



PUBLIC UTILITY DISTRICT NO. 1 of CHELAN COUNTY

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April 28, 2017

Ms. Kimberly D. Bose, Secretary, and
Mr. Nathaniel J. Davis, Sr., Deputy Secretary
FEDERAL ENERGY REGULATORY COMMISSION
888 First Street, NE
Washington, DC 20426

VIA ELECTRONIC FILING

Re: **Lake Chelan Hydroelectric Project No. 637**
Article 406 – Wildlife Habitat Plan
Annual Winter Wildlife Survey Report for 2016/17

Dear Secretary Bose and Deputy Secretary Davis:

On September 18, 2013, the Federal Energy Regulatory Commission (Commission) issued the “*Order Approving Wildlife Habitat Plan Update under Article 406.*”¹ In accordance with Section 4 of the approved plan, the Public Utility District No. 1 of Chelan County, Washington (Chelan PUD) will provide an annual report on the results of the winter wildlife surveys by April 30 each year for the next four years to the Commission, the U.S.D.A. Forest Service, the National Park Service (NPS), the U.S. Fish and Wildlife Service (USFWS) and the Washington Department of Fish and Wildlife (WDFW).

Chelan PUD hereby files the 2016/17 Annual Winter Wildlife Survey Report. This report will be provided to the above agencies along with a copy of this letter.

Please do not hesitate to contact me or Von Pope at (509) 661-4625 regarding any questions or comments regarding this report.

Sincerely,

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Enclosure: 2016/17 Annual Winter Wildlife Survey Report

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¹ 144 FERC ¶ 62,242 (2013)

LAKE CHELAN ANNUAL WINTER WILDLIFE SURVEY REPORT

WINTER of 2016-2017



Von R. Pope and Kelly A. Cordell

Public Utility District No. 1 of Chelan County

P. O. Box 1231

Wenatchee, Washington 98807

April 2017

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INTRODUCTION

Since 1982, the Public Utility District No. 1 of Chelan County (Chelan PUD) has monitored big-game and other wildlife that winter along the Lake Chelan Hydroelectric Project (License No. 637) as a Federal Energy Regulatory Commission (FERC) compliance measure. On 31 March 2004, the existing operating license expired, though monitoring continued during annual licenses. On 6 November 2006, a new operating license was awarded to Chelan PUD (FERC 2006). On 10 April 2008, the FERC approved the Lake Chelan Wildlife Plan, which prescribed the continuation of annual winter wildlife surveys similar to those conducted during the second license for the project (1974-2004). During consultation on the new Lake Chelan Wildlife Habitat Plan, the Lake Chelan Wildlife Forum elected to add waterbirds to the Lake Chelan winter wildlife survey for the 50-year-license period (2006-2056). Up to 12 winter wildlife surveys are conducted by boat on Lake Chelan from late November through late March each winter. The objective for the Lake Chelan winter wildlife survey is to monitor numbers of wintering big game, waterfowl and waterbirds, eagles, and other wildlife observed during the winter boating surveys. Results are documented in the Lake Chelan Winter Wildlife Survey Report, which is provided to the FERC, the Washington Department of Fish and Wildlife (WDFW), the U.S. Fish and Wildlife Service (USFWS), the USDA Forest Service, and the National Park Service (NPS) by 30 April annually as required by Article 406 in the operating license.

Lake Chelan provides a unique opportunity to monitor big game, waterfowl, eagles, and furbearers that tend to concentrate at lower elevations along the lake during the winter months. While surveys provide only minimum species numbers, repeated counts over time provide an index of population status for a number of wildlife species. Spatial and temporal information, as well as sex and age ratios collected for some species, provides useful information to state and federal natural resource management agencies for wildlife management along Lake Chelan. In addition, long-term population indices may be useful in observing the response of some wildlife species to wildfires that have occurred in the Lake Chelan basin over the past decade or so. The Rex Creek and Deer Point fires (2001 and 2002, respectively) burned a significant portion of deer winter range along the north shore, destroying extensive bitterbrush stands. More recently, Flick Creek, Domke Lake, Wolverine, and Chelan Complex Fires have further altered the habitat along both shores of Lake Chelan. This report summarizes winter wildlife monitoring along Lake Chelan for the winter of 2016-2017.

SURVEY AREA

Lake Chelan lies in central Washington on the east slope of the Cascade Mountains in northern Chelan County. The lake is approximately 1 mile wide and 50 miles long. It extends from the Columbia River breaks to the high Cascades. The lake's maximum elevation is 1,100 feet (mean sea level), with mountain peaks in excess of 8,000 feet above the lake. Most of the survey area lies within both the Wenatchee National Forest and the North Cascades National Park complex. Six vegetation zones, described by Franklin and Dyrness (1973), lie within the survey area: *Pinus ponderosa*, *Pseudotsuga menziesii*, *Abies grandis*, *Pinus contorta*, *Abies lasiocarpa*, and *Artemisia tridentata/Agropyron spicatum*. The survey area (Figure 1) includes a 40-mile stretch of Lake Chelan and the surrounding terrain from First Creek, at Lake Chelan State Park (lake mile 13), to the mouth of the Stehekin River, at Stehekin (lake mile 54) and encompasses both shores.

METHODS

Survey Methods

Each winter season, Chelan PUD schedules 12 boating surveys along Lake Chelan to provide an index of wildlife wintering along the lake. The winter season is defined as late November through late March. Each winter season is divided into four periods with three surveys in each including: early (late November – mid-December), mid (late December – early January), late (mid – late February) and the green-up period (March). During each survey, the boat is driven up one shore of the lake (north or south) and down the opposite shore. Each year, the initial shoreline surveyed is chosen at random and the route alternates thereafter to balance the number of morning and afternoon sighting opportunities along each shore.

A minimum of 2 people conduct the surveys from an open boat to maximize visibility. The boat is driven at a slow cruising speed (~25 mph) usually within 100-200 yards of the lake shoreline. Wildlife species observed are identified using 10 x 40mm binoculars from the boat or with spotting scopes (20-60 x 60mm and 6-100 x 100mm) from the shore. The same area (Lake Chelan State Park to Stehekin) is surveyed each survey (Lake mile 13.5 - 54.5, Figure 1) unless inclement weather (high winds or heavy snow) necessitate termination of a survey. Winter wildlife surveys are postponed if inclement weather becomes a safety concern or if visibility will be very poor. If poor weather persists, postponed surveys may be cancelled if they cannot be rescheduled during the same winter period in which they were scheduled.

Big Game and Furbearer Observations

All big game and furbearer species observed are recorded to the nearest tenth lake mile and the shore on which they are observed (north or south). Mule deer (*Odocoileus hemionus*), mountain goat (*Oreamnos americanus*), and bighorn sheep (*Ovis canadensis*) may be classified by age and sex. The extent to which these animals are classified varies depending on the species, the winter period being surveyed, and visibility conditions. Other big game or furbearers that may be encountered such as coyotes (*Canis latrans*), black bear (*Ursus americanus*), cougar (*Felis concolor*), and bobcat (*Felis rufus*) are recorded but not classified by age or sex.

Deer are classified by age, sex, and species to the extent possible during the first two survey periods (early and mid-winter). For bucks, the maximum number of antler points on one side is recorded. During the remaining two periods (late winter and green-up) deer are only classified by age (adult or fawn) and species since bucks have typically shed their antlers. When visibility is poor or long distances prevent age and sex identification, deer are recorded as unclassified. Mule deer are the dominant species observed, however, black-tailed (*O. h. columbianus*) or white-tailed deer (*O. virginianus*), and elk (*Cervus elaphus*) are observed occasionally and recorded by species, age, and sex where possible. Deer counts through mid-winter provide information on the buck populations and buck/doe ratios while late winter and green-up surveys provide an index of adult/fawn ratios and potential recruitment for portions of the Manson, Entiat, Slide Ridge, and Clark Game Management Units.

Typically, mountain goats are observed from long distances making sex classification more difficult. Therefore, mountain goats are only classified by age (adults and kids). Relative abundance, distribution, and age data provide an index for managing mountain goat in the Lake Chelan Basin. In past years the Stehekin Valley was surveyed once per winter (rarely twice) with binoculars and spotting scopes from observation points along the valley roads. These surveys have usually consisted of two consecutive days of surveying for goats, the afternoon of one day followed by the morning of the second day. The

Stehekin Valley surveys supplement the surveys along the lake by adding information on goat abundance, distribution, and age composition in the Stehekin Valley. Results of these surveys have often been influenced by weather conditions that limit visibility. The number of goats observed during these surveys has varied from zero to 40.

Historically, bighorn sheep were native to Washington and the Lake Chelan area. Overharvest, parasites, and diseases carried by domestic sheep eliminated bighorns from Washington by the early 1900's. In March 1999, WDFW coordinated the release of 13 bighorn sheep onto the north shore of Lake Chelan along with the USDA Forest Service and the Foundation for North American Wild Sheep (FNAWS). Key to this re-introduction was the FNAWS negotiations to remove domestic sheep from the USDA Forest Service grazing allotment in that area of the north shore of Lake Chelan. An additional 34 bighorns were released on the north shore of Lake Chelan in February and March 2000. The sheep were released between Grade and Coyote creeks. The transplanted bighorns were captured from expanding populations in Lincoln, Kittitas, and Yakima counties in Washington and from the Okanogan Valley of southern British Columbia. During 2009, 12 bighorn sheep along Lake Chelan were radio-collared by WDFW to monitor this population. An additional 14 sheep were collared during February 2014.

