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Source: Wildlife Biology, 16(4) : 342-356

Published By: Nordic Board for Wildlife Research

URL: https://doi.org/10.2981/09-066

Wildl. Biol. 16: 342-356 (2010)
DOI: 10.2981/09-066

www.wildlifebiology.com

Current management

A survey of galliform monitoring programs and methods in the United States and Canada

Joseph P. Sands & Michael D. Pope

We mailed survey questionnaires to 62 upland game bird managers in the United States and Canada in 2004. We received questionnaires from 47 of the 62 (76%) upland game bird managers that were contacted and 43 (91%) respondents provided information on how monitoring data were used. Responses indicated monitoring programs (population trends and/or harvest monitoring) for 23 species of Galliformes, with 145 ± 208 personnel days/year devoted to monitoring. Estimating general population trends (e.g. up or down) was the most frequent objective (N=41; 95%) of survey data. Other applications of data included assessments of hunting activity, evaluations of regional programs and reviews of conservation status related to Endangered Species Act petitions. The majority of respondents (i.e. 63%) with monitoring programs considered the programs within their states to be effective with respect to their objectives. Many states rely upon hunter surveys, harvest data or road counts to access demographic and population data to address major conservation and management issues. The relevance of these issues is growing and agencies must respond with management recommendations, but often must do so with limited data on the status of their populations. Comprehensive monitoring should be a major component of conservation and management planning for upland gamebird populations particularly as a tool to track and evaluate the effectiveness of management actions and inform management options.

Key words: Galliformes, monitoring effectiveness, population monitoring, survey, upland game birds

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Received 21 July 2009, accepted 9 July 2010

Associate Editor: John W. Connelly

Upland game birds are important wildlife resources for most states and provinces in North America (in this paper, upland game bird(s) refers only to species within the order Galliformes). They provide substantial revenue from stamp and license sales, and recreational opportunities that include hunting and wildlife viewing (e.g. Burger et al. 1999, Conner 2007). Long-term declines of species such as the northern bobwhite *Colinus virginianus* (Brennan 1991, Peterson et al. 2002, Link et al. 2008) and the greater sage-grouse *Centrocercus urophasianus* (Connelly & Braun 1997, Schroeder et al. 2004) highlight the importance of effective population monitoring to assist in the conservation and management of upland game birds.

Many techniques have been described for monitoring upland game bird populations, including walked line transect surveys (Guthery 1988), aerial line transect surveys (Shupe et al. 1987, Rusk et al. 2007), call/territorial male counts (Blackford 1958, Gullion 1966, DeMaso et al. 1992), roadside and brood count surveys (Bennett & Hendrickson 1938,

Kozicky et al. 1952), hunter harvest surveys (Leopold 1933, Amman & Ryel 1963) and wing/tail collections (Allison 1963, Dalke et al. 1963). However, consolidated documentation of methods currently used by state wildlife managers to evaluate upland game bird populations are lacking.

Mail-in questionnaires have been used in wildlife research to collect data including information on harvest levels and abundance (Bellrose 1947, Rogers 1963), hunter knowledge, attitudes and values (Duffey & Stiehl 1983, Cartwright & Smith 1990, Vangilder et al. 1990, Haroldson & Kimmel 1992), and the success of management plans and monitoring techniques of specific species (Rogers 1963) or groups of species (Snyder et al. 1999). Given the ecological and economic importance of many upland game birds and potential changes in the legal status of declining populations, it is important to evaluate the effectiveness of survey methods and monitoring protocols for many of these species.

Without adequate data on the status of upland game bird populations, wildlife managers cannot effectively detect changes in populations, produce regulations that optimize sustainable harvest or develop management plans for upland game bird populations based on demographic data. Many methods used to evaluate populations and demographics of upland game birds lack the standardisation and rigorous statistical design necessary for effective management (Warner 1991). To our knowledge no study has quantified upland game bird monitoring efforts of state and provincial wildlife agencies on a continental scale. Thus, our objectives were to: 1) collect and compare information regarding upland game bird monitoring techniques used in the United States and Canada, 2) determine how monitoring data are used and 3) summarize the self-reported effectiveness of monitoring techniques.

Material and methods

During January 2004, we mailed a 3-page questionnaire (Appendix I) and a cover letter to 62 representatives from state and provincial wildlife agencies in 50 U.S. states and 12 Canadian provinces which were responsible for managing upland game birds. If a survey was not returned, we attempted to contact the subject by telephone or email to encourage a response. The survey design and questions were reviewed and approved by Oregon State University's Institutional Review Board (IRB #2401) for compliance with federal regulations on research using human subjects.

