BC Environment

STATUS OF THE WESTERN GREBE IN BRITISH COLUMBIA

by
A.E. Burger

Wildlife Working Report No. WR-87

March 1997

British Columbia, Canada's most westerly province, has a bounty of biological diversity. British Columbia's snowclad peaks, rain-drenched forests, arid grasslands, all sizes of rivers, lakes, and wetlands, and a long and rugged coast provide habitats for more species of living organisms than are found anywhere else in Canada. However, this very diversity means that there is much to be discovered about these organisms — their distribution, abundance, habitat requirements, and interrelationships with their environment. Increasing our knowledge of this biodiversity will help us with the complex task of sustainably managing our land and waters.

In 1992, the Provincial Government initiated a co-operative biodiversity research program with funding from the Corporate Resource Inventory Initiative, the British Columbia Ministries of Forests (Research Branch), Environment, Lands, and Parks (Wildlife and Habitat Protection Branches), and Tourism and Culture (Royal B.C. Museum); and the Forest Resource Development Agreement (FRDA II).

In 1995, the Ministry of Forests Research Branch and the Ministry of Environment, Lands and Parks developed a biodiversity research and extension strategy, with the assistance of the provincial research community. This strategy was presented to Forest Renewal BC (FRBC), who provided funding for a program beginning in 1995. The goal of the extension component of this program is to extend information to scientists, resource managers, and the public through biodiversity publications. These publications are intended to increase awareness and understanding of biodiversity, promote the concepts and importance of conserving biodiversity, and communicate provincial government initiatives related to biodiversity. We hope that they will be used as tools for the conservation of British Columbia's rich, living legacy.

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“Wildlife Working Reports frequently contain preliminary data, so conclusions based on these may be subject to change. Working Reports receive little review. They may be cited in publications, but their manuscript status should be noted. Copies may be obtained, depending upon supply, from the Ministry of Environment, Lands and Parks, Wildlife Branch, 780 Blanshard Street, Victoria, BC V8V 1X4.”

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FOREWORD

In cases where a Wildlife Working Report or Bulletin is also a species' status report, it may contain a status recommended by the author for the species. This recommended status is the opinion of the author and may not necessarily reflect that of the Wildlife Branch. Official status designation will be made by the Wildlife Branch in consultation with experts, and the data contained in the status report will be considered during the evaluation process.

ABSTRACT

British Columbia supports a small breeding population of Western Grebes (*Aechmophorus occidentalis*) of less than 200 pairs, and a large wintering population, numbering tens of thousands of birds. Breeding occurs regularly at three sites in the southern interior: Shuswap Lake at Salmon Arm, the north arm of Okanagan Lake, and at Duck Lake in the Creston Valley. Numbers at Swan Lake (Vernon) have declined and breeding has occurred only once since 1966. A colony of 5-35 pairs existed in Williams Lake in the 1930s and 1940s, but declined until breeding ceased in the 1960s. There are two records (1986 and 1988) of a single pair with young at Westham Island near Vancouver. Breeding has also occurred at the south end of Kootenay Lake (one year) and Leach Lake (two years), both near Creston. Single breeding records, some of which might be erroneous, exist for 6 other sites. The principal cause of the decline or demise of Western Grebe colonies in British Columbia appears to be disturbance caused by recreational boating (Williams, Okanagan and Swan lakes). Disturbances and habitat changes caused by industrialization and urbanization (Williams, Shuswap and Swan lakes), marinas and campgrounds (Shuswap, Swan and Okanagan lakes) and cattle (Williams, Swan and Shuswap lakes) have all affected the grebes. The colony at Duck Lake is well protected, but is susceptible to fluctuating water levels and possibly encroachment of milfoil weed. The impacts of chemical contaminants have not been fully investigated in British Columbia. Western Grebes at Port Alberni had high levels of dioxins and furans, but eggs from Duck Lake had low concentrations of organo-chlorides. Prey availability has not been fully investigated, but breeding birds seemed to tolerate moderate prey fluctuations. About 100 000 Western Grebes overwinter in coastal British Columbia, from breeding sites in western Canada and the northwestern United States. The southern Strait of Georgia and adjacent sheltered waters support the highest wintering densities. Christmas bird counts made between 1957 and 1994 at 25 coastal sites fluctuated, but showed no overall increases or declines. Local aggregations of wintering grebes are threatened by oil spills, gill-nets, aquaculture and chemical pollution, but there is no evidence of significant impacts. The following are recommendations:

1. Investigation of the effects of recreational boating, and implementation of boating restrictions where necessary.
2. Annual monitoring of breeding sites for 3-5 years.
3. Improvements to control water levels (Duck Lake).
4. Habitat rehabilitation and control of livestock.
5. Rehabilitating old colonies (Williams and Swan lakes) and creating new ones (e.g., Kamloops Lake).

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1 INTRODUCTION

The Western Grebe (*Aechmophorus occidentalis*) is a rare breeding resident and a common winter migrant in British Columbia. The breeding population is small (less than 200 pairs), is largely restricted to three inland lakes, and is declining at some colonies (Forbes 1988; Campbell et al. 1990). Tens of thousands of Western Grebes overwinter in sheltered coastal waters, and this population appears stable.

This report reviews the populations, habitats and status of Western Grebes in British Columbia. The breeding and wintering populations live in very different habitats, appear to have differing population trends and are subject to different threats. Likewise, the population trends and factors affecting breeding success differ among the colonies. For these reasons, few generalizations pertain to the entire provincial population and the report focuses on the various sub-populations in some detail. Munro (1941) and Forbes (1984, 1988) provided earlier reviews of Western Grebes in British Columbia. In addition to published papers and agency reports, this report used data from the British Columbia Nest Record Scheme (hereafter BCNRS), and the Sight Record Cards (SRC) housed in the Royal British Columbia Museum. Information from colonies was obtained from local naturalists and officials of the Ministry of Environment, Lands and Parks, the Canadian Wildlife Service and Ducks Unlimited. All the active colonies were visited by A. E. Burger in late July and early August 1990 to obtain data on habitat use and the problems facing each population.