Information on bighorn sheep relative abundance and age and sex ratios is important for monitoring and managing this re-introduced herd. Winter surveys are optimum for gathering data on bighorn sheep abundance, age, sex, and distribution because the sheep congregate on winter range at relatively lower elevations (Geist 1971). Bighorn sheep observed are counted and classified by age (adult or lamb) and sex (ram or ewe) when conditions allow during each survey period. Bighorn rams are further classified as class I, II, III, or IV rams (Geist 1968).

Eagles, Waterfowl, and Water Bird Observations

Eagles, waterfowl, and other water birds (grebes, gulls, loons) observed are recoded to the nearest tenth lake mile and to the nearest shore to which they are observed. When visibility permits, eagles, waterfowl, and other birds observed on the lake are classified by species using 10 x 40mm binoculars or variable power spotting scopes. In addition, eagles may be recorded as adults or sub-adults when conditions allow. When visibility is poor, ducks may be classified as dabblers or divers, or simply as unknown waterfowl. The mouth of the Stehekin River is generally surveyed from the shoreline with spotting scopes as visibility allows. This area generally exhibits the highest concentration and species diversity of waterfowl within the survey area.

Data Summary Methods

Data gathered are summarized for the overall winter season and by each winter period to provide population metrics (age and sex ratios) and/or allow for monitoring of specific trends (annual population indices) for the species observed. In addition, data may be summarized by shore (north or south) to provide similar information for different management areas. To provide a minimum estimate for the number of mountain goats observed in the survey area by winter season, we tallied the maximum number of goats recorded within each particular band (or area) among all surveys. The geographic separation between areas where goat bands were observed is assumed to be large enough that goats are not moving between bands during the winter season which could lead to biased counts.

Since deer shed their antlers after the mid-winter period, the early and mid-winter periods are used to monitor buck ratios (bucks/100 does) and buck age structure (number of 1, 2, 3, or 4 point and greater bucks). Throughout the winter survey season age data are recorded and summarized to determine fawn ratios (fawns/100 adults). Similar population metrics are calculated for bighorn sheep

for all surveys. Unclassified animals are removed from the data set prior to calculating any age or sex ratios. Since visibility may limit the ability to classify animals and may greatly influence buck/ram and fawn/lamb ratios, only surveys that have a classification rate of 25% or greater are used to calculate these ratios.

The average number of all species observed during each winter period and for the winter season overall is calculated by totaling the number of animals observed during each survey and dividing by the number of surveys conducted in each period (typically 3). The overall average is calculated by totaling the number of animals observed over the entire winter survey season divided by the number of surveys collected (typically 12). Since the number of animals observed on any particular survey may vary drastically (especially for deer), the maximum number of animals observed on any one survey are reported to provide an indication of minimum numbers. However, relatively low numbers for any species observed does not necessarily indicate low population numbers. Winter and weather conditions may combine to limit the number of animals present or visible for one or more surveys conducted.

RESULTS AND DISCUSSION

During the winter season of 2016-2017, 9 complete surveys were conducted between 22 November 2016 and 28 March 2017 (Table 1). Two surveys were cancelled due to inclement weather, and a third was cut short and rendered incomplete due to dangerous wave conditions resulting from high winds. The data from the incomplete survey was not included in summaries. The area surveyed was consistent and complete for the remaining 9 surveys. Visibility was reduced during a portion of 1 survey due to low clouds or fog. Reduced visibility likely limited the numbers of animals seen, especially for mountain goats, which are frequently observed at higher elevations than deer and bighorn sheep. In addition to poor visibility, vegetative cover and topography undoubtedly further limited the number of animals recorded. Therefore, all numbers are considered to represent the minimum number present during any one survey.

Mountain Goats

Goat Counts

During the winter of 2016-17, the number of mountain goats seen per boat survey this past winter ranged from 11 to 53 (Table 1). The maximum number of mountain goats observed for the entire survey area on any one day during the 2016-17 ($n = 53$) occurred on 29 November 2016. The maximum number observed for the 2016-17 season along the north shore ($n = 29$) occurred on 6 December 2016, while the maximum number observed along the south shore ($n = 40$) for any one day occurred on 29 November 2016. Surveys for mountain goats in the Stehekin Valley were not conducted during the 2016-17 season.

Estimated numbers

Unlike the recent mild winters, the 2016-2017 winter was considered a normal winter with average to slightly above average snowpack (NRCS 2017). However, the minimum number of goats estimated for the Lake Chelan wintering area surveyed during the 2016-17 winter season was relatively low ($n = 70$; Figure 2). This is below the long-term average of 128 mountain goats observed within the entire survey area. The estimated number of mountain goats observed along the south shore ($n = 40$) was lower than the long-term average (AVG = 56). The estimated number of mountain goats on the north shore ($n = 30$) was also lower than the long-term average (AVG = 66). Trend data (1982 to 2016) for

estimated mountain goat population numbers (Figure 3) show that typically, the north shore has had more mountain goats, with the exception of surveys in the early to mid-1980's and in recent years (Table 2). While bands of goats were seen in similar places along each shore in previous seasons, the numbers of goats observed during the 2016-17 surveys were similar between both shores of the lake. The total population is likely substantially higher than the estimated minimum of 70 mountain goats.

The ratio of kids/100 adults is a measure of mountain goat kid production and survival. Within the survey area, a ratio of 22.0 kids/100 adults was observed (Figure 4) during the 2016-17 winter season. We observed 25.0 kids/100 adults (AVG = 23.1) along the north shore and 18.2 kids/100 adults (AVG = 26.5) along the south shore during the 2016-17 winter season. Kid ratios have generally been higher along the south shore from the winters of 2003 through 2010 compared to that of the north shore (Table 2). The recent series of consecutive mild winters has likely influenced higher kid production and survival along Lake Chelan. In the early 1980's, kid ratios were slightly higher along the north shore of the lake. During the mid 2000's the ratios along the north shore fell but the south shore demonstrated a higher kid to adult ratio (Figure 5). During the last few winters, the kid to adult ratio has fallen along the south shore.

From the winter of 1990-91 to 1999-00, the ratio of kids/100 adult goats along the north shore was relatively low (16.4) compared to the average ratios of 26.4 and 24.9 observed during the 1980's and following the Rex Creek fire in 2001, respectively. This year's ratio of 25.0 was relatively lower than recent years, but higher than the long-term average of 23.1 kids/100 adults along the north shore, despite the relatively low numbers of goats observed.

It appears that mountain goats have underutilized much of the available mountain goat winter range along Lake Chelan. Until recently, goats were not using portions of their winter ranges that were used in the early to mid-1980's (especially along the south shore) or portions of winter ranges were being used by fewer goats. Since 1999-00, relatively few goats (n = 93) have been observed in the area uplake of Riddle Creek along the south shore. From 1982-83 until 1998-99, goats were more frequently observed in the same area (n = 703). No observations of goats were made uplake of Riddle Creek along the south shore during the 2016-17 season.

Few goats were observed uplake of the Canoe Creek vicinity along the north shore during the 2016-17 survey season. These portions of historic habitat appear to be underutilized. Washington Department of Game surveys that were conducted within the survey area between 1954 and 1970 (Fielder and McKay 1984) recorded greater mountain goat use uplake of Canoe Creek along the north shore and in the Stehekin Valley compared to what we have seen since the winter of 2005-06. Surveys conducted within the Stehekin Valley have produced low numbers of goats since the winter of 2000-01 (n = 13). However, surveys have not been conducted in the Stehekin Valley since the winter of 2012-13.

Historically, the total number of mountain goats observed during our winter monitoring efforts along Lake Chelan has not shown strong growth in response to management efforts conducted since the late 1970's. Mountain goat hunting along the south shore of the lake and in the Stehekin Valley had been closed since the 1978 hunting season. Goat hunting on the north shore of the lake closed in 1980. In 2001, limited mountain goat hunting (1-2 tags) resumed on the north shore. In 2012, the south shore opened to a limited number of goat tags.

After the introduction of goats from the Olympic Mountains in 1983 and 1984 (Fielder and Keese 1988) the overall population and the ratio of kids per 100 adults increased for several years, but then declined again (Figures 4 and 5). Prescribed fires and fertilization on goat winter ranges also have not resulted in a substantial increase in goat populations. Supplementation with mineral blocks containing 90

ppm of selenium to increase production (Fielder 1986) coincided with a local increase in kid production on the downlake portion of the goat winter range along the north shore. Wildfires that have occurred since the summer of 2001 within the Lake Chelan drainage have burned thousands of acres of mountain goat winter range. Johnson (1983) noted that changes in habitat after fires may lead to population increases. Ratios of kids/100 adults for the entire survey area have generally been on the increase since the winter beginning in 1996.

During the summer of 2001, the Rex Creek Fire burned most of the area on the north shore from the lake to the ridge-top from approximately Moore Point to Safety Harbor Creek (18 miles). Almost every location along the north shore of the lake where mountain goats were observed during surveys suffered a 30-100% burn of vegetation.

Chelan PUD surveys have compiled 35 years of data on mountain goat abundance, distribution, and kid to adult ratios for the north and south shores of Lake Chelan. Since the Rex Creek fire, goat numbers increased along the north shore of the lake, kid ratios lagged slightly behind those of the south shore until the winter of 2011-12 and since. Continued monitoring of this mountain goat population after recent large-scale fires (see below) has provided data to explore this hypothesis.

