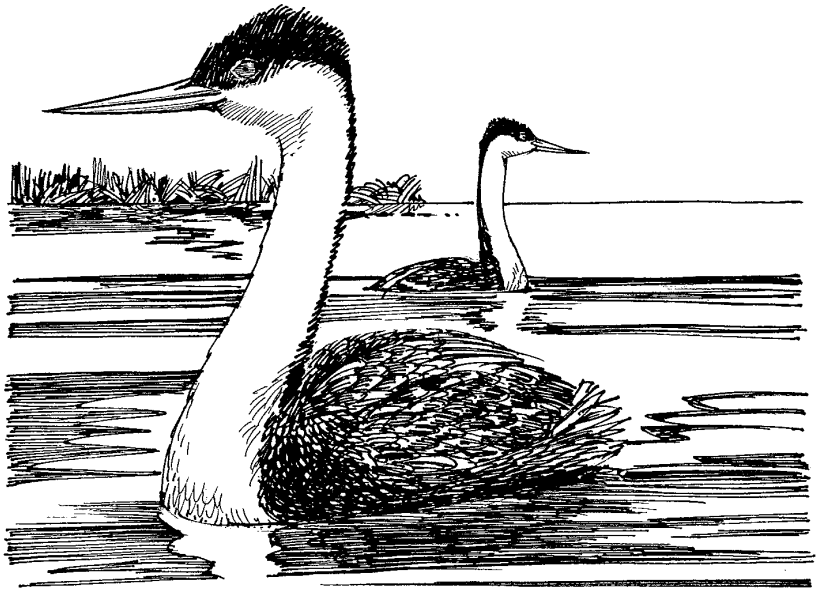
alberta's species at risk program

Status of the Western Grebe (*Aechmophorus occidentalis*) in Alberta:

Update 2012



Alberta Wildlife Status Report No. 60 (Update 2012)

Alberta Conservation Association

Alberta Government

Status of the Western Grebe (*Aechmophorus occidentalis*) in Alberta:

Update 2012

Prepared for:
Alberta Environment and Sustainable Resource Development (ESRD)
Alberta Conservation Association (ACA)

Update prepared by:
Mara Erickson

Much of the original work contained in the report was prepared by Jill Yanch in 2006.

This report has been reviewed, revised, and edited prior to publication.
It is an ESRD/ACA working document that will be revised and updated periodically.

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DEDICATION

This status report is dedicated to Kristina Norstrom, a committed and passionate wildlife biologist who worked for Alberta Fish and Wildlife (Alberta Environment and Sustainable Resource Development) and truly made a difference in wildlife conservation. Kristina willingly helped out on projects that rely on the cooperation of many Fish and Wildlife biologists, such as the province-wide, long-term study of the western grebe. She conducted aerial and boat-based surveys of western grebes, and waded through colonies to count nests. This sort of spirit and support from colleagues like Kristina is a big part of why we have been able to collect data on this species for this report. Sadly, Kristina died in a helicopter accident while doing aerial surveys of caribou in May 2013. She was well respected by her colleagues and will be deeply missed.

Alberta Fish and Wildlife, July 2013

PREFACE

Every five years, Alberta Environment and Sustainable Resource Development reviews the general status of wildlife species in Alberta. These overviews, which have been conducted in 1991 (*The Status of Alberta Wildlife*), 1996 (*The Status of Alberta Wildlife*), 2000 (*The General Status of Alberta Wild Species 2000*), 2005 (*The General Status of Alberta Wild Species 2005*), and 2010 (*The General Status of Alberta Wild Species 2010*), assign individual species "ranks" that reflect the perceived level of risk to populations that occur in the province. Such designations are determined from extensive consultations with professional and amateur biologists, and from a variety of readily available sources of population data. A key objective of these reviews is to identify species that may be considered for more detailed status determinations.

The Alberta Wildlife Status Report Series is an extension of the general status exercise, and provides comprehensive current summaries of the biological status of selected wildlife species in Alberta. Priority is given to species that are *At Risk* or *May Be At Risk* in the province, that are of uncertain status (*Undetermined*), or that are considered to be at risk at a national level by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Reports in this series are published and distributed by Alberta Conservation Association and Alberta Environment and Sustainable Resource Development. They are intended to provide detailed and up-to-date information that will be useful to resource professionals for managing populations of species and their habitats in the province. The reports are also designed to provide current information that will assist Alberta's Endangered Species Conservation Committee in identifying species that may be formally designated as *Endangered* or *Threatened* under Alberta's *Wildlife Act*. To achieve these goals, the reports have been authored and/or reviewed by individuals with unique local expertise in the biology and management of each species.

EXECUTIVE SUMMARY

The western grebe (*Aechmophorus occidentalis*) is a colonial waterbird that winters on the Pacific coast and migrates inland to breed at the shallow margins of medium to large lakes and wetlands. The species is local and uncommon in Alberta and exists only in North America, with a distribution that is widespread across the western and central parts of the continent. Historical data regarding colony locations and population sizes in Alberta are typically unavailable or are not comparable to recent data because different objectives and sampling techniques were used in different surveys. Thus, population trends over the long term are difficult to assess.

In 2007, the Minister of Alberta Sustainable Resource Development designated the western grebe as a *Species of Special Concern*. Several other provincial and state agencies in North America have also recognized the western grebe as a species of special management concern. The western grebe is ranked as *Sensitive* in *The General Status of Alberta Wild Species 2010*, based on the species' local distribution, sensitivity to human disturbance and habitat degradation.

In 2001, systematic surveys were initiated by the Fish and Wildlife Division of Alberta Sustainable Resource Development in central, northeastern and northwestern Alberta to fill in the knowledge gaps and create a foundation of comparable studies. Since 2001, nesting has been confirmed at 22 lakes in the province, and survey results suggest significant population declines and low reproductive success, primarily in the central and northeastern regions. A number of lakes that previously supported nationally important colonies of western grebes (more than 1000 breeding adults) now support only regionally important colonies (between 200 and 1000 breeding adults). These data were summarized in a 2006 status report on the western grebe. Since 2008, additional efforts were undertaken to locate any previously unknown western grebe breeding colonies in the province, as well as to better document lakes supporting fewer than 100 birds. Data compiled for this update show that 13 of 26 lakes in Alberta that historically supported large breeding colonies (100 or more birds with confirmed breeding) no longer do so, while no new large colonies to replace them have been discovered.

The greatest threats to the western grebe include human disturbance and habitat degradation (including oil spills and pollution), and reduction of its prey base. In some circumstances, fluctuations in water levels can be detrimental to western grebe breeding success. It is likely that the western grebe is more vulnerable than previously considered, and the species' presence in Alberta may be jeopardized in the long term.

ACKNOWLEDGEMENTS

For the original 2006 status report prepared by Jill Yanch:
I am very grateful to the following people and organizations that made this report possible: Sue Peters (Alberta Conservation Association [ACA]) provided guidance, and Hugh Wollis (Fish and Wildlife Division [FWD], a division of Alberta Sustainable Resource Development, Spruce Grove), Christine Found (FWD, Lac La Biche), Robin Gutsell (FWD, Spruce Grove), Wayne Nordstrom (Alberta Community Development), Tom Maccagno (Lac La Biche Birding Society), Lisa Priestley (Beaverhill Lake Bird Observatory), Amy Wotton (Lesser Slave Lake Bird Observatory), Ted Hindmarch (Beaver River Naturalists Society, Cold Lake), George Newton (Federation of Alberta Naturalists, Cold Lake), Marsha Hayward (Cold Lake), CN Environment and Gavin Berg (FWD, Spruce Grove) provided information on the western grebe in Alberta. Garry Bogdan (Canadian Wildlife Service, Wildlife Enforcement Branch) provided information on the Migratory Birds Convention Act, John Elliot (Canadian Wildlife Service) provided information on the western grebe in British Columbia, and David Nysewander (Washington Department of Fish and Wildlife, Puget Sound Ambient Monitoring Program) and John Bower (Western Washington University) provided information on coastal western grebe populations. Mark Heckbert (FWD, High Prairie) and Frank Fraser (Parks and Protected Areas Division, Alberta Community Development) assisted in tracking down data. Hugh Wollis, Morley Riske (Professor Emeritus, Augustana Faculty, University of Alberta), Sue Peters, Lisa Matthias (FWD, Edmonton) and Robin Gutsell reviewed this report and provided additional information. I would like to acknowledge the individuals and organizations that have directed efforts to western grebe research in Alberta, including Stephen Hanus (FWD, Spruce Grove; ACA), Lisa Wilkinson (FWD, Edson), Matt Hanneman (FWD, High Prairie), Mark Heckbert, Anne Hubbs (FWD, Athabasca), Hugh Wollis, Christine Found and Gavin Berg; Fish and Wildlife Division and the Lesser Slave Lake Bird Observatory.

Preparation of this report was funded by the Alberta Conservation Association and the Fish and Wildlife Division of Alberta Sustainable Resource Development.

For the 2012 update prepared by Mara Erickson:
M.E.E. would like to acknowledge the following individuals for their expertise and assistance in updating this report: Sue Peters (Alberta Conservation Association), Robin Gutsell (Alberta Environment and Sustainable Resource Development [ESRD]), Hugh Wollis (ESRD), and Wendy Calvert (Canadian Wildlife Service) reviewed and edited this report and provided additional guidance and information. Hugh Wollis, Kristina Norstrom (ESRD), Alain Fontaine (ESRD), Mark Heckbert, (ESRD), Christine Found (formerly with ESRD), Robin Gutsell, Chris Davis (ESRD), Dave DeRosa (formerly with ESRD), Gerard Beyersbergen (Canadian Wildlife Service), Wendy Calvert, and Gavin Berg (ESRD) provided updated data and valuable comments. The calculation of generation length benefited from discussions with Paul Smith (Smith and Associates Ecological Research Ltd.) and Rian Dickson (Pacific WildLife Foundation).

Preparation of this updated report was funded by Alberta Conservation Association and Alberta Environment and Sustainable Resource Development.

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INTRODUCTION

The western grebe (*Aechmophorus occidentalis*) is a member of the Podicipedidae family, an ancient lineage of piscivorous (fish-eating) diving specialists. It is a colonial-nesting waterbird that breeds on medium to large lakes and wetlands, and builds floating nests anchored to emergent or floating vegetation. Western grebes are local and uncommon in Alberta and their distribution is wide across western and central North America (Berg et al. 2004, Hanus et al. 2002a). Declines in some of Alberta's western grebe populations were noticed in the 1970s as a result of habitat loss, boating disturbances and the bioaccumulation effects of pesticides (Hanus et al. 2002a). The western grebe was designated as a *Species of Special Concern*[1] by the Minister of Alberta Sustainable Resource Development (Fish and Wildlife Division 2008). It is considered *Sensitive* in the province according to *The General Status of Alberta Wild Species 2010* (Alberta Sustainable Resource Development 2010b), because the species is highly sensitive to human activity and development, as well as habitat degradation (Fish and Wildlife Division 2005).

The western grebe has received little research and monitoring attention throughout its range, and the majority of historical information (prior to 2001) in Alberta comes from incidental observations and waterbird surveys. The nature of these early data prevents accurate comparison with more recent systematic surveys, making assessment of western grebe population trends problematic (Hanus 2002). This report summarizes historical and current information on the western grebe in Alberta as a step in establishing its status in the province.

[1] See Appendix 1 for definitions of selected status designations.

SPECIES TAXONOMY

The western grebe was split taxonomically in 1985 into the dark-phase western grebe (*Aechmophorus occidentalis*) and the pale-phase Clark's grebe (*Aechmophorus clarkii*) (Ahlquist et al. 1987, Monroe et al. 1985). The ranges of the two species across North America overlap, but are not well known (Semenchuk 1992, Stokes 1996). In Alberta, Clark's grebe breeds only in the extreme south of the province at sites such as Crow Indian Lake, Pakowki Lake and Verdigris Lake (Fisher and Acorn 1998, Semenchuk 1992). A geographically distinct subspecies of the western grebe, *Aechmophorus occidentalis ephemeralis*, exists in Mexico as a permanent resident with limited range (O'Donnel and Fjeldså 1997). This status report considers only the western grebe (*A. occidentalis*).

DISTRIBUTION

1. Alberta - Western grebes are local and uncommon in Alberta from April to October (Fisher and Acorn 1998, Wollis and Stratmoen 2010), and inhabit all natural regions in the province with the exception of the Canadian Shield and Rocky Mountain natural regions (Alberta Conservation Information Management System 2006, Hanus 2002). Breeding Bird Atlas surveys between 1987 and 1991 reported western grebes in 8% of surveyed squares in the Boreal Forest and Parkland natural regions, 6% in the Grassland Natural Region, and 2% in the Foothills Natural Region (Semenchuk 1992). Recent surveys indicate no change in distribution, although declines in relative abundance were noted in the Boreal Forest and Parkland natural regions, while an increase in relative abundance was noted in the Grassland Natural Region (Semenchuk 2007). Breeding occurs primarily in the Boreal Forest, Parkland and Grassland natural regions south of latitude 56° N (Figure 1; Hanus 2002, Kristensen and Nordstrom 1979, Semenchuk 1992). The species' requirement for a sufficiently long

