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Study Proposal

UPLAND GAME BIRD ECOLOGY

Study II: Population Characteristics and Habitat Use of Exploited Forest Grouse Populations

July 1, 2007 to June 30, 2008

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STUDY PROPOSAL
STATEWIDE WILDLIFE RESEARCH

STATE:	Idaho	**JOB TITLE:**	Upland Game Bird Ecology
PROJECT:	W-160-R-35		
SUBPROJECT:		**STUDY NAME:**	Population Characteristics and Habitat Use of Exploited Forest Grouse Populations
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PERIOD COVERED: July 1, 2007 to June 30, 2008

POPULATION CHARACTERISTICS AND HABITAT USE OF EXPLOITED FOREST GROUSE POPULATIONS

Abstract

Forest grouse (dusky grouse [*Dendragapus obscurus*], ruffed grouse [*Bonasa umbellus*], and spruce grouse [*Falcipennis canadensis*]) are popular among game bird hunters in Idaho. To properly manage these gamebirds, reliable survey techniques need to be developed, tested, and implemented. Currently, no standardized routes are monitored before the hunting season to track population trends or predict available harvest. Harvest rates, distribution, and effects on populations is unknown for forest grouse in Idaho. This study plan proposes two phases of research over six years (2009-2014). The first three years (Phase I) determines the relationship between two survey techniques and monitors harvest. The last three years (Phase II) implements the refined survey techniques statewide.

Recommendations

1. Conduct field research.
2. Provide completion report.
3. Publish results in a peer-reviewed journal.

Need

Forest grouse (dusky grouse, ruffed grouse, and spruce grouse) are among the most popular game birds in Idaho, annually averaging 148,000 harvested birds (1990-2006) and averaging 23% of the upland game bird harvest, second highest of all species (IDFG 2007). Unfortunately, abundance (density), population trends, and harvest rates (portion of population being harvested) are largely unknown. Forest grouse are also dependent on habitat often affected by land management decisions (e.g., riparian zones, mixed shrub uplands, and older growth timber). To properly manage these game birds and assess responses to habitat change and harvest by hunters, reliable survey techniques need to be developed and tested. In Idaho, no standardized routes are monitored before the hunting season to track population trends or forecast harvest. Forest grouse populations in close proximity to urban areas or other landscape features (e.g., roads) may have higher harvest rates than more remote populations. Also, forest management is changing to increase health of stands and prescriptions to reduce threats of wildfire, both of which may impact forest grouse.

Objectives

Develop forest grouse survey techniques, assess population status and trends among different habitats, and monitor forest grouse harvest rates.

Expected Results

Developing survey techniques for dusky, ruffed, and spruce grouse will provide population managers with accurate tools for monitoring abundance and tracking population trends. Monitoring harvest will allow for proper management of hunting to minimize impacts and sustain or increase population levels. Describing landscape-scale habitat use coupled with density estimates will assist land managers to develop forest health prescriptions that benefit forest grouse.

Approach

Survey Techniques

This project will develop forest grouse survey techniques by calibrating inexpensive indices with more expensive and extensive population estimates for territorial males and brood-rearing females. Devers et al. (2007) identified the need for development of standardized, annual indices for ruffed grouse population size. The same can be said for dusky and spruce grouse.

Territorial males. Forest grouse survey techniques to estimate abundance and trend by state game management agencies are typically done during the spring breeding season along roadside counts and mostly for drumming male ruffed grouse (Hungerford 1953, Petraborg et al. 1953, Dorney et al. 1958). Roadside counts and indices in general are less time consuming and less expensive than determining absolute densities (Bull 1981). Total counts of grouse using intensive flush searches have been used for research (Zwickel and Bendell 2004) but are not logistically and economically feasible as a management tool or for research if large, multiple areas are studied. Major and Olson (1980) recommended population studies be conducted on at least 1,000 ha study areas in every county in Indiana to monitor ruffed grouse populations. Densities of male ruffed grouse have been estimated from roadside counts by assuming all drumming cues are heard within 200 m from the road (Gullion 1966, Zimmerman and Gutiérrez 2007). Disadvantages of breeding season roadside counts are: 1) observers may not have similar hearing abilities so density estimates may be biased (Cyr 1981, Ramsey and Scott 1981), 2) non-displaying males and females are not counted, 3) remote areas without adequate roads are not sampled, and 4) detection probabilities to estimate density have not been determined to confidently accept assumptions about roadside counts.

Anderson (2001) argued roadside surveys or "convenience sampling" are not representative of wildlife populations and should not be used alone for making management decisions. One approach to alleviate this bias is to calibrate roadside surveys with more intensive and random methods throughout the habitat. Eberhardt and Simmons (1987) and Thompson et al. (1998) described a double sampling approach to calibrate inexpensive indices with expensive census methods. Thompson et al. (1998) state the functional relationship between the index and population density needs to be determined in order for the index to have any value. Rotella and Ratti (1986) correlated call counts (roadside surveys) and density estimates (flushing line transects) of gray partridge (*Perdix perdix*) but this correlation has not been examined for forest grouse.