We asked potential respondents a series of questions regarding population and harvest monitoring of upland game birds. Questions included whether or not a state/province monitored upland game birds, number of personnel days allocated to monitoring, the number of and which upland game bird species were monitored, how frequently upland game bird harvest regulations were reviewed, how effective respondents felt monitoring programs and methods were with respect to program goals, and applications and spatial extent of data collected. In this paper, the term monitoring applies to population (trends/abundance) monitoring as well as harvest monitoring.

We divided the returned surveys into four categories (N = number of surveys mailed): western states (N = 13), central states (N = 15), eastern states (N = 22) and Canadian provinces (N = 12; Table 1). Questions soliciting information on monitoring effectiveness (how well the methods worked relative

Table 1. Regional divisions among potential respondents by state/province, 2004.

Grouping	States/Provinces
Western states	Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming
Central states	Arkansas, Iowa, Illinois, Kansas, Louisiana, Michigan, Minnesota, Mississippi, Missouri, North Dakota, Oklahoma, Nebraska, South Dakota, Texas, Wisconsin
Eastern states	Alabama, Connecticut, Delaware, Florida, Georgia, Indiana, Kentucky, Maine, Maryland, North Carolina, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Virginia, Vermont, West Virginia
Canadian provinces	Alberta, British Colombia, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Northwest Territories, Quebec, Saskatchewan, Yellowknife, Prince Edward Island

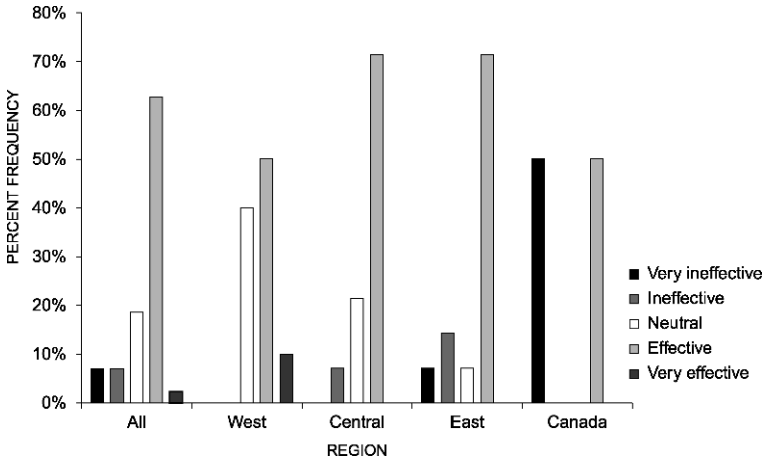

Figure 1. Reported effectiveness (N = 43) for upland game bird monitoring programs (population trends and/or harvest estimation) data applications in North America, in 2004.

to objectives) were given a range of 1-5 (1 = very ineffective, 2 = ineffective, 3 = neutral, 4 = effective, 5 = very effective), with 3 as a neutral to control for potential positive or negative bias (Fig. 1). Respondents were given the opportunity to mark questions not applicable (NA), and to only answer specific questions that applied to their state or province.

Results

We mailed 62 surveys and 47 (76%) were returned. The number of non-respondents was distributed similarly among regions for U.S. states (73-93%); however, only 50% of Canadian provinces responded (Table 2). Of 47 respondents, 43 (91.5%) monitored upland game bird population trends (see Table 2) and/or harvest of 24 upland game bird species. Mean personnel days allocated for monitoring populations was 145.0 ± 208 days/year for all respondents (see Table 2). An average of 5.0 ± 2.5 species (range: 1-12) was monitored per state/province, and western states reported the greatest average number of monitored species 7.0 ± 3.1 (Table 3). Species monitored the most frequently were wild turkey *Meleagris gallopavo* (N = 34; 72%), ruffed grouse *Bonasa umbellus* (N = 30; 64%), ring-necked pheasant *Phasianus colchicus* (N = 28; 60%) and northern bobwhite (N = 24; 51%; Table 4).

All western and central states that responded to the survey monitored upland game bird populations. Nearly 90% of the eastern states and 67% of Canadian provinces monitored their upland game birds (see Table 2). Western states monitored the greatest number of species (N = 19) compared to the other regions (range: 5-11; see Table 3). Central states allocated nearly twice the number of days to monitoring than western states, and more than four times the number allocated by eastern states (see Table 2). Of respondents with monitoring programs, 27 (65%) considered their programs 'effective' or 'very effective' with respect to their objectives, and six (14%) considered their programs 'ineffective' or 'very ineffective' (see Fig. 1). Of the respondents, eight (19%) considered their programs 'neutral' and one (2%) did not respond to the question.