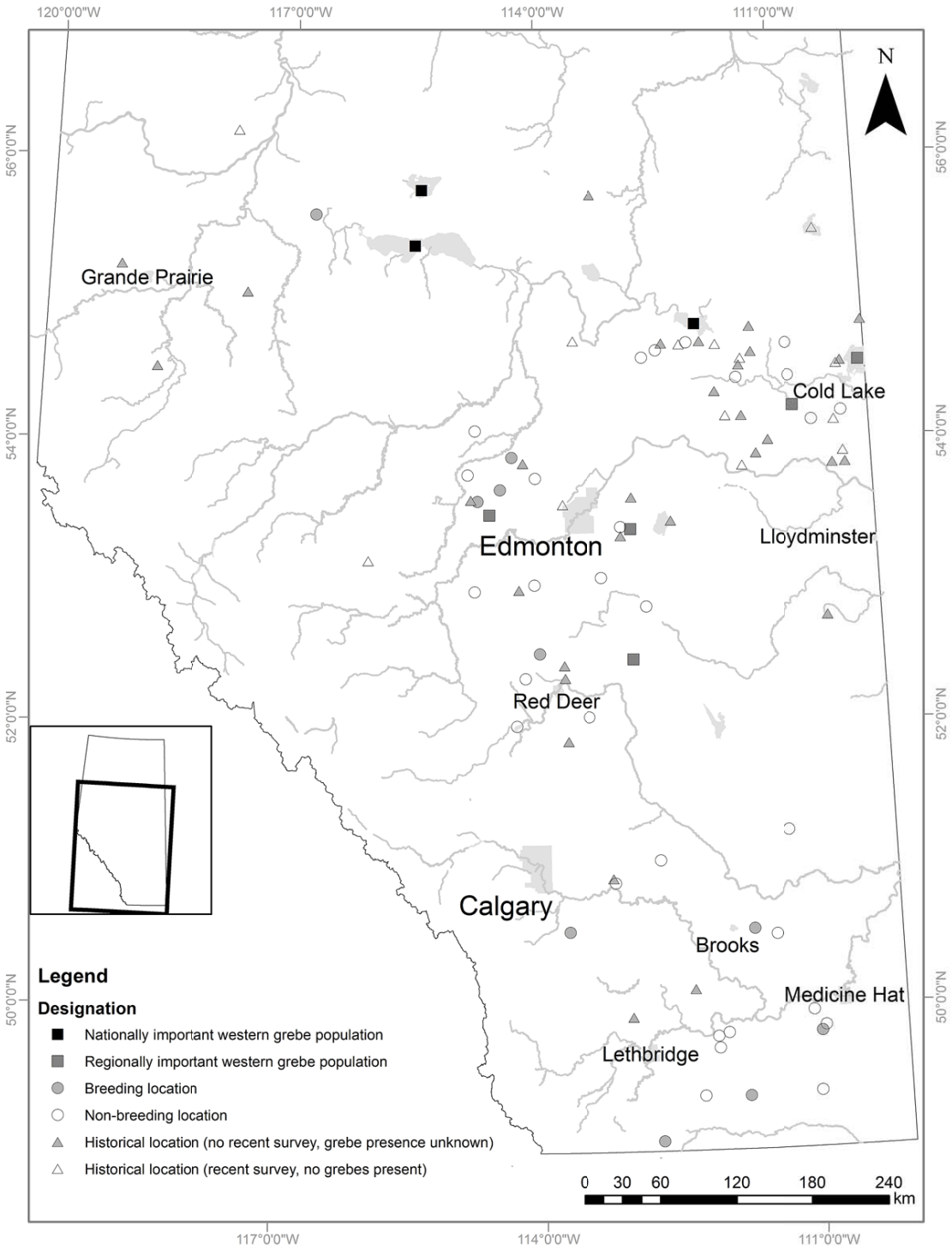

Figure 1. The distribution of western grebes in Alberta. Data are taken from the Fisheries and Wildlife Management Information System of Alberta Sustainable Resource Development (as of Nov. 2011). "Nationally important colonies" have records of more than 1000 breeding adults; "regionally important colonies" have records of between 200 and 1000 breeding adults; "breeding locations" have fewer than 200 western grebes; "non-breeding locations" have records of western grebes but no evidence of breeding; "historical locations" are separated into those that have not had recent surveys and therefore the presence/absence of grebes is unknown, and those that have had recent surveys (since 2004) with no records of western grebes. Lakes are assigned a designation based on their most recent survey.

ice-free period for nesting possibly prevents its expansion to areas further north. Based on their Alberta distribution (Figure 1), the extent of occurrence for western grebes in the province is approximately 186 400 km^2, which represents 39% of their range in Canada (Fraser 2000) and approximately 4% of their breeding range in North America (BirdLife International 2012a). The latter is an estimate based on the area of its distribution in Alberta relative to that in North America (Figure 2) and is not formally documented in the literature.

The area currently occupied by western grebe colonies in Alberta, as calculated by using standard 2-km by 2-km squares (IUCN 2001) for each colony, is 72 km^2. Western grebe colonies in Alberta vary in size, depending on habitat availability and suitability, and are much smaller than 4 km^2; colonies may be as small as 100 m x 30 m, such as at Lake Isle, or as large as 400 m x 300 m, such as at Cold Lake (A. Fontaine pers. comm., H. Wollis pers. comm.). Using a conservative overestimate of 0.15 km^2 for each breeding colony, the minimum area used by the species for breeding is less than 3.5 km^2 based on documented sightings of breeding grebes at 22 discrete locations in the past 10 years (see Appendices 2–4 for breeding locations). The minimum requirement for associated foraging habitat is unknown, but may be approximately 500 km^2 based on the area of the smallest lake that has supported a persistent colony (Lake Isle: 22.7 km^2) multiplied by 22 breeding lakes from the past 10 years.

The extent of occurrence has decreased from approximately 380 700 km^2 reported in 2006 (ASRD and ACA 2006) to the current estimate of 186 400 km^2. This decline is primarily happening in the central and northeastern parts of the species' range in Alberta. In the past 10 years, there have been more colony extirpations than re-colonizations, suggesting a decline in area of occupancy as well.

Surveys since 2001 report 22 sites with confirmed breeding activity and 26 additional occupied sites in Alberta (see Appendices 2–4); data collected from volunteer citizen scientists and submitted to eBird (http://ebird.org/) show an additional 22 non-breeding locations with 10 or more western grebes since 2002. However, relatively few lakes in the province support regionally important (200 to 1000 breeding adults), or nationally important (> 1000 breeding adults) colonies, as defined by Poston et al. (1990) (Table 1). The latest surveys of known breeding lakes conducted between May and August since 2009 (see Appendices 2–4) report three nationally important colonies at Lac la Biche, Lesser Slave Lake and Utikuma Lake in the Boreal Forest Natural Region; furthermore, Cold, Hastings, Moose, and Wabamun lakes in the Boreal Forest Natural Region, and Buffalo Lake in the Parklands Natural Region are considered regionally important sites (A. Fontaine pers. comm., K. Norstrom pers. comm., Wollis and Stratmoen 2010). Several sub-colonies may be formed on one lake, and their locations may vary depending on conditions (Burger 1997, Found and Hubbs 2004, Hanneman and Heckbert 2001, Hanus et al. 2002a). Colonies at both Cold Lake and Lake Isle have been recorded at previously used sites within the lake, stressing the importance of retaining nesting habitat on breeding lakes, even if western grebes use different areas of the lake from year to year (H. Wollis pers. comm.).

In addition to major breeding colonies, several historically occupied lakes in Alberta still support small numbers (<100 adults) of western grebes during the breeding season (see Appendices 2–4). These lakes may serve as important sites for non-breeding and/or transient adults, even if breeding activity is not confirmed. Despite their importance, these lakes are not included in the estimate of area of occupancy because this metric focusses on breeding colonies. In other cases where suitable nesting habitat has remained available, such as

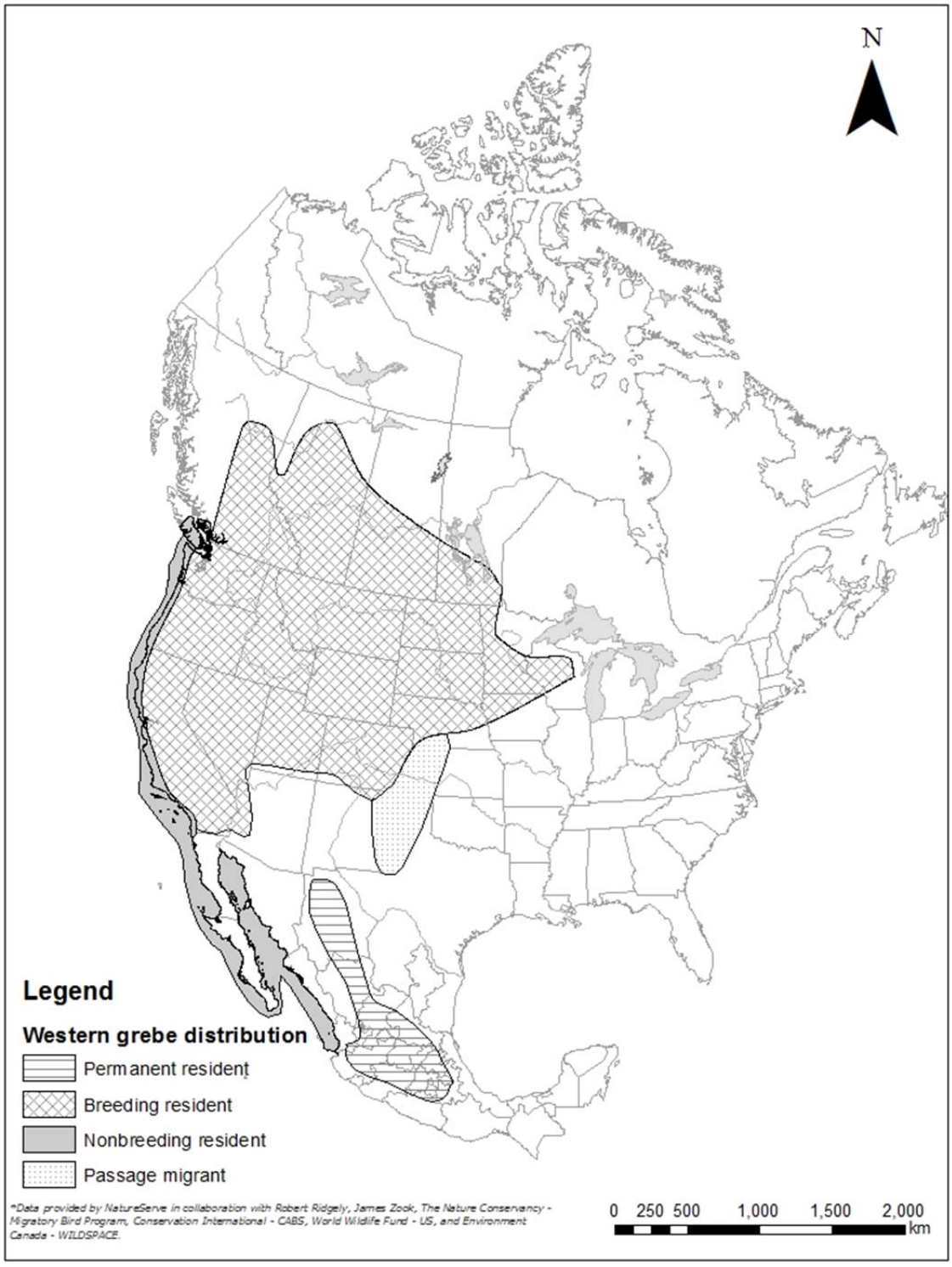

Figure 2. The distribution of western grebes in North America.

Table 1. Summary of lakes in Alberta supporting western grebe colonies of over 200 breeding birds (adapted from Hanus 2002). Bolded lakes currently hold a nationally- (> 1000 breeding birds) or regionally- (200–1000 breeding birds) important designation.

Natural Region	Lakes with 1000^{+} Birds (Date)	Lakes with 200 to 999 Birds (Date)
Boreal	Angling Lake (Unknown) Cold Lake (1970/78/89/2003/06) **Lac La Biche** (1980/88/2003/05/06/07/10) Lac Ste. Anne (1971/85/89/2001/03) **Lesser Slave Lake** (1979/2002/06/11) **Utikuma Lake** (2000/09) Wabamun Lake (2002/03/06)	**Cold Lake** (1980/81/83/85/2004/05/08) Frog Lake (1990/91) **Hastings** (2006/08/10) Lac Ste. Anne (1972/73/75/76/77/79/81/82/83/84/86/87 88/91//92/2002) Lesser Slave Lake (1970s/2000) **Moose Lake** (2008) Reita Lake (1981) Saskatoon Lake (1992) Wolf Lake (1985/88/89) **Wabamun Lake** (2001/04/07/08/10)
Foothills	N/A	N/A
Grassland	N/A	N/A
Parkland	Buffalo Lake (2006)	Beaverhill Lake (1960) **Buffalo Lake** (2008)
Rocky Mountain	N/A	N/A

at Lac la Nonne, adults with young have been documented after a few years of inactivity on the lake, further suggesting that western grebes may return to previously used sites.

Several lakes in Alberta appear to have been important migratory staging grounds for western grebes in the past. These include Frank Lake near High River, where 2200 western grebes were reported during fall migration in 1977, and Eagle, Namaka and Stobart lakes near Strathmore, where 1500 individuals were reported during spring migration in 1985 (IBA Canada 2004a, 2004b). No recent surveys have been conducted to determine use of the lakes as staging grounds.

2. Other Areas - The western grebe is found only in North America (Blood and Backhouse 1999). Its distribution is wide across the western and central parts of the continent, but is not well known (Figure 2; Berg et al. 2004, Stokes 1996). Western grebes breed from south-central British Columbia east through central and southern Alberta, central and southern Saskatchewan and southwestern Manitoba, central Minnesota and Wisconsin, and south through the western United States to northern New Mexico and west to California (Environment Canada 2002, Godfrey 1986, Ivey 2004, NatureServe 2011, Palmer 1962, Storer and Nuechterlein 1992). Western grebes migrate nocturnally to the Pacific coast to winter from southeastern Alaska and British Columbia south to central Mexico (British Columbia Resources Inventory Branch 1998, Burger 1997, NatureServe 2011). In addition, some grebes winter at inland lakes and reservoirs that do not freeze, from California east to Texas (Storer and Nuechterlein 1992), and are year-round residents at some of these lakes (Ivey 2004). Fall migration occurs from late August through mid-October, and spring migration inland occurs from late April through May (Campbell et al. 1990, Cannings et al. 1987, Semenchuk 1992, NatureServe 2011). Little is known about western grebe migration routes (Campbell et al. 1990).

HABITAT

Western grebes breed on large inland lakes and wetlands across eastern and central North America and migrate to the Pacific Coast to winter.

1. Alberta

1.1 Breeding Sites - Breeding western grebes have six basic habitat requirements (Forbes 1984):

1. A sufficiently long ice-free period to permit the growth of emergent vegetation and allow time for all phases of nesting.
2. Protection of nests from wind and wave action.
3. Sufficient water depth at the nest site for quick entry/exit (minimum 25 cm).
4. Stable water levels while nesting.
5. Access to open water with sufficient fish populations and free of vegetation.
6. Freedom from human disturbance.

The western grebe nests in large colonies (a group of nests spaced relatively close together within a given area), sometimes consisting of thousands of birds, at the shallow margins of medium to large lakes and marshes. Floating nests are constructed of plant material anchored to emergent vegetation such as cattails (*Typha* sp.), rushes (*Scirpus* spp.) or willows (*Salix* spp.). Good breeding sites are characterized by dense stands of this vegetation or, less favourably, thick mats of floating aquatic plants (Burger 1997, Ehrlich et al. 1992, Hanus et al. 2002a, 2002b, Semenchuk 1992, Stokes 1996). Nesting locations must be protected from wind and wave action to prevent flooding of nests—a major cause of nest failure as a result of storms or boat wakes (Storer and Nuechterlein 1992)—and they must be near enough to deep water to allow adults to either dive or exit the colony area if threatened (Nuechterlein 1975 in Kristensen and Nordstrom 1979). Relatively stable lake water levels during all periods of nesting are also required. During episodes of high water, emergent plants may not extend far enough out of the water to be useful for nesting, and during low water levels, shoreline plant growth may become too dense to accommodate the birds, or nests may be subject to tipping, breakage and stranding (Blood and Backhouse 1999, Burger 1997).

Once the young are ready to leave the nest, the birds spend the majority of their time foraging in open water. Western grebes select lakes that support adequate prey fish populations and provide access to deep, open water that is generally free of aquatic vegetation (Blood and Backhouse 1999, Burger 1997, Hanus et al. 2002a, 2002b, Semenchuk 1992). Lakes in Alberta that have historically sustained, or currently sustain, large colonies of more than 200 grebes (see Table 1) range from 7.5 km^2 to 1160 km^2 in area, and had/have average depths ranging from 1.7 m to 49.9 m (Hanus 2002, Mitchell and Prepas 1990).