In 1985, the Western Grebe was split taxonomically into the nominate dark-phase Western Grebe (*A. occidentalis*) and the pale-phase Clark's Grebe (*A. clarkii*) (American Ornithologists' Union 1985). The two species coexist at breeding sites in the United States, but Clark's Grebe is rare or absent at colonies in the northern United States and western Canada. There are few records of Clark's Grebes at breeding colonies in British Columbia: at Duck Lake, Creston, a mixed Western-Clark's pair with a chick was reported in 1982 (Forbes 1988) and a single Clark's Grebe in 1987 (Campbell et al. 1990); at Salmon Arm, Shuswap Lake, single Clark's Grebes were reported in 1981, 1982, 1983, 1990, 1991, 1993 and 1995 (Campbell et al. 1990, unpubl. records from D. and F. Kime and D. Munro); a single bird was seen on Okanagan Lake in spring 1994 (R. J. Cannings, unpubl. data), and a single bird at Swan Lake, Vernon in 1989 (C. Siddle, unpubl. data). Clark's Grebe is a rare winter vagrant in coastal British Columbia (Campbell et al. 1990).

Much of this report concerns the breeding population. There are reports of breeding at 14 sites in central and southern British Columbia, but breeding has occurred regularly at only five sites (Table 1). Of these five sites, breeding still occurs regularly at Shuswap Lake near Salmon Arm, the North Arm of Okanagan Lake, and at Duck Lake within the Creston Valley Wildlife Management Area, but no longer occurs at one site (Williams Lake), and is rare at another (Swan Lake, Vernon). Details are given below.

2 DISTRIBUTION

2.1 Distribution in North America

This species breeds in western North America from southern British Columbia, northern Alberta, central Saskatchewan and Manitoba south to California, northern Utah, North Dakota, Nebraska and southwestern Minnesota (Palmer 1962; Godfrey 1986; Storer and Nuechterlein 1992). Western Grebes winter along the Pacific coast from southeastern Alaska (small numbers) to northwestern Mexico (Godfrey 1986). Small numbers winter on ice-free inland lakes. The size of the North American population is unknown, but at least 118 000 have been counted on Christmas bird counts (Storer and Nuechterlein 1992).

Table 1. Records of breeding by Western Grebes in British Columbia. The list includes some unconfirmed records for which the identity of the species or the site may be incorrect.

Status and site of colony or nests	Details of breeding
Regularly used in 1980s and 1990s	
Shuswap Lake at Salmon Arm	Breeding occurs annually. See Section 5.4 and Table 5. Estimate in 1990s: 90 breeding pairs
Okanagan Lake, North Arm	Breeding occurs annually. See Section 5.6 and Table 7. Estimate in 1990s: 40 breeding pairs
Duck Lake in CVWMA*, Creston	Breeding occurs in most years. See Section 5.7 Estimate in 1990s: 60 breeding pairs
Previously regular, now rare	
Swan Lake, Vernon	Fairly regular breeding until 1966. One pair with brood in 1990. Still has summer visitors. See section 5.5 and Table 6.
Previously regular, now extirpated	
Williams Lake	Regular breeding 1930s and 1940s. Last breeding record in 1964. Still has summer visitors. See section 5.2 and Table 4.
Rare breeding, records from 1 or 2 years	
Westham Island, Delta	Two records of single broods in 1986 and 1988 (Weber and Ireland 1992). See section 5.8
Leach Lake, CVWMA*, Creston	Two records of single broods, in 1990 and 1991. Lake is adjacent to Duck Lake where breeding occurs regularly. See section 5.7.
Kootenay Lake, south end in CVWMA*	Four nests in 1982 (Forbes 1984). Breeding not recorded in other years. This is close to the Duck Lake colony. See section 5.7.
Unconfirmed records	
Kamloops Lake	Twenty pairs with "average of three young each", May and June 1973 (K.J. Fleming, BCNRS*). Record accepted by Forbes (1984, 1988) but not supported by local observers. See section 5.3.
White Lake, near Salmon Arm	Nest with 3 eggs, 24 May 1978 (Mary Mack, BCNRS*). Accepted by Forbes (1984, 1988). No other information and no other records from this site.
Unidentified lake near Summerland	One nest with 5 eggs, 1 July 1905 (E.M. Tait, BCNRS). Insufficient details and year incorrect. Record not accepted by Forbes (1984, 1988).
Near Fernie	"A number" of birds, "one sitting, apparently on a nest, 2 courting", 7 August 1953 (W.E. Coofrey, SRC*). Not mentioned in Forbes (1984, 1988).
Sanctuary Lake, near Douglas Lake	Set of 5 eggs, tentatively identified as Western Grebe, 6 June 1962 (A.L. Meugens, BCNRS*) Not accepted by Forbes (1984, 1988).
Mamette Lake	Nest with one egg, 19 May 1968, which might be a Red-necked Grebe (Forbes 1984). BCNRS card no longer with Western Grebe cards.

* CVWMA: Creston Valley Wildlife Management Area; BCNRS: British Columbia Nest Record Scheme (cards in Royal British Columbia Museum); SRC: Sight Record Card (Royal British Columbia Museum).

2.2 Distribution in British Columbia

Western Grebes are recorded regularly across the southern two-thirds of British Columbia, with most sightings from the coast and large inland lakes (Figure 1, Campbell et al. 1990). Details on the populations in various parts of the range follow.