Table 2. Survey results for evaluating methods for monitoring upland game bird population trends and/or harvest in North America, during 2004. The number of monitoring days refers to personnel days, not elapsed time.

Group	# Responded (%)	% Active monitoring	Average # monitoring days ± SD
Western states	11 (85)	100	101 ± 145
Central states	14 (93)	100	286 ± 286
Eastern states	16 (73)	88	50 ± 37
Canadian provinces	6 (50)	67	9 ± 0
All respondents	47 (76)	91	145 ± 208

Table 3. Number of upland game bird species monitored (population trends and/or harvest) in North America, during 2004.

Group	Average # species ± SD	# species monitored per region	Maximum # monitored in one state/province
Western states	7.0 ± 3.1	19	12
Central states	5.4 ± 1.5	11	7
Eastern states	2.9 ± 1.1	5	5
Canadian provinces	4.8 ± 2.5	10	8
All respondents	5.0 ± 2.5	23	12

Table 4. Frequency of population and/or harvest monitoring of upland game bird species[a,b] reported by state and provincial agency respondents (N = 43) in the United States and Canada, during 2004.

Species	All respondents	Western states	Central states	Eastern states	Canadian provinces
Ruffed grouse	30	7	8	11	4
Blue grouse[c]	5	5	NA	NA	0
Spruce grouse	7	4	0	0	3
Sharp-tailed grouse	16	7	7	NA	2
Greater sage-grouse	11	8	2	NA	1
Gunnison's sage-grouse	2	2	NA	NA	NA
Greater prairie-chicken	7	1	6	NA	NA
Lesser prairie-chicken	5	2	3	NA	NA
California quail	5	5	NA	NA	NA
Mountain quail	3	3	NA	NA	NA
Northern bobwhite	24	1	12	11	0
Gambel's quail	4	4	0	NA	NA
Scaled quail	3	1	2	NA	NA
Montezuma quail	1	1	0	NA	NA
Gray partridge	12	5	5	NA	2
Chukar partridge	6	5	0	1	NA
Ring-necked pheasant	28	8	12	6	2
Wild turkey	34	6	14	13	1
White-tailed ptarmigan	2	0	NA	NA	2
Willow ptarmigan	2	1	NA	NA	1
Rock ptarmigan	2	1	NA	NA	1
Himalayan snow partridge	1	1	NA	NA	NA
Plan chachalaca	1	NA	1	NA	NA

[a] Species within the order Galliformes only;
[b] See Appendix II for scientific names;
[c] Blue grouse *Dendragapus obscurus* has since been split into two species: dusky grouse *D. obscurus* and sooty grouse *D. fuliginosus*.

Of the respondents, 42 (89%) provided information on the spatial extent (e.g. statewide, specific counties/areas and systematically selected areas) of their monitoring (Fig. 2). Statewide survey was the most frequent spatial scale on which monitoring occurred (N = 35; 83%; see Fig. 2). Of the respondents, 43 (91%) provided information on how their monitoring data were used. Estimating population trends (e.g. up or down) was the most frequent application (N = 41; 95.3%) of survey data (see Fig. 2). Other applications of data included evaluation of regional management programs and conservation status reviews related to Endangered Species Act petitions (see Fig. 2). At the time of the

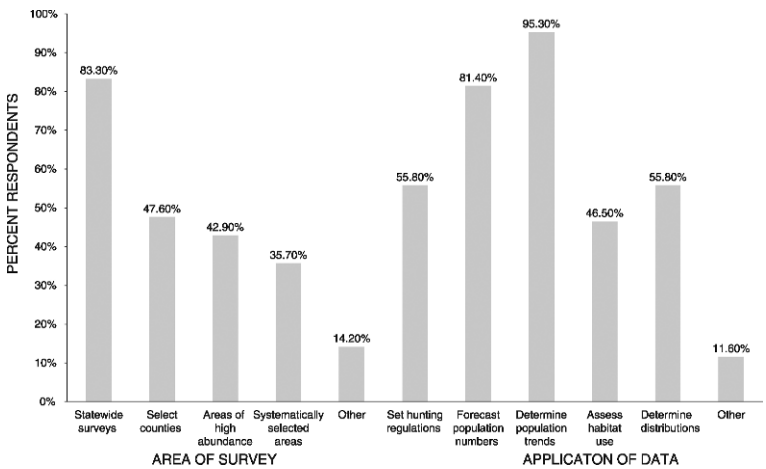

Figure 2. Upland game bird monitoring sampling area selections and monitoring (population trends and/or harvest estimation) data applications for all respondents that reported monitoring activities (N = 43) in North America, in 2004.