Deer

During the 2016-17 winter season 1,532 deer were observed for all surveys combined (Table 1). This was higher than the long-term average (AVG = 1,378). Of all deer recorded during 2016-17, 77% (n = 1,184) were observed on the north shore and the remaining 23% (n = 348) along the south shore. The greatest number of deer observed on a single survey (n = 461) was obtained during the late winter period (14 February 2017). This survey day also produced the highest numbers of deer observed along both the north shore (n = 367) and the south shore (n = 94; Table 3).

For all surveys, 1,146 deer (75%) were classified by age (adult or juvenile). Along the north shore, 75% (n = 891) of deer observations were classified; a similar rate 73% (n = 255) was classified along the south shore (Table 4). Fawn ratios (fawns/100 adults) have been calculated annually beginning in the winter of 2007-08 (Table 4). The north shore fawn ratio observed for the 2016-17 winter season was 16.1 fawns/100 adults. The south shore fawn ratio was 28.0 fawns/100 adults. Overall, the ratio observed for the entire survey area was 21.4 fawns/100 adults.

Only 5 bucks were observed during the 4 surveys conducted during the early (n = 3) and mid-winter (n = 1) surveys combined. A total of 2 bucks were observed along the north shore and 3 bucks were observed along the south shore during these early and mid-winter periods. When the late winter period surveys (February) begin, deer are not classified by sex due to antler drop. Therefore, the only data used for sex ratios (bucks/100 does) are the early and mid winter period surveys. Buck ratios specific to the north shore were below average (6.5 bucks/100 does) (AVG = 10.3), as were buck ratios along the south shore (12.0 bucks/100 does; AVG = 16.0). Due to the overall small sample size observed in 2016-17, we expect that these ratios do not accurately represent the actual sex ratio for this population.

Along the south shore, 64% of the total deer observed were within a 15-mile segment of relatively east-facing shoreline located between First Creek (lake mile 13) and Still Creek (lake mile 28). Much of the area between First Creek and downlake of 25-Mile Creek burned during the Chelan Complex fire in 2015. Sixty-one percent of all mule deer observations along the north shore occurred within a 10-mile segment of shoreline from Antilon Creek (lake mile 18) to Falls Creek (lake mile 29). This area is where the majority of deer observations generally occur during each winter. Much of the bitterbrush forage within this north shore area was burned during the Deer Point fire in 2002. In early 2012, the Forest Service conducted a

prescribed burn in the Coyote Creek vicinity to rejuvenate vegetation on the winter range. Additionally, a human-caused fire burned portions of this winter range in the Poison Creek vicinity during 2013.

Since the 1996-97 winter season, relatively fewer deer have been observed along Lake Chelan during annual winter surveys (Figure 6). The winter of 1996-97 was particularly harsh and an estimated 70% of the deer population in Chelan County was lost (WDFW 2003). While a recovery appears to be apparent based on winter survey data, the extent of the recovery is unknown since many recent winters have been considered mild. In mild winters, deer may not descend to the lower elevations of winter range where they are easily visible from the lake. Snowpack in the Chelan Basin during the winter of 2016-17 was average, but icy conditions during January and February 2017 likely contributed to higher numbers of deer observed during the late winter period. Observations of deer during 2016-17 along both shores were above the long-term average (Table 4).

Bighorn Sheep

Bighorn sheep were observed during 8 of 9 boat surveys during the 2016-17 winter season. The maximum number of bighorn sheep observed was 107. This maximum is the highest ever observed during winter surveys (Table 3). The cumulative number of sheep observations during 2016-17 was 407. The average cumulative number observed during winter surveys for all years since the sheep were re-introduced to the north shore in 1999 is 315. Collared sheep were observed during most surveys. All of the bighorn sheep observations during 2016-17 occurred along the north shore between lake miles 18 and 35.

During the spring of 2007, we began classifying all bighorn sheep (Geist 1968) observed on the Lake Chelan winter range. We classified 70% of all bighorn sheep recorded during the 2016-17 winter season. The ratio of rams/100 ewes observed was 43.3 rams/100 ewes (excluding surveys where <25% of sheep were classified). For classified rams, the maximums observed for any one survey by class was 5-Class I, 5-Class II, 13-Class III, and 7-Class IV. The lamb ratio was 8.3, calculated from surveys in which >25% of sheep were classified. The maximum number of lambs observed ($n = 3$) occurred on 23 March 2017. Since data on age and sex ratios has only been collected since 2006, future surveys will help establish trends for age and sex ratios for bighorn sheep. Although only a portion of the estimated 120 animals in the herd are observed during winter surveys, monitoring provides regular updates of herd composition and distribution.

Winter big game survey observations of bighorn sheep from 1999-01 through 2016-17 ranged from the deer fence at Green's Landing (lake mile 18) to the vicinity of Lone Fir Creek (lake mile 36). Most observations (92%) have occurred between Antilon Creek and the vicinity of Safety Harbor Creek, with the largest concentration of observations (69%) centered between Mitchell and Grade Creek. Expansion of grass vegetation along the north shore following the Rex Creek and Deer Point fires may have a positive influence on this bighorn sheep population. Bighorn sheep prefer open grassland habitats, as they are grazers rather than browsers such as deer.

Eagles, Waterbirds, and Other Wildlife

Eagle occurrences during winter surveys along Lake Chelan have been monitored since 1982. The maximum number of bald eagles (*Haliaeetus leucocephalus*) observed during any one survey during the 2016-17 effort was 9. The maximum number of golden eagles (*Aquila chrysaetos*) observed during any one survey in 2016-17 was 7. Eagle species are observed sporadically along either shore of the lake and are often found in large numbers associated with carrion along or near the shoreline.

Numbers of wintering waterbirds (waterfowl, grebes, gulls, herons, loons) along Lake Chelan are a relatively new addition to the winter wildlife surveys with 2016-17 being the 10th year of this data collection (Figure 7). Waterbird species numbers are recorded (Table 5) by location (tenth of lake mile) during each survey as part of the Lake Chelan license. Waterbirds were concentrated primarily at the upper-most end of the lake near the mouth of the Stehekin River. This area accounted for 77% (n = 5,574) of all observations (n = 7,213) during the winter of 2016-17. Additionally, the lower portions of the lake (Mitchell Creek downlake to survey start) accounted for 21% of all observations (n = 1,505) during the 2016-17 season.

The composition of waterbirds observed was dominated by waterfowl (Family Anatidae) which accounted for 95% of the total of all waterbirds observed for all surveys (Figure 8). American wigeon (*Anas americana*) were the most abundant waterfowl species observed and comprised 33% of total waterfowl observations, followed by Canada goose (*Branta canadensis*) (22%), ring-necked duck (*Aythya collaris*) (13%), and bufflehead (*Bucephala albeola*) (10%).

Other species such as lesser scaup (*Aythya affinis*), Barrow's goldeneye (*Bucephala islandica*), common goldeneye (*Bucephala clangula*), gadwall (*Anas strepera*), green winged teal (*Anas crecca*), redhead (*Aythya americana*), hooded merganser (*Lophodytes cucullatus*), northern pintail (*Anas acuta*), and common mergansers (*Mergus merganser*) were seen regularly but in smaller numbers and account for the majority of the remaining number of all waterfowl observed during the 2016-17 winter season. In 2016-17, we observed a maximum of 47 trumpeter swans, including 12 cygnets, during the 28 December survey. Table 5 illustrates the number and species of all waterbirds observed during the 2016-17 winter season.

Other waterbirds observed during the 2016-17 winter season included a number of grebes (Podicipedidae), 2 common loons, and 2 Pacific loons (Gaviidae). Grebe species observed included horned (*Podiceps auritus*), western (*Aechmophorus occidentalis*), eared (*Podiceps nigricollis*), and pied-billed (*Podilymbus podiceps*) grebes. Horned grebes were the most common grebe species observed by far, accounting for 95% of all grebe observations and 4% of all waterbird observations. We observed a maximum of 73 horned grebes (29 November 2016). Unlike the waterfowl, horned grebes were distributed throughout the survey area, with observations in nearly all lake miles surveyed. Two common loons (*Gavia immer*) were observed on 2 separate occasions on both 22 November 2016 and 22 February 2017. Additionally, two Pacific loons were observed together on 6 December 2016 near the mouth of the Stehekin River. American coot (*Fulica americana*) and great blue herons (Ardeidae) were uncommon and accounted for less than 1% of the total average of waterbirds observed for the 2016-17 winter season.

During the 2016-17 winter season biologists also observed 1 marmot, 1 western gray squirrel, 7 coyotes and 1 cougar. The cougar adult was observed along the south shore on 14 February 2017. Additionally, an adult cougar carcass was located along the north shore during the 23 March survey. The observation of the carcass did not count towards species totals; as all counted animals are alive. Notification of the carcass location and disposition was given to WDFW. Carrion resulting from winter mortality and predation influences the number of predators and scavengers seen along the lake during winter wildlife surveys. Most big game winter mortality generally occurs late in the winter when animals have exhausted their body fat and energy stores. The winter likely contributed to average ungulate survival and normal over-winter mortality.

Raptors other than eagles were also observed during surveys. Four red-tailed hawks (*Buteo jamaicensis*), 3 peregrine falcons (*Falco peregrinus*), 2 unidentified buteos, 1 Northern goshawk, 1 unidentified accipiter, and 1 unidentified raptor were observed throughout the survey season. A number

of corvids were also recorded during surveys. A total of 36 common ravens and 31 American crows were observed throughout the survey season. Additionally, 4 turkey vultures were observed during the final survey. Upland birds such as chukar were seen regularly along the north shore during mid and late winter survey periods, with a total of 42 observed. Many of these chukar were observed utilizing areas where ungulates had pawed through the snow to reach underlying vegetation.

