SHIRAS MOOSE IN IDAHO: STATUS AND MANAGEMENT

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ABSTRACT: Limited data indicate that Shiras moose (*Alces alces shirasi*) occurred in low numbers in Idaho throughout the 19th century. Harvest was allowed in Idaho during 1893-1898, after which seasons were closed. Shiras moose were fully protected in Idaho from 1899-1945. Moose populations increased during the 20th century and harvest seasons resumed in 1946. Harvest has focused on mature males, allowing continued population growth through the end of the 20th century. Rapid population growth during 1980-2000 resulted in moose dispersing westward from the Rocky Mountains and southward from the Panhandle region of Idaho. The management goal for moose in Idaho is to provide opportunities for recreational hunting and harvest of mature male moose. Although some managers assess moose populations directly by aerial survey, most managers rely on indirect measurements (e.g., hunter success rate and antler spread of bulls harvested) to assess the impact of harvest on moose populations. Other population indicators (e.g., dispersal into previously unoccupied areas, damage to private property) have been used as indicators of social tolerance for expanding moose populations. Where moose have approached the limit of social tolerance, attempts to stabilize or reduce populations by harvest of females and translocation of 'problem' moose have been utilized. Both a historic perspective of moose abundance and a revised statewide population estimate are provided.

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Typical moose habitat in Idaho encompasses timbered western slopes of the Rocky Mountains. In Idaho, moose occupy all western slopes of the Rocky Mountains westward to Hells Canyon and isolated mountain ranges south of Salmon, Idaho along the border with Montana and Wyoming southward to Utah.

Moose are managed as a game animal in Idaho. The Idaho Department of Fish and Game (IDFG) holds management authority and has identified moose as a trophy species; a big game animal whose population is sufficient to support only strictly regulated annual harvest. In addition to regulating harvest, IDFG has responsibility to respond to depredation complaints caused by moose (Toweill 1988). Moose occupied slightly more than half (51%) of Idaho, an area of 109,668 km^2 (42,343 mi^2) in 2002. Moose are hunted in all administrative regions of Idaho, and in about two-thirds of Idaho Game Management Units (GMU) (Fig. 1). The recent expansion of moose in Idaho has allowed the IDFG to increase moose hunting opportunity from < 20% of GMUs during 1946-1982 to > 60% of GMUs by 2000 (Fig. 2).

We describe recent range expansion of moose, summarize IDFG harvest data, and provide a revised population estimate for Shiras moose in Idaho.

HISTORIC DISTRIBUTION

The distribution of moose in 2002 was much greater than at any previous time in

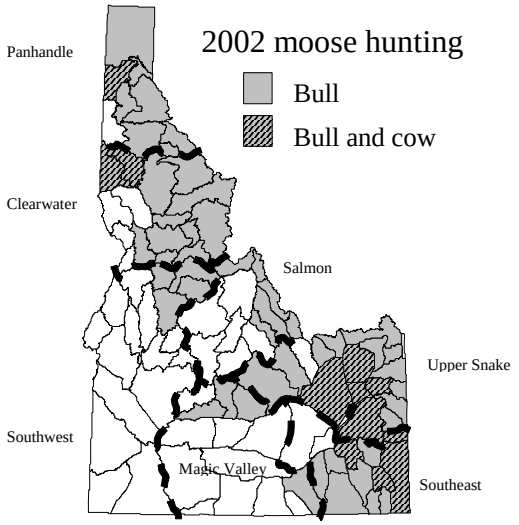

Fig. 1. State of Idaho, Department of Fish and Game administrative regions and Game Management Units showing availability of bull and cow moose permits, 2002.

recorded history. Explorers with Merriwether Lewis and William Clark's Corps of Discovery failed to observe moose, although they were informed by native Americans in 1806 that there were "… plenty of moos (sic) to the S.E. of them on the East branch [Salmon River] of Lewis's [Snake] river …" (Thwaites 1959, vol. 5:99). Journals of the fur trappers and explorers that traveled throughout the western Rocky Mountains between 1806 and 1850 failed to mention the occurrence of moose (Compton and Oldenburg 1994). Houston (1968) concluded that few if any moose occupied the area of Jackson Hole and Yellowstone National Park prior to 1850. Few records of moose in northern Idaho exist prior to 1900.