Table 5. Frequency (average years ± SD) of review of hunting regulations for upland game birds in North America, during 2004.

Group	Frequency of hunting regulation review
Western states	2.5 ± 1.4
Central states	2.0 ± 1.8
Eastern states	2.4 ± 1.6
Canadian provinces	2.3 ± 2.3
All respondents	2.3 ± 1.6

survey (i.e. 2004), hunting regulations were reviewed an average of every 2.3 ± 1.6 years (range: 1-5 years; Table 5).

Of the respondents, 47% (20 states and two provinces) used roadside and rural mail carrier count surveys to monitor 14 species, 57% (24 states and three provinces) surveyed hunters to monitor harvest of 21 species and 34% (15 states and one province) used wing and tail collections to monitor harvest of 13 species. All respondents that used rural mail carrier surveys were from the central region.

Responses to questions on the most accurate monitoring techniques were highly variable. Of the respondents, 33 (70%) considered 13 methods to be the most accurate and effective when costs of implementing monitoring methods were not considered (Table 6). Brood counts (N = 10; 30%), prairie grouse lek counts (N = 8; 24%), hunter surveys (N = 8; 24%), call/whistling counts (N = 7; 21%), roadside counts (N = 6; 18%) and wing/tail collections (N = 3; 9%) were the most frequently reported methods (see Table 6). When costs of implementing a monitoring program were considered, 32 (68%) of the respondents considered nine methods to be the most accurate/effective; brood counts (N = 11; 34%), hunter surveys (N = 11; 34%), prairie grouse lek counts (N = 6; 19%), roadside count surveys (N = 5; 16%), wing/tail collections (N = 3; 9%) and calling/whistling counts (N = 3; 9%; Table 7).

Discussion

Use of indices

Most monitoring efforts for upland game birds in North America (> 80%) involved the use of statewide indices conducted primarily to assess population trends and forecast numbers for hunting seasons. However, the precision and/or accuracy of these kinds of assessments are difficult to evaluate without knowledge of detection probabilities of individuals over space and time (MacKenzie & Kendall 2002, Anderson 2001, 2003). More precise data necessary for conservation planning likely cannot be obtained from these methods without testing them against estimates of population size (Lint et al. 1995).

Roadside count surveys of individuals are currently used by many of the central states and have been used in avian monitoring since the 1920s (Nice & Nice 1921). Roadside surveys were considered cost effective by many of the states likely because they allow a large area and a wide range of habitats to be sampled in a relatively short time period, and permit managers to monitor multiple species with

Table 6. Frequency (in %) of methods considered most effective by respondents when costs of monitoring were not considered, during 2004.

Method	All respondents		Western states		Central states		Eastern states		Canadian provinces	
Brood counts	10	(30.3)	1	(10.0)	2	(20.0)	7	(70.0)	0	(0.0)
Lek counts	8	(24.2)	5	(50.0)	3	(30.0)	0	(0.0)	0	(0.0)
Hunter surveys	8	(24.2)	3	(30.0)	1	(10.0)	3	(30.0)	1	(33.0)
Call counts	7	(21.2)	1	(10.0)	0	(0.0)	6	(60.0)	0	(0.0)
Roadside counts	6	(18.2)	0	(0.0)	5	(50.0)	0	(0.0)	1	(33.0)
Wing-tail collections	3	(9.1)	2	(20.0)	1	(10.0)	0	(0.0)	0	(0.0)
Winter flock counts[a]	1	(3.0)	1	(10.0)	0	(0.0)	0	(0.0)	0	(0.0)
Mark and recapture[b]	1	(3.0)	1	(10.0)	0	(0.0)	0	(0.0)	0	(0.0)
Territorial surveys	1	(3.0)	1	(10.0)	0	(0.0)	0	(0.0)	0	(0.0)
Aerial surveys	1	(3.0)	0	(0.0)	0	(0.0)	0	(0.0)	1	(33.0)
Direct counts	1	(3.0)	0	(0.0)	0	(0.0)	0	(0.0)	1	(33.0)
Check stations	1	(3.0)	0	(0.0)	0	(0.0)	1	(10.0)	0	(0.0)
Fall covey counts	1	(3.0)	0	(0.0)	0	(0.0)	1	(10.0)	0	(0.0)

[a] Winter flock counts for wild turkey;
[b] Mark and recapture for greater sage-grouse.