Line transects (flushing strips) have been used to estimate grouse abundance (Frank 1946, Hayne 1949, Gates et al. 1968), but not for surveying displaying males. The widely accepted line transect method (Burnham et al. 1980, Buckland et al. 2001) does not assume all animals are detected, as other methods do, but does require all animals on the line be detected. Perpendicular distances of the observed animal to the transect line are used to estimate density (Burnham and Anderson 1984). Since displaying male forest grouse are not easily seen but are heard, auditory cues are detectable (Moore 1955) similar to the variable circular plot method (Reynolds et al. 1980) on points along a transect. These points are spaced to avoid detecting the same bird twice. Buckland et al. (2001) calls this combination of line transect and variable circular plot "point transect sampling." Manuwal and Huff (1987) called it "point count method" and estimated relative abundance of forest birds, including blue and ruffed grouse, but did not determine density. Variable circular plot requires ocular and/or auditory estimation of distance to the displaying bird, which can introduce error (Scott et al. 1981) especially for auditory cues from birds facing away from the observer (Alldredge et al. 2007).

To overcome this bias in distance estimation, we propose determining distance by plotting intersecting vectors towards auditory cues of displaying males from multiple points along a line transect and plotting the distance from the line transect to the perceived location of the displaying bird. This combination of techniques, which we call "point intersection transect", to our knowledge, has not been documented in peer-reviewed literature. Graham and Hunt (1958) used the "intersection method" (Graham 1940) to survey drumming ruffed grouse within a 40 ha area but not along point transects. Zimmerman and Gutiérrez (2007) used auditory triangulation to find drumming ruffed grouse but did not estimate density with line transects. During our pilot project in 2007, we detected auditory cues of male dusky and ruffed grouse along 1,000 m line transects, and measured the angle to the displaying birds in 2008, but did not test the accuracy of the directions (Archibald 1974) or plot the perpendicular distance to the transect to determine density. Graham (1940) did not compare actual drumming locations to intersections from the different observation points but did comment that accuracy decreases as distance between the bird and the observer increases.

A detection function (Buckland et al 2001) can be determined for each observer so a more accurate assessment of density can be obtained rather than assuming a 200-400 m detectability radius and assuming equal abilities among observers. Actual locations of displaying males will be determined to assess accuracy of directions from observation points and accuracy of distances to the line transect. Abilities of observers cannot be standardized but can be quantified if wildlife being counted can be mapped (Magnusson et al. 1978). Radio-marked males will be used to determine detectability of displays by observers with covariates of vegetation, topography, and atmospheric conditions.

The hypothetical example (Figure 1) of using the proposed point intersection transect method is based on field observations made during the pilot project (Connelly and Musil 2007, unpublished 2008 field season). In the example, Directions 2, 6, and 8 are considered very strong detections and are in line with the actual location of the displaying male. Directions 1, 3, and 5, are considered strong but slightly inaccurate. Directions 4, 7 (faint) and 9, 10 (very faint) are inaccurate and therefore would not be used to estimate distance from the transect line. The observation at point "h" did not detect the displaying male next to it because the observer likely disrupted the security of the male and he stopped displaying. After the observer moved to observation point "i", the male resumed displaying and was detected by Direction 6. If the displaying bird is on the line or close enough to flush from the site, the observer will likely see the display stage denoted by fresh droppings and be able to manually measure the distance to the transect.

Spruce grouse males are more difficult to survey because they display less often than dusky and ruffed grouse (pers. comm. Dr. Michael Schroeder, Washington Department of Fish & Wildlife). Detection and attraction of dusky (Stirling and Bendell 1966, Martinka 1972) and spruce grouse males (Schroeder and Boag 1989) has been increased with playback recordings of female calls. March and Church (1980) used playback calls of male gray partridge to elicit responses along roadside surveys. No references can be found, though, for combining line transects and playback techniques. Falls (1981) stated playback was useful to calibrate more rapid census techniques that miss detecting territorial birds. We propose testing playback with forest grouse to determine if accuracy of density estimates can be increased.

Brood-rearing females. Most studies of forest grouse have assumed an equal male to female sex ratio in the spring but no studies have confirmed this assumption. Differences in sex ratios in the fall harvest have been attributed to lack of females in the population due to increased predation of nesting and brood-rearing hens rather than selectivity for males by hunters (Rusch and Keith 1971, Davis and Stoll 1973).

It is difficult to determine the female proportion of the population except during the brood-rearing period. Attraction of secretive females with broods have been accomplished with playback recordings of chick distress calls for dusky (Stirling and Bendell 1966), ruffed (Healy et al. 1980), and spruce grouse (Ellison 1974) and has been used for capturing and marking but not for survey sampling. We propose using playback recordings to attract brood-rearing females to estimate abundance. Density estimates will be inaccurate if the distance from where females begin their approach to the recording cannot be determined because of their secretive nature and visual obstruction by dense vegetation. Females may be detected by hearing their vocal response to the chick distress call and may not approach the recording (pers. comm. Dr. David Delahanty, Idaho State University). Therefore, without an accurate estimate of the detection distance, surveying females with broods may likely be a relative abundance rather than an absolute density estimate. Healy et al. (1980) found ruffed grouse hens were receptive to play-back calls through August. We conducted several trials in 2008 and found similar results but did not estimate distance of first contact with the brood-rearing hen. If hens do not approach but do vocalize, acoustic triangulations similar to those described above for male displays could be used to estimate density.

Habitat Use

Extensive micro-habitat studies have historically been conducted, especially for ruffed grouse in Eastern USA with limited amount in the West, but is beyond the scope of this project. However, relating density of all three forest grouse species to landscape-scale cover types influenced by forest management practices is important for understanding abundance in Idaho and will be investigated.

