is known, the corresponding dB is determined from those estimates. The change in days afield (dDAF) for a given dB is derived from (8). With H and K constant, the new probability (PROB) is then calculated by substituting the new levels of DAF and B into equation (1). This keeps the duck hunters in the flyway on the isoquant representing a constant total harvest (K) while allowing BL and SL to vary.

The change in SL consistent with the change in BL is determined by the elasticity of SL with respect to DAF (the ratio of the percent change in SL to the percent change in DAF):

$$(9) \quad E = \frac{d\text{SL}}{\text{SL}} \bigg/ \frac{d\text{DAF}}{\text{DAF}} = \left( \frac{d\text{SL}}{d\text{DAF}} \right) \left( \frac{\text{DAF}}{\text{SL}} \right)$$

Equation (9) shows how much SL must change to produce the change in DAF required by the new level of BL. If BL is increased, SL must decrease if total harvest is to be held constant.

After the new probability of duck hunting is determined, the difference (dPROB) between it and the base probability is multiplied by the total number of hunters (H) to obtain the change in the number of duck hunters (dDH). Assuming that the new hunters will spend the same amount on equipment as the average of previous duck hunters (AES), the product of dDH and AES is the first part of the economic impact (IMP<sub>1</sub>) caused by changing BL. The second part of the impact (IMP<sub>2</sub>) is the change in variable

expenditures. It is the product of dHD, the change in hunter days due to the change in BL, and average variable spending (AVS) per day.

$$(10) \quad \text{Impact} = \text{IMP}_1 + \text{IMP}_2$$

$$(10.1) \quad \text{IMP}_1 = \text{dDH}(\text{AES}), \text{ where:} \\ \text{dDH} = (\text{dPROB})(\text{H})$$

$$(10.2) \quad \text{IMP}_2 = (\text{dHD})(\text{AVS}), \text{ where:} \\ \text{dHD} = \text{dDH}(\text{DAF} + \text{dDAF}) + \text{dDAF}(\text{DH})$$

Thus, the economic impacts are measured as changes from the base case in terms of hunter equipment spending and spending for food, travel and lodging as the number of duck hunters and days afield change in response to the regulatory alternatives.

#### Estimation of the Model Parameters

As discussed above, the individual hunter is assumed to first decide whether to hunt ducks and then decide the amount of time to spend in the field. The individual's decision whether or not to hunt ducks is specified as a function of age, sex, residence in rural versus urban areas, income, season length, and average bag per day and amount of waterfowl habitat in the hunter's home state. The last two variables are included as measures of the relative quality and availability of waterfowl among states. The days afield (DAF) equation is a function of household income, average daily harvest, season length, and residence in rural versus urban areas. The variables in the equations are defined in Table 9. Data used for this analysis are from the 2001 National Survey of Fishing, Hunting and Wildlife Associated Recreation, and the Waterfowl Harvest and Hunter Activity Administrative Reports for the 1979 through 2001 seasons. These data sources provide the required variability in harvest, season length and bag limits to allow the estimation of the economic model.

The two equations were estimated on a national basis because there was insufficient variation for some variables to estimate individually for each flyway. The probability equation was estimated with logit equation, and the days afield equation was estimated with ordinary least squares. Below each parameter estimate is the t-value in parentheses. The probability equation is estimated for all hunters. The days afield equation is estimated for those hunters who hunted ducks. The results are shown in Table 10 below.

**Table 10. Results**

Parameter	Probability (Eq. 11)		Days Afield (Eq. 12)
	Coefficient	Marginal Effect	
Intercept	-5.0656 (0.00757)	--	8.3864 (2.38639)
AGE	-0.0177 (0.000072)	-0.0035 (000007.32)	
SEX	1.0035 (0.00473)	0.1289 (.00025)	
METRO	0.3904 (0.00195)	0.0010 (.00015)	-3.7244 (0.96550)
INCOME	0.0090 (0.000027)	0.0768 (.00000288)	-0.0223 (0.01353)
BD00	0.3540 (0.00257)	0.0017 (.00015)	2.1340 (1.10002)
WH97	0.0053 (0.000017)	0.0041 (.00000154)	
SL	0.0206 (0.000066)	0.0696 (.00000511)	0.0465 (0.02640)
	n = 4,479 LR = 523,149.36 Pr > ChiSq = 0.0001		n = 611 R <sup>2</sup> = 0.041 F = 6.47 Pr > F = 0.0001

In equation (11), all coefficients are significant and show that the probability that a hunter will hunt ducks is higher for male hunters and residents of urban areas, other things being equal. The probability decreases among older hunters but increases with household income and with the quality of duck hunting and length of the season in the home state. BD00, representing average daily bag in the previous year, was used instead of B as a measure of the quality of hunting in the individual's home state. The quality of the previous year's duck hunting was considered a more relevant factor for hunter decisions in 2001.