The breeding distribution of the western grebe is limited by the availability of suitable lake and wetland habitats, and further restricted by human activity. Western grebes depend on large lakes for nesting and feeding requirements, and these lakes are often the most coveted by humans for recreation and cottage development (Berg et al. 2004, Hanus et al. 2003). In Alberta, trends toward increased tourism and agricultural, forestry, and oil and gas development (Schneider et al. 2003) have resulted in negative effects on waterbirds, including habitat alteration, fragmentation and loss, as well as increased access and human-caused disturbances mainly from boating, water-skiing, jet-skiing, wake-boarding and cottage development (Brechtel 1981, Burger 1997, Found and Hubbs 2004, Koonz and Rakowski 1985, Korschgen and Dahlgren 1992, Schneider et al. 2003, H. Wollis pers. comm.). Colonial waterbirds are highly vulnerable to these site-specific disturbances and habitat changes (Jurick 1985, Newbrey et al. 2005), and may adapt by colonizing in other areas (Poston et al. 1990). However, dispersal

to other sites or re-colonization of historical sites may be a problem for the western grebe if suitable habitat is not available as a result of land-use changes, habitat loss or human disturbance (H. Wollis pers. comm.). It appears that the species returns each year to historical breeding sites, thereby making it especially vulnerable (Berg et al. 2004).

There are several lakes in the province that have historically supported breeding populations of western grebes, but no longer do so despite the presence of apparently suitable nesting habitat. These include Thunder Lake in central Alberta, and Lac Sante, Ethel, Frog, Garner, Muriel, North Buck and Wolf lakes in the northeastern part of the province (Appendices 2 and 3; Found and Hubbs 2004, Hanus et al. 2002a).

1.2 Wintering Sites - In Alberta, observations of western grebes overwintering at Wabamun Lake, Waterton Lakes and in the Lethbridge area have been recorded (Semenchuk 1992). A portion of Wabamun Lake used to remain open during the winter as a result of the heat produced from the TransAlta Utilities Corporation Wabamun Generating Plant, built in 1956 near the village of Wabamun, allowing western grebes to overwinter on the lake. However, as of 31 March 2010, all TransAlta plants retired commercial operations on Wabamun (TransAlta 2010), so western grebes no longer overwinter there.

2. Other Areas

2.1 Migratory Staging Grounds - Western grebes migrate in loosely formed flocks and typically use large, deep lakes as staging grounds, often remaining for days to feed and rest (Campbell et al. 1990, Cannings et al. 1987, Fisher and Acorn 1998). In British Columbia, though the birds generally avoid areas of human activity, it does not appear that human disturbance or habitat alterations are negatively affecting the use of certain lakes for staging purposes (Burger 1997).

2.2 Wintering Grounds - In winter, western grebes reside on the Pacific coast in areas that provide sufficient fish populations for food, such as sheltered coastal bays and lagoons, and, uncommonly, some inland freshwater lakes (American Ornithologists' Union 1998 in NatureServe 2011, Anderson et al. 2011, Godfrey 1986, Semenchuk 1992, Stokes 1996).

CONSERVATION BIOLOGY

The western grebe is a member of the Podicipedidae (grebe) family, an ancient lineage that spans 80 million years and is not closely related to any other birds (Llimona and del Hoyo 1992). Of the 22 recognized species of grebes worldwide, three are extinct and five are considered either vulnerable or endangered (BirdLife International 2012b). The western grebe is North America's largest and most gregarious (living or moving in flocks or groups) grebe species. It measures approximately 64 cm in length and weighs up to 1.8 kg. The species is best distinguished by its long, curved neck, contrasting black and white coloration, red eyes and thin, sharp bill (Blood and Backhouse 1999, Fisher and Acorn 1998).

Western grebes feed on fish, which constitute between 80% and 100% of their diet, as well as molluscs, crustaceans and aquatic insects (Blood and Backhouse 1999, Stokes 1996). Their adaptations for diving—lobed toes and legs set far back on their body—facilitate their ability to obtain food underwater; these adaptations also make movement on land difficult (Godfrey 1986, Semenchuk 1992). Western grebes initiate moult and tend not to fly once they are established on a lake during their breeding season (Nuechterlein 1982, Piersma 1988). They spend nearly all of their time in the water and flight is limited other than migration, which occurs nocturnally in loose flocks. They breed in colonies and pairs become very aggressive when defending

the small territory around their nest, which results in a fairly uniform distribution of nests (Nuechterlein 1975 in Burger 1997).

Similar to other colonial waterbirds that exhibit site tenacity (Bongiorno 1970; Southern 1977), western grebes often occupy the same breeding lake year after year as well as the same colony location within that lake. According to historical reports from the late 1970s along with more recent surveys, western grebes have been returning to Cold Lake's Centre Bay for over 30 years (Found and Hubbs 2004, Kristensen and Nordstrom 1979). The breeding colony at Wabamun Lake remained in the same nesting area even after a Canadian National train derailment in 2005 spilled over 700 000 L of oil near the shore, most of which polluted the lake (Erickson 2010, Kemper et al. 2008). However, due to low power in detecting genetic differentiation between breeding colonies, coupled with limited re-sightings of banded birds, the degree to which individual western grebes exhibit breeding site fidelity is not well known (Anderson et al. 2011, Humple 2009). In the status update on the western grebe in British Columbia, Anderson et al. (2011) suggest that fidelity between wintering and breeding sites appears to be low, but that the use of stable isotopes may aid in determining the amount of migratory connectivity and site fidelity to both wintering and breeding sites.

Courtship begins shortly after arrival inland in late April and early May (Pease 2001). The spectacular courtship behaviour of the western grebe is a very complex and elegant dance consisting of a variety of calls, gestures and synchronized rushes (Fisher and Acorn 1998). Breeding generally occurs annually, but may be deferred during periods of unsuitable conditions (Nuechterlein 1975 in Burger 1997). Nesting generally peaks in June, but varies according to geographical location and seasonal factors such as the timing of ice-melt and water levels (Found and Hubbs 2004, Hanus et al. 2002a, 2003, Kristensen and Nordstrom 1979). Both sexes participate in nest building, incubation (approximately 23 days) and chick rearing. Young leave the nest once their down is dry, usually within hours after hatching, and are raised in deeper, open water on their parents' backs for the first week before becoming independent. This mobility makes it nearly impossible to study the growth and survivorship of individual broods. Fledging occurs at 49 to 51 days (Semenchuk 1992) and juveniles reach independence at 63 to 77 days (Palmer 1962, Storer and Nuechterlein 1992).

The reproductive biology of the western grebe in Alberta is poorly understood (Berg et al. 2004). The age of first breeding is not known but is probably by one year of age, similar to other grebe species including eared (*Podiceps nigricollis)* and red-necked (*P. grisegena*) grebes (Cullen et al. 1999, Storer and Nuechterlein 1992, Stout and Nuechterlein 1999); however, Eichhorst (1994), concluded that the age of first breeding for most western grebe individuals is probably two years. Therefore, age of first breeding is averaged at 1.5 years in this report.

Western grebes are single-brooded, with clutch (a complete set of eggs laid for one brood) sizes that vary among colonies (Semenchuk 1992 and references therein). Studies in Alberta show that mean clutch sizes range from one to four eggs per nest (Found and Hubbs 2004, Hanus et al. 2002a, 2002b), which is within the range of results reported in other studies conducted in Canada and the northwestern United States (Hanus et al. 2002a, Kristensen and Nordstrom 1979, Riske 1976). Clutch sizes observed in Alberta lie at the lower end of this range at Wabamun Lake (1.8 eggs/nest; Hanus et al. 2002a), Lac Ste. Anne (2.3 eggs/nest; Hanus et al. 2002a), Lac La Biche (1.2–2.4 eggs/nest; Found and Hubbs 2004), and Cold Lake (2.11 eggs/nest; Found and Hubbs 2004). Historically, clutch sizes at Lac Ste. Anne were generally 3 to 4 eggs per nest (Riske 1976) and 3 to 5 eggs per nest at Cold

Lake (Kristensen and Nordstrom 1979). The cause of this apparent reduction in clutch size is unknown.

A high proportion of empty nests and high rates of nest abandonment, likely indications of failed nesting attempts caused by disturbance, have been observed at Wabamun Lake and Lac Ste. Anne (Hanus et al. 2002a). Additionally, western grebes have low recruitment rates (the number of offspring entering the population each year), thus reducing the potential for population growth and recovery from decline (Forbes 1988, Hanus et al. 2002b). For example, the average number of young per adult at Lac Ste. Anne was documented at between 0.60 and 0.73 (Hanus et al. 2002a), and in British Columbia, 0.79 (Forbes 1988). The combination of the above factors suggests low reproductive success at many colonies in Alberta.

Survival rates in the wild for western grebes are not known, but adult survival for three grebe species in Europe was reported to range from 0.60–0.75 (Abt and Konter 2009). Using this reported range of survival rates as well as reproductive rates (above) from western grebes in Alberta and B.C., and a life-table-based calculation method suggested by IUCN Standards and Petitions Subcommittee (2013; see equation 1 on pg. 24 in this reference), generation length for western grebes is estimated to lie within a range of 2.5–5.2 years. Eichhorst (1994) considered that for western grebes a reasonable estimate of generation length was five years based on ratios derived from a correlation between age of first breeding and generation length. In addition, although average lifespan for western grebes is unknown, potential maximum longevity is estimated at 14 years (Environment Canada 2002); marked western grebes as old as 9 to potentially 16 years have been recovered (Eichhorst 1992). Therefore, for western grebes, a generation length nearer the higher end of the estimated range might be more likely. The IUCN recommends assessing a decline over three generations or 10 years, whichever is longer (IUCN 2001). Based on the lower end of the range calculated for generation length (2.5 years), three generations would be 7.5 years, which is less than 10 years; therefore, analysis of trend should be carried out on a minimum length of 10 years. Based on the upper end of that range (5.2 years), three generations would be 15.6 years, which is greater than 10 years; therefore, analysis of trend should be carried out on a maximum length for three generations of approximately 15 years.

POPULATION SIZE AND TRENDS

At the turn of the 20th century, tens of thousands of western grebes were killed for their feathers (Ehrlich et al. 1988, Storer and Nuechterlein 1992). With protection from some of North America's first conservation laws, the species appeared to rebound (Bower 2003), but declines were noticed again in the late 1950s when the prolific use of pesticides began to have negative effects on food chains (Center for Ecological Health Research 1998).

Western grebes have received little research and monitoring attention throughout their range in North America (Hanus et al. 2002a). This has been attributed to the following three factors: the species is not a game bird, its behaviour precludes traditional air- and ground-based surveys as it dives when disturbed, and its status has typically been unassessed or considered secure (Hanus et al. 2002a).

1. Alberta - In Alberta, populations showed signs of decline as early as the 1970s as a result of habitat loss, boating disturbances and the bioaccumulation effects of pesticides (Hanus et al. 2002a, Riske 1976). Population data for the province are limited; the majority of historical information comes from waterbird surveys (Purdy et al. 1983) and incidental observations collected after 1970 (Riske 1976), with an intensification beginning in 1990 (Hanus 2002).

A synthesis of provincial data up to 2002 can be found in Hanus (2002). The nature of these historical data prevents them from being easily compared to recent observations. Although the data provide insight into which Alberta lakes have supported grebe colonies in the past, estimates of population sizes and colony locations are typically unavailable. Thus, obtaining accurate population assessments and long-term trends for the western grebe is problematic (Hanus 2002).

Recently, efforts have been made to locate western grebe colonies throughout Alberta, quantify their populations and investigate reproductive success. Since 2000, a number of projects have begun, with initial surveys focusing primarily on central Alberta, as well as the northeastern and northwestern parts of the province. In 2008, additional lakes were surveyed in an attempt to encompass all natural regions that historically supported western grebes. This report addresses population trends within each region with a focus on recent studies, because of the inability to generate trends with historical data. Where possible, historical data are presented to reflect western grebe population changes in the areas studied since 2000 (see subsections, below).

When referring to Alberta's population of western grebes in this report, the term "estimate" indicates an enumeration of adult western grebes on a lake, either from individual counts of adult birds or an estimate of the lake's breeding population based on the number of nests counted in a western grebe colony (2 adults per nest). Because these surveys were often done only once per lake per breeding season, constructing confidence intervals for these "population estimates" is not possible. When tracking western grebe abundance over time, it is appropriate to use the population estimate derived from the enumeration method that yielded the highest estimate when more than one visit to a site was made; this is appropriate because with population estimates based on enumeration (i.e., counting only the nests/adult grebes that were actually seen), it is not possible to overestimate the true number of birds.

The most recent survey data compiled in 2011 indicate that Alberta is home to over 9500 breeding western grebes (9549; see Table 2); approximately 10% to 14% of the total North American population (estimated at 70 000 to 100 000; B. Eichhorst pers. comm. in O'Donnel and Fjeldså 1997). This is a decrease of just over one-quarter (28%) from the previous estimate of approximately 13 000 breeding western grebes compiled from comparable surveys in 2006 (13 316; ASRD and ACA 2006). If this rate of decline were to be extrapolated over 10 years, it would be equivalent to a decline of approximately 49%; extrapolated over the maximum estimate for three generations (15 years; see Conservation Biology section), it would be equivalent to a decline of approximately 63%. In Alberta, nationally- and regionally-important designations are confined to only a handful of lakes, including three sites of national importance (Lac La Biche, Utikuma Lake and Lesser Slave Lake) and five sites of regional importance (Buffalo, Cold, Hastings, Moose and Wabamun lakes) (Table 1; Wollis and Stratmoen 2010). The Cold Lake population declined in size from nationally important to regionally important since 2003 (K. Norstrom pers. comm.). Lake Isle and Lac Ste. Anne are no longer considered regionally important sites.

1.1. Central Alberta - A series of comprehensive surveys was initiated by the Fish and Wildlife Division of Alberta Sustainable Resource Development (ASRD) in 2001 to provide a foundation for monitoring western grebe populations in central Alberta. The study commenced in the Stony Plain study area (52 lakes initially, 11 592.6 km^2, Boreal Forest Natural Region, northwest of Edmonton), and expanded in 2004 to include the Parkland study area (11 lakes, Parkland Natural Region,

Table 2. Most recent abundance estimates from known western grebe breeding lakes in Alberta based on structured surveys; at some lakes, more recent observations have been made but these were not complete counts.