Radii contours at 200 and 400 m (Figure 1) from the point intersection transects and roadside routes will be used for sampling habitat cover from GIS landscape layers provided by the U.S. Forest Service. Resource selection functions (Manly et al. 2002) will be estimated from home ranges and point intersection transects to predict species occurrence and fitness similar to Aldridge and Boyce (2007). Road density, age of forest stand, tree composition, and forest management strategies will be incorporated into the resource selection functions to determine their effects on abundance, productivity, and vulnerability to harvest.

Landscape parameters will also be quantified to model effects of topography and floral density on detection of displaying males and brood-rearing females along point intersection transects. Covariates for detection functions will be measured to determine which parameters most influence the observer's accuracy of hearing displaying males or seeing brood-rearing hens from the transect points.

Harvest

The statewide forest grouse hunting season structure has remained constant in Idaho since 1990 with a 122 day season (1 Sep – 31 Dec) and a four-bird bag and eight-bird possession limit in the aggregate. From 1990 to 2006, the annual harvest has averaged 148,000 $\pm$ 34,000 (mean $\pm$ 95% CI, IDFG 2007) birds in the aggregate and 14 $\pm$ 3% of all hunters pursue forest grouse, for about 34,000 $\pm$ 8,000 hunters annually (pers. comm. B. Ackerman – IDFG). The 2006 telephone survey separated the harvest among forest grouse species for the first time in the Department's history and estimated 37,000 forest grouse hunters, of which, 47% harvested ruffed grouse, 37% dusky, 11% spruce, and 6% did not know which forest grouse they had harvested (pers. comm. D. Kemner - IDFG). From the 2006 telephone survey, ruffed grouse composed 61% (n = 79,500) of the statewide forest grouse harvest, dusky 28% (n = 36,900), spruce 8% (n = 9,900), and unknown 3% (n = 3,500). Most (64%) of the ruffed grouse harvest occurs in the northern regions (Region 1 Panhandle = 38%, Region 2 Clearwater = 26%) and most (72%) of the dusky grouse harvest occurs in the northern and western regions (Region 3 Southwest = 33%, Panhandle = 21%, and Clearwater = 18%). The majority (52%) of spruce grouse are also harvested in the Southwest Region.

Throughout the North American range of forest grouse, Alaska currently has the most liberal hunting seasons (1 Aug – 15 May, five bag/10 possession in one hunting zone, 10 Aug – 31 Mar, 15 bag/30 possession in most of the other zones). In addition to the regular hunts, California has an archery only season (19 Aug – 8 Sep) as does British Columbia (25-31 Aug). Connecticut, Massachusetts, New Jersey, South Carolina, West Virginia, and Nova Scotia do not allow hunting on Sundays. Connecticut, Massachusetts, and North Carolina have season limits of 8, 15, and 30 birds, respectively, in addition to daily bag and possession limits.

There is a dichotomy of season start dates for forest grouse hunting in the lower 48 States. Eastern states (east of Mississippi River) start seasons later than 15 September whereas western states start earlier than 15 September as reported in each state's 2007 upland game hunting regulations. No research has been published that determines the effects of early hunting seasons on forest grouse. Palmer and Bennett (1963) suggested breeding populations will not be adversely affected if fall harvest is <50% of the fall population. They also found 75% of the harvest occurs during the first 15 days of the season and 95% for the first 30 days. They concluded extending the hunting season later would not increase the harvest but did not comment on effects of beginning the season earlier. Their hunting season presumably started in October since pre-hunting censuses were conducted in late September. Devers et al. (2007), in an extensive study on ruffed grouse in Eastern USA, determined that hunting was compensatory at a harvest of <20% of the population but did not compare hunting season start dates. Bump et al. (1947) determined 17% of the population could be harvested without affecting numbers "…in well-stocked coverts." but did not discuss if it was prudent to start the season before 1 October. Kubisiak (1984) suggested heavy early season hunting may be a major factor depressing grouse populations but did not separate harvest impacts between sexes or ages and did not study harvest seasons starting before 15 September.

No other upland game bird in Idaho, other than mourning doves (*Zenaida macroura*), have hunting seasons as early as forest grouse. If early September harvest is affecting populations, it is likely impacting females with broods. Brood break-up for ruffed grouse has been documented to occur during early to mid-September in eastern states (Godfrey and Marshall 1969, Rusch and Keith 1971) but has not been studied in the West. Dusky grouse brood break-up occurs over a longer period and as early as late July (Zwickel and Bendell 2004). Juvenile dusky grouse that "wander" (Zwickel et al. 1968) after brood break-up searching for suitable winter habitat are more susceptible to mortality than those that settle into adequate habitat and flocks. Zwickel (1982) found adult female dusky grouse were more susceptible to harvest because they remained on breeding areas longer than migrating adult males and unsuccessful yearling females. He also recommended long-term studies are needed to determine if higher proportions of females in the harvest affects population productivity and breeding densities.