In equation (12), all coefficients are significant at the 10 percent level. The coefficients of BD00 and SL are positive which indicates that hunters in states with a longer season length and high bag per day hunt ducks more days per year than do hunters in other states, other things being equal. Also, the number of days spent duck hunting is inversely related to income and residents of urban areas, other things being equal.

Estimates of equations (3) and (4) were developed for each flyway from the coefficients in (11) and (12) by using flyway mean values for all independent variables except BD00 and collapsing them into the intercept (Table 11). The same coefficients of BD00 from equations (11) and (12) were used in all flyways. For example, the intercept (a) in the probability equation is 10.509 for the Mississippi Flyway. The slope (b) in the

probability equation is 0.002 for all flyways. The key parameters used in the analysis are shown in Table 11 below.

**Table 11. Key Flyway Parameters Used in 2004 Update**

	<i>Flyway</i>			
	<i>Atlantic</i>	<i>Mississippi</i>	<i>Central</i>	<i>Pacific</i>
Eqn 3. $PROB = a + bB$				
a =	12.467	10.509	9.741	9.336
b =	0.002	0.002	0.002	0.002
Eqn 4. $DAF = c + eB$				
C =	0.550	-0.247	-0.749	-0.324
E =	2.134	2.134	2.134	2.134
Eqn 7.1. J =	2.638	1.896	1.476	1.814
Response of B to BL				
Increase in BL	3.0%	3.5%	5.0%	3.9%
Decrease in BL	-8.4%	-7.9%	-9.9%	-8.1%
Elasticity of SL to DAF	4.977	6.214	4.404	3.186

The elasticity of SL with respect to DAF (percent change in SL due to a one percent change in DAF) was estimated from a set of time series/cross section data for the years 1979 to 2001. The equation is as follows:

$$\begin{aligned}
 DAF = & 3.87 + .033SL + .456\text{lagged bag/day} + 1.033 \text{ split seasons} + .057 \text{ zones} + \\
 & (.006) \quad (.402) \quad (.276) \quad (.22) \\
 & .099 \text{ bag limit} + .042 \text{ pacific flyway} + .036 \text{ central flyway} + .073 \text{ Miss. North} \\
 & (.039) \quad (.017) \quad (.013) \quad (.013) \\
 & \text{flyway} + .214 \text{ Miss. South flyway} + .016 \text{ Atlantic flyway} \\
 & (.016) \quad (.011)
 \end{aligned}$$

R squared = .87

N = 115

The partial of DAF with respect to SL = .033 computed for the nation was converted to a flyway specific elasticity of SL with respect to DAF – the percent change of SL for a one percent change in DAF. This was done by taking the reciprocal and multiplying it by the ratio of DAF to SL for each flyway. The Mississippi Flyway elasticity is 6.214.

The remaining estimates for the base case representing the 2001 hunting season were obtained from other sources. Starting with the first row of Table 11, the total seasonal duck harvest (K) used in equation (1) was obtained from the Administrative Report. The numbers of hunters differs somewhat in the 2001 Survey, the 2002 Administrative Report, and state license data. Estimates of duck hunters from Administrative Reports

were used to be compatible with harvest and days afield information. Total hunters of all game and participation rates are from the 2001 Survey.

The base case probability (PROB) was estimated as follows. Daily harvest (B) and days afield (DAF) are from the 2002 Administrative Report, and PROB was solved for by substituting H and K into equation (1). The responsiveness (dB/B) of daily harvest (in percent) to a one unit change in bag limit (dBL) based on research results is in Table 11. It is flyway specific and is shown separately for increases and decreases. For example, an increase in the Mississippi Flyway BL from 4 to 5 ducks per day causes a 3.5 percent increase in B and a decrease in the BL from 4 to 3 per day causes a 7.9 percent decrease in B. To extend the results to more than a unit change in bag limit the same rate of change is applied to additional units in either direction, i.e., a change from 4 to 6 ducks per day yields twice the change in B as a change from 4 to 5.