Table 7. Frequency (in %) of methods considered most effective by respondents when costs of monitoring were considered, during 2004.

Method	All respondents		Western states		Central states		Eastern states		Canadian provinces	
Brood counts	11	(34.4)	1	(11.1)	4	(36.4)	6	(60.0)	0	(0.0)
Hunter surveys	11	(34.4)	4	(44.4)	1	(9.1)	5	(50.0)	1	(50.0)
Lek counts	6	(18.8)	4	(44.4)	2	(18.2)	0	(0.0)	0	(0.0)
Roadside counts	5	(15.6)	0	(0.0)	5	(45.5)	0	(0.0)	0	(0.0)
Wing-tail collection	3	(9.4)	3	(33.3)	0	(0.0)	0	(0.0)	0	(0.0)
Call counts	3	(9.4)	1	(11.1)	0	(0.0)	2	(20.0)	1	(50.0)
Winter flock counts[a]	1	(3.1)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)
Telemetry surveys	1	(3.1)	0	(0.0)	0	(0.0)	1	(10.0)	0	(0.0)
Direct counts	1	(3.1)	0	(0.0)	0	(0.0)	0	(0.0)	1	(50.0)

[a] Winter flock counts for wild turkey.

one sampling effort (Tapper 1988). However, roadside surveys may not produce results that are representative of an entire area because of the potential bias of modified habitat structure and composition surrounding roadsides (Hanowski & Niemi 1995, Betts et al. 2007).

Roadside count surveys of broods have been used to monitor many species of upland game birds in North America including ruffed grouse (Amman & Ryel 1963), sooty grouse *Dendragapus fuliginosus* (Zwickel 1958, 1990), sage-grouse *Centrocercus* spp. (Patterson 1952, Dalke et al. 1963), northern bobwhite (Schwartz 1974) and scaled quail *Callipepla squamata* (Hoffman 1965). Rice (2003) found that results from brood count surveys for pheasants had low precision when used to assess harvest and were not a cost-effective method. Without data collected from a large number of brood routes and multiple replications, information from brood counts may not accurately reflect production (Anderson 1983).

Postal Service employees are often recruited to participate in rural mail carrier roadside surveys throughout the year. This system was initiated by Nebraska in 1945 (Hickey 1955), and has been used for pheasants and wild turkeys (Applegate 1997, Applegate & Williams 1998), ruffed grouse (Amman & Ryel 1963) and northern bobwhite (Applegate & Williams 1998). Rural mail carrier counts are an inexpensive tool for surveying populations, but a bias was noted when the number of carriers participating from year to year was not relatively constant (Robinson et al. 2000).

Call count surveys during the breeding season have been used with varying success for New World quail (Levy et al. 1966, Schwartz 1974, Heffelfinger et al. 1999, Guthery et al. 2001). In some areas, call counts during the breeding season have exhibited a strong correlation with the fall harvest (Bennitt 1951, Smith & Gallizioli 1965, Snyder 1985), and were most affected by time of year, time of day, wind velocity, temperature and relative humidity (Robel et al. 1969). Winter covey call counts of northern bobwhites were a poor index of density in southern Texas rangelands due to a weak relationship between coveys heard calling and covey density, and failure to meet the underlying assumptions (i.e. individuals call at a constant intensity, proportion of coveys calling is consistent over time and space, and observers can accurately identify and separate coveys) of the method (DeMaso et al. 1992). Call counts for pheasants in Washington detected only large changes in populations over the short-term (i.e. 2-3 years; Rice 2003).

Most of the western and central states with lek-forming grouse present monitored these species using lek counts. Lek counts may be useful as population indices, however, use of lek survey data to estimate absolute population size may be inappropriate (Applegate 2000).

Line and strip transects were not frequently used to assess upland game bird populations. These methods are labour intensive and expensive particularly if applied to large areas. Most states likely do not have the resources to conduct repeated comprehensive surveys using these techniques on a large scale.