Over-harvest of hens with broods could be occurring, especially in areas with dense roads. Dorney (1963) theorized areas with easy access near major metropolitan centers had low ruffed grouse populations due to high vulnerability to hunting. Hunters tend to harvest most of their ruffed grouse within 200 m of roads (Fischer and Keith 1974). Ellison (1974) found 13% of the spruce grouse banded within 3.2 km of roads were harvested at a rate of 30 birds/km. In road dense areas, this could be contributing to over-harvest of vulnerable hens with broods that have not dispersed, thus ultimately affecting population levels. DeStefano and Rusch (1986) found an even distribution of harvested ruffed grouse by age and sex but attributed this to a high density of hunters distributed evenly across the landscape. Their hunting season started 1 October, possibly after brood break-up.

In Idaho, because forest grouse harvest has not been separated by species prior to 2006, no long-term species trends can be generated. Overall, forest grouse harvest has fluctuated since 1990 from an estimated high of 292,800 in 1996, and a low of 43,900 in 1997, with no noticeable decline in trend during the last 16 years (Figure 2).

Without an estimate of harvest by gender and age, it is difficult to assess the impact of the current hunting season structure. There is no available research that documents at what level hen and brood harvest is compensatory and at what point it becomes additive. Determining date of brood break-up, harvest rates of hens with broods, as well as harvest of males is an imperative first step before experiments can be conducted with season start dates.

Idaho currently does not survey forest grouse population levels prior to hunting seasons to predict harvest as is done for other upland game bird species. Spring drumming counts for ruffed grouse have been correlated with fall harvest (Stoll 1980, Kubisiak 1984). Major and Olson (1980) recommend tracking spring and summer weather and counting broods to predict fall grouse densities and hunter success.

Miyasaki (2001) monitored dusky grouse harvest in Idaho using wing barrels, radio-marked birds, and check station data and found telemetry and check station data showed the same juvenile to hen ratio, but wing barrel data was different and more variable. The difference was likely due to wing barrel collection occurring after opening weekend and throughout the season. Compliance by hunters for the voluntary deposit of wings into barrels was not determined and may attribute to the variability. Miyasaki (2001) observed juvenile groups of 10-20 dusky grouse in late August and speculated they were more susceptible to harvest than adults and yearlings which had migrated. If juveniles are more susceptible to harvest because they remain in areas with hunter access, then harvest data may not be representative of the population's productivity. Also, if methods for determining harvest are concentrated during specific times, biased results may occur. We propose to conduct mandatory hunter check stations throughout the hunting season to more thoroughly monitor harvest. Check stations after opening weekend would be stratified among weekends, weekdays, and opening weekends of big game seasons.

Study Areas

A pilot project was conducted in the Squaw Creek drainage of Game Management Unit 32A (Southwest Region) during 2007-2008 and was determined to have few dusky and no spruce grouse and therefore not adequate for testing survey techniques for grouse other than ruffed grouse. Andrus Wildlife Management Area (AWMA) in Southwest Region has both dusky and ruffed grouse. It has an adequate road system for comparing roadside surveys with random transects, has sufficient access control to allow two check stations to survey complete hunter use of the area, and was used in Miyasaki's (2001) research. An adequate spruce grouse study area will be determined for the 2010 field season within the Southwest Region. Survey areas for each forest grouse species within the other six IDFG regions will be determined after survey techniques are calibrated and regional population managers consulted.

Duration of Work

This study will be conducted in two phases (Table 1). Phase I (2009-2011) is the calibration of survey sampling techniques (roadside routes and random transects) and monitoring harvest in the Southwest Region where all three forest grouse species exist. Another telemetry and survey sampling season (2009) is needed in GMU 32A to establish a population trend line and to satisfy the public's interest in the Squaw Creek drainage population. During 2010-2011, only survey sampling will occur in GMU 32A, discontinuing capture/marking. Phase I research at AWMA will be conducted on dusky and ruffed grouse. A study area will be determined in 2009 for spruce grouse Phase I research during 2010-2011.

Phase II research (Table 1) involves implementation of roadside survey routes in each IDFG region during 2012-2014, but will not include capture/marking of grouse or check stations. Roadside routes will be chosen to represent the majority of the habitat available and to be used for long-term routes. Roadside surveys will be continued in Phase I study areas after 2011 to obtain long-term data sets for monitoring grouse trends in Southwest Region.

Budget Estimates

The breadth of this study is dependant upon available funds. Currently, a majority of the upland game bird research budget has been directed towards greater sage-grouse (*Centrocercus urophasianus*). Therefore, procurement of outside funding will be imperative to conduct this project as proposed. An annual estimate of funds is provided in Table 2.

During Phase I, six technicians are required to establish and conduct survey transects/routes, trap grouse, and conduct telemetry on two study areas, annually. Only two technicians are needed to operate check stations and conduct telemetry during hunting season. An initial purchase of 80 radio transmitters will occur in 2009. Less funding is needed in 2010 because only replacement radios will be purchased. More radios will be purchased in 2011 to replace those reaching the limit of battery life, thereby increasing the annual cost of the project that year. Four pick-ups and two ATVs will be used for transportation. Equipment and supplies includes camp groceries and supplies for technicians living in the field, aerial telemetry flights for finding missing radio-marked grouse, and telemetry equipment.

During Phase II, only two technicians are required to establish and conduct roadside surveys during four months in the spring. One technician will work study areas in northern (Panhandle and Clearwater regions) and another for northeastern Idaho (Upper Snake and Salmon regions). Roadside surveys in southern Idaho (Southwest, Magic Valley, Southeast regions) will be conducted by permanent research employees.