Fire Influence

The north shore has experienced a number of fires within the last decade. The Rex Creek Fire in the summer of 2001 burned 55,913 acres between Moore Point (lake mile 48) and Safety Harbor Creek (lake mile 30). The fire was started by a lightning storm on 12 August 2001 and eventually burned over much of the mountain goat wintering area between the lake and the ridge-tops along the north shore. The Rex Creek Fire burned goat foraging areas in a patchy mosaic pattern due to the rocky nature of goat habitat. Goats may actually benefit from re-growth of vegetation on their winter ranges, especially fast growing grasses and forbs (Johnson 1983). Erosion from the steep charred hills in this region has been significant in some drainages due to lost vegetation.

During the summer of 2002, the human-caused Deer Point Fire burned over a large portion of the mule deer and bighorn sheep ranges along the north shore of Lake Chelan. The area burned consisted of approximately 43,000 acres situated between Coyote Creek downlake to near Green's Landing and included elevations ranging from lake level to high-elevation ridge tops. Much of the burn in lower elevations rejuvenated grasses and shrubs, but the extensive stands of bitterbrush that existed in the Camas Creek area were destroyed. Stand-replacing fires occurred within the Little Gold, Poison, and Camas Creek drainages at mid-to-high elevations. The Deer Point Fire burned large areas and removed most winter forage in areas downlake from Coyote Creek where bighorn sheep have been observed to winter. Lack of forage for deer and bighorns was a concern during the winter immediately after the fire. Feeding stations were established but the winter was mild and the stations were underutilized. In the years following the fires, mild winters with little snowfall have occurred, allowing mule deer and bighorn sheep to maximize use of available forage along the north shore. The bighorns seem to have taken advantage of vigorous re-growth of grasses following the Rex Creek and Deer Point fires. Grass forage for bighorn sheep should continue to be good if noxious weeds (especially cheatgrass) do not invade too heavily following subsequent burns.

Mule deer may suffer the effects of the Deer Point Fire for decades. Both bitterbrush and sagebrush are important winter browse plants for mule deer (Young and Clements 2002), especially during harsh winters along the north shore of Lake Chelan. During mild winters, deer feed on grasses and forbs much of the winter and supplement these forages with bitterbrush. However, during winters with deep snow, deer depend on sagebrush and bitterbrush because the erect, woody stems are available above the snow. Intense fires that burn sage and bitterbrush stands may increase the risk of malnutrition or starvation during harsh winters, potentially leading to population declines. Bitterbrush plants live a long time; up to 70 years (Young and Clements 2002). It will be decades before extensive stands of bitterbrush again cover the north shore of Lake Chelan. Bitterbrush is very difficult to grow from seed or seedlings, even under good conditions. Poor access, dry south-facing slopes that face the direct rays of the summer sun, low precipitation, the reduction of an existing seed source on site (in the form of mature plants), and very poor access for planting will all combine to make re-establishment of bitterbrush stands on the north shore of Lake Chelan difficult. Recent winters (2002-03 through 2005-06; 2014-15) have been very mild with little snow and few deer were observed at the lower elevations along the lake. There was no evidence that an above normal winter kill of mule deer occurred during the winters since 1996-97. The winter of 2016-17 was considered normal, with near-average snowpack. However, rain on snow events

during late January through February contributed to an icy crust on top of snow, making it difficult for ungulates to access food. It was evident in many locations along Lake Chelan that ungulates were utilizing food sources above the snow (seedling pines, ceanothus, bitterbrush) for forage during 2016-17, leaving many ceanothus shrubs entirely stripped of their leaves. WDFW's spring 2017 mule deer winter range surveys in GMU's 245, 247, 250, and 251 found that wintering mule deer in these units have declined by 26% from 2016 data (WDFW 2017). During future winters with normal or above normal snow levels and duration, mule deer mortality along Lake Chelan may be high due to the lack of mature bitterbrush stands.

The Flick Creek fire started on 26 July 2006 and burned 7,993 acres of mixed low to mid-elevation forest between Purple Point Campground in Stehekin downlake to Fish Creek. The only general area that has not recently burned in wildfire along the north shore of Lake Chelan is the approximately two mile segment (lake mile 28-30) between Coyote and Safety Harbor creeks. However, small portions of this area have been treated to prescribed burns in recent years.

Until recently, the south shore had not seen a large-scale wildfire in a number of years. The North 25-Mile Fire (8,845 acres) burned over some areas of winter range within the 25-Mile Creek and Box Canyon areas in 1998 (M. Lenz, pers. comm.). The Pot Peak (17,314 acres) and Deep Harbor (29,314 acres) fires burned large areas of the south shore in 2004. Much of the Deep Harbor complex burned through mixed coniferous forest in a mosaic. However, some areas (such as the Big Creek drainage) experienced stand-replacing fire events. Additionally, some portions of the Pot Peak Fire burned into regenerating forest within the North 25-Mile fire area. In 2007, the Domke Lake fire burned approximately 11,791 acres of thick, coniferous forest from the South Fork of Bear Creek north and west to Railroad Creek. During 2015, The Wolverine Fire burned 65,512 acres along 15 miles of shoreline from Castle Creek to Pyramid Creek and over the Entiat River divide along the south shore near Lucerne. In addition, the 2015 Chelan Complex burned nearly 89,000 acres downlake along the south shore, mainly at low elevation.

While wildfires have impacted much of the winter range along Lake Chelan, the effects of controlled burns may also be examined. As part of the Lake Chelan Wildlife Habitat Plan (CCPUD 2013), the USFS is conducting controlled burns to reduce fuels that may contribute to larger, hotter fires, and to improve some habitats for winter range. To date, two controlled burns have been conducted as part of the Lake Chelan Wildlife Habitat Plan; one in Coyote Creek in 2012 (644 acres) and another at Safety Harbor Creek in 2014 (642 acres), both along the north shore. Future reports may focus on where and what types of burns have been conducted and how the numbers of wintering ungulates in these areas may respond.

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Figure 1. Lake Chelan Winter Wildlife Survey Area.



Figure 2. Mountain goat observation areas along Lake Chelan by shore (north and south) showing composition of groups observed (maximum for all counts) during 2016-2017 Lake Chelan Winter Wildlife Survey.

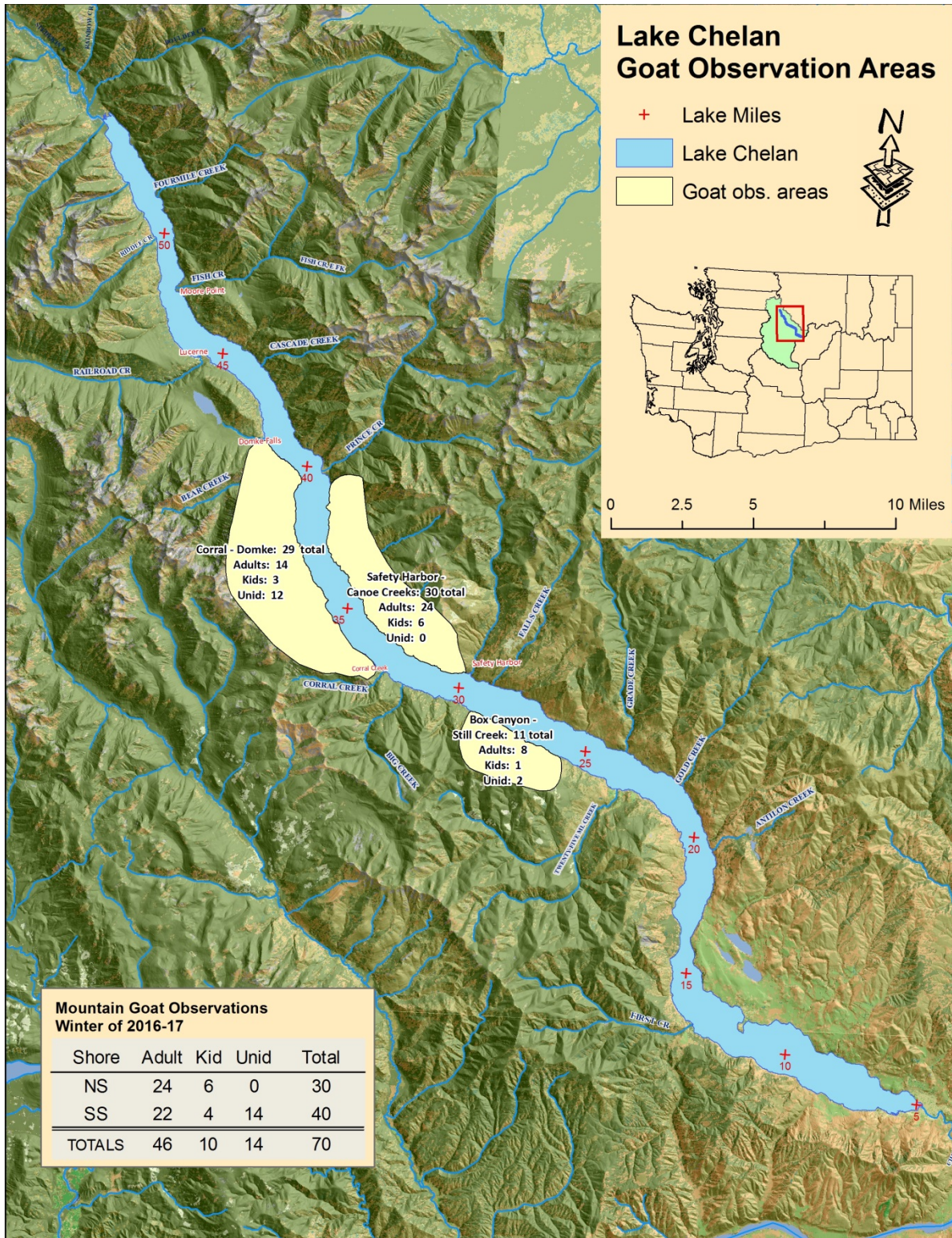


Figure 3. Number of mountain goats estimated along Lake Chelan by shore (including the Stehekin Valley) for all Lake Chelan Winter Wildlife Surveys, winters 1982-83 to 2016-17.