3 GENERAL BIOLOGY

3.1 Reproductive Capability

Western Grebes nest colonially among emergent vegetation on inland lakes. Colonies in British Columbia have never exceeded 90 nests (Forbes

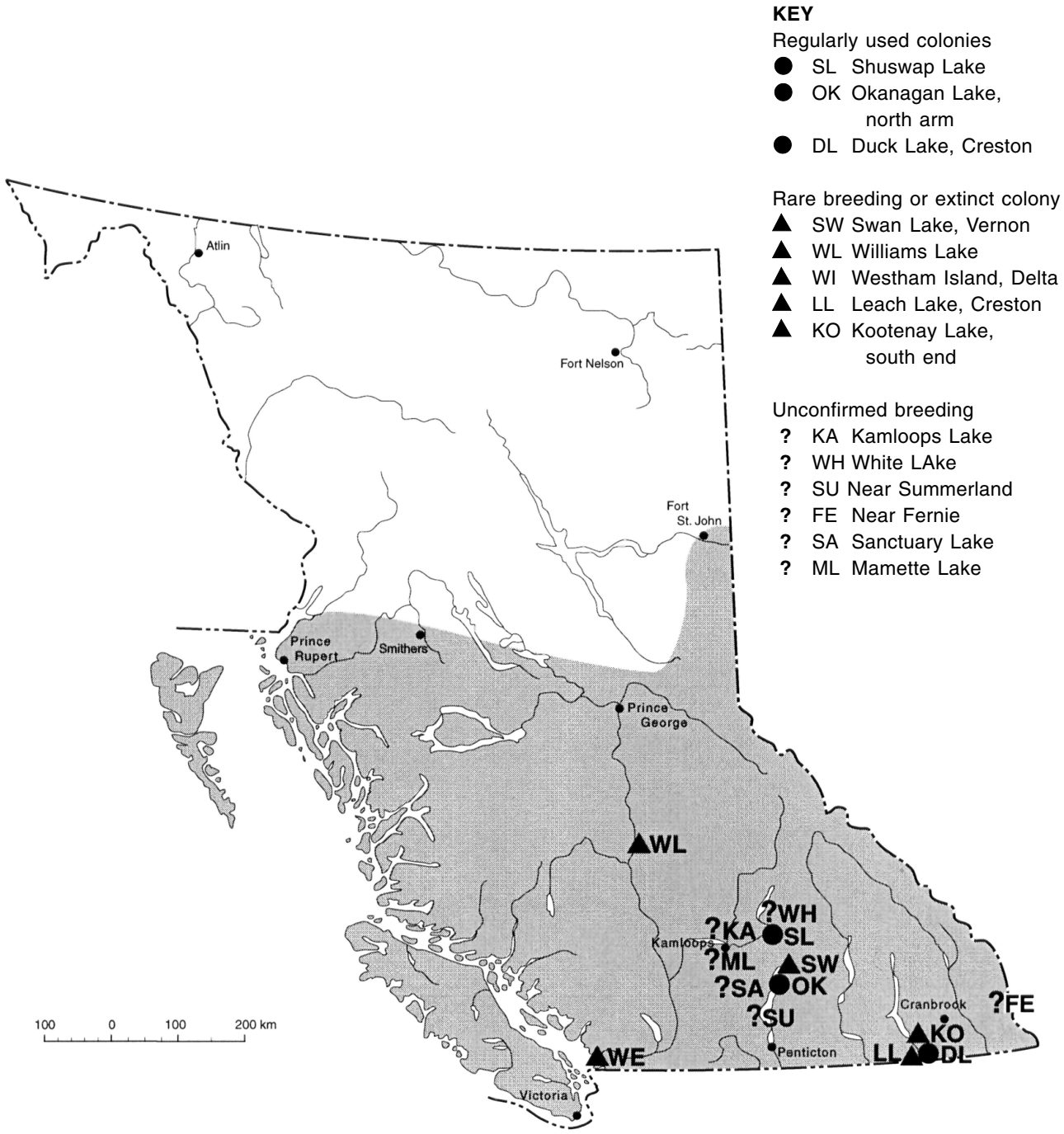

Figure 1. Distribution of the Western Grebe in British Columbia.

1988, Campbell et al. 1990), which is considerably smaller than colonies to the south and west in the heart of the species range (Palmer 1962). Several sub-colonies may form on a lake. Nests are matted platforms of plant matter, generally rushes (*Scirpus*) or cat-tails (*Typha*), which are usually floating and attached to rushes or willow trees. Each pair defends a small territory around its nest, which leads to fairly uniform spacing of nests within a colony (Nuechterlein 1975). Both sexes participate in nest-building, incubation and rearing the chicks. Incubation lasts 23 or 24 days; chicks are fed for 42-56 days and are independent at 63-77 days (Palmer 1962; Storer and Nuechterlein 1992). In British Columbia, clutches have been reported from 29 April to 31 August, but most laying occurs in late May and early June; young have been reported from 5 June to 31 August, and most hatch in late June and early July (Campbell et al. 1990).

The age of first breeding is not known, but might be one year (Storer and Nuechterlein 1992). There are usually adult-plumaged birds at each colony that do not attempt breeding. These might be one- or two-year-olds gaining experience, but not actively breeding. Breeding appears to occur annually, although adults might forgo breeding if conditions are unsuitable. Adults tend to return to their natal water-bodies, but not necessarily the natal colony (Nuechterlein 1975). The average lifespan is unknown, but marked birds aged 9-16 years have been reported (Storer and Nuechterlein 1992; Eichhorst 1992).

Clutch size ranges between 2-7 eggs (Palmer 1962; Storer and Nuechterlein 1992). The mean clutch size for the colonies in British Columbia ranged between 2.9 and 3.7 eggs, and showed no significant inter-year variation (Forbes 1988). Most clutches (some incomplete) in British Columbia had 2-4 eggs (Table 2), which were more than those in Utah (2.4 eggs), and California (2.4), and similar to those in Colorado (3.4, Forbes 1988).

The chicks usually leave the nest within hours of hatching and are brooded on the back of one of the parents. The non-brooding parent delivers food to the chicks. Families generally leave the colony to raise the chicks in deeper, more open water. This habit makes it virtually impossible to study the growth and survival of individual broods.