JOB 1. FOREST GROUSE SURVEY TECHNIQUES

Objectives

Develop survey techniques for each of the three forest grouse species and calibrate roadside indices with density estimates obtained from line transects. This project will also compare abundance of forest grouse among different landscapes throughout Idaho.

Null Hypotheses

There is no difference in results of survey techniques among different study areas/habitats/land management practices.

There is no difference in detection of forest grouse among observers, landscape features, and meteorological conditions.

Procedures

Roadside Indices

Roadside surveys for displaying male forest grouse will be conducted 1 April – 15 June depending on access conditions. Routes will be at least 5 km long, started ½ hour before sunrise and ending <2 hours after sunrise. Routes may include trails when roads are not extensive enough or available. Observation points will be at 800 m intervals and observed for five minutes/stop. Stops will be spaced to avoid overlap of observations if roads/trails switch-back due to topography. Routes will not be run when wind is >15 km/hr or precipitation is heavy. Routes will be repeated at least two times by each observer and spaced $\geq$1 week apart by the same observer. Routes will be run by the second observer within three days of being run by the previous observer. Routes will be run in opposite directions for each successive run by the same observer but in the same direction between observers for each replication.

Parameters recorded for roadside survey routes will include:

- Observer
- Date
- Roadside route/point
- Replicate number
- Type of road (primary, secondary, off-road vehicle access, bicycle, or foot trail)
- Direction of route being run (e.g., low elevation to high)
- Temperature (^{o}C) change from beginning to end of run
- Barometric pressure change during last 12 hours (mb)
- Relative humidity (%) beginning and end of route
- Direction (azimuth) to display
- Display strength (very faint, faint, strong, and very strong)
- Time (minutes) since sunrise for each stop

- Maximum/average decibels (db) of background noise at each stop
- Background noise (e.g., stream, songbirds, wind)
- Number of displays by individual species and territories
- Moon phase (% illumination)
- % cloud cover
- % snow cover

Point Intersection Transect Surveys

Random start points will be generated within the study areas using ArcGIS (ESRI, Redlands, CA) and spaced 400 m apart. Transects will be added to reach ≥40 detections/species (Burnham et al. 1980) but preferably 60-80 detections (Buckland et al. 2001). We found >12 transects were needed in our pilot project area to meet 40 detections of ruffed grouse. Random directions (azimuth) for each transect will be generated and spaced >400 m from the nearest transect. Transects will be 1,000 m in length and marked with surveyor flagging at each observation point spaced 100 m apart for 11 points along the transect (Figure 1). Each transect will be run at least four times (twice by each observer) from ½ hour before sunrise to two hours after sunrise. Transects will be conducted with the same weather protocol as for roadside surveys.

Program DISTANCE (Buckland et al. 2001) will be used to analyze the transect data and post-stratification will be conducted to determine density among riparian, shrub-steppe, coniferous forest, deciduous forest, mixed, and alpine cover types obtained from U.S. Forest Service databases. Truncation of the furthest 10-15% of the data will depend on the spread of the distance data (Bibby et al. 2000). Buckland et al. (2001) stress the need for a pilot survey to estimate point transect length to obtain a predetermined level of precision. From data obtained during the pilot study during 2007-2008, we determined 1,000 m transects were manageable distances for completion within two hours of sunrise.

Transects will be run for displaying males (1 Apr – 15 Jun) and brood-rearing females (1 Jun – 15 Jul). Female play-back recordings will be used for dusky and spruce grouse male sampling and chick distress calls for all female species. We will use the protocol similar to Schroeder and Boag (1989) to detect male dusky and spruce grouse by first listening for male displays for one minute, then alternating 1.5 minutes of playing the female recording for a total of five minutes at each point. For attracting brood-rearing females, Healy et al. (1980) recommended playing chick calls for 4-5 minutes then listening. We propose playing the chick distress recording for 30 seconds, listening and watching for 30 seconds, and repeating the sequence for five minutes at each observation point, similar to March and Church (1980). We currently have female calls for spruce and dusky grouse but only chick distress calls for ruffed grouse. These will be obtained or recorded personally.

The detection distance for brood-rearing females will be estimated by using radio-marked females. Females will be captured with noose-poles (Zwickel and Bendell 1967, Schroeder 1986) when they are attracted to chick distress playbacks. Females may become "trap shy" and not respond to subsequent chick distress playbacks thus biasing repeated surveys along the same transect. If noose-poling is not effective, walk-in traps similar to Backs et al. (1985) will be used near creek bottoms and springs where hens with broods are accessing water and forage.

Radio-marked females will be located via triangulations prior to playback to determine distance traveled and velocity toward the recording and/or detection of vocal response. These samples will provide a basis for modeling the area being surveyed for comparison with Healy et al. (1980) that estimated an effective sampling distance of 65-150 m. We theorize females with broods early in the season, i.e., first two weeks after hatch (pers. comm. Rich Hoffman, Colorado Division of Wildlife, retired), close (<100 m), and in open understory are more likely to be detected than hens further away, later in the season, and in more dense cover. Care will be taken to avoid attracting predators thereby jeopardizing grouse we are surveying or attempting to capture.