Study Area	Year	Lake	Estimated Number of Western Grebes*	Source
Northwest Alberta	2011	Lesser Slave	3504	A. Fontaine 2011 unpubl. data
	2009	Utikuma	1220	Wollis and Stratmoen 2010
	2011	Winagami	8	M. Heckbert 2011 unpubl. data
Northeast Alberta	2011	Cold	490	K. Norstrom 2011 unpubl. data
	2010	Hastings	~300	H. Wollis pers. comm.
	2010	Lac La Biche	1512	K. Norstrom 2011 unpubl. data
	2008	Moose	549	Erickson 2010
	2008	Lac la Nonne	31	Erickson 2010
Central Alberta	2011	Wabamun	380	H. Wollis unpubl. data
	2009	Gull	170	Wollis and Stratmoen 2010
	2009	Isle	130	Wollis and Stratmoen 2010
	2008	Buffalo	888	Wollis and Stratmoen 2010
Southern Alberta	2010	Frank	50	H. Wollis unpubl. data
	2010	Tilley 'B' Reservoir	~100	H. Wollis unpubl. data
	2009	Crow Indian	100	Wollis and Stratmoen 2010
	2009	Murray	107	Wollis and Stratmoen 2010
	2010	Pakowki	~10	H. Wollis unpubl. data
Total			**9549**	

** Abundance estimates represent a **minimum** estimate of western grebes for that year and were determined from nest counts (2 breeding adults per nest) or boat surveys of adult grebes (a total estimate of adults), whichever yielded the highest estimate.*

southwest of Edmonton). Descriptions and locations of the study areas are detailed in Hanus et al. (2002a) and Berg et al. (2004), and the data are summarized in Appendix 2 and Figure 3. The Stony Plain project was the first of its kind in Alberta and has served as a model for surveys throughout the province (Hanus et al. 2002a). Additional historically occupied lakes were surveyed in 2008, in order to obtain a complete census of western grebe breeding colonies (Erickson 2010).

1.1a Stony Plain Study Area (Boreal Forest Natural Region) - The total annual population in the Stony Plain study area has ranged from 380 to 2554 grebes since 2001, with marked drops in 2004, 2005, 2007 and 2011 (Figure 3; Berg et al. 2004, Wollis and Stratmoen 2010). The population decreased from 2003 to 2004 by approximately 54%, and again by approximately 36% from 2004 to 2005 (Wollis and Stratmoen 2010). In 2006, the region's population estimate nearly doubled because of an increase in breeding adults at Wabamun Lake, but this appears to be an isolated occurrence as regional estimates decreased in 2007 to previous levels (Wollis and Stratmoen 2010).

Since 2001, breeding has occurred consistently on only three lakes of the 52 initially surveyed: Wabamun Lake, Lac Ste. Anne and Lake Isle, which are also the three largest lakes in the study area (Appendix 2, Figure 3). These colonies have been present for over 20 years at Wabamun Lake and Lake Isle, and over 30 years at Lac Ste. Anne (Hanus et al. 2002a). Local populations at each lake have shown

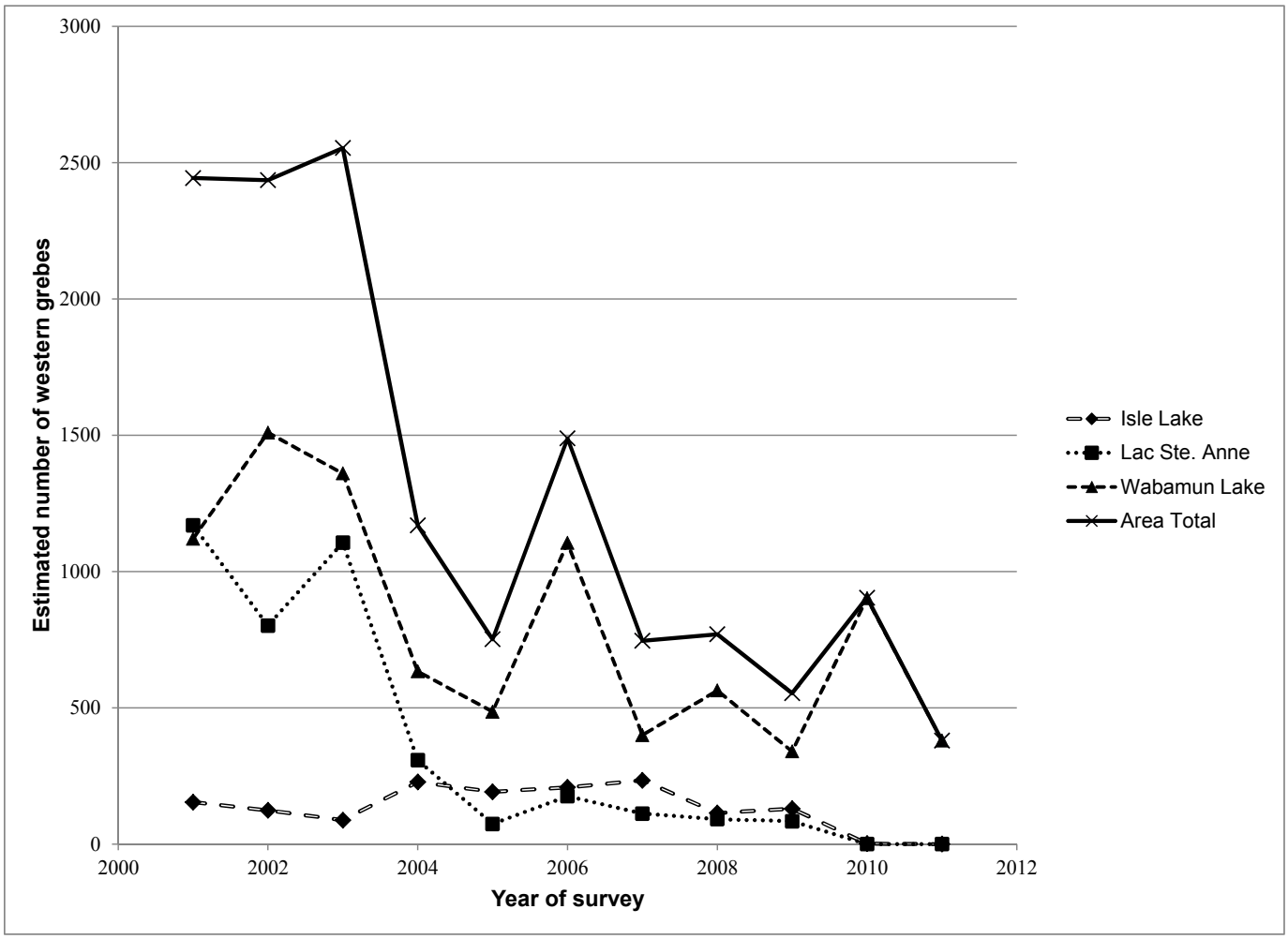

Figure 3. Estimated number of adult breeding western grebes in the Stony Plain area, including Lake Isle, Lac Ste. Anne and Wabamun Lake between 2001 and 2011. Abundance estimates represent a minimum estimate of western grebes for that year and were determined from nest counts (2 breeding adults per nest) or boat surveys of adult grebes (a total estimate of adults), whichever yielded the highest estimate.

considerable fluctuations in size over the years. In 2004, colonies at Wabamun Lake and Lac Ste. Anne were the largest in the study area and represented 54% and 26% of the Stony Plain study area population, respectively. Both showed significant declines from 2003 to 2004 and again in 2005 (Wabamun: -53% and -23%; Lac Ste. Anne: -72% and -76%) (Berg et al. 2004).

On 3 August 2005, a Canadian National train derailment near the summer village of Whitewood Sands Beach on Wabamun Lake spilled over 700 000 L of bunker fuel and pole-treating oil into the lake. Final numbers show that at least 368 western grebes, approximately 76% of Wabamun Lake's 2005 population, were affected by the spill. Of these, 333 birds were found dead or were euthanized, and 35 were cleaned and released elsewhere (CN Environment pers. comm. to J. Yanch in 2006, G. Berg pers. comm. to J. Yanch in 2006). Very few juveniles were found; almost all of the birds found were adults, suggesting the 2005 breeding production at the lake was considerably affected. Interestingly, the population at Wabamun Lake more than doubled from 2005 to 2006, but declined again

in 2007 to levels lower than the 2005 (pre-oil spill) estimate. Since 2007, abundance estimates have fluctuated from year to year, with 2011 estimates at the second lowest since 2001 (H. Wollis pers. comm.).

The colony at Lac Ste Anne has declined since surveys began in 2001, with the exception of slight increases in 2003 and 2006. Once considered a nationally important colony in 2001 and 2003, Lac Ste Anne has supported fewer than 200 adults since 2005 (Table 1). No individuals were observed in 2010 and 2011.

The Lake Isle colony remained relatively stable from 2004 to 2009, with estimates ranging from 113 to 234 breeding adults. No breeding colony was observed in 2010, although two adults with young were spotted on the lake that year (H. Wollis pers. comm.). Nesting western grebes were recorded in 2011 at a former colony site. This is one of three recorded incidents of re-colonization of an abandoned site within a breeding lake in Alberta (H. Wollis pers. comm.). An attempt at a nest count in 2011 was unsuccessful, most likely because storm activity damaged the nests prior to surveying (H. Wollis pers. comm.).

Throughout the Stony Plain study area, no new colonies have been recorded since surveys in the 1970s. It is unclear whether the three adults noted at Big Lake in 1982 (Purdy et al.1983) were remnants of a former colony or transient non-breeders. Individuals observed on Lac La Nonne and Thunder Lake during recent surveys in 2008 and Sandy Lake in 2006 may also represent remnants of historically documented breeding populations; these lakes provide suitable nesting habitat, yet few individuals have been found. Breeding has not been confirmed at Thunder Lake since the early 1970s, but adults with young have been documented at Lac la Nonne (Erickson 2010, Hanus et al. 2002a).

1.1b Parkland Study Area (Parkland Natural Region) - Surveys in the Parkland study area were initiated in 2004. Results showed that 9 of the 11 lakes surveyed supported a total of 711 western grebes in 2004, but breeding was not confirmed at any of the lakes at that time (Appendix 2). The greatest numbers of birds were observed at Gull and Buffalo lakes, which supported 45% and 43% of the population, respectively. A survey in 2005 found two breeding colonies at Buffalo Lake, but no count of nests was made (H. Wollis pers. comm.). Population estimates at Buffalo Lake in 2006 and 2008 documented a breeding population of 1030 and 888 adults, respectively. Gull Lake appears to support a fluctuating population (ranging between 25 and 320 adults since 2004) of western grebes. Breeding at Gull Lake is suspected, but a colony site has not been found (Wollis and Stratmoen 2010).

Historical information suggests that Beaverhill Lake supported over 600 western grebes in 1960, despite having been dry in the 1920s. Although Beaverhill Lake was not included in the Parkland study area, it is known that the lake no longer supports the birds, except during migration, as it has been virtually dry since around 2003 (L. Priestley pers. comm. to J. Yanch in 2006). Western grebes may be able to re-colonize the lake if the habitat becomes suitable again (H. Wollis pers. comm.).

1.2 Northeast Alberta (Boreal Forest Natural Region) - In 2000, Alberta Environment began a long-term monitoring program to measure the relative abundance and occurrence of colonial nesting species, waterfowl and other waterbirds in the Lac La Biche/Athabasca area, and to assess lakeshore habitat and shoreline development. Surveys for the productivity and nesting success of western grebes, consistent with those initiated in central Alberta, were later integrated into the program (Found 2004).

Survey results suggest a trend toward an overall decline in the regional western grebe population (Appendix 3). At least 18 lakes in the Northeast area of the Boreal Forest region supported western grebe colonies in the 1980s (Hanus 2002 in Found and Hubbs 2004). During a 2003 survey of those 18 lakes plus an additional 51 lakes in that region, only 9 lakes of the historical 18 were occupied by western grebes, 7 of which had confirmed breeding activity: Lac La Biche, Angling, Cold, Hastings, Wolf, Moose and Muriel lakes (Found and Hubbs 2004). Two additional lakes supported small numbers of non-breeding individuals (Manatokan Lake, 1 western grebe; Missawawi Lake, 30-55 western grebes) (Found and Hubbs 2004). The regional population at that time was estimated at 7554 breeding adults, with Lac La Biche and Cold Lake as the dominant colonies, accommodating 61% and 26% of the total population, respectively (Found and Hubbs 2004). Both lakes supported nationally important colonies in 2003 (Found and Hubbs 2004). In 2008, 4266 western grebes were observed on 13 of 28 lakes surveyed in the region, with four lakes supporting breeding colonies: Cold, Hastings, Lac La Biche and Moose lakes[2]. Angling Lake had supported approximately 50 adults in 2005, but breeding activity was not confirmed and subsequent surveys documented only one adult in 2008. The Cold Lake population accommodated 14% of the regional population in 2008, and has since decreased in relative abundance. The local population at Hastings Lake has fluctuated considerably over the past several years, but has supported a breeding colony of between 120 and 346 adults since 2007. Lac la Biche, the only nationally important colony in this area, continues to support the largest percentage of the regional population (71%), but has decreased in relative abundance by 50% between 2008 and 2010. The regionally important breeding colony at Moose Lake increased slightly by 7% from 2006 to 2007 and again by 46% from 2007 to 2008 when it accommodated 13% of the regional population. It appears that many lakes in the region that historically supported breeding populations no longer do so. These include former colonies on Lac Sante, Ethel, Frog, Garner, Muriel, North Buck and Wolf lakes (Found 2004, Found and Hubbs 2004, Found unpubl. data 2005). However, small numbers of non-breeding grebes continue to be documented on many of these lakes (Appendix 3).

1.3 Northwest Alberta (Boreal Forest Natural Region) - The most extensive studies in the northwest portion of the Boreal Forest Natural Region include a 36-lake survey conducted in 2000 by the Fish and Wildlife Division of ASRD (Hanneman and Heckbert 2001), and periodic surveys of Lesser Slave Lake over the last 30 years (Eadie 2002, Fraser 2000). In 2001, the Lesser Slave Lake Bird Observatory initiated western grebe surveys to locate colonies, estimate the number of breeding adults on the lake, identify possible threats, and begin assessing lakeshore nesting habitat suitable for western grebes. Survey methods were expanded and standardized in 2002 (Eadie 2002). Historical and current data for northwestern Alberta are summarized in Appendix 3.

The most recent surveys from the northwest area of the Boreal Forest Region (conducted between 2009 and 2011) indicate a regional western grebe population of 4732, concentrated primarily at Lesser Slave Lake with 74% of the regional population and Utikuma Lake with 26% of the regional population. Winagami Lake had a small number (<1% of the regional population) of breeding adult western grebes, but a colony was not located (A. Fontaine pers. comm.).

[2] Abundance estimate calculated using data from the 2008 field season, with the exception of Lac la Biche, which was surveyed in 2007.

Between 2002 and 2006, the Joussard colony population at Lesser Slave Lake had declined by 27%, and no breeding activity was evident at the historical site from 2007 to 2010. The absence of breeding from 2007 to 2009 may have been due to high water levels, which allowed the ice to scour the dead emergent vegetation from the previous year (H. Wollis pers. comm.). This left no shelter or building material for nests until new vegetation could emerge from the water. The low density and the delay in growth precluded adequate emergent vegetation growth for the establishment of nests. In addition, disturbance from an adjacent marina development in 2009 and 2010 may have affected the breeding activity of western grebes during this time (A. Fontaine pers. comm.).

The emergent plant structure at the Joussard colony site in 2010 and 2011 had improved from that in 2008–2009 (A. Fontaine pers. comm.). In 2011, western grebes bred at the historical site with population estimates of over 3500 breeding adults, based on nest counts conducted using aerial photography (A. Fontaine pers. comm.).