There have been no detailed analyses of egg and chick survival in British Columbia. Most broods contained one or two chicks (range 1-4, Table 2). The mean production of near-fledging young at Duck Lake in 1982, which was a year of relatively low fish abundance (Forbes 1985), was 0.79 young per adult, or 1.58 per pair (Forbes 1988). It is not clear whether Forbes' adult tally included non-breeding birds. Counts at Shuswap Lake in the late summers of 1990-95 yielded an average of 1.55 large young per family (range 0.74-1.81, D. & F. Kime, unpubl. data), but these counts did not consider failed breeders and are thus inflated. Fledgling production at other colonies in British Columbia has not been determined. Production at B.C. colonies compares favourably with the number of young per mated pair in Utah (0.35), California (1.0) and Manitoba (0.53-0.88) (Forbes 1988; Storer and Nuechterlein 1992).

Rates of recruitment into the breeding populations are not known. The colonies at Shuswap and Okanagan lakes, and in the Creston Wildlife Management Area appear capable of maintaining stable populations if left undisturbed. Colonies at Williams and Swan lakes have declined and are effectively extirpated. The population trends and factors affecting breeding success are discussed in detail for each colony.

3.2 Migration

Western Grebes move to the Pacific coast during the winter, ranging from southeastern Alaska south to central Mexico (Storer and Nuechterlein 1992). The virtual absence of any pale-phase

Table 2. Clutch and brood sizes of Western Grebes breeding in British Columbia.

Location	Year	Date	Nests: Clutch size 0	1	2	3	4	5	6	7	NR*	Broods: Brood size 1	2	3	4	NR*	Total nests	Total nests with eggs	Total broods	Estimated total breeding pairs
Williams Lake	1938	July 4			3	2											5	5	0	
Williams Lake	1942	June 5	8	2	4	0	3					1					17	9	1	40
Williams Lake	1949	July 8									6		1				6	0	1	
Shuswap L. Salmon Arm	1963	Jun 9	8	3	2	7	5	1									26	18	0	
Shuswap L. Salmon Arm	1964	June 29	32	3	7	13	7	1									63	31	0	63
Shuswap L. Salmon Arm	1973	June 16	17	6	7	11	3										44	27	0	44
Shuswap L. Salmon Arm	1976	June 3	32	5	5	2	1	1									46	14	0	30-50
Shuswap L. Salmon Arm	1990	Aug 2										4	8	1	1		0	0	14	14
Shuswap L. Salmon Arm	1993	Jul 19										23	17	2			0	0	63	42
Shuswap L. Salmon Arm	1994	Jul 21										39	38	9	1		0	0	87	86
Swan Lake, Vernon	1933	July 17											1				0	0	1	
Swan Lake, Vernon	1950	June 7			5	10	2										17	17	0	42
Swan Lake, Vernon	1951	June 7										1					0	0	1	
Swan Lake, Vernon	1960	June 8				1					3						4	4	0	
Swan Lake, Vernon	1963	May 25	2	0	2	1	2										7	5	0	20
Swan Lake, Vernon	1965	May 29	1	0	3	2	1	1									8	7	0	
Swan Lake, Vernon	1966	May 22				1											1	1	0	
Swan Lake, Vernon	1966	May 22				2											2	2	0	
Swan Lake, Vernon	1990	Aug 2											1				0	0	1	1
N. Arm Okanagan Lake	1977	Aug 2												1			0	0	1	
N. Arm Okanagan Lake	1977	Aug 4										1	1				0	0	2	
N. Arm Okanagan Lake	1978	June 20	3	3	0	1	1	1	0	1							10	7	0	10
N. Arm Okanagan Lake	1978	July 25											1				0	0	1	
N. Arm Okanagan Lake	1978	Aug 10										4	2				0	0	6	
N. Arm Okanagan Lake	1986	June 17	27	8	12	25	9	0	2								83	56	0	83
N. Arm Okanagan Lake	1990	Aug 7										3	12	2			0	0	17	17
Duck Lake, Creston	1981	June 21	1	0	1	4	9	2									17	16	0	50
Leach Lake, Creston	1990	Aug 10											1				0	0	1	1
Westham Island, Delta	1986	Aug 29											1				0	0	1	1
Westham Island, Delta	1988	Sep 14											1				0	0	1	1
Totals			131	30	51	82	43	7	2	1	9	76	85	15	2	0	356	219	199	
Percentage				10	20	40	20	3	1	0.5		43	48	8	1					
				% of 216 clutches								% of 178 broods								

*NR: clutch or brood sizes not recorded. Data from the B.C. Nest Record Scheme and Sight Record Cards in the Royal B.C. Museum, Forbes (1984, 1988), Stirling (1964), Weber and Ireland (1992) and unpublished data from the Salmon Arm Bay Nature Enhancement Society and A.E. Burger. When more than one card was completed for the same season in a colony, only the card with the highest nest or brood count was used here. Records from early in the season (before 20 May) were omitted.

Clark's Grebes indicates that the wintering population in British Columbia is drawn from northern breeding sites in western Canada and the northern United States.

The spring migration into the interior occurs in late April through May, primarily across the southern part of the province, with many large lakes being used as staging grounds (Cannings et al. 1987; Campbell et al. 1990). Thousands of grebes can be seen at some lakes. Small numbers remain through the summer at the coast or on lakes where no breeding has been reported (Campbell et al. 1990). The coastward fall migration may begin in late August, but is generally concentrated from mid-September through mid-October (Campbell et al. 1990). Small numbers may winter on inland lakes (Cannings et al. 1987; Campbell et al. 1990).