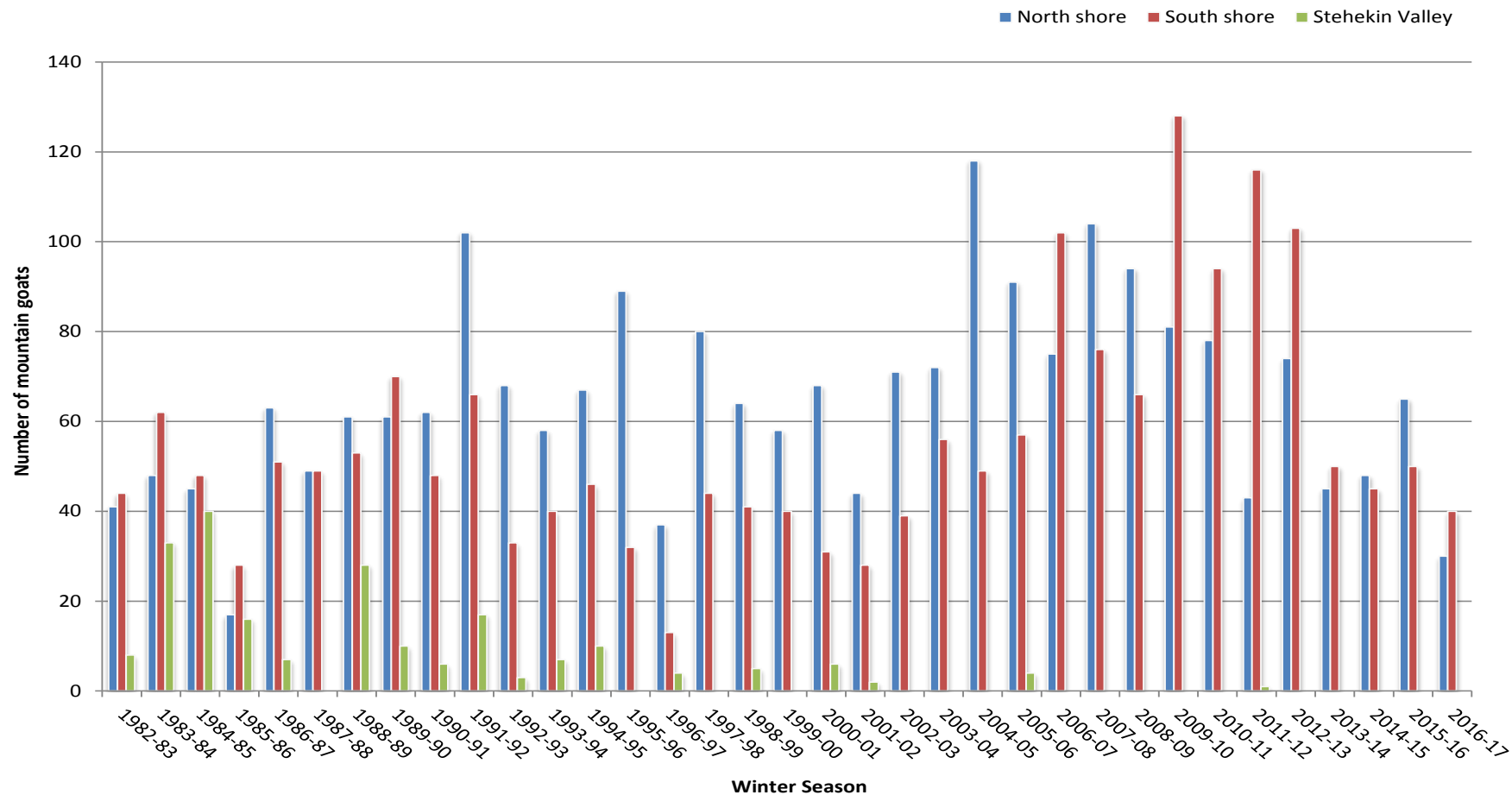


Figure 4. Mountain goat kid to adult ratios (kids/100 adults) for the entire survey area (including Stehekin Valley) for all Lake Chelan Winter Wildlife Surveys, winters 1982-83 to 2016-17.

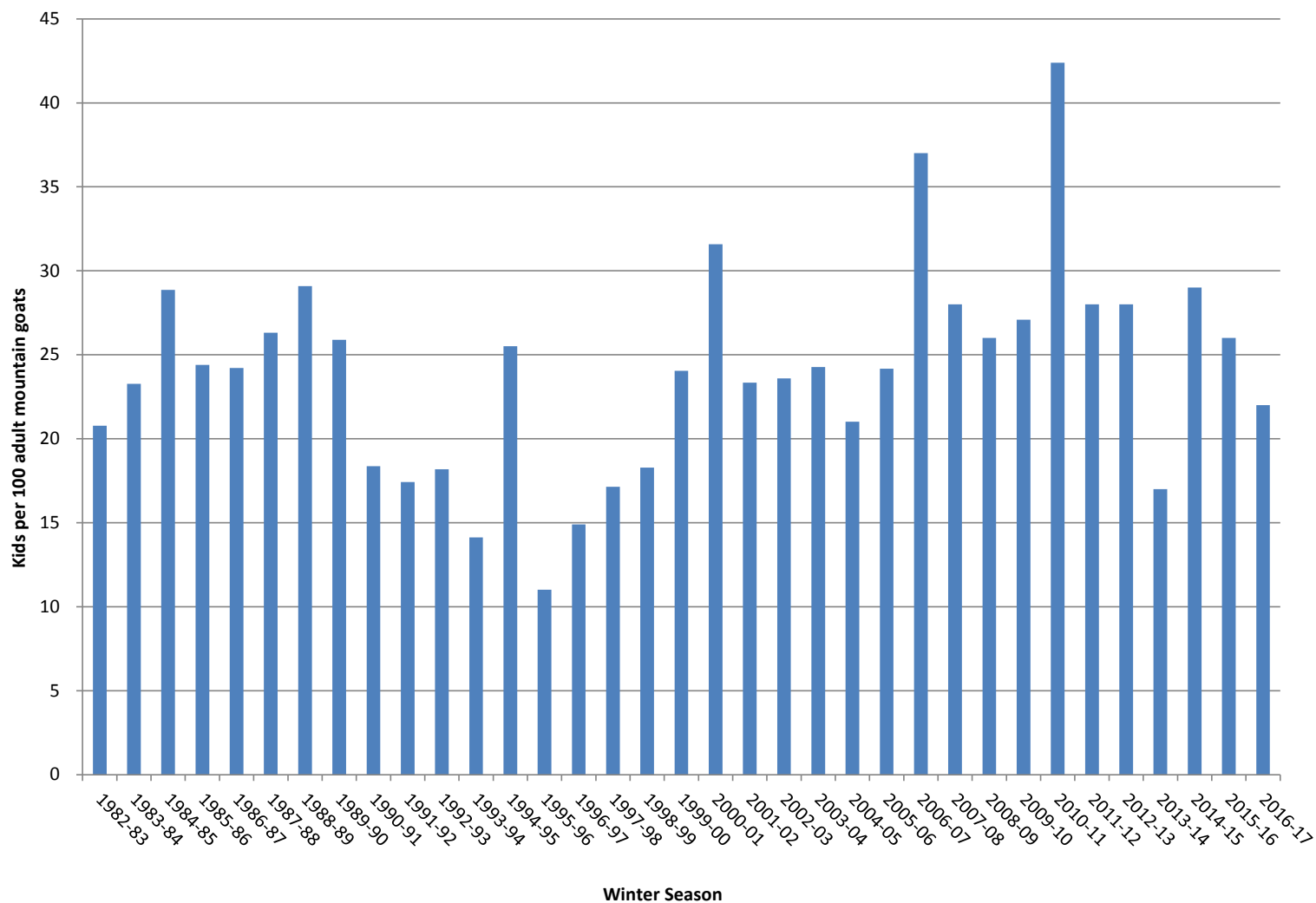


Figure 5. Mountain goat kid ratios (kids/100 adults) by lakeshore for all Lake Chelan Winter Wildlife Surveys, winters 1982-83 to 2016-17.