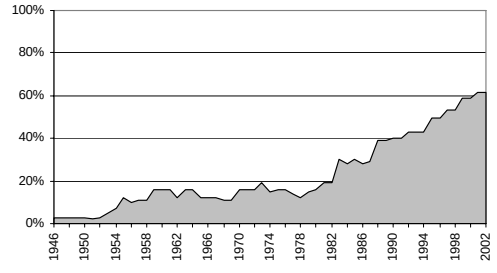

Fig. 2. Percent of Game Management Units with moose permits offered, Idaho 1946-2002.

Moose apparently became established in the area of Yellowstone National Park soon after 1850, and were reported in the Salmon River mountains in 1891 (Merriam 1891). The first hunting season for moose was established in Idaho in 1893, but was closed in 1898 due to concern about dwindling herds. Writing in 1905, Brooks reported that moose occurred in southeastern Idaho in a range bounded by "the eleventh auxillary meridian on the west and the Fall or Cascade Creek on the east" and by "the southern branch of the Warm River on the north and the Big Robinson on the South" (Brooks 1905:201), an area known as Big Black Mountain or Moose Mountain that "barely measures ten miles in diameter" (Brooks 1905:202). He reported that moose had formerly ranged as far south as Jackson Hole and east of the North Fork of the Snake River in Idaho, Wyoming, and Montana, but that the range had become progressively restricted within the previous decade (1895-1905).

Elimination of moose hunting seasons in Idaho beginning in 1899 may have allowed moose populations to grow. Bailey (1935) reported that there were "numbers" of moose in the Chamberlain Basin and Salmon River watershed in 1902. Davis (1939) reported that Idaho moose numbered about 500 in 1910. Citing reports of increasing moose in the upper Snake River Valley in 1935 and an estimate of 528 moose in national forests of northern Idaho in 1925, Davis (1939) estimated that Idaho had 1,000 moose in 1939.

Thirty permits authorizing the harvest of bull moose in Fremont County only were authorized by the Idaho Department of Fish and Game (IDFG) in 1946, and again in 1947. During that period, Fremont County was believed to include the range of more than half the moose in Idaho (Biladeau 1949). An aerial survey of moose in Fremont County in 1949 yielded observations of 536

moose (Biladeau 1949).

Records from states adjacent to Idaho provide additional indication of moose population expansion. Moose from eastern Idaho apparently expanded southward into Utah by 1906 or 1907, although a population was not considered established until 1947 (Durrant 1952, Utah Division of Wildlife Resources 2000). In similar fashion, moose populations expanded westward from the Priest Lake basin by 1954, establishing a population in northeastern Washington (Poelker 1972). Moose likely crossed Hells Canyon and the Snake River from Idaho into the Blue Mountains of Washington (Ingles 1965) and Oregon (Verts and Carraway 1998), although there is no evidence that these movements resulted in establishment of new populations to date. Moose incursions into Oregon have continued with increasing frequency, with 25 records since 1960, 18 of those since 1990 (Vic Coggins, Oregon Department of Fish and Wildlife, file data, November 2002).

MOOSE MANAGEMENT

Moose are managed by IDFG to provide high quality hunting opportunities and associated recreation, while encouraging expansion of moose populations into suitable habitat in Idaho (Leege et al. 1990). Harvest of moose is strictly controlled. Permits are issued randomly to applicants. Successful applicants become ineligible for life following harvest of one moose of either sex.

Allocation of Hunt Permits

Harvest of moose is regulated by controlled hunt permits allocated by random draw. Each permit is restricted to either antlered or antlerless moose (hereafter bull or cow) within a particular hunt area. Every hunter is required to have each harvested moose checked by a representative of IDFG.