The first population estimate for Utikuma Lake was in 2000 at more than 1700 birds, based on an aerial survey. In 2006, the colonies could not be found. Subsequently, researchers have been unable to conduct proper nest counts, although A. Fontaine (pers. comm.) estimated 1220 breeding adults in 2009 and has noted the colonies have been occupied since then. It may be the case that western grebes bred at Utikuma Lake when the habitat at Lesser Slave Lake was poor and vice versa, as the local populations increased in opposite years.

1.4 Southern Alberta (Grassland Natural Region) - In 2004, many lakes in the Grassland Natural Region of southern Alberta were surveyed for waterbirds. Western grebes were present on 10 lakes, and 295 adults were identified (Appendix 4). However, breeding activity was evident only at Shanks and Crow Indian lakes, accounting for 48% of the total number seen. In 2009–2010, breeding activity was documented on five lakes: Crow Indian, Frank, Murray, Pakowki, and Tilley 'B' Reservoir. With the exception of Pakowki, where only a handful of grebes were observed, abundance estimates ranged from 50 to 107 breeding adults at the other four lakes (H. Wollis pers. comm.). Clark's grebes may also be present in this area of the province but are distinguishable from western grebes by their bright orange-yellow bill and white eye-line, and as a result of their low numbers would not have greatly affected western grebe counts in this area or in the provincial count overall.

Fluctuating water levels in southern Alberta play a role in the suitability of lakes to support western grebes. For example, Pakowki Lake had higher water levels in 2010 than in the previous decade and western grebes were observed, but a count was not feasible (H. Wollis pers. comm.). Additional surveys are needed in this region to better assess population trends, site fidelity and habitat suitability.

1.5 Provincial Summary – Major breeding sites for the western grebe in Alberta are confined to only a handful of lakes, including three nationally important breeding lakes and five regionally important breeding lakes. Recent surveys suggest significant population declines in central and northeastern parts of the province with the exception of Moose Lake, which has experienced an increase in abundance. Local populations appear to be increasing in northwestern Alberta at Lesser Slave Lake and potentially Utikuma Lake, although abundance estimates at the latter location have been logistically difficult to obtain (A. Fontaine pers. comm.). Cold Lake, Lac Ste. Anne and Wabamun Lake have decreased from sites of national importance since 2003, with Lac Ste. Anne no longer

supporting a breeding colony (Table 3). It appears that many lakes in the northeastern region that historically supported populations no longer do so, including former colonies on Lac Sante and Frog, Garner, Muriel, North Buck and Wolf lakes (Table 3; Found 2004, Found and Hubbs 2004, Found unpubl. data 2005). Western grebes are actively breeding on select lakes in the Parkland and Grassland natural regions, and continued annual surveys for abundance will help to evaluate population trends better. Nine breeding lakes that have been surveyed at least five times since 2000 have shown considerable fluctuations in population estimates over the past 10 years (Figure 4). However, across the province, 13 out of 26 lakes in Alberta that have historically supported large breeding colonies (100 or more birds with confirmed breeding since 1957) no longer do so (Table 3), while no new large colonies to replace them have been discovered.

Several lakes throughout the province, known to have historical breeding populations of western grebes, have been observed to support small numbers of the species (see Appendices 2–4), although these populations are not consistent from year to year. However, they may be serving as important sites for transient adults or, in some cases (such as Gull Lake or Lac la Nonne, where young have been observed), may have retained enough suitable habitat for the re-establishment of a colony.

2. Other Areas - The lack of comparable time-series population data for the western grebe in Alberta mirrors the situation across the species' range. However, there are many indications that western grebe populations are declining in several locations throughout Canada and the United States (Bower 2003, Burger 1997, Ivey 2004, Koonz and Rakowski 1985, Nysewander et al. 2005, Puget Sound Action Team 2004).

2.1 Breeding Sites - In British Columbia, two of the five primary western grebe nesting sites in the province have been abandoned, and the small breeding population at the three remaining sites is threatened by human disturbance (Anderson et al. 2011, Burger 1997). Declines in breeding populations are also noted in southern Manitoba (Koonz and Rakowski 1985), Washington, where the western grebe is being considered for legal designation (Gaydos and Nysewander 2011 in Anderson et al. 2011)), and California (Ivey 2004, Robison et al. 2008).

2.2 Wintering Grounds - The southern Strait of Georgia, B.C., and adjacent Puget Sound, Washington, are believed to support the greatest winter densities of western grebes in the species' range (Bower 2003, Burger 1997). The most comprehensive historical marine bird census of this area was the Marine Ecosystems Analysis Puget Sound Project (MESA), conducted during 1978–1979. The study used a wide variety of survey techniques to assess hundreds of sites and transects in 13 regions off the mouth of the Strait of Juan de Fuca, the Washington mainland, the Canadian Gulf Islands and Port Townsend (Wahl et al. 1981 in Bower 2003).

More recent studies designed to be compared with the historical MESA data have commenced in the same areas. These studies include the Puget Sound Ambient Monitoring Program—an extensive research project that initiated marine bird surveys in 1992—and surveys conducted by researchers from Western Washington University and Simon Fraser University. When compared to MESA results, these studies showed declines ranging from 80% to over 95% in western grebe wintering populations over the last 25 years, and suggested that this trend is consistent along the Pacific coast of the northern U.S. and Canada (Anderson et al. 2009, Anderson et al. 2011, Bower 2003, Nysewander et al. 2005, Puget Sound Action Team 2004). However, increases in western grebe populations along the coast of southern California suggest that, while still exhibiting an overall coastal decrease, western grebes

Table 3. Summary of lakes in Alberta that once had large breeding colonies (over 100 birds) but no longer have active colonies. Highest breeding population estimates and most recent estimates are presented here; for the complete data set and data sources, see Appendices 2 and 3.

Lake (P = Parkland Region, B= Boreal region)	**Year**[1]	**Number of Western Grebes**[2]	**Breeding Confirmed** (Y = yes, N= no/unknown)	**Comments on potential cause (H. Wollis, pers. comm.)**
Angling Lake (B)	1981 2008	1680 1	Y N	
Beaverhill Lake (P)	1960 2009	600 0	Y N	Virtually dry in 2013
Buck Lake (P)[3]	1978 2008	136 32	N N	
Conn Lake (B)	1993 2009	300 0	Y N	
Frog Lake (B)	1991 2008	600 0	Y N	On 26 June 1992 it was noted that the water level in lake was getting very low
Garner Lake (B)	1985 2008	102 0	Y N	
Lac Sante (B)	1993 2008	150 0	Y N	
Lac Ste. Anne (B)	1985 2010	1500 0	Y N	Uncertain as to cause of abandonment– heavy use by boaters, many cabins, construction of marina and cottage development adjacent to site
Muriel Lake (B)	2003 2008	>760 40	Y N	Water level very low
North Buck Lake (B)	1991 2008	124 2	Y N	
Reita Lake (B)	1981 2008	532 0	Y N	Water level dropped substantially
Thunder Lake (B)	1968 2008	100+ 4	Y N	Fish winter kill, increased boating activity
Wolf Lake (B)	1985 2008	720 0	Y N	

[1] For specific dates of surveys, see the original reference listed in Appendices 2 and 3.

[2] Abundance estimates represent a minimum estimate of western grebes for that year and were determined from nest counts (2 breeding adults per nest), boat surveys of adult grebes (a total estimate of adults), or incidental sightings, whichever yielded the highest estimate.

[3] Breeding was confirmed in 1972 at Buck Lake

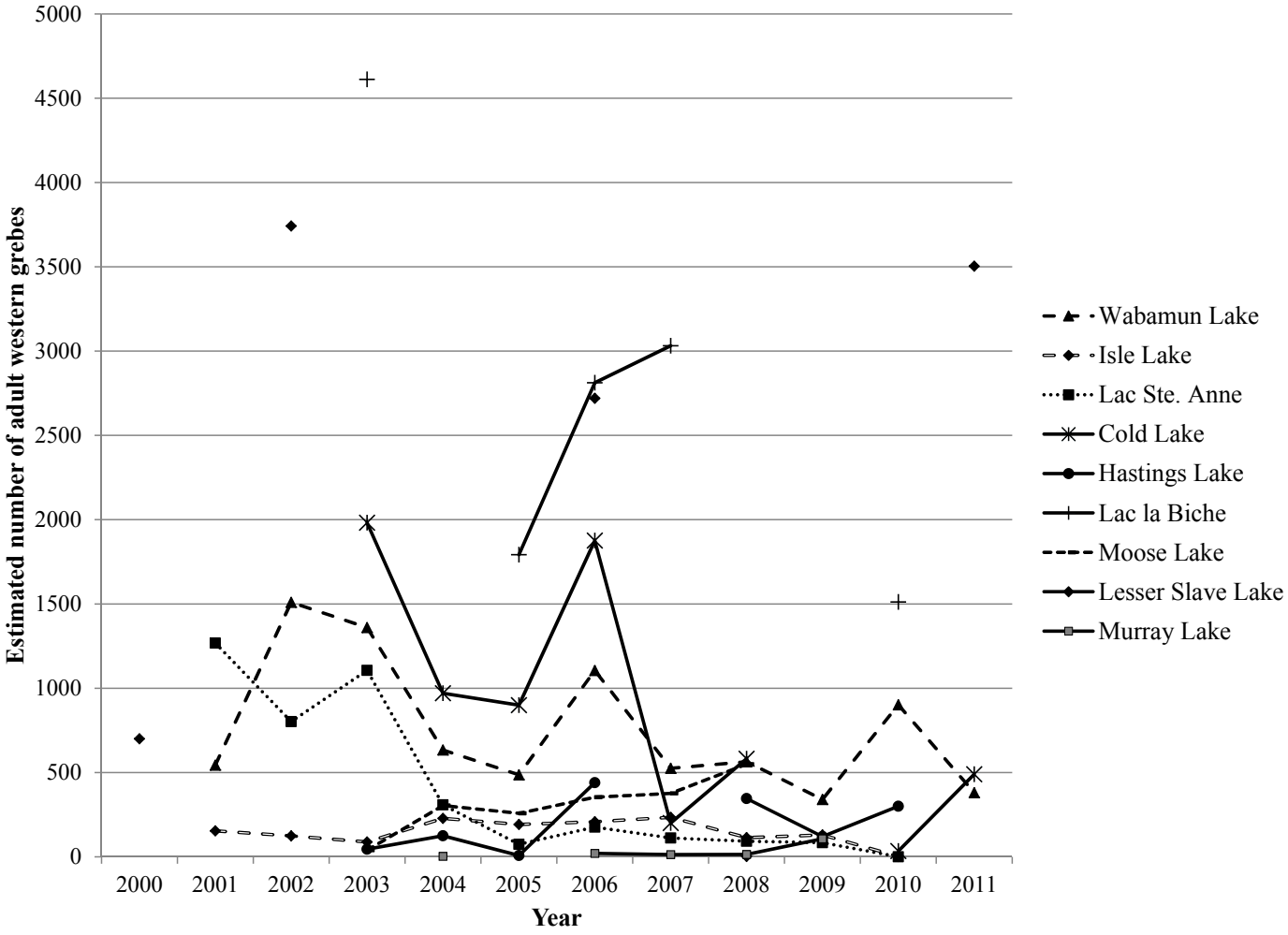

Figure 4. Estimated number of adult breeding western grebes from lakes that were surveyed at least five times since 2000 and have had breeding status since at least 2004. Not all lakes were surveyed every year. Abundance estimates represent a minimum estimate of western grebes for that year and were determined from nest counts (2 breeding adults per nest) or boat surveys of adult grebes (a total estimate of adults), whichever yielded the highest estimate. See Appendices 2-4 for abundance estimates depicted in Fig. 4.

are also shifting their centre of distribution southward (Anderson et al. 2011).

Christmas Bird Count data also show considerable declines in western grebe wintering populations. Since 2004, the population of the entire coastal region of British Columbia, Washington, Oregon and California has declined by 44% (National Audubon Society 2011). It is important to note that although Christmas Bird Counts provide data over long periods of time, they are no substitute for larger systematic surveys. These counts do not account for birds using pelagic areas (referring to the open sea), and several factors may lead to overestimations in recent counts, including an increased number of observers over time, increased effort over time, and the incorporation of boats in more recent surveys (Bower 2003).

LIMITING FACTORS

Limiting factors are those that can affect habitat quality and availability, reproductive success, and survival of the western grebe, thereby making the species more susceptible to population decline. Some natural limiting

factors include fluctuating water levels before colony establishment and during nesting, storms with high wind, egg depredation and disease (Berg et al. 2004, Burger 1997, Hanus et al. 2002b).

The colonial behaviour of western grebes exposes them to single and localized events that can have serious implications for entire colonies. It is likely that site-specific conditions are contributing to the declines observed at breeding sites in Alberta, and that cumulative effects of the following factors are negatively affecting the species locally, regionally and throughout its range (Berg et al. 2004, Hanneman and Heckbert 2001, Hanus et al. 2002a, Jurick 1985, Nysewander et al. 2005).

1. Habitat Degradation - Habitat degradation was identified as a major threat to Alberta's western grebes over 30 years ago (Riske 1976). The ongoing draining of wetlands and small water bodies for residential, industrial or agricultural expansion may have hydrological effects on the watersheds used by western grebes (for example, Beaverhill Lake and Big Lake; H. Wollis pers. comm.). The clearing of emergent vegetation for housing, cottage and dock or marina development reduces and fragments viable nesting habitat at many Alberta lakes (see Table 4). At Wabamun Lake, a distinct line of cleared and uncleared emergent vegetation is obvious along the shores, with virtually no emergent vegetation in front of the cottages (H. Wollis pers. comm.). The western grebes nest in the intact portion that lies in front of undeveloped private land. At Lac Ste. Anne, a large condominium and marina is being developed adjacent to the former western grebe colony (H. Wollis pers. comm.). At Lesser Slave Lake, a marina was in development adjacent to the western grebe colony site from 2008 to 2010. A stop order was enforced by the Department of Fisheries and Oceans in 2011 (A. Fontaine pers. comm.). Shoreline development is thought to be a major factor in the extirpation of western grebes at some lakes in British Columbia (Anderson et al. 2011, Burger 1997).

Cattle grazing, power boating and snowmobile activity can also damage breeding habitat. Grazing of shoreline vegetation and boating can reduce the extent of emergent vegetation and can pose a threat to the colonies of Lesser Slave Lake (Eadie 2002). Snowmobiles that drive over reed beds in the winter result in broken and submerged reeds the following spring. This occurred at Lake Isle in 2002, and forced the western grebe colony to relocate to an area of sparser vegetation, increasing the colony's exposure to wind, avian predators and competition from other nesting birds (Berg et al. 2004). In addition, intentional manipulation of lake water levels (either by raising or lowering), or the introduction of invasive wetland plants, can cause changes in habitat composition and lead to a significant decrease in reproductive success (British Columbia Resources Inventory Branch 1998, Hanus et al. 2002b).