Hunter contributed materials

Wing and tail collections were utilized by $\leq 42.0\%$ of all respondents whose agencies monitored upland game birds. Wing and tail collections are generally inexpensive to conduct because they rely primarily on volunteer participation by hunters. Volunteer wing barrels established at check stations or specific

collection sites may substantially increase sample sizes (Hoffman & Braun 1975).

Data from wings (particularly of grouse and quail) may be used to better understand the distribution and timing of harvest in specific areas, the relative proportions of harvest among species, the sex and age structure of the population and the chronology of breeding activity. However, harvest statistics may not precisely represent sex and age ratios in a hunted population because not all ages and sexes have an equal likelihood of harvest during hunting seasons, and demographic parameters may also differ among ages and sexes (Pollock et al. 1989). For example, northern bobwhite harvests are generally biased towards juveniles and females (Pollock et al. 1989, Shupe et al. 1990, Roseberry & Klimstra 1992). Immature ruffed grouse were harvested more frequently than adults along roadsides in Wisconsin (Dorney 1963) and Alberta (Fischer & Keith 1974). An analysis of data from 10 years (1962-1971) of wings/tails collected from ruffed grouse in Ohio determined that juveniles were less likely to be harvested as a 5-month hunting season progressed (Davis & Stoll 1973), but Flanders-Wanner et al. (2004) found no change over time in the harvest ratio of juvenile and adult plains sharp-tailed grouse *Tympanuchus phasianellus jamesi* or greater prairie-chickens *T. cupido pinnatus* during a 3½-month hunting season in Nebraska.

Hunter harvest surveys

Hunter harvest surveys (i.e. telephone and mail questionnaires) have been used by many states to estimate harvest (Sondrini 1950, LaPierre 1997, Tuovila et al. 2002), and many of the respondents in our survey believed that these surveys were an effective method of collecting harvest information on upland game bird populations. Results from harvest surveys may be biased because respondents inflate their success rates (Bellrose 1947, Deming 1950, Atwood 1956, Martinson & Whitesell 1964), or inadvertently give approximate (rounded) answers to questions (Beaman et al. 2005a). In Colorado, significant differences were found between 'hunter report cards' and check station data from turkey hunters (Meyers 1965). Meyers (1965) suggested that check stations provided more accurate estimates of population parameters than other hunter solicitation methods, but may not be applicable on a statewide basis because of high labour and maintenance costs. An additional problem with hunter surveys is non-response bias when hunters do not return survey questions because of lack of interest (Martinson & Whitesell 1964). This bias may be reduced by sending survey cards prior to hunting season (Beaman et al. 2005b) conducting surveys soon after the close of hunting seasons (Kurzejeski & Vangilder 1992) and directly contacting non-respondents (Barnes 1946). Most of the information collected from hunters is based on non-random sampling, and may not represent birds harvested from all habitat types. Changes in hunting pressure and intensity for one species may also affect the harvest rate of another (Tapper 1988).

Manager confidence in survey data

Survey responses indicated that the majority of managers considered monitoring within their states to be effective at providing adequate information on upland game bird populations. At least one species of upland game bird can be legally hunted in every U.S. state and Canadian province, yet $< 60.0\%$ respondents used monitoring data to set hunting regulations (e.g. bag limits and season lengths). Many states rely upon hunter surveys, harvest data or road counts to access demographic and population data. Of the upland game bird species in the United States and Canada, 20 are native, and at least eight, all shrub-grassland grouse species, northern bobwhite, mountain quail *Oreortyx pictus* and scaled quail, have exhibited significant declines throughout all or significant portions of their range. While some states have responded by implementing more intensive methods to monitor declining populations, upland game bird managers still face many challenges in selecting and implementing more effective monitoring strategies or improving existing programs because of limitations in funding, time, training and staff.

Conclusions

The success of upland game bird monitoring programs depends on careful determination of monitoring goals, sound sampling design and consideration of factors that affect the choice of monitoring techniques applied to upland game bird management (Martinka & Swenson 1981, Jones 1986, Thompson et al. 1998, Bibby et al. 2000). These factors include the purpose and projected outcomes of monitoring, the habitat and behaviour of the species being monitored, the size and

physiography of the sample area, the season in which monitoring will be conducted, time of day and weather conditions (Schultz 1954, Robel et al. 1969, Martinka & Swenson 1981, Shaw 1985). It has long been understood that monitoring methods must be tested and modified with respect to the above factors before being fully employed (Leopold 1933).