Hunter demand for moose permits is high. In 1980, IDFG received 25,524 applications for 140 moose permits (Leege et al. 1990), with the result that only 1 person among 182 applicants obtained a moose hunting permit (at that time, all permitees were limited to harvest of antlered moose). To reduce competition after 1980, applicants were required to submit funds for the purchase of their permit and tag with their application. This requirement reduced the number of applicants by over half (from 25,524 to 11,649) in 1981. Increases in the number of permits offered annually has resulted in a higher likelihood of being drawn for a permit since that time.

Likelihood of drawing a permit for antlered moose was about 10% from 1990-1999, and has been near 20% since 2000 (Fig. 3). The number of applications for antlerless moose permits has expanded rapidly since 1990, when drawing success was similar to that for antlered moose (about 15%). However, the number of antlerless moose permits offered annually has increased even more rapidly, so that by 1999 the number of applicants was less than the number of antlerless permits available. Permits not fully subscribed in the annual drawing have been sold on a 'first-come' basis following the drawing. Permittees unsuccessful in harvesting a moose must wait 2 years before becoming eligible for another moose tag. Regulations are reviewed and permit levels established on alternate, odd-numbered years.

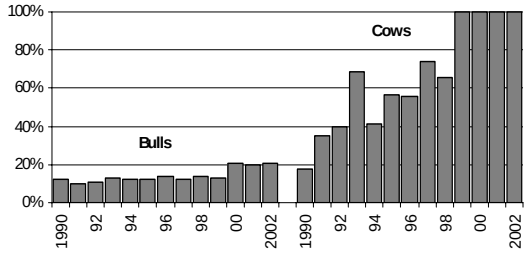

Fig. 3. Percent (%) of first-choice applications for bull and cow moose permits being drawn, Idaho 1990-2002.

Successful moose hunters must have their animal checked by an IDFG representative within 10 days of harvest. Unsuccessful hunters are required to submit their unused moose tag as proof of non-use (failure to do so is presumptive evidence of harvest and exclusion from future draw opportunity).

Most moose hunting in Idaho occurs on public land. A summary of land ownership in areas open to moose hunting (Fig. 4) indicates that 94% of the land area is managed by federal or state government. The vast majority of federal and state land in Idaho is open to hunting.

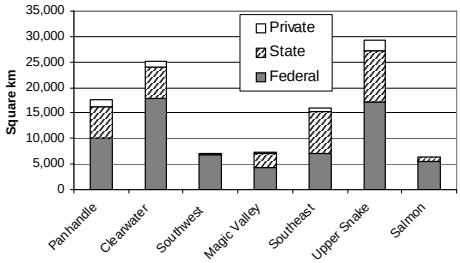

Fig. 4. Area (km^2) open to moose hunting in Idaho by administrative region, and land ownership, 2002.

Controlled Harvest

IDFG moose management philosophy is to allow harvest of antlered moose at levels which allow populations to continue to expand. Therefore, harvest quotas for antlered moose (i.e., moose having at least one antler longer than 15.2 cm or 6 inches) are limited, and adjusted as necessary to achieve a mean maximum antler spread of harvested bull moose $\geq$ 89 cm (35 inches). At this harvest level, the mean age of harvested moose is believed to be approximately 4 years of age (Gasaway et al. 1987).

Harvest of antlerless moose is designed primarily to reduce moose population growth, promote human health and safety where moose occur in suburban settings, and limit moose depredations.

Moose hunting seasons are long. Hunting seasons for bull moose extend 86 days, from August 30 to November 23 annually. Hunting seasons for cow moose typically extend 40 days (October 15-November 23). Long seasons allow successful applicants maximum opportunity for hunting recreation and opportunity to harvest. Opening dates for cow seasons were delayed until October 15 in an effort to reduce losses of orphaned calves by allowing them an additional 10 weeks to mature.