3.3 Prey and Foraging Requirements

Western Grebes eat fish predominantly, but also take aquatic insects (Coleoptera, Hemiptera and Orthoptera) and crustaceans (shrimp and small crabs) (Lawrence 1950; Phillips and Carter 1957; Forbes 1985; Vermeer and Ydenberg 1989; Storer and Nuechterlein 1992). Feeding at inland lakes in British Columbia has been studied only at Duck Lake, where two of the ten species of fish were eaten: juvenile Yellow Perch (*Perca flavescens*) and Pumpkinseed (*Lepomis gibbosus*). These were selected because they were abundant, small enough to fit into the grebe's gape, and formed schools as juveniles (Forbes 1985).

Starvation of chicks or adults at breeding colonies in British Columbia has not been reported. Adults seem able to adjust to occasional declines in prey by increasing their foraging effort (Forbes 1985), and prey shortages do not appear to cause breeding failure in this province, although there are too few data to be conclusive.

3.4 Factors Affecting Breeding Success

Western Grebes breeding in British Columbia have six basic requirements (Forbes 1984).

1. Freedom from human disturbance.
2. Stable water levels while nesting.
3. Protection of nests from wind.
4. Sufficient water depth at the nest site for diving.
5. Access to open, weed-free water with sufficient fish populations.
6. A sufficiently long ice-free period to permit the growth of emergent vegetation and allow time for all phases of nesting.

Similar conclusions were reached by Nuechterlein (1975), Kraft (1983) and Storer and Nuechterlein (1992).

Human disturbance comes mainly from recreational boaters, water-skiers and jet-skiers. The birds leave their nests when boats and people are nearby, leaving eggs vulnerable to crows and other predators. The wakes of power boats can also tip or flood nests. Chicks and adults can be separated when diving to avoid boats. Power boats contributed to the demise of the colonies on Williams Lake and Swan Lake, and currently threaten the colony on Okanagan Lake.

Western Grebe nests in British Columbia were built in water 15-120 cm deep, with the average depth about 70 cm (Forbes 1984). The water should be shallow enough to permit growth of emergent vegetation such as *Typha*, *Scirpus* or willows, but deep enough to permit the grebe to dive if threatened. Dropping water levels can cause nests to tip, or break apart, or restrict the access of the adults, while rising water levels can flood nests or destroy suitable emergent vegetation (Nuechterlein 1975). Significant losses of nests and eggs caused by changing water levels have been reported from Shuswap Lake (Buffam

1964; D. Munro, pers. comm.). This is a chronic problem at Duck Lake, Creston (Forbes 1985; Butler et al. 1986), and might also affect grebes on Swan Lake (A. Bryan, pers. comm.).

High winds and waves can flood nests, and are a major cause of nest failure (Storer and Nuechterlein 1992). Waves accounted for nearly 70% of the nesting losses in Delta Marsh, Manitoba (Nuechterlein 1975). A summer storm destroyed a colony of 65 nests at Duck Lake in 1976, and winds caused losses in this colony in other years (BCNRS, B. Stushnoff, pers. comm.). The cat-tails that had previously protected this colony from wind seem to have become too dense to allow nesting by Western Grebes, forcing them to use more exposed sites. The result has been very low nesting success in the 1990s.

As noted in section 3.3, prey availability does not appear to limit breeding, but this requires study. Dense growth of aquatic weeds might restrict foraging areas for Western Grebes (e.g., milfoil in the shallow lakes of the Creston Valley Wildlife Management Area).

Prolonged winters and ice-covered lakes probably contribute to limiting the northerly distribution of this species. The present nesting areas are all in southern British Columbia where the lakes thaw early and the summers are warm.

4 HABITAT

4.1 Habitat at Breeding Sites in British Columbia

The regular breeding sites are all shallow margins of freshwater lakes, both large (Okanagan Lake, 352 km^2; Shuswap Lake, 319 km^2) and medium-sized (Swan Lake, 4.5 km^2; Duck Lake, 11 km^2). Habitat characteristics of sites used for breeding in British Columbia, including Ecoregions, Biogeoclimatic Zones and Broad Habitat Classes, are summarized in Table 3. In general these sites fall within the drier, warmer parts of the province, with low summer precipitation, temperatures averaging above 18°C in July and relatively long, frost-free (and ice-free) periods.

There have been no detailed analyses of the water quality, aquatic vegetation, prey abundance and other features of the grebe's nesting habitat. Such analyses are needed to reveal if other inland lakes (e.g., Kamloops Lake, Nicola Lake) meet these requirements and therefore might be potential nesting sites. All of the colonies are threatened to some extent by human disturbance, cattle grazing and/or foreshore development, and only Shuswap Lake and the Creston colonies have any measure of protection. Each colony is discussed in section 5.

4.2 Habitat Used as Migratory Staging Grounds

Spring and fall migrants stop over at many lakes, sloughs and river backwaters in southern British Columbia (Campbell et al. 1990). Most birds, sometimes in flocks of 2000 or more, use the larger lakes, including Windemere, Kootenay, Osoyoos, Okanagan, Skaha, Vaseux, Shuswap, Kamloops, Nicola, Williams, Puntchesakut and Charlie (Peace River area) lakes (SRC; Munro 1941; Cannings et al. 1987; Campbell et al. 1990). The birds use these lakes to rest and feed, and may remain for several days. They generally avoid areas of human activity, and there is no evidence that habitat changes or other human influences are affecting these staging sites.

4.3 Habitat Used by Wintering Grebes

Wintering Western Grebes occur in small groups or large flocks, which can exceed 10 000 individuals (Campbell et al. 1990). They use a variety of marine habitats including sheltered inlets, channels and sounds, and relatively open water within 1 km of the shore. Large concentrations occur in the southern Strait of Georgia, among the Gulf Islands, in the Strait of Juan de Fuca and

Table 3. Habitat classification and characteristics of sites used for breeding by Western Grebes in British Columbia. Kamloops Lake is included as a potential colony. Ecological classification data from Demarchi (1993), and climatic data from Farley (1979).