2. Human Disturbance - The sensitivity of western grebes to human disturbance has been well established. Development and recreational activities, including boating, water-skiing and personal watercraft use, cause wave, audio and visual disturbances that can threaten nests and degrade the viability of the colony sites. The number of boats, size of motors and types of water sports have increased dramatically on Alberta's lakes, exacerbating these negative effects (Berg et al. 2004, Found 2004, Hanus et al. 2002a; see Table 4). Recreational wakeboarding with boats designed to produce a powerful wake can cause problems for colonies on recreational lakes such as Wabamun Lake (H. Wollis pers. comm.). Newly hatched western grebe chicks ride on their parents' back for the first week of their life, then swim on their own in the open water. They are very vulnerable to boat traffic at this time. A boat that approaches these birds at a high rate of speed often causes the young bird to become separated from the parent because the parent

Table 4. Assessment of threats from development and recreational activity at known western grebe breeding lakes (with 100 or more birds) in Alberta.

Study Area	Year	Lake	Estimated proportion of provincial population[1]	Amount of recreational activity on lake (H/M/L)[2]	Minimum % Shoreline Developed[3]	Comments on threats and high counts over recent years (H. Wollis, pers. comm.)
Northwest Alberta	2011	Lesser Slave (a)	37%	H	7.3	Subject to water level fluctuations. In 2008 water level rose dramatically, which precluded nesting on the traditional site. Grebes did not seem to nest elsewhere on the lake. A large marina development is proposed nearby.
	2009	Utikuma	13%	L	<1	In 2000, 1702 grebes observed; subject to winterkill
Northeast Alberta	2011	Cold	5%	H	6.9	In 1979, 1000 nests were counted by Fish and Wildlife personnel
	2010	Hastings	~3%	H	19.2	In 1990, 225 grebes observed
	2010	Lac La Biche	16%	H	16.4	In 1981, 3124 grebes observed
	2008	Moose	6%	H	31.0	Substantial boating.
Central Alberta	2011	Wabamun	4%	H	33.4	In 2001, 1120 grebes observed. Recreational boating has and continues to increase substantially. Water lever in lake raised dramatically in 2007 leading to reduction in suitability of traditional nesting site.
	2009	Gull	2%	H	6.1	Western grebes may no longer be breeding at this lake. There is considerable recreational boating and cottage development.
	2009	Isle	1%	H	30.9	In 2002, 154 birds observed nesting in two adjacent colonies. Low water levels, considerable recreational boating and extensive cottage development.
	2008	Buffalo	9%	H	6.9	
Southern Alberta	2009	Crow Indian	1%	L	Unknown	Part of an irrigation system so subject to dramatic changes in water levels.
	2009	Murray	1%	L	<1	Part of an irrigation system and subject to dramatic water level changes.

[1] Proportions were calculated based on a provincial population estimate of 9549 (see Table 2).

[2] Based on the number of public boat launches and the amount of development along the shoreline; in some cases, the rank was modified based on personal observations of M. Erickson (Erickson 2010), publically available information about the lake (e.g., popular fishing location), and information in satellite imagery of the shoreline.

[3] Based on digitized aerial photos, as used in Erickson (2010). Numbers represent minimum values, as some aerial photos are outdated by 8-10 years.

may dive, either causing the chick to fall off its back, or re-surfacing a distance away (H. Wollis pers. comm.). Repeated disturbance may permanently isolate the young bird, making it very vulnerable to predation. The long-term impact of recreational disturbance may be evident at Thunder Lake, where suitable nesting habitat is available but no longer used (Hanus et al. 2002a). Declines at Thunder Lake began after the establishment of Thunder Lake Provincial Park, development of boating access, and a general increase in human presence (J. Kinnaird pers. comm. in Hanus et al. 2002a). Birding enthusiast and long-time resident of the Barrhead area, J. Kinnaird, regularly visited a western grebe colony on Thunder Lake in the early 1960s. Subsequent to his observations, the lake was developed for boating recreation with boat ramps and docks. The site no longer has an active colony of western grebes; however, whether the decline was caused by recreation, winterkill of fish or other causes is unknown (H. Wollis pers. comm.).

Additionally, historical colony sites at Lac Ste. Anne (Purdy et al. 1983) are no longer active in areas that now maintain high boat traffic and other human disturbance (Hanus et al. 2002a, H. Wollis pers. comm.). Boating disturbance was a primary factor leading to western grebe extirpation at some lakes in British Columbia (Burger 1997), and also may be affecting the Wabamun Lake colony (H. Wollis pers. comm.).

Western grebes exhibit strong avoidance behaviour in the presence of humans (Burger 1997, Hanus et al. 2002a). When nesting sites are approached, the adults leave the nest and move into open water until the threat is gone. As the birds often do this hastily, eggs do not get covered with vegetation to protect them from extreme temperatures and predators, eggs may be knocked into the water, or hatchlings left in nests may be permanently separated from their parents (Berg et al. 2004, Kristensen and Nordstrom 1979). This can have severe impacts on the overall productivity of the colony, and areas subject to frequent disturbance have high rates of nest abandonment and low reproductive success (Berg et al. 2004, Hanus et al. 2002b, Kristensen and Nordstrom 1979, Riske 1976). It is likely that nest predation by crows, ravens and gulls contributed to the population declines and low reproductive success observed at Lac Ste. Anne, Wabamun Lake and other lakes. This problem is exacerbated by human disturbance factors (Berg et al. 2004, Found 2004, Kristensen and Nordstrom 1979). At Wabamun Lake, for example, there is a large population of crow nests near the traditional western grebe colony (H. Wollis pers. comm.).

3. Oil Spills - The gregarious behaviour of western grebes makes them highly vulnerable to oiling mortality, both in their wintering and breeding habitats. Oil spills in coastal regions can span vast areas and kill thousands of birds (Curtis 2005, NatureServe 2011). The spill at the breeding site of Wabamun Lake in August of 2005 occurred after the nesting period and the oil was prevented from entering the primary nesting habitat. However, the event negatively affected at least 76% of the lake's adult western grebe population immediately (through birds either dying or being captured, cleaned and released) and may affect future generations through long-term effects on the ecosystem and the condition of the breeding birds (H. Wollis pers. comm.). In 2010, there was still residual oil near the current western grebe colony site, and therefore still poses a potential threat to birds in the colony, as it takes only microlitres of oil to damage an egg (G. Berg pers. comm., Szaro et al. 1978, H. Wollis pers. comm.).

4. Pollution - Western grebes, like many piscivorous waterbirds, are subject to elevated levels of chlorinated hydrocarbons and heavy metals magnified in the food chain. These chemicals accumulate in their bodies and can affect immunological and neurological processes, reduce eggshell thickness and reproductive success, and cause high adult

mortality rates. The effects of pollution on the western grebe were noticed as early as the 1950s in the United States, and though some recovery occurred after the ban of DDT in the 1970s, subsequent studies show that pollution from agricultural and industrial applications is still a problem (Elbert and Anderson 1998, Elliot and Martin 1998, Forsyth et al. 1994, Hanus et al. 2002a, Herman et al. 1969, Kraft 1983 in Burger 1997). In Alberta, exposure to pollution may result from the runoff of fertilizers, pesticides and herbicides into lakes and marshes (Priestley 2002). Industrial activities including power generation, transportation and petroleum production add to pollution, as do cottage use and other recreational activities (H. Wollis pers. comm.), although it is unknown what effect these sources of pollution currently have on Alberta's population of western grebes.

5. Reduction of Prey Base - A stable isotope analysis of the food web of Lake Wabamun, Alberta indicated that western grebes eat larger fish species and forage offshore in deeper water; this suggests that the fish community and lake morphometry are important components in determining which lakes this species will use (Newbrey et al. 2012). Changes in forage fish populations caused by commercial fisheries (C. Davis pers. comm. in Found and Hubbs 2004), pollutants, alteration of spawning habitat, introduction of sport or invasive fish species, and climate change likely affect western grebe populations (Bower 2003, Puget Sound Action Team 2004).

6. Sport and Commercial Fishing - Fishing at lakes inhabited by western grebes also brings the side effect of disturbing birds, and potentially causes problems if waste fishing line is discarded into the water. Grebes tangled in line and unable to fly have been observed on Alberta lakes, and are likely indicative of a widespread problem (H. Wollis pers. comm). Thus, it is important to teach anglers about proper disposal of waste line (Berg et al. 2004, Masterman 2004).

During certain commercial fishing operations, fishermen have been known to take many diving ducks, loons and grebes. C. Davis (pers. comm.) stated there could be as many as 100-150 western grebes killed annually in nets on Lac la Biche. Former Slave Lake fisheries biologist D. DeRosa (pers. comm.) suggested there were many western grebes killed on both Utikuma and Lesser Slave Lake as a result of the fisheries.

7. Water Level Fluctuations - Natural fluctuations in water levels can provide opportunities for grebe nesting habitat to develop, as has occurred at Lake Isle. Here, dropping water levels have allowed expansion of reed beds and of the western grebe colony (H. Wollis pers. comm.). Increased water levels in the southern part of the province may have allowed for the establishment of western grebes on lakes and reservoirs that were previously unsuitable, although these colonies tend to be unstable from year to year. In other circumstances, fluctuations in water levels can be detrimental to western grebe breeding success. The break-up of ice during the spring at lakes with high water levels can shear off the previous year's emergent vegetation, leaving no old growth for the establishment of nests (W. Calvert pers. comm., H. Wollis pers. comm.). This was most likely a contributing factor to the absence of a colony at Lesser Slave Lake in 2007, as the existing vegetation was too sparse to provide adequate protection for nests (H. Wollis pers. comm.). Decreased water levels in the northeast part of the province have rendered once suitable reed beds too dense for western grebes to use, especially if they are not able to engage in their normal diving activity (Wollis and Stratmoen 2010).

STATUS DESIGNATIONS[3]

1. Alberta - The western grebe is identified as a *Species of Special Concern* in Alberta after

[3] See Appendix 1 for definitions of selected status designations.

a 2006 assessment by the Endangered Species Conservation Committee [ESCC] and its Scientific Subcommittee (Alberta Sustainable Resource Development 2010a). The ESCC requested a re-evaluation of the western grebe within five years because of concerns regarding its population decline (R. Gutsell pers. comm.). The species is also protected under Alberta's *Wildlife Act* as a "non-game species." This provides basic protections against activities such as killing, harassment, possession and trafficking, as well as protection of the nest. Western grebes are included in the Alberta Conservation Information Management System's Watch List as S3 (Alberta Conservation Information Management System 2011, NatureServe 2011), and are currently considered *Sensitive* in Alberta (Alberta Sustainable Resource Development 2010b) based on the species' local distribution and sensitivity to human disturbance, as well as habitat degradation.

2. Other Areas - The status of the western grebe has not yet been assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC); however, a report on the national status is in preparation. According to *Wild Species 2010: The General Status of Species in Canada*, the species is considered *Secure* in Canada, *May Be At Risk* in British Columbia and *Secure* in Saskatchewan and Manitoba (Canadian Endangered Species Conservation Council 2011). The western grebe has been assigned to the provincial Red List in British Columbia (B.C. Conservation Data Centre 2012) as a result of population declines, few active breeding sites, and the vulnerability of those sites to habitat degradation and human disturbance. It is protected under the British Columbia *Wildlife Act* as a non-game species (Burger 1997).

The global heritage rank of the western grebe is G5, with the last global review occurring in 1996 (Alberta Conservation Information Management System 2007, NatureServe 2011), and the species is included in the IUCN Red List Category of Least Concern (O'Donnel and Fjeldså 1997). National conservation status for the species in Canada is N3 for the non-breeding population and N5 for the breeding population. National conservation status for the species in the United States is N5 for both breeding and non-breeding populations, though state rankings (primarily for breeding populations) range from S1 (Kansas, Wisconsin), to S2 (Idaho), S3 (Arizona, Nebraska, New Mexico, Oregon, Texas, Washington), and S4 (Colorado, Montana, Nevada, South Dakota, Utah, Wyoming). The species is currently Not Ranked/Under Review in California, North Dakota and Minnesota (NatureServe 2011). The western grebe is a candidate species for listing as *Sensitive*, *Threatened* or *Endangered* in Washington State (Washington Natural Heritage Program 2011). The species is protected federally under the *Migratory Birds Convention Act, 1994*, which protects migratory birds and their nests from disturbance and "take," defined as possession, sale, purchase, barter, transport, import and export. Ivey (2004) proposed that in the United States, abandonment of nests caused by anthropogenic factors can also be considered as take. In Canada, there has never been a case that has dealt with the specific issue of "take" and human disturbance (G. Bogdan pers. comm. to J. Yanch in 2006).

The western grebe was on the North American Blue List each year from 1973 to 1986. By 1982, the population appeared to be stabilizing at a "reduced level," and in 1986, the species was delisted to a species of "special concern" (Tate 1986 in Semenchuk 1992). Though not a legal designation, the Blue List was designed to identify patterns of impending or ongoing serious losses in regional bird populations (National Audubon Society 2004).

RECENT MANAGEMENT IN ALBERTA

Recent management for the western grebe in the province has been concentrated in central Alberta. This includes public education through the establishment of public awareness signs (a total of 11 signs at five lakes within the Stony

Plain study area), presentations and newsletter articles (for further details see Hanus et al. 2002b). Protective notations (PNTs) have been applied for, or established, at all of the western grebe colonies in central and northwestern Alberta. These notations give management guidelines and show allowable land uses for that area (Alberta Sustainable Resource Development 1997). Progress is being made in this matter in the additional regions in Alberta (Hanneman and Heckbert 2001, Hanus et al. 2002b, Found 2004, Wollis and Stratmoen 2010). Several breeding sites have been listed as Important Bird Areas (IBAs) in part because of the western grebe colonies they support (Lac La Biche, Lesser Slave and Utikuma lakes), and IBA Conservation Plans have been created for Lac La Biche and Lesser Slave Lake that outline site-specific needs for education, habitat protection and enhancement, enforcement, research and monitoring (Fraser 2000, Gammon 2000). Cold Lake was not included during the initial Alberta IBA screening in 1999, but efforts are being made to rectify this (G. Newton pers. comm. to J. Yanch in 2006). Lac La Biche is recognized as a Provincial Bird Sanctuary and regulations prohibit disturbance (except in cases where access is required) or hunting of birds found on the lake surface or its islands (Gammon 2000). Regions in central and southern Alberta are within the boundaries of the international *Northern Prairie and Parkland Waterbird Conservation Plan* area, which recognizes the western grebe as a species of high concern (Beyersbergen et al. 2004). The plan provides an overview of the status and current knowledge of waterbirds and waterbird habitat in the region, and outlines strategies and priorities for monitoring, research and management.

SYNTHESIS

The western grebe is highly sensitive to habitat alteration and human disturbance, and recent studies suggest significant population declines are continuing in central and northeastern Alberta, with trends toward low reproductive success and extirpation. Nationally and regionally important breeding sites are limited to a handful of lakes in the province and several have shown alarming rates of population decline. The colonial nature of western grebes contributes to their sensitivity. While the evolutionary advantage of colonial nesting can be effective in natural, low-disturbance systems, it can be compromised by large-scale disturbances or human development. Unlike the red-necked grebe, which is dispersed over all available habitat on a lake and may still thrive even if development or human interaction alters a portion of nesting habitat, western grebes do not exhibit the same mobility. Therefore, it is important to focus on the larger western grebe colonies (50 nests or more) for the purpose of conservation.