Since 1990, moose hunters have averaged 5.4-8.2 days of hunting before harvesting an antlered (bull) moose, and 2.6-5.2 days before harvesting an antlerless moose (Fig. 5). More days hunting for each bull harvested reflects reduced availability due to lower numbers of bulls versus cows and great selectivity in choosing a bull to harvest for this once-in-a-lifetime trophy. Mean number of days prior to harvest has stayed relatively constant in the last 12 years for both bulls and cows (Fig. 5).

Moose harvest success has ranged from > 60% to > 80% annually (Fig. 6). The most common cause identified by unsuccessful hunters for failure to harvest a moose is lack of participation during the hunting season.

Harvest data are used to monitor the effect of hunting on moose populations. The statewide objective for mean antler

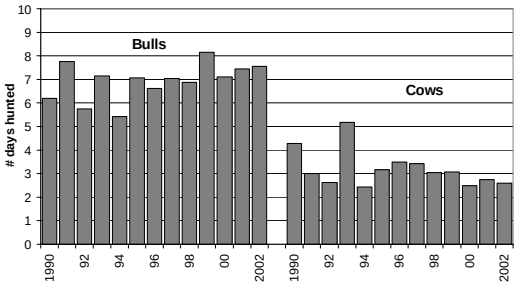

Fig. 5. Mean number of days hunted prior to harvest for bull and cow moose, by year in Idaho, 1990-2002.

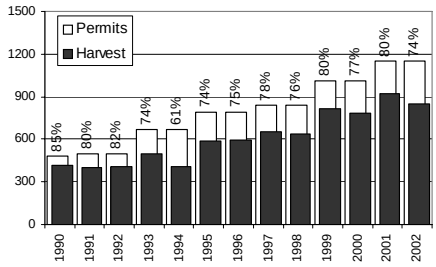

Fig. 6. Moose permits and harvest including all zones and tags statewide, Idaho 1990-2002. Percent harvest success labeled above permits.

spread is $\geq$ 89 cm (35 inches) among all harvested bulls, and has been in place since 1990. Antler spread of harvested moose has been maintained at that level since 1990 (Fig. 7). Maximum antler spread recorded in Idaho has been 152 cm (60 inches), and each year a few moose are harvested that approach this size (Fig. 7).

Annual harvest of antlered moose is generally believed to account for 15% of known bulls, although data are limited. Based on file data from the northeastern portion of GMU 1 (Jim Hayden, personal communication, IDFG), the population of moose was 0.31 moose/km^2 (0.80 moose/mi^2) during February 1993. Bull moose density was 0.093 bull moose/km^2 (0.24 bull moose/mi^2) in this area, and bull moose harvest density was 0.015 bull moose/km^2 (0.04 bull moose/mi^2). This equated to an estimated annual hunting mortality rate of 14% [0.015/(0.015 + 0.093)].

Some areas are more heavily exploited. In GMU 2 near the Washington border, annual harvest was estimated to account for 38% of the bull moose present in 1996, and 33% of the bull moose in 2000. Surveys of GMU 2 conducted in February 1996 resulted in an estimate of 0.104 moose/km^2 (0.27 moose/mi^2) and 0.031 bull moose/km^2 (0.08 bull moose/mi^2). Harvest accounted for 0.019 bull moose/km^2 (0.05 bull moose/mi^2) in 1996, for a harvest rate of 38% [0.019/(0.019 + 0.031)]. Moose populations had increased to 0.193 moose/km^2 (0.50 moose/mi^2) in 2000, with an estimated 0.039 bull moose/km^2 (0.10 bull moose/mi^2). Annual harvest accounted for 0.019 bull moose/km^2 (0.05 bull moose/mi^2), yielding an annual harvest rate of 33% [0.019/(0.019 + 0.039)]. Estimates of comparatively higher annual harvest in GMU 2 were reflected in smaller average antler spread from this GMU, although sample sizes are small (Jim