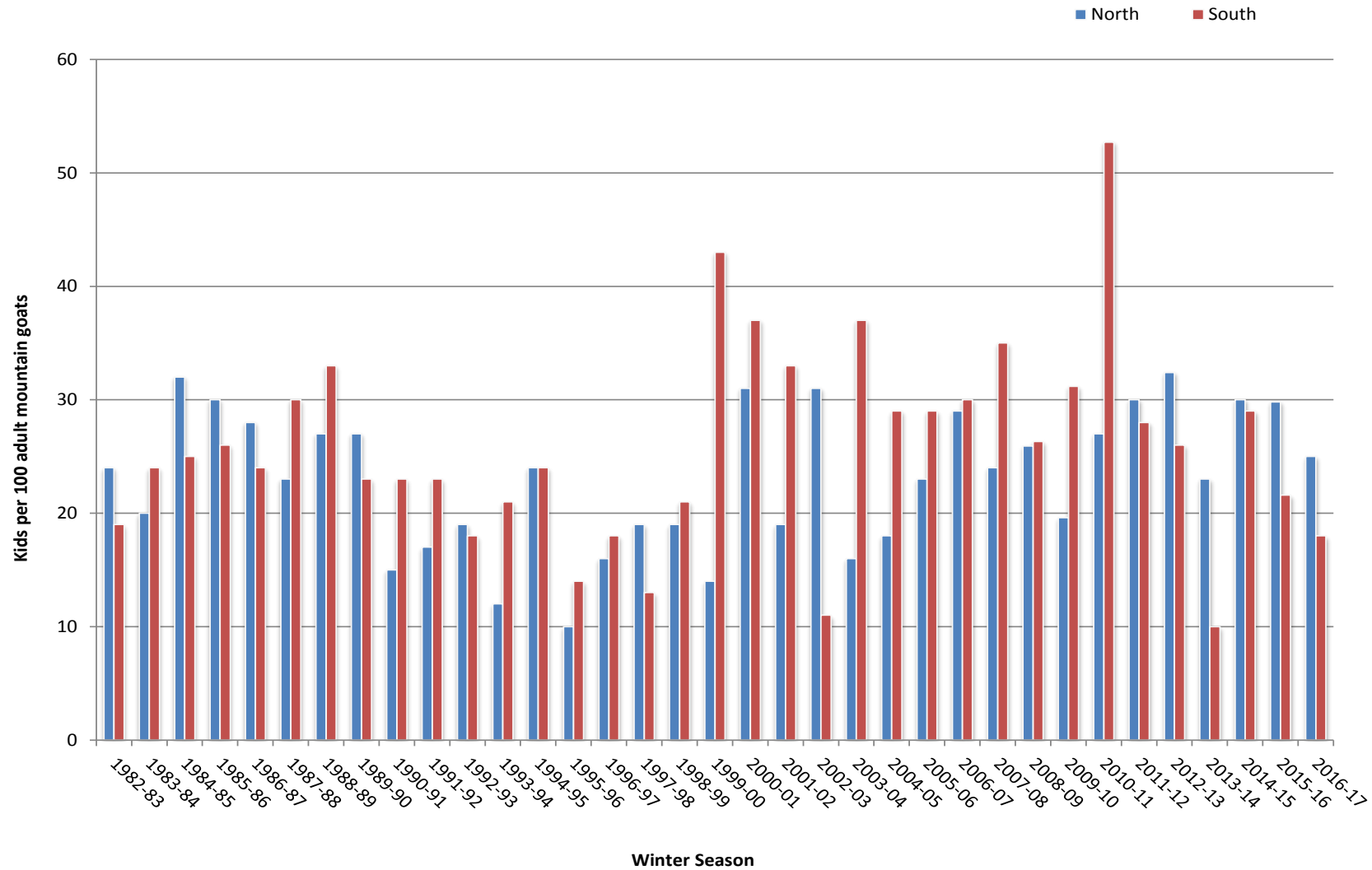


Figure 6. Ungulate maximum counts by winter season for all Lake Chelan Winter Wildlife Surveys, winters 1982-83 to 2016-17.

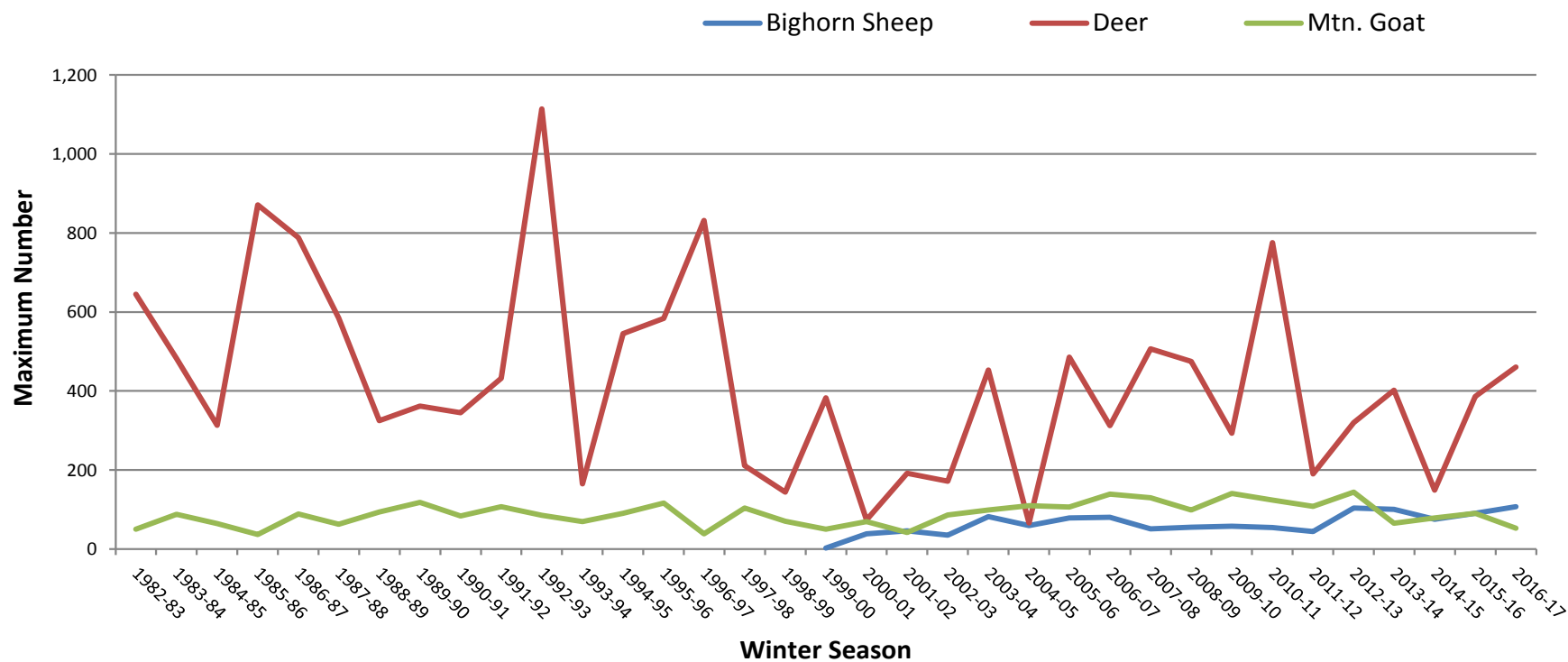


Figure 7. Waterbird composition by type represented as a percent of total waterbirds observed for the Lake Chelan Winter Wildlife Survey, 2016-17.

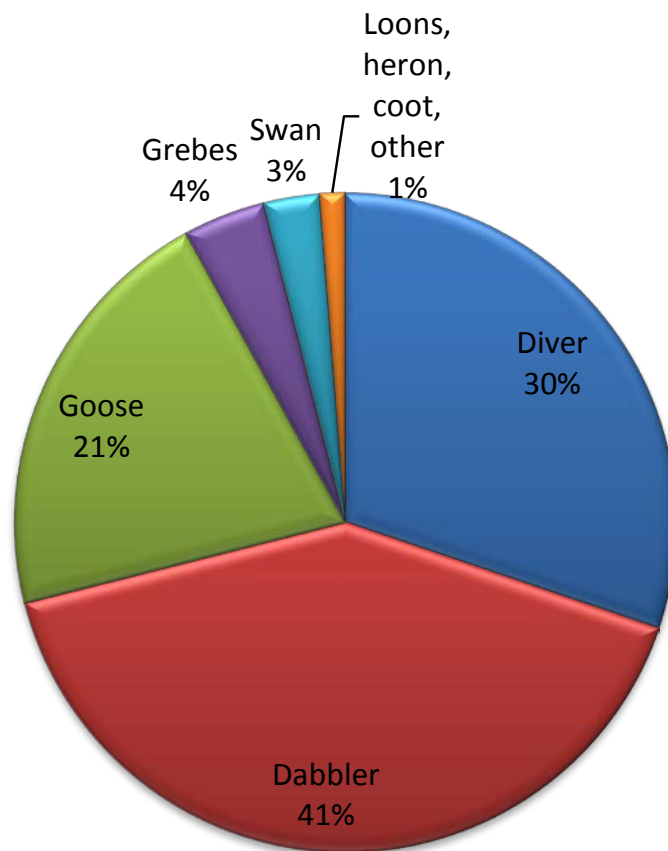


Figure 8. Composition of waterfowl (Family: Anatidae) observed for the 2016-17 Lake Chelan Winter Wildlife Survey.