The parameters recorded for point intersection transects will include:

- Observer
- Date
- Transect
- Replicate number
- Temperature (^{o}C) change from beginning to end of run
- Change in barometric pressure during last 12 hours (mb)
- Time (minutes) since sunrise for observation
- Direction (azimuth) to display
- Display strength (very faint, faint, strong, very strong)
- Location of displaying grouse (UTM coordinates)
- Distance (m) from plotted intersections to transect
- Distance (m) from displaying grouse to transect
- Direction Error (Deg) of audio direction from observer to true location of grouse
- Distance Error (m) between estimated location and grouse location to transect
- Distance of grouse to nearest road/trail, edge of cover type, and open water
- GPS estimated location error
- Moon phase
- % cloud cover

The following covariates will be recorded to analyze their influences on detection of displaying males or brood-rearing females:

- Hearing ability of observer (min/max frequency range)
- Maximum/average decibels (db) of background noise at each stop
- Background noise (e.g., stream, songbirds, wind)
- Playback recording of female elicited response
- Elevation change (m) from grouse to observation point (+ if grouse is downhill, - if uphill)
- Topographic obstruction (0 = clear line of site, 1 = obstruction by hill/ridge)

- Distance (m) from observer to grouse
- Tree density (#/ha) by diameter breast height (1 = <9 cm, 2 = >9 cm dbh) for deciduous vs. coniferous trees between grouse and observer along a 2 m wide strip transect
- Tree height (m) by category (1 = ≤2 m, 2 = >2 m)
- Shrub density (#/ha) by species between grouse and observer (1 = <9 cm, 2 = >9 cm dbh) along 2 m wide strip transect
- Shrub height (m) by category (1 = <2 m, 2 = 2-3 m, 3 = >3 m) between grouse and observer within 2 m wide strip transect
- Foliar growth (0 = no leaves, 1 = 50% leaf growth, 2 = 100% leaf growth) by tree and shrub height category
- Snow cover (0 = no snow, 1 = <25% ground covered, 2 = 25-50%, 3 = 50-75%, 4 = >75%)
- Slope (Deg) from grouse location and observation point
- Aspect (Azimuth) grouse location and observation point
- % of annual precipitation occurring during breeding season
- Previous winter severity index (snow depth, temperature extremes)

The following landscape parameters will be recorded within contours of 200 and 400 m around each point intersection transect (Figure 1) and roadside survey point:

- Route (roadside or transect)
- Location point along route or transect
- Number of individual grouse detected (# within each contour for point intersection transect)
- Linear distance of roads
- Stand age (years)
- % composition of dominant overstory and understory species
- % cover type (e.g., riparian, shrub-steppe, coniferous, deciduous, mixed, alpine)
- Time (years) since last silviculture action (e.g., clear-cut, thinning, prescribed burn) or natural occurrence (e.g., wildfire, avalanche)

JOB 2. FOREST GROUSE HARVEST

Objectives

Determine forest grouse harvest rates and factors affecting fall harvest for each species in Idaho. Determine forest grouse harvest distribution throughout the hunting season.

Null Hypotheses

There is no difference in harvest rates among sexes or age classes or among different intervals during the hunting season.

Procedures

Capture and Marking

As part of the survey technique study (Job 1), males and females detected along transects will be captured, banded, and radio-marked. A modified mirror trap (Bendell and Fowle 1950, Gullion 1965) for ruffed grouse was developed and tested during our pilot study in 2007 (Connelly and Musil 2007) and 2008. All 12 ruffed grouse males continued to display after being banded and radio-collared, so this activity will not likely disrupt subsequent transect surveys, at least for ruffed grouse. Schroeder (1986) modified a noose pole developed by Zwickel and Bendell (1968) for capturing multiple forest grouse species and we will use it for capturing dusky and spruce grouse males as well as all female grouse. If noose poling, in combination with chick distress calls is not effective for capturing females, walk-in traps similar to Backs et al. (1985) will be used near creek bottoms and springs in late summer. Necklace style (Riley and Fistler 1992) radio transmitters ≤2% of grouse body mass (Kenward 1987) will be used and programmed with four-hour mortality sensors (Advanced Telemetry Systems, Isanti, MN 55040). At least 20 male and 20 female grouse of each species will be radio-marked. Standard sex and age techniques summarized by Dimmick and Pelton (1994) will be used for grouse identification.

Radio-marked grouse will be located at least twice per week after capture and during the hunting season and at least one location/month during winter. Tracking will be ground based by either circling the radio-marked bird without flushing or triangulation from points <50 m from the bird. Locations will be evenly distributed diurnally among three periods: sunrise to two hours after sunrise, >2 hours after sunrise to >2 hours before sunset, and <2 hours before sunset. Landscape-scale habitat selection will be determined similar to Whitaker et al. (2006) and Aldridge and Boyce (2007). Digital habitat maps will be developed for each study area using data from the U.S. Forest Service.

Hunter Surveys

Mandatory check stations will be conducted on all major roads accessing the study areas throughout the hunting season. Opening weekend will be surveyed while subsequent weekends and weekdays will be randomly stratified. Opening days and weekends of big game seasons will also be targeted for check stations. Check stations will be operated from sunrise to sunset. Coordination with regional check stations will be necessary to reduce disturbance of hunters.