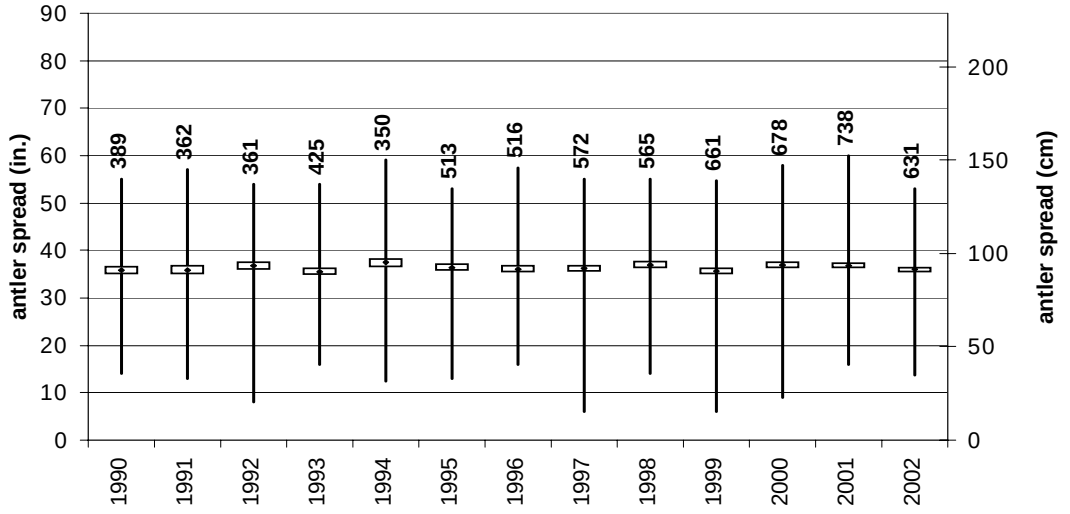

Fig. 7. Mean antler spread and 95% confidence interval for moose in Idaho, 1990-2002. Sample sizes shown above range, height of wide box is 95% CI.

Hayden, personal communication, IDFG).

Moose populations and harvests are greatest in northern Idaho (Panhandle and Clearwater regions) and extreme eastern Idaho (Upper Snake and Southeast Idaho) (Fig. 1). Among all regions, mean antler spread ranges from 89.9 cm (35.4 inches) in the Salmon region to 94.0 cm (37.0 inches) in the Panhandle region (Fig. 8). Mean antler measurements do differ ($P < 0.001$) among regions, with the Panhandle and Upper Snake regions being similar and slightly greater than Clearwater and Southeast regions (Fig. 8).

Among the moose harvested during seasons designated for antlerless harvest, a portion (3-22%) are males (primarily calves). Since 1990, the portion of antlerless harvest consisting of males has averaged 7.6% (Table 1).

Unregulated Harvest and Mortality

This category includes all recorded annual losses of moose to human activity. Major elements of these types of losses include vehicle accidents and illegal hunter harvest. The extent of these losses is difficult to measure, because there is no central repository for this information and reporting is sporadic.

In addition to these causes of mortality, other factors may also impact local moose populations. One of these factors is translocation of moose by IDFG. IDFG has legal responsibility to respond to wildlife depredation concerns (Toweill 1988), and one means of addressing these concerns is translocation of moose within Idaho. Methodology for translocating moose was described by Naderman (1994). Although the number of translocations of moose varies annually depending on severity of winter weather, during the winter of 2001-2002 approximately 104 moose were physically relocated away from Idaho Falls and nearby areas in eastern Idaho.