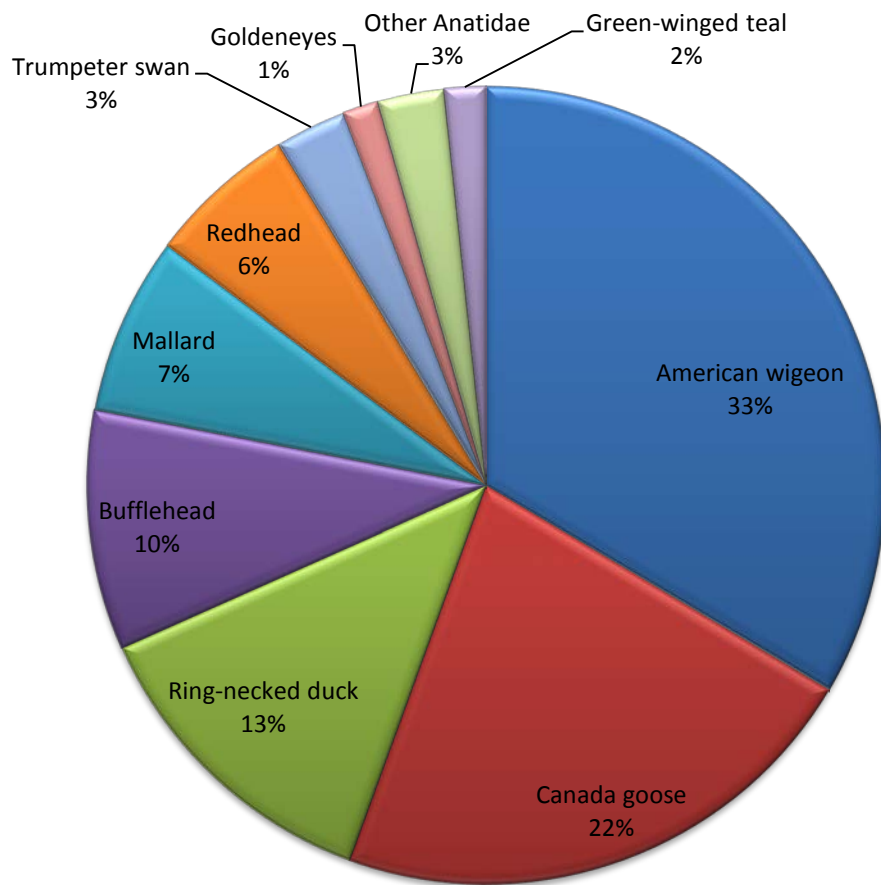


Table 1. Overall summary of wildlife observed by winter period for the 2016-17 Lake Chelan Winter Wildlife Survey.

	Date	Mountain Goats	Deer	Bighorn Sheep	Bald Eagles	Golden Eagles	Waterfowl & waterbirds	Furbearer	Other
Early-Winter	22-Nov	19	10	32	0	0	537	-	31 AMCR, 1 RTHA
	29-Nov	53	15	0	3	1		2 COYO	2 CORA
	6-Dec	41	13	39	3	0	603	-	1 CORA
Mid-Winter	28-Dec	43	47	45	3	0	862	1 COYO	2 CORA, 8 CHUKAR
	no survey								
	no survey								
Late-Winter	7-Feb	29	396	107	9	7	1,124	2 COYO	7 CORA, 8 CHUKAR
	14-Feb	28	461	33	3	4	1171	1 COUG	1 NOGO, 26 CHUKAR, 1 UEAGLE
	22-Feb	37	264	49	3	4	721	2 COYO	2 CORA
Green-up	survey incomplete								
	23-Mar	11	151	41	8	3	730	-	9 CORA, 3 PEFA, 2 UBUTEO, 1 UACCP, 1 UEAGLE
	28-Mar	33	175	61	6	3	706	1 MARMOT	2 UEAGLE, 1 URAPTOR, 4 TUVU, 3 RTHA, 13 CORA

Table 2. Mountain goat observations by winter season, including maximum number by age, kid proportions (% of total) and ratios (kids/100adults) by WDFW Goat Unit and overall for all Lake Chelan Winter Wildlife Surveys; winters of 1982-83 through 2016-17.

North shore (WDF&W goat unit #6)							Kids/100	South shore (WDF&W goat unit #7)							Kids/100	Stehekin Valley (WDF&W goat unit #21)							Kids/100	TOTAL LAKE CHELAN STUDY AREA							Kids/100
Winter	Total	Adult	Kid	Unid	% kids	adults		Winter	Total	Adult	Kid	Unid	% kids	adults		Winter	Total	Adult	Kid	Unid	% kids	adults		Winter	Total	Adult	Kid	Unid	% kids	adults	
1982-83	41	33	8	0	20	24		1982-83	44	37	7	0	16	19		1982-83	8	7	1	0	13	14		1982-83	93	77	16	0	17	21	
1983-84	48	40	8	0	17	20		1983-84	62	50	12	0	19	24		1983-84	33	26	7	0	21	27		1983-84	143	116	27	0	19	23	
1984-85	45	31	10	4	24	32		1984-85	48	36	9	3	20	25		1984-85	40	30	9	1	23	30		1984-85	133	97	28	8	22	29	
1985-86	17	10	3	4	23	30		1985-86	28	19	5	4	21	26		1985-86	16	12	2	2	14	17		1985-86	61	41	10	10	20	24	
1986-87	63	47	13	3	22	28		1986-87	51	41	10	0	20	24		1986-87	7	7	0	0	0	0		1986-87	121	95	23	3	19	24	
1987-88	49	39	9	1	19	23		1987-88	49	37	11	1	23	30		1987-88	0	Poor weather conditions - no visibility						1987-88	98	76	20	2	21	26	
1988-89	61	48	13	0	21	27		1988-89	53	40	13	0	25	33		1988-89	28	22	6	0	21	27		1988-89	142	110	32	0	23	29	
1989-90	61	48	13	0	21	27		1989-90	70	57	13	0	19	23		1989-90	10	7	3	0	30	43		1989-90	141	112	29	0	21	26	
1990-91	62	54	8	0	13	15		1990-91	48	39	9	0	19	23		1990-91	6	5	1	0	17	20		1990-91	116	98	18	0	16	18	
1991-92	102	87	15	0	15	17		1991-92	66	52	12	2	19	23		1991-92	17	16	0	1	0	0		1991-92	185	155	27	3	15	17	
1992-93	68	57	11	0	16	19		1992-93	33	28	5	0	15	18		1992-93	3	3	0	0	0	0		1992-93	104	88	16	0	15	18	
1993-94	58	52	6	0	10	12		1993-94	40	33	7	0	18	21		1993-94	7	7	0	0	0	0		1993-94	105	92	13	0	12	14	
1994-95	67	54	13	0	19	24		1994-95	46	37	9	0	20	24		1994-95	10	7	3	0	30	43		1994-95	123	98	25	0	20	26	
1995-96	89	81	8	0	9	10		1995-96	32	28	4	0	13	14		1995-96	0	Poor weather conditions - no visibility						1995-96	121	109	12	0	10	11	
1996-97	37	32	5	0	14	16		1996-97	13	11	2	0	15	18		1996-97	4	4	0	0	0	0		1996-97	54	47	7	0	13	15	
1997-98	80	67	13	0	16	19		1997-98	44	38	5	1	12	13		1997-98	0	Poor weather conditions - no visibility						1997-98	124	105	18	1	15	17	
1998-99	64	54	10	0	16	19		1998-99	41	34	7	0	17	21		1998-99	5	5	0	0	0	0		1998-99	110	93	17	0	15	18	
1999-00	58	51	7	0	12	14		1999-00	40	28	12	0	30	43		1999-00	0	Poor weather conditions - no survey						1999-00	98	79	19	0	19	24	
2000-01	68	52	16	0	24	31		2000-01	31	19	7	5	27	37		2000-01	6	5	1	0	17	20		2000-01	105	76	24	5	24	32	
2001-02	44	37	7	0	16	19		2001-02	28	21	7	0	25	33		2001-02	2	2	0	0	0	0		2001-02	74	60	14	0	19	23	
2002-03	71	54	17	0	24	31		2002-03	39	35	4	0	10	11		2002-03	Poor weather conditions - no survey						2002-03	110	89	21	0	19	24		
2003-04	72	62	10	0	14	16		2003-04	56	41	15	0	27	37		2003-04	No survey						2003-04	128	103	25	0	20	24		
2004-05	118	100	18	0	15	18		2004-05	49	38	11	0	22	29		2004-05	No survey						2004-05	167	138	29	0	17	21		
2005-06	91	74	17	0	19	23		2005-06	57	42	12	3	22	29		2005-06	4	4	0	0	0	0		2005-06	152	120	29	3	19	24	
2006-07	75	58	17	0	23	29.3		2006-07	102	71	31	0	30	43.7		2006-07	No survey						2006-07	177	129	48	0	27	37		
2007-08	104	75	18	11	19	24.0		2007-08	76	49	17	10	26	34.7		2007-08	0	0	0	0	0	0		2007-08	180	124	35	21	22	28	
2008-09	94	54	14	26	21	25.9		2008-09	66	38	10	18	21	26.3		2008-09	No survey						2008-09	160	92	24	44	21	26		
2009-10	81	51	10	20	16	19.6		2009-10	128	93	29	6	24	31.2		2009-10	Poor weather conditions - no survey						2009-10	209	144	39	26	21	27		
2010-11	78	37	10	31	21	27.0		2010-11	94	55	29	10	35	52.7		2010-11	No survey						2010-11	172	92	39	41	30	42		
2011-12	43	30	9	4	23	30.0		2011-12	116	86	24	6	22	27.9		2011-12	1	0	0	1				2011-12	160	116	33	11	22	28	
2012-13	74	34	11	29	24	32.4		2012-13	103	77	20	6	21	26.0		2012-13	0	0	0	0	0	0		2012-13	177	111	31	35	22	28	
2013-14	45	22	5	18	19	22.7		2013-14	50	20	2	28	9	10.0		2013-14	No survey						2013-14	95	42	7	46	14	17		
2014-15	48	30	9	9	23	30.0		2014-15	45	21	6	18	22	28.6		2014-15	No survey						2014-15	93	51	15	27	23	29		
2015-16	65	47	14	4	23	29.8		2015-16	50	37	8	5	18	21.6		2015-16	No survey						2015-16	115	84	22	9	21	26		
2016-17	30	24	6	0	20	25.0		2016-17	40	22	4	14	15	18.2		2016-17	No survey						2016-17	70	46	10	14	18	22		
AVG	65					23.1		AVG	55					26.3		AVG	8.6						AVG	126.2							

Table 3. Average and maximum numbers of ungulates observed by species and winter season for all Lake Chelan Winter Wildlife surveys, 1982-83 through 2016-17.