Measure	Williams Lake	Kamloops Lake	Shuswap Lake	Swan Lake	Okanagan North Arm	Creston Valley	Westham Island
Ecoprovince	Central Interior (CEI)	Southern Interior (SOI)	Southern Interior (SOI)	Southern Interior (SOI)	Southern Interior (SOI)	Southern Interior Mountains (SIM)	Georgia Depression (GED)
Ecoregion	Fraser Plateau	Thompson-Okanagon Plateau	Thompson-Okanagon Plateau	Thompson-Okanagon Plateau	Thompson-Okanagon Plateau	Columbia Mountains and Highlands	Lower Mainland
Ecosection	Fraser River Basin (FRB)	Thompson Basin (THB)	Northern Thompson Upland (NTU)	Northern Okanagon Basin (NOB)	Northern Okanagon Basin (NOB)	Southern Columbia Mountains (SCM)	Fraser Lowland (FRL)
Biogeoclimatic zone	Interior Douglas-fir	Bunchgrass	Interior Douglas-fir	Interior Douglas-fir	Interior Douglas-fir	Interior Cedar-Hemlock	Coastal Western Hemlock
Broad Habitat Classes	Large Lake (LL) Marsh (MR)	Large Lake (LL) Marsh (MR)	Large Lake (LL) Marsh (MR)	Large Lake (LL) Marsh (MR)	Large Lake (LL) Marsh (MR) Small Lake (LS)	Large Lake (LL) Marsh (MR)	Estuary (ES) Marsh (MR)
Altitude (m)	940	350	510	380	450	600	0
Mean July temp (C)	18-20	20-22	18-20	18-20	18-20	18-20	16-18
Mean annual frost-free days	100-140	140-180	140-180	140-180	140-180	100-140	180-220
Mean days of rain in July	6-9	3-5	6-9	3-5	3-5	6-9	3-5

in some sheltered waters on western Vancouver Island (Vermeer et al. 1983).

Potential threats to Western Grebes at sea include oil spills, toxic pollutants, and loss of habitat through aquaculture. Western Grebes are vulnerable to gill-nets, but most gill-netting occurs in late summer before the grebes return to the ocean. Chronic, low-volume oil spills kill small numbers of Western Grebes in British Columbia (Burger 1993), but the large concentrations in the Strait of Georgia are vulnerable to catastrophic spills. Grebes are exposed to a range of toxic contaminants in their winter range. Concentrations of polychlorinated biphenyls (PCBs) were found to increase in Western Grebes between October and February, during the period that the birds were overwintering in Puget Sound, just south of British Columbia (Henny et al. 1990). High levels of polychlorinated bibenzodioxin (PCDD) and bibenzofuran (PCDF) contaminants were found in Western Grebes wintering in the Somass Estuary at Port Alberni in 1989 (Vermeer et al. 1993). These toxins were ingested in prey and by swallowing contaminated feathers. No studies were done to see if the dioxins and furans were affecting the birds' health, but the residue concentrations might have been sufficient to affect reproduction in sensitive bird species (Vermeer et al. 1993).

5 POPULATIONS, BIOLOGY AND PROBLEMS AT SPECIFIC BREEDING SITES

5.1 Review of Nesting Records

Western Grebes have been recorded breeding at 14 sites in British Columbia (Forbes 1988; Campbell et al. 1990; Table 1). Three, well-established colonies regularly used for breeding are on Shuswap Lake at Salmon Arm, the north arm of Okanagan Lake and Duck Lake in the Creston Valley Wildlife Management Area. Two colonies that were once regularly used were at Williams Lake (last recorded breeding in 1964) and Swan Lake, Vernon (used once since 1966). Breeding has been reliably reported in one or two years at three sites: Leach Lake and the south end of Kootenay Lake in the CVWMA (Forbes 1988; A.E. Burger and S. Boyd, unpubl. data), and at Westham Island near Vancouver (Weber and Ireland 1992). Unconfirmed records of breeding, in a single year in each case, come from six other sites (Table 1). The identity of the species is questionable in two cases (Mamette and Sanctuary lakes, see Forbes 1988) and possibly a third (Fernie). The location of the nest near Summerland is not known (see Forbes 1988) and the year is incorrect (given as 1905, but E.M. Tait was born in 1910, Campbell et al. 1990). Forbes (1988) accepted the Kamloops and White lakes records, but there has been no additional breeding reported here or other supporting evidence. Some of these sites might provide suitable nest sites in the future.

The maximum numbers of breeding pairs, or occupied nests, at regularly used colonies were as follows: Williams Lake: 17 nests and one brood in 1942, although 40 pairs were reported in that year; Shuswap Lake: 87 broods in 1994; Swan Lake, Vernon: 17 nests in 1950 with 42 pairs in the same year; north arm of Okanagan Lake, 83 nests in 1986; Duck Lake: 80-90 pairs in 1982-84 (Table 2, Forbes 1988). These maxima occurred in different years, but indicate that the total breeding population for British Columbia has probably never exceeded 300 active pairs. The current breeding population is estimated to be less than 200 pairs (90 at Shuswap Lake, 40 at Okanagan Lake and 60 at Duck Lake).

5.2 Williams Lake

5.2.1 Historical review

Breeding was first recorded at Williams Lake in 1935, when Munro (1941) reported 35 pairs nesting by the Sugar Cane Indian Reserve, at the eastern end of the lake, among extensive beds of

Table 4. Counts and breeding records of Western Grebes at Williams Lake, B.C.