Among 527 moose deaths recorded in Fremont County between 1969 and 1975 (Ritchie 1978), legal harvest accounted for 217 (41%). The balance of losses was comprised of 165 moose illegally harvested (31%), 32 moose allocated to Indian harvest (6%), and 113 moose deaths attributed to natural causes, accidents, and unknown

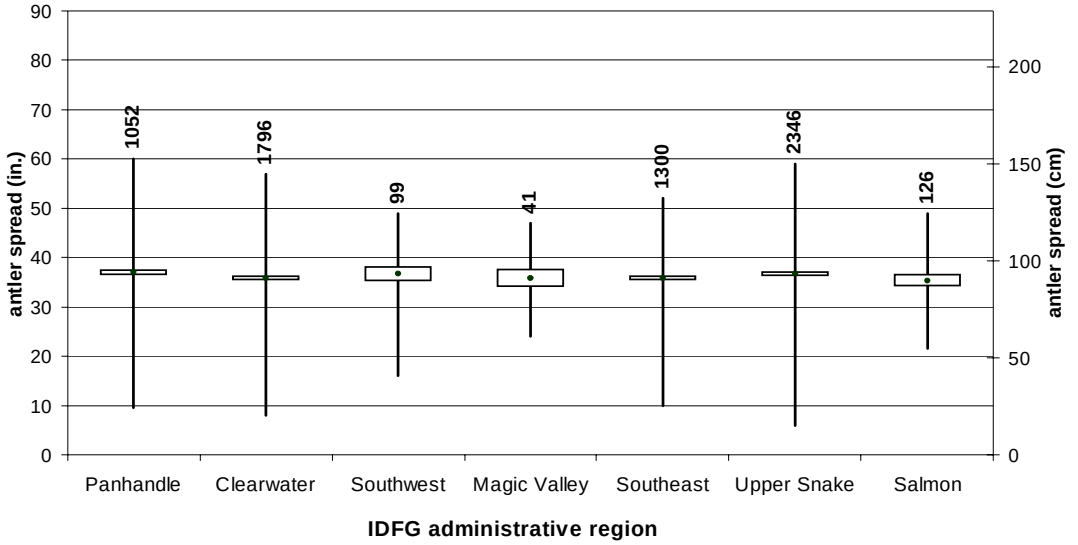

Fig. 8. Mean antler spread and 95% confidence interval for moose in Idaho by administrative region, 1990-2002. Sample sizes are shown above range, height of wide bar is 95% CI.

Table 1. Antlerless moose permits, harvests, and % male calves in the antlerless harvest in Idaho, 1993-2001.

Year	Antlerless Permits	Total Harvest	% Males in harvest (n)
1993	65	54	22.2% (12)
1994	65	40	10.0% (4)
1995	81	63	7.9% (5)
1996	81	63	3.2% (2)
1997	98	73	11.0% (8)
1998	98	66	6.1% (4)
1999	123	109	3.9% (4)
2000	123	87	6.9% (6)
2001	142	93	4.3% (4)
Total	**876**	**648**	**7.6% (49)**

causes (21%).

Research conducted on moose between June 1979 and December 1980 in central Idaho near Elk City (Pierce et al. 1985) documented cause of death for 40 moose. Of these, 10 (25%) were legally harvested. Of the balance, 21 (50%) were illegally killed, 6 (15%) were harvested by tribal members, and 3 (8%) moose deaths were due to accidents and natural causes. Pierce et al. (1985) reported that 7 of 20 moose radio-collared by one of the authors (Kuck, unpublished) near Soda Springs in southeastern Idaho died during 1978-1981. Six of those animals (86%) were illegally harvested. Pierce et al. (1985) concluded that unregulated harvest from all causes was largely unreported and often underestimated.

A review of all recorded mortality other than legal hunting during the period 1990-2002 revealed that mortality due to vehicle (including train) collisions and illegal harvest were the dominant causes of non-hunting related mortality (Table 2). Mortality due to vehicle collisions is significantly underestimated, since there is no comprehensive effort to collect moose-vehicle collision data and mortally injured moose capable of moving away from the scene of an accident under their own power are rarely recorded as mortalities. If located, post-mortem cause of death for these animals is usually categorized as either natural or unknown. Given the relatively high likelihood of vehicle accidents going unreported to IDFG and post-collision mortality of moose struck but able to leave the scene of a collision, it is suspected that reported moose mortality due to vehicle collisions may represent half of actual mortality. While losses of approximately 50 moose/year due to collisions have been reported since 1990, annual losses were estimated to be more than twice that number by local Conservation Officers, and increasing as both moose and roads proliferate.