The following parameters will be recorded at check stations for each hunter:

- Date of harvest
- Hours hunted for each species
- # harvested by species, age, and sex
- # of marked birds harvested
- # grouse seen
- # of hunters in group hunting together for grouse

- Type of pursuit hunting – dog, roadside, atv (type), foot
- Purpose of hunt – primarily for grouse vs. primarily for other game (list other game)
- Weapon used – pistol, rifle, shotgun, bow/arrow, other projectile

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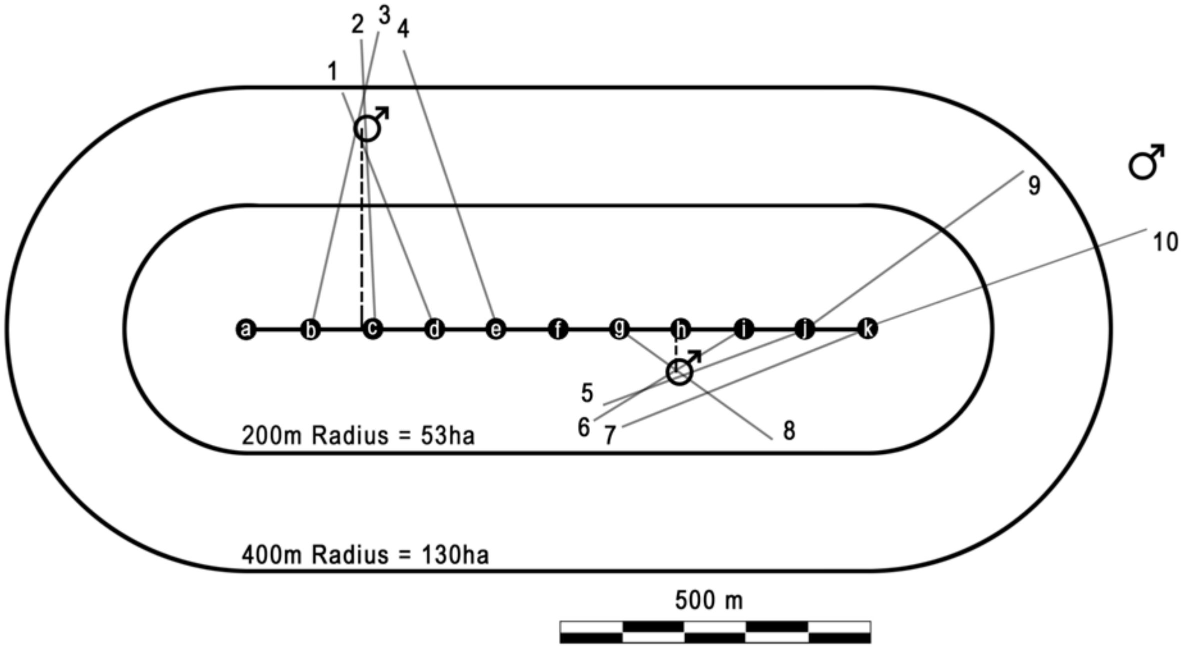

Figure 1. Hypothetical detection of three displaying forest grouse males and 10 scenarios of directions to the auditory cues from 11 observation points (a – k) spaced at 100 m intervals along a 1,000 m transect. Perpendicular distance (dashed lines) from transect to center of triangulation error polygon is used to estimate density in program DISTANCE. Concentric contour lines at 200 and 400 m used to sample variables at landscape scale.

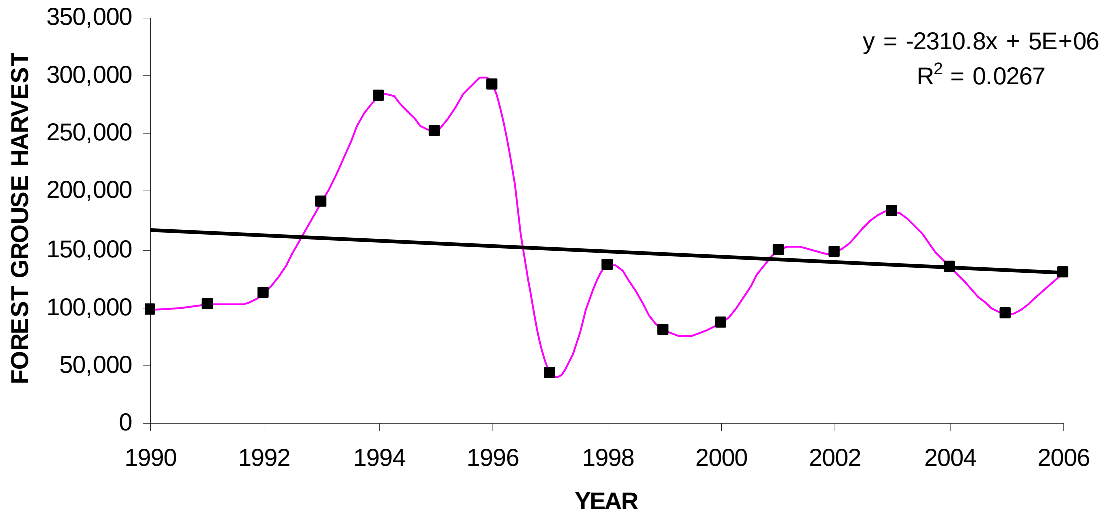

Figure 2. Harvest trend of forest grouse in Idaho (IDFG 2007).

Table 1. Annual time table by study areas for proposed forest grouse research project, Idaho.