Year	Maximum number counted in each time period						Evidence of breeding
	April	May	June	July	Aug	Fall	
1935			76				35 breeding pairs (Munro 1941)
1936					100		About 50 juv., 11 Aug (J.A.Munro - SRC)
1937			51		83		30 immature (J.A.Munro - SRC)
1938			6	51			5 nesting pairs, 4 July (BCNRS)
1939			50				25 nests with eggs, 1 June (L.Jobin - SRC)
1941				100			"Approx. 50 pairs" (J.A. Munro - SRC)
1942			80				17 nests, 9 with eggs, plus one brood, 5 June (BCNRS)
1948				33			
1949							6 nests, 1 brood of 2, 8 July (BCNRS)
1950		1					
1952			1				
1953				1			
1959		8					Courtship (4 May), in 4 pairs (6 May) (SRC)
1960		4				10	Courtship dance 29 May (A.Roberts - SRC)
1961	4						
1962		6	25		35		10 nests, June (Stirling 1962, BCNRS)
1963		10					
1964	13			50		1	8 young, 23 July (BCNRS)
1965			2				
1966		25	3			32	
1968		118					
1969						2	
1970		120	26				
1971		11			15		No young seen in census (Campbell et al. 1990)
1972				28			"Several small ones, possibly young", 10 July (A.R. - SRC)
1974		75		13			"No sign of young", 5 July (A. Roberts - SRC)
1975		57				1	
1976		10					
1977		50	6				"No evidence of nesting" 24 June (A.Roberts - SRC)
1978	13	103	5		9	17	Thorough check - no nests (A.Roberts + Cannings - SINC)
1979	70	22		5	3		
1980		13	11	1		14	No young (SINC)
1981		3				10	
1982		200		1			
1983	97	30					
1984	20	62	6			23	
1985						6	
1986						15	
1987						1	
1988	1	40			10		
1989	90	56		20	5	30	
1990	75	50					
1992	75+					12	
1995	75+	1				30	
Mean count	34.8	44.8	24.9	27.5	32.5	13.6	
No. years	11	24	14	11	8		

Sources: BCNRS - B.C. Nest Record Scheme (Royal B.C. Museum), SRC - Sight Record Cards (Royal B.C. Museum), SINC - Scout Island Nature Centre

Scirpus and other emergent plants. The colony was fairly stable in the 1930s and early 1940s, with 50-100 adults and 5-35 nests (Table 4, Munro 1941). Few data are available for the following 30 years, although six nests were reported in 1949, 10 nests in 1962 and eight young in 1964 (Table 4). The last confirmed breeding record was in 1964, although A. Roberts (Sight Record Card) reported "several small ones, possibly young" on 10 July 1973. Thorough checks for nests or chicks were made in 1977 and 1978 but in vain (Table 4). Anna Roberts of the Williams Lake Field Naturalists has maintained records of Western Grebes since 1959, but reported no evidence of nesting since 1964. The number of grebes reported during the breeding season (June through August) has declined fairly consistently since the 1940s, and in the 1980s there were usually less than 10 birds (Figure 2).

5.2.2 Recent observations

Western Grebes continue to visit Williams Lake during their spring and fall migration in flocks of up to 200 birds, but few remain through the summer (Table 4, Figure 2). There have been no intensive searches for nests since the 1970s.

5.2.3 Factors affecting the grebes

The decline and demise of the Williams Lake colony can be attributed to human disturbance. Munro (1941) mentioned that local people removed eggs, and that predation of eggs by American Crows (*Corvus brachyrhynchos*) was common when boaters drove birds off their nests. Stirling (1962) stated that industrial installations and power boats were spoiling the grebe colony. Recreational boating continues to disrupt grebes in the 1990s. The west end of the lake has a float-plane base, and expanding recreational, light-industrial and housing developments. Water levels were raised when the lake was dammed in the 1960s, but the effect on grebes is not known.

Grazing and trampling of emergent vegetation by cattle during the winter might affect grebes by destroying much of the previous season's growth (Munro 1941). Grazing by cattle appears to be reduced in the 1990s (A. Roberts, pers. comm.). Populations of small fish appear to be abundant and are unlikely to be a limiting factor (A. Roberts, pers. comm.).

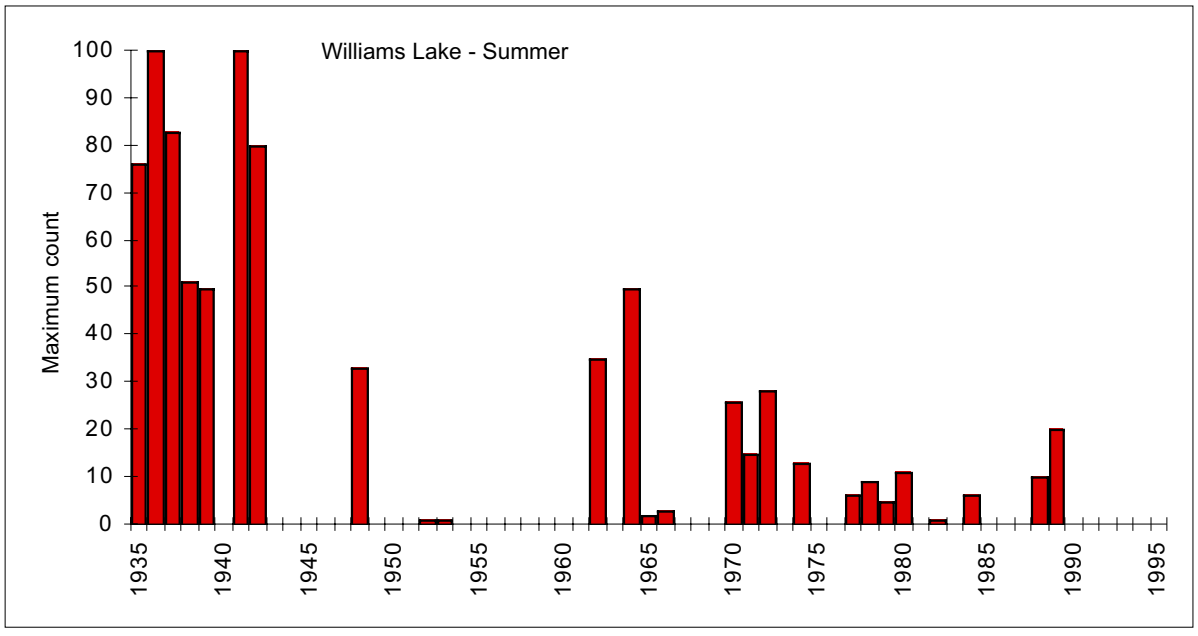

Figure 2. Maximum counts of Western Grebes at Williams Lake during the summer.