Illegal harvest is also believed to be significantly under-reported. Illegal harvest and wounding of moose by hunters seeking elk and deer are rarely reported by individuals responsible, most of whom are fearful of receiving a citation. Many of the people who illegally harvest moose do so in locales where the potential for discovery is low (private lands, remote sites, etc.), and such individuals may hide evidence of their activity (Pierce et al. 1985). Although 30-40 illegal kills have been recorded annually statewide since 1990 (Table 2), Pierce et al. (1985) estimated that 5-10% of moose populations in 2 study areas died annually as a result of recorded illegal kills.

Annual losses due to illegal harvest are likely increasing as expanding moose populations provide additional opportunities.

Table 2. Documented human-caused and natural/unknown moose mortalities not considered legal harvest for Idaho, 1990-2002.

Category	Mortality Factor	Number
Human-caused	Vehicle & train	452
	Illegal kill	416
	Indian harvest	97
	Other human-caused	48
Natural/Unknown	Unknown	177
	Natural mortality	71
	Winter kill	46
	Predation	5

We believe (based on reports from Conservation Officers statewide and investigations of illegal harvest) that annual illegal kill of moose averages 50 moose/region, or 350-400 moose statewide.

In addition to illegal kills, moose in Idaho may also be legally harvested by members of several Indian tribes holding subsistence or harvest treaty rights. Such harvest is rarely reported to IDFG. Since 1990, 97 incidents of moose harvest by Indians have been reliably reported, which accounts for only 7% of all moose mortalities recorded due to causes other than IDFG-regulated harvest (Table 2).

Natural Losses

Losses of moose due to natural causes (predation, disease, accidents, malnutrition, etc.) are rarely reported. Most occur away from human habitations or roads, and many occur during seasons (i.e., winter) when few humans are active in remote portions of moose habitat. Natural mortality of moose older than calves is believed similar to that reported for adult cow moose in Alaska by Ballard et al. (1991), where an annual mortality of 5.2% was recorded. Bangs et al. (1989) recorded a slightly higher rate of mortality (8%), with mortality of animals aged 1-5 years only 3%. Since 1990, natural and unknown-caused moose mortalities account for 299 cases (23%) of all non-harvest mortalities (Table 2). In Idaho, potential predators on moose include black bears (*Ursus americanus*), mountain lions (*Felis concolor*), and wolves (*Canis lupus*). Data relative to predation on moose in Idaho is scarce; only 5 of 1,312 known non-harvest mortalities since 1990 have been attributed to predators (Table 2). Mountain lions are suspected as the cause of 3 of the 5 recorded predator kills in Idaho (Big Game Mortality Reports, IDFG, Boise, Idaho, USA).

POPULATION ESTIMATION

Population estimates for moose are difficult to obtain, even in relatively small areas, and total counts are impossible over large areas. Helicopter surveys have been used to provide a means of estimating moose numbers over large areas in Idaho, but large areas occupied by moose occur in steep, heavily-vegetated terrain where aerial surveys are impossible.

The first statewide estimates of Idaho's moose population were 500 moose in 1910, and 1,000 moose in 1939 (Davis 1939). Hatter (1949) reported a population of 1,000 moose in Idaho, based on an aerial survey of moose in Fremont County conducted in 1949. It is unclear whether Hatter considered herds in northern Idaho (where very few moose may have been present at that time) in his estimate, which was reported as a statewide total population estimate.