The western grebe may be more vulnerable than previously believed and its status in Alberta may be jeopardized in the long term. Monitoring for this species in Alberta should focus on principal sites already identified, as well as increased investigation into other areas of the province (e.g., Grassland Natural Region, where surveys were recently initiated) to gain more accurate population estimates for future assessments. Historically occupied lakes that continue to support small numbers (<100 adults) of western grebes should also be monitored regularly, as these sites have the potential for colony re-establishment as long as suitable habitat is retained, a prey-base exists and disturbance is limited. Research is also needed on clutch sizes, brood survival, natural and human-related causes of breeding failure, and habitat use (Berg et al. 2004, Burger 1997, Hanus et al. 2002b). Another important data gap is the level of site fidelity western grebes exhibit for a particular breeding site.

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Appendix 1. Definitions of status ranks and legal designations.

A. The General Status of Alberta Wild Species 2010 (after Alberta Sustainable Resource Development 2010b)

2010/2005 Rank	1996 Rank	Definitions
At Risk	Red	Any species known to be *At Risk* after formal detailed status assessment and designation as *Endangered* or *Threatened* in Alberta.
May Be At Risk	Blue	Any species that may be at risk of extinction or extirpation, and is therefore a candidate for detailed risk assessment.
Sensitive	Yellow	Any species that is not at risk of extinction or extirpation but may require special attention or protection to prevent it from becoming at risk.
Secure	Green	Any species that is not *At Risk, May Be At Risk* or *Sensitive*.
Undetermined	Status Undetermined	Any species for which insufficient information, knowledge or data is available to reliably evaluate its general status.
Not Assessed	n/a	Any species that has not been examined during this exercise.
Exotic/Alien	n/a	Any species that has been introduced as a result of human activities.
Extirpated/Extinct	n/a	Any species no longer thought to be present in Alberta (Extirpated) or no longer believed to be present anywhere in the world (Extinct).
Accidental/Vagrant	n/a	Any species occurring infrequently and unpredictably in Alberta, i.e., outside its usual range.

B. Alberta Species at Risk Formal Status Designations
Species designated as *Endangered* under Alberta's *Wildlife Act* include those listed as *Endangered* or *Threatened* in the Wildlife Regulation (in bold).

Endangered	**A species facing imminent extirpation or extinction.**
Threatened	**A species likely to become endangered if limiting factors are not reversed.**
Species of Special Concern	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Data Deficient	A species for which there is insufficient scientific information to support status designation.

C. Committee on the Status of Endangered Wildlife in Canada (after COSEWIC 2010)

Extinct	A species that no longer exists.
Extirpated	A species that no longer exists in the wild in Canada, but occurs elsewhere.
Endangered	A species facing imminent extirpation or extinction.
Threatened	A species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
Special Concern	A species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
Not at Risk	A species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient	A category that applies when the available information is insufficient to (a) resolve a wildlife species' eligibility for assessment, or (b) permit an assessment of the wildlife species' risk of extinction.

Appendix 1 continued:

D. Heritage Status Ranks: Global (G), National (N), Subnational (S) (after Alberta Conservation Information Management System [formerly Alberta Natural Heritage Information Centre] 2007, NatureServe 2011)

G1/N1/S1	5 or fewer occurrences or only a few remaining individuals. May be especially vulnerable to extirpation because of some factor of its biology.
G2/N2/S2	6 to 20 or fewer occurrences or with many individuals in fewer locations. May be especially vulnerable to extirpation because of some factor of its biology.
G3/N3/S3	21 to 100 occurrences; may be rare and local throughout its range, or in a restricted range (may be abundant in some locations). May be susceptible to extirpation because of large-scale disturbances.
G4/N4/S4	Typically > 100 occurrences. Apparently secure.
G5/N5/S5	Typically > 100 occurrences. Demonstrably secure.
GX/NX/SX	Believed to be extinct or extirpated; historical records only.
GH/NH/SH	Historically known; may be relocated in the future.
G?/N?/S?	Not yet ranked, or rank tentatively assigned.

E. United States Endangered Species Act (after National Research Council 1995)

Endangered	Any species that is in danger of extinction throughout all or a significant portion of its range.
Threatened	Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Appendix 2. Summary of historical and current information on western grebes in central Alberta. Only lakes associated with western grebes during the breeding season, either historically or currently, are included in this appendix.

Lake (S = Stony Plain Study Area, P = Parkland Study Area)	**Year**[1]	**Number of Western Grebes**[2]	**Breeding Confirmed** (Y = yes, N= no/unknown)		**Source**
Beaverhill Lake (P)	1960	600	Y		C. Hampson pers. comm. in Hanus 2002
	2009	0		N	Wollis and Stratmoen 2010
Big Lake (S)	1982	3		N	Purdy et al. 1983 in Hanus 2002
	2001	0		N	Hanus et al. 2002b
	2008	0		N	Erickson 2010
Buck Lake (P)	1970	63		N	Riske 1976 in Hanus 2002
	1972	9	Y		Riske 1976 in Hanus 2002
	1978	136		N	Riske 2002 unpubl. data in Hanus 2002
	2004	16		N	Berg et al. 2004
	2008	32		N	Erickson 2010
Buffalo Lake (P)	1992	Present	Y		Gray et al. 1992 in Hanus 2002
	2004	309		N	Berg et al. 2004
	2005	>200	Y		H. Wollis pers. comm.
	2006	1030	Y		Wollis and Stratmoen 2010
	2008	888	Y		Wollis and Stratmoen 2010
Coal Lake (P)	2004	6		N	Berg et al. 2004
	2008	0		N	Erickson 2010
Driedmeat Resevoir (P)	1973	3		N	Kelsall et al. 1973 in Hanus 2002
	2004	5		N	Berg et al. 2004
	2008	5		N	Erickson 2010
Glennifer Lake (P)	2004	10		N	Berg et al. 2004
Gull Lake (P)	2000	25		N	Bjorge & Potter 2000 unpubl.data in Hanus 2002
	2004	320		N	Berg et al. 2004
	2008	25		N	D. Prescott pers. comm.
	2009	170	Y		Wollis and Stratmoen 2010
Isle Lake (S)	1982	96	Y		Purdy et al. 1983 in Hanus 2002
	1990	138	Y		Folinsbee 1990 unpubl. data in Hanus 2002
	2001	154	Y		Hanus et al. 2002b
	2002	124	Y		Hanus et al. 2002a
	2003	88	Y		Hanus et al. 2003
	2004	228	Y		Berg et al. 2004
	2005	192	Y		Wollis and Stratmoen 2010
	2006	208	Y		Wollis and Stratmoen 2010
	2007	234	Y		Wollis and Stratmoen 2010
	2008	114	Y		Wollis and Stratmoen 2010
	2009	130	Y		Wollis and Stratmoen 2010
	2010	Present	Y		H. Wollis pers. comm.
	2011	Present	Y		H. Wollis pers. comm.
Lac La Nonne (S)	1971	13		N	Riske 1976 in Hanus 2002
	1982	2		N	Riske 2002 unpubl. data in Hanus 2002
	1992	40		N	Riske 2002 unpubl. data in Hanus 2002
	2001	25		N	Hanus et al. 2002b
	2002	20		N	Hanus et al. 2002b
	2006	10		N	Kemper et al. 2008
	2008	31	Y		Erickson 2010

(Appendix 2 con't)

Lake (S = Stony Plain Study Area, P = Parkland Study Area)	Year[1]	Number of Western Grebes[2]	Breeding Confirmed (Y = yes, N= no/unknown)		Source
Lac Ste. Anne (S)	1971	1000+	Y		Riske 1976 in Hanus 2002
	1981	629	Y		Riske 2002 unpubl. data in Hanus 2002
	1985	1500	Y		Riske 2002 unpubl. data in Hanus 2002
	1991	647	Y		Riske 2002 unpubl. data in Hanus 2002
	2001	1268	Y		Hanus et al. 2002b
	2002	802	Y		Hanus et al. 2002a
	2003	1106	Y		Hanus et al. 2003
	2004	308	Y		Berg et al. 2004
	2005	74	Y		Wollis and Stratmoen 2010
	2006	176	Y		Wollis and Stratmoen 2010
	2007	112	Y		Wollis and Stratmoen 2010
	2008	92	Y		Wollis and Stratmoen 2010
	2009	84	Y		Wollis and Stratmoen 2010
	2010	0		N	H. Wollis pers. comm.
Pine Lake (P)	1976	6		N	Riske 2002 unpubl. data in Hanus 2002
	1981	5		N	Riske 2002 unpubl. data in Hanus 2002
	1990	2		N	Riske 2002 unpubl. data in Hanus 2002
	2004	3		N	Berg et al. 2004
	2008	2		N	Erickson 2010
Pigeon Lake (P)	1971	100		N	Riske 1976 in Hanus 2002
	2004	20		N	Berg et al. 2004
	2008	1		N	Erickson 2010
Sandy Lake (S)	2002	150+		N	Hanus et al. 2002a
	2003	0		N	Hanus et al. 2003
	2004	22		N	Berg et al. 2004
	2006	21		N	Kemper et al. 2008
	2008	0		N	Erickson 2010
Sylvan Lake (P)	1993	3		N	Hanus 2002
	2004	22		N	Berg et al. 2004
Thunder Lake (S)	1968	100+	Y		J. Kinnaird pers. comm. in Hanus 2002
	1980	251		N	Riske 2002 unpubl. data in Hanus 2002
	1981	273		N	Riske 2002 unpubl. data in Hanus 2002
	1990	1		N	Riske 2002 unpubl. data in Hanus 2002
	2001	3		N	Hanus et al. 2002b
	2006	3		N	Kemper et al. 2008
	2008	4		N	Erickson 2010
Wabamun Lake (S)	1982	184	Y		Purdy et al. 1983 in Hanus 2002
	1989	80+	Y		Folinsbee 1989 in Hanus 2002
	2001	544	Y		Hanus et al. 2002b
	2002	1510	Y		Hanus et al. 2002a
	2003	1360	Y		Hanus et al. 2003
	2004	634	Y		Berg et al. 2004
	2005	486	Y		Wollis and Stratmoen 2010
	2006	1105	Y		Wollis and Stratmoen 2010
	2007	525	Y		Wollis and Stratmoen 2010
	2008	564	Y		Wollis and Stratmoen 2010
	2009	340	Y		Wollis and Stratmoen 2010
	2010	902	Y		H. Wollis pers. comm.
	2011	380	Y		H. Wollis pers. comm.

[1] For specific dates of surveys, see the original reference.

[2] Abundance estimates represent a **minimum** estimate of western grebes for that year and were determined from nest counts (2 breeding adults per nest), boat surveys of adult grebes (a total estimate of adults), or incidental sightings, whichever yielded the highest estimate.

Appendix 3. Summary of historical and current information on western grebes in northeastern and northwestern (designated NW) Alberta (partially adapted from Found and Hubbs 2004). Only lakes associated with western grebes during the breeding season, either historically or currently, are included in this appendix.

Lake	Year[1]	Number of Western Grebes[2]	Breeding Confirmed (Y = yes, N= no/unknown)		Source
Angling Lake	1981	1680	Y		Gunderson 1981 unpubl. data in Hanus 2002
	2003	30	Y		Found and Hubbs 2004
	2004	200	Y		Found 2004
	2005	50	Y		Found 2005
	2008	1		N	Erickson 2010
Baptiste Lake	2008	0		N	Erickson 2010
Beaver Lake	2008	0		N	Erickson 2010
Brock Lake	2006	6		N	Kemper et al. 2008
	2008	0		N	Erickson 2010
Cold Lake	1978	2012	Y		Kristensen and Nordstrom 1979
	1979	2000	Y		Alberta Environment 1993
	1985	508	Y		Alberta Environment 1993
	2003	1982	Y		Found and Hubbs 2004
	2004	970	Y		Found 2004
	2005	528	Y		Found 2005
	2006	1876	Y		Kemper et al. 2008
	2007	>200	Y		C. Found unpub. data
	2008	582	Y		Wollis and Stratmoen 2010
	2010	34	Y		H. Wollis unpub. data
	2011	490	Y		H. Wollis unpub. data
Conn Lake	1993	300	Y		Chabaylo 1993 unpub. data in Hanus 2002
	2009	0		N	Wollis and Stratmoen 2010
Cooking Lake	2004	7		N	Kemper et al. 2008
	2008	4		N	Erickson 2010
Ethel Lake	1981	84	Y		Gunderson 1981 unpubl. data in Hanus 2002
	1989	80	Y		Anonymous 1995
	2003	No Colony		N	Found and Hubbs 2004
	2008	0		N	Erickson 2010
Fork Lake	2008	11		N	Erickson 2010
Frog Lake	1957	200		N	Hampson 1957 unpubl. data in Hanus 2002
	1965	150		N	Riske 1965 unpubl. data in Hanus 2002
	1991	600	Y		Hanus 2002
	2003	No Colony		N	Found and Hubbs 2004
	2008	0		N	Erickson 2010
Garner Lake	1985	102	Y		Anonymous 1995
	2003	0		N	Found and Hubbs 2004
	2008	0		N	Erickson 2010
Hastings Lake	1990	225		N	Moore 1990 unpubl. data in Hanus 2002
	2003	10	Y		Found and Hubbs 2004
	2004	125	Y		Found 2004
	2005	4		N	Found 2005
	2006	440	Y		Kemper et al. 2008
	2008	346	Y		Erickson 2010
	2009	120	Y		Wollis and Stratmoen 2010
	2010	>300	Y		H. Wollis unpubl. data

(Appendix 3 con't)

Lake	Year[1]	Number of Western Grebes[2]	Breeding Confirmed (Y = yes, N= no/ unknown)		Source
Ironwood Lake	2008	0		N	Erickson 2010
Kinosiu Lake	2008	0		N	Erickson 2010
Lac La Biche	1980	3124	Y		Anonymous 1980
	1988	3000	Y		Alberta Environment 1993
	2003	4612	Y		Found and Hubbs 2004
	2004	>366 [3]	Y		Kemper et al. 2008
	2005	1792 [4]	Y		C. Found unpubl. data
	2006	2812	Y		Kemper et al. 2008
	2007	3226	Y		Wollis and Stratmoen 2010
	2010	1512	Y		H. Wollis unpub. data
Lac Sante	1987	50	Y		Hanus 2002
	1993	150	Y		Gunderson 1993 unpubl. data in Hanus 2002
	2003	0		N	Found and Hubbs 2004
	2008	0		N	Erickson 2010
Manatokan Lake	2003	1		N	Found and Hubbs 2004
	2008	9		N	Erickson 2010
Marguerite Lake	1982	120		N	Gunderson 1982 unpub. Data in Hanus 2002
	recent	0		N	Wollis and Stratmoen 2010
Missawawi Lake	2003	55		N	Found and Hubbs 2004
	2008	1		N	Erickson 2010
Moose Lake	1990	400	Y		Found and Hubbs 2004
	2003	39	Y		Found and Hubbs 2004
	2004	304	Y		Found 2004
	2005	258	Y		Found 2005
	2006	353	Y		Kemper et al. 2008
	2007	376	Y		C. Found unpub. data
	2008	549	Y		Erickson 2010
Muriel Lake	1991	400-600	Y		Hanus 2002
	2003	>760	Y		Found and Hubbs 2004
	2004	0		N	Found 2004
	2008	40		N	Erickson 2010
North Buck Lake	1991	124	Y		Moore 1991 unpubl. data in Hanus 2002
	2003	0		N	Found and Hubbs 2004
	2008	2		N	Erickson 2010
Reita Lake	1981	532	Y		Gunderson 1981 unpubl. data in Hanus 2002
	2003	0		N	Found and Hubbs 2004
	2008	0		N	Erickson 2010
Skeleton Lake	2007	25		N	C. Found unpub. data
Winefred Lake	2008	0		N	K. Norstrom pers. comm.
Wolf Lake	1980	346	Y		Alberta Environment 1993
	1985	720	Y		Alberta Environment 1993
	1989	540	Y		Alberta Environment 1993
	2003	40	Y		Found and Hubbs 2004
	2004	0		N	Found 2004
	2005	0		N	Found 2005
	2008	0		N	Erickson 2010

(Appendix 3 con't)

Lake	Year[1]	Number of Western Grebes[2]	Breeding Confirmed (Y = yes, N= no/ unknown)		Source
Cardinal Lake (NW)	2000	30	Y		Hanneman and Heckbert 2001
Lesser Slave Lake (NW)	2000	700	Y		Hanneman and Heckbert 2001
	2002	3742	Y		Eadie 2002
	2006	2720	Y		Kemper et al. 2008
	2008	Present		N	Erickson 2010
	2011	3504	Y		A. Fontaine pers. comm.
Utikuma Lake (NW)	2000	>1700	Y		Hanneman and Heckbert 2001
	2006	20		N	Kemper et al. 2008
	2008	Present	Y		A. Fontaine pers. comm.
	2009	1220	Y		Wollis and Stratmoen 2010
	2010	Present	Y		A. Fontaine pers. comm.
	2011	Present	Y		A. Fontaine pers. comm.
Winagami (NW)	2011	8	Y		M. Heckbert pers. comm.