In addition to long-standing problems such as broad-scale habitat loss, upland game bird species now face challenges from emerging issues such as climate change and energy developments (transmission lines, wind energy facilities, pipelines and geothermal development) that may have serious impacts on population dynamics and persistence. The relevance of these issues is growing dramatically and agencies must respond with management recommendations, but often must do so with limited data on the status of their populations. To this end, comprehensive monitoring should be a major component of conservation and management planning for upland gamebird populations, particularly as a tool to evaluate effectiveness and inform of management actions.

Acknowledgements - we thank the upland game bird managers throughout the United States and Canada who participated in our survey and provided thoughtful responses to survey questions. L. Brennan, D. Budeau, B. Dugger, D. Edge, D. Robinson and two anonymous reviewers provided valuable comments on early drafts of this manuscript. L. Newton from Oregon State University's Survey Center provided valuable suggestions about the survey design. We thank Oregon State University's Institutional Review Board for their prompt evaluation of our methodology. This project was supported by Oregon State University's Department of Fisheries and Wildlife Game Bird Research program, and the University Honors College.

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Appendix I. Survey of Galliform monitoring programs and techniques used in the United States and Canada, in January 2004.

Part A

Non-Migratory Upland Game Bird Monitoring and Census Protocols General Information
Questions 1-6 ask for general information regarding the effectiveness of upland game bird monitoring protocols in your state. If a question does not apply to your state, please mark NA.

Q1. Do you actively monitor (survey, census, wing/tail collection) populations of upland game birds?

1. NO	Thank you. This is all the information we need from you at this time. Please return your survey in the postage-paid envelope provided.
2. YES	Please continue with survey.

Q2. Approximately how many workdays (statewide) are allocated to *upland game bird surveys* per year?_____

Q3. Please indicate whether or not your state conducts upland game bird surveys using each of the following sampling techniques. (*Indicate YES or NO by circling one number for each technique*)

	YES	NO
a) Statewide surveys.....	1	2
b) In a few chosen counties.....	1	2
c) In areas containing high populations of game birds..	1	2
d) In systematically selected areas.....	1	2
e) Other.....		
(Describe_____)		

Q4. Please indicate whether or not the results from these surveys used in each of the following ways. (*Indicate YES or NO by circling one number for each applicable use*)

	YES	NO
a) To set hunting regulations.....	1	2
b) To forecast game bird population numbers...	1	2
c) To determine population trends.....	1	2
d) To assess habitat use.....	1	2
e) To determine distributions of upland game birds.....	1	2
f) Other		
(Describe_____)		

Q5. Generally, how frequently are upland game bird hunting regulations (e.g. bag limits/season lengths) evaluated or reviewed in your state?

1. Once a year
2. Every 2 years
3. Every 3 years
4. Every 4 years
5. Every 5+ years

Q6. What was the most recent year that upland game bird hunting regulations (e.g. bag limits/season lengths) were re-evaluated in your state?

_____ Year of last re-evaluation

Part B

Effectiveness of Non-Migratory Upland Game Bird Monitoring and Census Protocols.
The following table asks for your opinion regarding the effectiveness of upland game bird monitoring protocols in your state, and the time of year in which the monitoring is conducted. If a method or species does not apply to your state, mark NA.

Statement	Very ineffective	Ineffective	Neutral	Effective	Very effective	NA	Time of year used: March - May	June - August	September - November	December - February
Miscellaneous upland species										
Roadside counts										
a) Driving	1	2	3	4	5	NA	1	2	3	4
b) Rural mail carrier	1	2	3	4	5	NA	1	2	3	4
c) Which species? _____										
Mail-in hunter surveys	1	2	3	4	5	NA	1	2	3	4
a) Which species?										
Wing/tail collections	1	2	3	4	5	NA	1	2	3	4
a) Which species? _____										
Ruffed grouse										
Drumming surveys										
a) Roadside	1	2	3	4	5	NA	1	2	3	4
b) Foot-transect	1	2	3	4	5	NA	1	2	3	4
Flush census (foot-transects)	1	2	3	4	5	NA	1	2	3	4
Brood counts	1	2	3	4	5	NA	1	2	3	4
Blue grouse										
Hooting counts	1	2	3	4	5	NA	1	2	3	4
Brood counts	1	2	3	4	5	NA	1	2	3	4
Spruce grouse										
Drumming counts	1	2	3	4	5	NA	1	2	3	4
Brood counts	1	2	3	4	5	NA	1	2	3	4
Prairie grouse										
Lek counts										
a) Sage grouse	1	2	3	4	5	NA	1	2	3	4
b) Sharp-tailed grouse	1	2	3	4	5	NA	1	2	3	4
c) Prairie chicken	1	2	3	4	5	NA	1	2	3	4
Brood counts	1	2	3	4	5	NA	1	2	3	4
Ptarmigan										
Territorial male call play-backs	1	2	3	4	5	NA	1	2	3	4
Mapping territorial males	1	2	3	4	5	NA	1	2	3	4
Foot transects	1	2	3	4	5	NA	1	2	3	4
Brood counts	1	2	3	4	5	NA	1	2	3	4
Which species? _____										
Quail										
Whistling counts										
a) No. of bobwhite	1	2	3	4	5	NA	1	2	3	4