Wildlife Managers of IDFG, using a variety of data and input from local Conservation Officers, estimated the moose population in each GMU in Idaho during 1981, 1985, and 1990 (IDFG 1981, Hayden et al. 1985, Leege et al. 1990). Other estimates of Idaho's moose population (Table 3) appear in Karns (1998) and Timmermann and Buss (1995, 1998). With population surveys unavailable, biologists typically employ indices (relative measures of some object such as pellet groups or tracks) to detect trends in populations. Only rarely can such indices be correlated to population number except in a very general sense. In Idaho, statewide population trends are monitored using a combination of aerial survey estimates over small areas, and indices based on mandatory check of hunter harvested moose and antler measurements of bull moose. Since current harvests are inconsistent with published estimates of moose populations in Idaho, we reviewed available data in an effort to derive an updated statewide estimate of Idaho's moose population.

Table 3. Historic estimates of moose in Idaho.

Year	IDFG[1]	Karns[2]	Timmermann & Buss[3]
1960		4,100	
1965		4,400	
1970		4,600	
1975		4,700	
1980		4,900	
1981	3,530		
1982			3,600
1985		4,385	5,100
1990	4,565	5,100	5,500

[1]Wildlife Species Management Plans; Idaho Department of Fish and Game 1981, Hayden et al. 1985, Leege et al. 1990.

[2]Karns 1998.

[3]Timmermann and Buss 1995, 1998.

Population Estimate Based on Occupied Range and Population Density

One way to estimate Idaho's moose population is to derive a population density then expand that to population area.

Moose densities in Wyoming, immediately east of Idaho, were estimated using fixed-wing and helicopter surveys designed to produce confidence intervals within 10% (Hnilicka 1994). Estimates averaged 0.042 moose/km^2 (0.11 moose/mi^2) of occupied habitat, and ranged from 0.04 – 0.52 moose/km^2 (0.10 – 1.34 moose/mi^2) (Hnilicka 1994). In areas where comparable surveys have been flown in Idaho, comparable moose densities have been recorded. Aerial survey data from the Caribou National Forest of eastern Idaho (IDFG 2002) yielded estimates of moose densities of 0.24-0.40 moose/km^2 (0.63-1.04 moose/mi^2). Similar data obtained from aerial surveys in northern Idaho's Priest River drainage (Jim Hayden, personal communication, IDFG) indicated that moose densities may reach 0.42 moose/km^2 (1.1 moose/mi^2).

If we assume that Idaho moose densities are bracketed by the minimum density for moose dispersal of 0.2 moose/km^2 reported by Gasaway et al. (1980) and the average density of 0.29 moose/km^2 reported for Wyoming, then Idaho would have a statewide moose population between 20,000 and 30,000 moose (0.2 * 109,038 = 21,808 moose, and 0.29 * 109,038 = 31,621 moose). This is based upon an estimated occupied range equal to the area of GMUs now having a moose harvest season (Fig. 1).

Population Estimate Based on Harvest and Estimated Mortality

Moose populations remain stable if annual recruitment equals annual losses. Since we know or can estimate annual losses of the male portion of the population, and since we have samples from the population that reflect the relative proportions of males, females, and calves within the population, we can derive a crude but conservative estimate of population size—crude because harvest (the best monitored mortality factor) is dependent on the number of permits issued annually, and conservative since we assume population stability despite evidence that the statewide moose population is expanding.

To derive this estimate, we need to know the proportion of the population comprised of males (34%, based on aerial survey data collected in 2000 and 2002), the number of bull moose removed annually by hunters (733 plus 4 male calves in 2001), and the proportion of the males removed by harvest (estimated to be 15%). Then, the number of males in the population can be estimated (737/0.15 = 4,913). Since males comprised 34% of the total population, the population can be estimated (4,913/0.34 = 14,450). A population of 14,450 moose in Idaho would equate to 0.13 moose/km^2 (0.34 moose/mi^2).

While both of these estimates are crude approximations, we believe they provide bounds on Idaho's moose population, and that Idaho moose conservatively numbered between 15,000 and 25,000 animals in 2002;

approximately 3 times population estimates published in 1990 (Table 3).

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