[1] For specific dates of surveys, see the original reference.

[2] Abundance estimates represent a **minimum** estimate of western grebes for that year and were determined from nest counts (2 breeding adults per nest), boat surveys of adult grebes (a total estimate of adults), or incidental sightings, whichever yielded the highest estimate.

[3] Partial nest survey only because of poor weather; only counted the smaller colony NE of Current Island. Larger colony on NW shore not counted.

[4] Partial nest survey only. Colony of approximately 200 western grebe nests NE of Current Island existed; nest count not completed.

Appendix 4. Summary of historical and current information on western grebes in southern Alberta. Only lakes associated with western grebes during the breeding season, either historically or currently, are included in this appendix.

Lake	Year[1]	Number of Western Grebes[2]	Breeding Confirmed (Y = yes, N= no, U = unknown)		Source
Blood Indian Creek Reservoir	2008	3		N	Erickson 2010
Crow Indian Lake	2004	2	Y		CWS unpubl. data
	2009	100	Y		Wollis and Stratmoen 2010
Deadhorse Lake	2007	9		N	CWS unpubl. data
Fincastle Lake	2004	47		N	CWS unpubl. data
Frank Lake	2004	9		N	CWS unpubl. data
	2007	7		N	CWS unpubl. data
	2010	50	Y		H. Wollis pers. comm.
Horsefly Reservoir	2004	12		N	CWS unpubl. data
Louisiana Lakes Reservoir	2007	30		N	CWS unpubl. data
Murray Lake	2004	3		N	CWS unpubl. data
	2006	20		N	CWS unpubl. data
	2007	13		N	CWS unpubl. data
	2008	14		N	Erickson 2010
	2009	107	Y		Wollis and Stratmoen 2010
Pakowki Lake	2010	Present	Y		H. Wollis pers. comm.
Rattlesnake Reservoir	2004	76		N	CWS unpubl. data
Seven Persons Lake	2004	2		N	CWS unpubl. data
	2008	2		N	Erickson 2010
Shanks Lake	2004	140	Y		CWS unpubl. data
Stobart Lake	2007	12		N	CWS unpubl. data
Taber Lake	2004	2		N	CWS unpubl. data
Tyrell Lake	2004	2		N	CWS unpubl. data
Tilley B Reservoir	2010	<100	Y		H. Wollis pers. comm.

[1] For specific dates of surveys, see the original reference.

[2] Abundance estimates represent a **minimum** estimate of western grebes for that year and were determined from nest counts (2 breeding adults per nest), boat surveys of adult grebes (a total estimate of adults), or incidental sightings, whichever yielded the highest estimate.

Appendix 5: Technical Summary

A summary of information contained within this report, and used by the Scientific Subcommittee of Alberta's Endangered Species Conservation Committee for the purpose of status assessment based on International Union for the Conservation of Nature criteria. For definitions of terms used in this technical summary, go to: http://www.iucnredlist.org/technical-documents/categories-and-criteria and http://www.cosepac.gc.ca/eng/sct2/sct2_6_e.cfm

Genus species: *Aechmophorus occidentalis*
Common name: Western Grebe
Range of occurrence in Alberta: Western grebes are local and uncommon in Alberta from April to October and inhabit all natural regions in the province with the exception of the Canadian Shield and Rocky Mountain natural regions. They occur as far south as Shanks Lake (49.0694ºN, -112.7197ºW), as far east as Cold Lake (54.5497 ºN, -110.0830 ºW), as far west as Winagami Lake (55.6527ºN, -116.7319ºW) and as far north as Utikuma Lake (55.8330ºN, -115.4166ºW)

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time as indicated in the most recent IUCN guidelines is being used) See Conservation Biology, p. 9. *Generation length* likely lies toward the higher end of a range of 2.5–5.2 years, calculated from a life-table-based analysis based on demographic rates of western grebes as well as other grebe species. Analysis of trend is generally carried out over a span of 10 years or three generations, whichever is the longer. Based on the lower end of the range calculated for generation length (2.5 years), three generations would be 7.5 years, which is less than 10 years; therefore, analysis of trend should be carried out on a minimum length of 10 years. Based on the upper end of that range (5.2 years), three generations would be 15.6 years, which is greater than 10 years; therefore, analysis of trend should be carried out on a maximum length for three generations of approximately 15 years. Therefore, given the range calculated for generation length, decline over 10 years or three generations should be calculated over a range of 10-15 years; decline over 5 years or two generations (whichever is the longer) should be calculated over a range of 5-10 years.	2.5-5.2 yrs (likely closer to the upper end of the range)

(Appendix 5 continued)

Is there an observed continuing decline in number of mature individuals? See Population Size and Trends in Alberta (pp. 9–16), Figure 3 (p. 12) and Figure 4 (p. 18). Although annual surveys have shown fluctuations in population estimates over the past several years, there is an overall decline in the number of breeding individuals compared to the 2006 provincial estimate. In addition, 13 out of 26 lakes in Alberta that have historically supported large confirmed breeding colonies no longer do so and no new colonies have been discovered. This represents a 50% decrease in area of occupancy (area of breeding colonies) over 54 years (1957-2011); in the last 10 years or 3 generations (10-15 years), grebes disappeared from 4 of 17 (24%) of those lakes, and in the last 5 years, they disappeared from 2 of 15 (13%), equivalent to 13% to 24% over 5 years or 2 generations (5-10 years).	Yes
Estimated percent of continuing decline in total number of mature individuals within 5 years or two generations. See Population Size and Trends in Alberta, pp. 9–16. For western grebes, the lower end of the range of 2 generations would be 5 years; however, the upper end of the range could be a maximum of 10.4 years. For this evaluation, a range of 5-10 years is used. Estimates of decline are based on the rate of decline from 2006 and 2011 provincial population estimates. Based on a 28% reduction in the last 5 years, a 49% reduction can be projected over 10 years.	Minimum reduction of 28% in 5 years or a maximum reduction of 49% in 2 generations (i.e., 10 years)
The Observed/Estimated percent reduction in total number of mature individuals over the last 10 years or three generations. See Population Size and Trends in Alberta, pp. 9–16. For western grebes, decline over 10 years or 3 generations is calculated over a range of 10-15 years. Data are not available over three generations, but during the recent 5-year period between 2006 and 2011, the population declined by 28%.	Greater than 28% reduction over the last 10 years or 3 generations

(Appendix 5 continued)

Projected percent reduction in total number of mature individuals over the next 10 years or three generations. See Population Size and Trends in Alberta, pp. 9–16. Estimates of decline are based on the reduction in provincial population estimates that occurred between 2006 and 2011.	Minimum reduction of 49% in 10 years or a maximum reduction of 63% in 3 generations (i.e., 15 years)
Estimated percent reduction in total number of mature individuals over any [10-year, or 3-generation] period, over a time period including both the past and the future. See Population Size and Trends, pp. 9–16. The population has declined by 28% over the last 5 years (2006 to 2011); based on this, a minimum decline of 49% in 10 years (2006-2016) or a maximum reduction of 63% in 3 generations (i.e., 15 years; 2006-2021) can be projected.	Estimated minimum reduction of 49% in 10 years or a maximum reduction of 63% in 3 generations (i.e., 15 years) including past and future
Are the causes of the decline clearly reversible and understood and ceased? See Limiting Factors, pp. 18–22.	No
Are there extreme fluctuations in number of mature individuals? See Population Size and Trends in Alberta (pp. 9–16) and Appendices 2–4. There are large fluctuations in abundance estimates from year to year; some breeding lakes show relatively consistent abundance, while others have experienced extreme fluctuations. However, taken together, the provincial population does not fluctuate enough to meet the IUCN definition of extreme fluctuation.	No

Extent and Occupancy Information

Estimated extent of occurrence See Distribution in Alberta, p. 3.	186 400 km²

(Appendix 5 continued)

Area of occupancy (AO) (Always report 2km x 2km grid value; other values may also be listed if they are clearly indicated [e.g., 1x1 grid for plants]). See Distribution in Alberta, p. 3.	72 km² (based on a 2-km x 2-km grid) <3.5 km² (based on estimated colony sizes)
Is the total population severely fragmented? See Distribution in Alberta, p. 3. Although the habitat is fragmented, grebes can move between lakes, as shown by re-colonizations and fluctuations in abundance on lakes.	No
Number of locations See Distribution in Alberta (p. 3) and Appendices 2–4. Colonies can be considered separate locations because they are likely affected by threatening events independently.	22 (breeding) plus 26 (occupied) since 2001
Is there an observed continuing decline in extent of occurrence? See Distribution in Alberta, p. 3.	Yes
Is there an inferred continuing decline in index of area of occupancy? See Distribution in Alberta (p. 3) and Population Size and Trends in Alberta (pp. 9–16). Estimates of area of occupancy depend on number of occupied colonies; however, because of variation in survey effort, number of colonies counted differs from year to year, making comparison difficult. Nevertheless, in the past 10 years, there have been more colony extirpations than re-colonizations, suggesting a decline in area of occupancy. Overall, 13 out of 26 lakes in Alberta that have historically supported large confirmed breeding colonies no longer do so and no new colonies have been discovered.	Yes

(Appendix 5 continued)

Is there an observed continuing decline in number of subpopulations? See Population Size and Trends in Alberta (pp. 9–16) and Appendices 2–4. There is an overall decline in the number of breeding colonies in the province. This is expected to continue with increased human development and habitat loss. There have been instances of re-colonizations, but these have occurred less frequently than the loss of colonies in the past 10 years.	Yes
Is there an observed continuing decline in number of locations? See Population Size and Trends in Alberta (pp. 9–16), Table 3 (p. 17) and Appendices 2–4. Most lakes could be considered separate locations and several lakes in all regions that once supported western grebe no longer do so. This is expected to continue with increased human development and habitat loss.	Yes
Is there an inferred continuing decline in area and/or quality of habitat? See Habitat Degradation in the Limiting Factors section, p. 19. Several lakes in Alberta that support this species either already have heavily developed shorelines, or continue to be developed, reducing the amount of emergent vegetation available for nesting**.**	Yes
Are there extreme fluctuations in number of subpopulations?	No
Are there extreme fluctuations in number of locations?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each subpopulation)

Population	N Mature Individuals
Provincial estimate of breeding adults See Table 2, p. 11	**9549**
Total	**9549**

Quantitative Analysis

Probability of extinction in the wild (A quantitative analysis was not done for this species)	not applicable

Threats (actual or imminent, to populations or habitats)

Current threats include (see Limiting Factors, pp. 18–22, and Table 4, p. 20)**:**

- Natural habitat disturbance (e.g., storms, waves destroying nests; ice scouring old vegetation
- Predation
- Human-induced disturbance (e.g., boating, wake-boarding, recreational activities causing nest abandonment or causing wakes that destroy nests; snowmobiling that scours off old vegetation)
- Habitat loss through shoreline development and vegetation removal
- Large-scale disasters (e.g., oil spills)

Rescue Effect (immigration from outside Alberta)

Status of outside population(s)? See Population Size and Trends in Other Areas, pp. 16–18. The western grebe appears to be declining in both its wintering and breeding grounds, as well as shifting its centre of distribution south (at least during the wintering season).	
Is immigration known or possible? See Conservation Biology, pp. 7–8. Based on the considerable fluctuations in abundance estimates on breeding lakes from year to year, immigration is possible.	Immigration is not known, but is likely
Would immigrants be adapted to survive in Alberta? See Habitat in Alberta, pp. 6–7.	Yes

(Appendix 5 continued)

Is there sufficient habitat for immigrants in Alberta? See Habitat in Alberta (pp. 6–7) and Limiting Factors (pp. 18–22). Habitat in Alberta appears to be suitable on many lakes that once supported grebes but no longer do so. Human activity and other limiting factors have likely caused the decline and/or extirpation in many areas that might provide suitable habitat. Lakes that are designated as important bird areas or bird sanctuaries may provide sufficient habitat for immigrants in Alberta.	Possibly
Is rescue from outside populations likely? See Population Size and Trends in Other Areas (pp.16–18) and Limiting Factors (pp.18–22). Rescue may be unlikely as a result of widespread declines of the species, as well as habitat concerns because of human activity and other limiting factors.	Possible, but not likely

Current Status (See Status Designations, pp. 22–23)

Provincial: *Species of Special Concern*

National: N3 (non-breeding); N5 (breeding)

Elsewhere:

- British Columbia: Red Listed
- Manitoba and Saskatchewan: Secure
- Global heritage rank: G5
- National conservation status for the species in
    - Canada: N3 (non-breeding); N5 (breeding)
    - United States: N5 (breeding and non-breeding)
- State rankings
    - S1: Kansas, Wisconsin
    - S2: Idaho
    - S3: Arizona, Nebraska, New Mexico, Oregon, Texas, Washington
    - S4: Colorado, Montana, Nevada, South Dakota, Utah, Wyoming
    - Not Ranked/Under Review: California, North Dakota and Minnesota
- The western grebe is a candidate species for listing as *Sensitive*, *Threatened* or *Endangered* in Washington State

Author of Technical Summary: Mara E. Erickson and Robin Gutsell

Additional Sources of Information:

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