Winter	Average # Observed					Maximum # Observed				
	Mountain goats		Mule deer		Bighorn Sheep	Mountain Goats		Mule Deer		Bighorn Sheep
	North shore	South shore	North shore	South shore	North shore	North shore	South shore	North shore	South Shore	North shore
1982-83	12.4	19.1	264.0	14.0		22	34	625	36	
1983-84	11.6	24.8	71.0	17.0		44	47	410	72	
1984-85	8.8	22.3	68.0	16.0		25	39	282	31	
1985-86	3.6	9.7	168.0	32.0		11	26	768	103	
1986-87	14.2	16.5	161.0	18.0		52	37	758	95	
1987-88	15.4	18.0	110.9	24.0		43	30	534	64	
1988-89	15.4	27.8	74.5	8.3		44	50	315	16	
1989-90	26.3	32.2	83.0	5.9		54	64	357	43	
1990-91	32.9	20.1	110.4	7.1		56	45	337	24	
1991-92	40.1	23.6	88.4	2.2		79	35	427	9	
1992-93	30.0	14.6	190.3	24.9		66	19	1039	75	
1993-94	19.4	14.8	31.8	13.3		52	28	156	32	
1994-95	29.8	14.0	157.5	25.4		59	31	536	69	
1995-96	27.3	10.5	94.3	19.8		86	30	539	81	
1996-97	10.5	3.2	221.5	50.5		35	8	709	123	
1997-98	25.3	11.6	40.3	4.8		70	34	211	34	
1998-99	27.6	11.6	34.8	4.9		56	24	143	32	
1999-00	13.3	7.3	46.3	2.2	1.3	34	20	375	8	2
2000-01	23.9	7.2	28.8	6.1	9.8	49	26	63	16	38
2001-02	14.0	9.8	41.3	8.6	10.2	29	27	192	29	46
2002-03	23.5	8.7	39.3	11.3	12.8	53	33	146	71	35
2003-04	26.0	17.2	77.3	15.3	29.4	77	48	388	65	82
2004-05	44.3	11.7	8.7	10.8	23.5	100	26	24	52	59
2005-06	28.3	18.0	125.4	49.7	37.5	78	41	429	160	79
2006-07	41.2	48.8	89.1	31.2	41.6	62	77	218	94	80
2007-08	48.4	20.8	164.4	42.9	28.8	97	42	388	131	51
2008-09	37.8	19.3	102.6	54.0	34.5	67	55	301	174	55
2009-10	36.3	59.5	83.8	46.3	34.7	56	108	257	111	58
2010-11	31.0	44.8	196.8	74.3	26.6	78	82	558	201	54
2011-12	23.0	47.0	37.0	34.6	18.3	43	108	93	97	44
2012-13	32.3	33.4	81.8	46.3	45.3	74	97	247	115	104
2013-14	20.1	11.2	87.5	25.6	37.0	45	32	364	71	100
2014-15	29.9	15.9	45.1	19.0	34.9	44	41	119	78	75
2015-16	20.9	21.6	69.6	47.1	44.6	64	46	195	191	90
2016-17	18.9	13.8	131.6	38.7	45.2	29	40	367	94	107
Average	24.7	20.3	97.9	24.3	28.7	max. 100	max. 108	max. 1039	max. 201	max. 104

Table 4. Mule deer herd composition (percent by shore) summarized by winter season for all Lake Chelan Winter Wildlife Surveys, 1982-83 through 2016-17.

Winter	North Shore										South Shore									
	% Does	% Fawns	% Bucks	# Classified	# UnClassified	Total	% Classified	% UnClassified	Fawns/100 adults	Bucks/ 100 does	% Does	% Fawns	% Bucks	# Classified	# UnClassified	Total	% Classified	% UnClassified	Fawns/100 adults	Bucks/ 100 does
1982-83	57	37	6	1286	598	1884	68	32			68	30	1	73	11	84	87	13		
1983-84	63	31	5	522	527	1049	50	50			66	26	8	119	127	246	48	52		
1984-85	52	37	11	186	625	811	23	77			71	24	5	75	116	191	39	61		
1985-86	68	27	5	258	1752	2010	13	87			66	31	3	74	304	378	20	80		
1986-87	75	23	3	473	1454	1927	25	75			54	29	17	35	186	221	16	84		
1987-88	64	32	4	684	644	1328	52	48			70	28	1	129	162	291	44	56		
1988-89	68	30	3	219	668	887	25	75			74	19	7	27	73	100	27	73		
1989-90	73	20	7	121	862	983	12	88			0	0	0	0	75	75	0	100		
1990-91	76	13	11	293	1032	1325	22	78			57	6	37	46	37	83	55	45		
1991-92	75	22	3	271	776	1047	26	74			90	10	0	10	16	26	38	62		
1992-93	66	29	4	437	1726	2163	20	80			60	23	18	80	220	300	27	73		
1993-94	90	8	2	89	293	382	23	77			74	18	8	92	67	159	58	42		
1994-95	67	25	7	621	1269	1890	33	67			68	27	4	156	148	304	51	49		
1995-96	75	19	6	295	837	1132	26	74			75	20	4	69	166	235	29	71		
1996-97	81	16	3	1411	1018	2429	58	42			80	16	5	296	266	562	53	47		
1997-98	89	8	3	38	448	486	8	92			0	0	0	0	57	57	0	100		
1998-99	77	21	2	39	380	419	9	91			50	30	0	2	57	59	3	97		
1999-00	53	29	18	17	539	556	3	97			67	33	0	12	14	26	46	54		
2000-01	66	32	3	162	183	345	47	53			68	26	6	37	36	73	51	49		
2001-02	68	26	6	147	344	491	30	70			72	19	9	32	78	110	29	71		
2002-03	66	33	0	9	464	473	2	98			56	21	13	16	119	135	12	88		
2003-04	61	27	12	173	715	888	19	81			64	29	7	45	138	183	25	75		
2004-05	64	36	2	44	60	104	42	58			64	32	4	28	102	130	22	78		
2005-06	66	34	0	55	1456	1511	4	96			61	30	9	124	479	603	21	79		
2006-07	55	37	8	919	145	1064	86	14			51	29	20	329	55	384	86	14		
2007-08	77	19	4	899	1074	1973	46	54	20.1	11.1	79	17	3	268	247	515	52	48	17.4	8.6
2008-09	82	17	2	778	453	1231	63	37	20.1	7.5	74	21	5	330	318	648	51	49	25.2	17.7
2009-10	55	11	1	559	279	838	67	33	19.1	5.1	39	10	2	237	226	463	51	49	25.6	14.3
2010-11	65	25	10	1694	689	2383	61	39	38.5	20.8	43	18	11	558	333	891	72	28	37.8	26.2
2011-12	42	8	2	232	212	444	52	48	18.1	18.9	54	13	2	286	129	415	69	31	23.0	28.6
2012-13	62	24	10	572	36	608	94	6	39.2	16.0	48	28	11	194	38	232	94	6	57.0	23.0
2013-14	65	20	0	635	240	875	73	27	30.8	0.0	28	25	6	143	113	256	56	44	90.0	20.0
2014-15	50	11	1	222	139	361	61	39	41.7	8.3	25	6	0	58	94	152	38	62	60.0	0.0
2015-16	53	22	3	525	241	766	69	31	41.1	5.4	56	18	3	331	187	518	64	36	31.6	5.3
2016-17	66	11	4	891	293	1184	75	25	16.1	6.5	66	18	8	255	93	348	73	27	28.0	12.0
AVG	67	23	5	451	652	1093	40	60	28.5	10.3	58	21	7	130	141	270	43	57	39.6	16.0

Table 5. Waterbirds observed per survey by species for all Lake Chelan Winter Wildlife Surveys, 2016-17.

Species	Survey												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
American Coot							9	10	8		8	7	42
American wigeon	136	345	384	203			295	305	220		220	191	2,299
Barrows goldeneye	15	25	2	28				2	23		11	12	118
Bufflehead	107	156	76	74			34	42	38		53	86	666
Canada goose	174	50	40	216			412	330	112		76	101	1,511
Common goldeneye	3	5	3	6			2	7	15		6	16	63
Common loon	1								1				2
Common merganser	1	4	2	11			3	3	6		4		34
Eared grebe									2		1		3
Gadwall							2		3		19	13	37
Great blue heron		2											2
Green-winged teal				24							39	52	115
Horned grebe	37	73	13	22			20	36	38		24	14	277
Hooded merganser		2										4	6
Lesser scaup			8	31			4						43
Mallard	15	32	17	55			98	134	28		71	45	495
Northern pintail												1	1
Pacific loon			2										2
Pied-billed grebe				3			3	1	1		1	1	10
Redhead	39	56	28	58			56	39	50		45	44	415
Ring-necked duck				83			146	220	176		136	113	874
Trumpeter swan	9	9	28	47			40	42			16	6	197
Western grebe				1									1
	537	759	603	862	0	0	1,124	1,171	721	0	730	706	7,213