b) California quail	1	2	3	4	5	NA	1	2	3	4
c) other sp: _____	1	2	3	4	5	NA	1	2	3	4
Flushing census										
a) No. of bobwhite	1	2	3	4	5	NA	1	2	3	4
b) California quail	1	2	3	4	5	NA	1	2	3	4
c) other sp: _____	1	2	3	4	5	NA	1	2	3	4
Brood counts										
a) No. of bobwhite	1	2	3	4	5	NA	1	2	3	4
b) California quail	1	2	3	4	5	NA	1	2	3	4
c) other sp: _____	1	2	3	4	5	NA	1	2	3	4
Ring-necked pheasant										
Crowing counts	1	2	3	4	5	NA	1	2	3	4
Brood counts	1	2	3	4	5	NA	1	2	3	4
Chukar partridge										
Roadside counts	1	2	3	4	5	NA	1	2	3	4
Brood counts	1	2	3	4	5	NA	1	2	3	4
Gray partridge										
Roadside counts	1	2	3	4	5	NA	1	2	3	4
Brood counts	1	2	3	4	5	NA	1	2	3	4
Wild turkey										
Roost tree counts	1	2	3	4	5	NA	1	2	3	4
Gobbler counts	1	2	3	4	5	NA	1	2	3	4
Brood counts	1	2	3	4	5	NA	1	2	3	4

Part C

Non-Migratory Upland Game Bird Species Monitored/Comments.
Items 7-11 ask for your final opinions regarding upland game bird monitoring in your state; list all upland game birds monitored by your state, and comments regarding this survey.

Q7. *Overall*; monitoring of upland game birds in your state is

1. Very ineffective,
2. Somewhat ineffective
3. Neutral
4. Effective
5. Very effective.

Q8. *Regardless of cost*; of the monitoring or census method(s) for upland game birds used in your state which methods do you believe are most accurate, and why?

Q9. *Considering costs*; of the monitoring or census method(s) for upland game birds used in your state which methods do you believe are most accurate, and why?

Q10. Please list all the species of upland game birds monitored by your state:

Q11. The lines below are open for your comments, or for you to add additional information that you believe may be relevant to this survey. Thank you very much for your time.

Appendix II. Common and scientific names of Galliformes mentioned in the text and/or tables.

Family	Common name	Scientific name
Odontophoridae	Northern bobwhite	*Colinus virginianus*
	Scaled quail	*Callipepla squamata*
	Gambel's quail	*Callipepla gambelii*
	California quail	*Callipepla californica*
	Montezuma quail	*Cyrtonix montezumae*
	Mountain quail	*Oryeortyx pictus*
Phasianidae	Ruffed grouse	*Bonasa umbellus*
	Dusky grouse[a]	*Dendragapus obscurus*
	Sooty grouse[a]	*Dendragapus fuliginosus*
	Spruce grouse	*Falcipennis canadensis*
	Greater sage-grouse	*Centrocercus urophasianus*
	Gunnison sage grouse	*Centrocercus minimus*
	Greater prairie-chicken	*Tympanuchus cupido*
	Lesser prairie-chicken	*Tympanuchus pallidicinctus*
	Sharp-tailed grouse	*Tympanuchus phasianellus*
	Willow ptarmigan	*Lagopus lagopus*
	White-tailed ptarmigan	*Lagopus leucurus*
	Rock ptarmigan	*Lagopus mutus*
	Ring-necked pheasant	*Phasianus colchicus*
	Chukar	*Alectoris chukar*
	Gray partridge	*Perdix perdix*
	Himalayan snow partridge	*Tetraogallus himalayensis*
	Wild turkey	*Meleagris gallopavo*
Cracidae	Plain chachalaca	*Ortalis vetula*

[a] Dusky grouse and sooty grouse were formerly one species: Blue grouse *Dendragapus obscurus*.