	Phase I[a]			Phase II		
Study Areas by Region	2009	2010	2011	2012	2013	2014
GMU 32A[b]	X	*	*	X	X	X
Andrus WMA[b]	X	X	X	X	X	X
Spruce Grouse TBA[b]		X	X	X	X	X
Panhandle				X	X	X
Clearwater				X	X	X
Magic Valley				X	X	X
Southeast				X	X	X
Upper Snake				X	X	X
Salmon				X	X	X

[a] X denotes research conducted, * denotes research limited to roadside surveys and random transects, no telemetry.

[b] Study areas within Southwest Region. Spruce grouse study area to be arranged.

Table 2. Cost estimates by year for proposed forest grouse research project, Idaho.

	Phase I			Phase II		
Item	2009	2010	2011	2012	2013	2014
Labor	89,000	89,000	89,000	28,100	28,100	28,100
Vehicles	17,100	17,100	17,100	9,700	9,700	9,700
Equipment/supplies	24,900	13,800	23,500	4,000	4,000	4,000
Total	131,000	119,900	129,600	41,800	41,800	41,800

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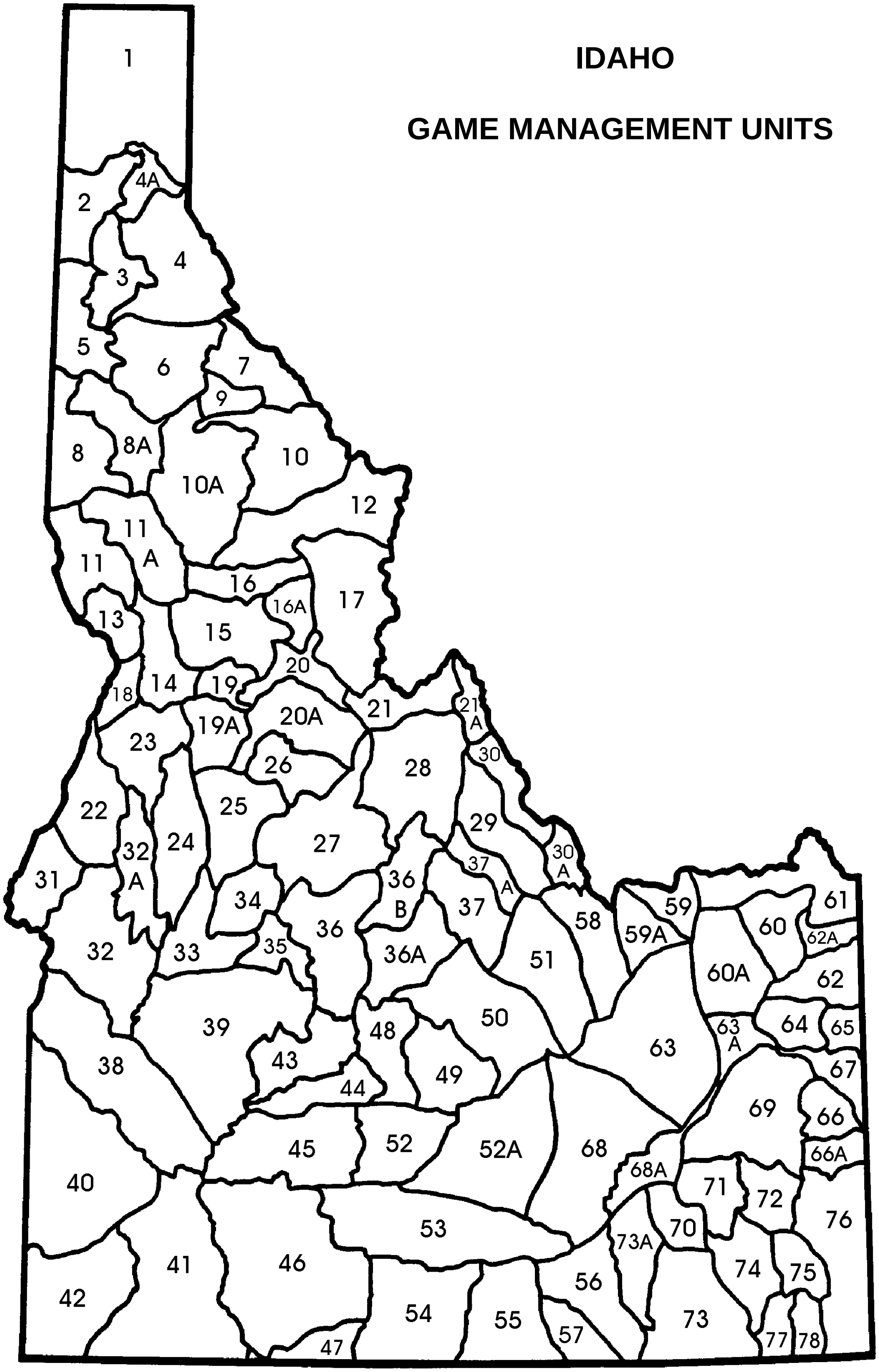
GAME MANAGEMENT UNITS



FEDERAL AID IN WILDLIFE RESTORATION

The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sale of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program then allots the funds back to states through a formula based on each state's geographic area and the number of paid hunting license holders in the state. The Idaho Department of Fish and Game uses the funds to help restore, conserve, manage, and enhance wild birds and mammals for the public benefit. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes necessary to be responsible, ethical hunters. Seventy-five percent of the funds for this project are from Federal Aid. The other 25% comes from license-generated funds.