5.2.4 Habitat ownership and conservation status

The extinct colony was within Indian Reserve No. 1 (Sugar Cane Reserve). There is now fairly dense housing in one part of the reserve, and other areas bordering the wetlands are used for agriculture. It might be possible to rehabilitate this colony with the co-operation of the local First Nations band. Excluding cattle from emergent vegetation and restricting boating in the shallow northeast bays where the grebes forage might induce the small summer population to breed.

5.3 Kamloops Lake

The only record of breeding at Kamloops Lake was in 1973, when 20 pairs (not 60 as quoted by Forbes 1988) were reported with chicks by K.J. Fleming (Table 3). None of the local naturalists or wildlife officers knows anything about this record, and there might also have been an error in reporting the location. R. Howie, R. Ritcey and S. Roberts of Kamloops monitored the grebes from 1980 to 1995, and are unlikely to have missed evidence of breeding. Their data show that Western Grebes are regular migrant visitors to Tranquille in spring and fall, and 10-20 birds often remain during the breeding season (Figure 3).

In 1990, the tract of marsh at Tranquille was established as a Wildlife Management Area. There appears to be a plentiful supply of fish here (D. Low, pers. comm.), and with the creation of suitable beds of cat-tails or similar emergent vegetation, the grebes might be induced to breed. The river mouth on the south side of the lake, privately owned, also appears to be a potential breeding area.

5.4 Shuswap Lake at Salmon Arm

5.4.1 Historical review

Breeding was first reported in 1962 (Stirling 1962). Breeding success was low in the 1960s (Buffam 1964; Stirling 1964), but the number of nests appeared to stabilize, with 40-50 in the 1970s and 1980s (Table 5). The number of birds counted at the colony has fluctuated (probably due to incomplete counts), and appears to have increased in the 1990s (Figure 4).

5.4.2 Recent observations

In the 1990s the maximum summer population averaged 266 birds (including young) with 30-90 breeding pairs (Table 5, Figure 4). The grebes have nested at several sites in Salmon Arm Bay, but principally in the marsh immediately west of the marina and in the extensive areas of emergent vegetation southeast of the mouth of the Salmon River. The primary foraging, loafing and chick-rearing area is the open water northeast of the

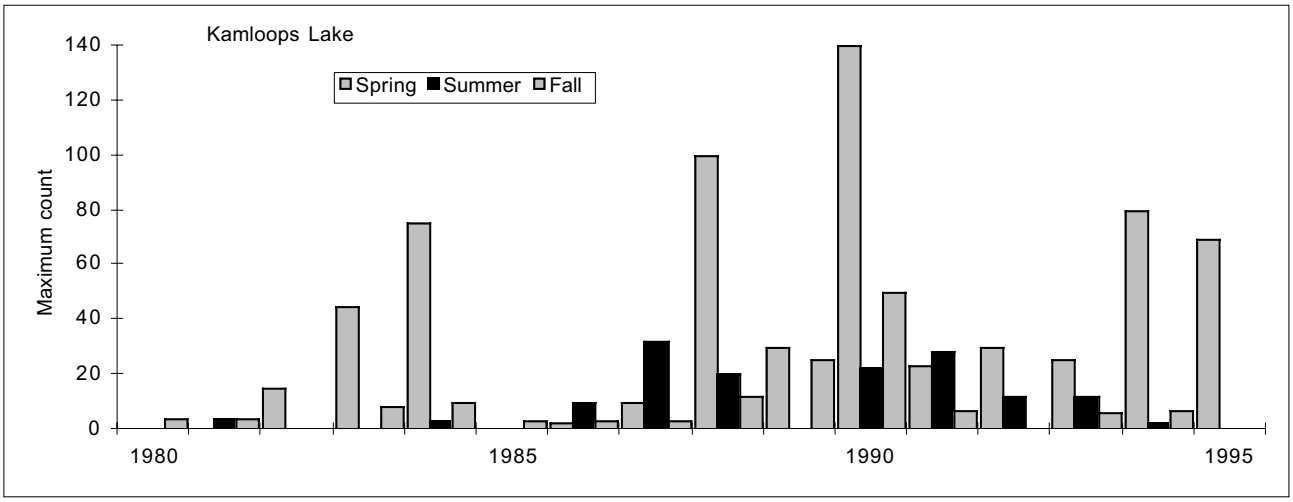

Figure 3. Maximum counts of Western Grebes at Kamloops Lake during the spring, summer and fall.

Table 5. Counts and breeding records of Western Grebes at Salmon Arm, Shuswap Lake, B.C.

	Maximum number counted in each period						
Year	April	May	June	July	Aug	Fall	Evidence of breeding, and other notes
1950					100		D.A. Munro (SRC)
1951					150		
1962			34				9 nests, 23 June (BCNRS)
1963	3		57			6	26 nests, 9 June (Stirling 1964)
1964			(126)	77			63 nests, 29 June (Buffam 1964)
1970					200		
1971							
1972							
1973			76	75	10		44 nests, 16 June; young present 30 July (BCNRS, SRC)
1974							
1975							
1976			50				65 nests (46 completed, 14 with eggs), 3 June (BCNRS)
1977			140		90		
1978							
1979							
1980				50		51	
1981					173		34 young (incomplete count, no date; F. Kime & D. Munro)
1982					174		34 young (incomplete count, no date; F. Kime & D. Munro)
1983					142		26 young (incomplete count, no date; F. Kime & D. Munro)
1987		65		150			Est. 47 nests (D.A. Munro)
1988					222		Est. 50 nests (J.H. Shaver)
1989	191	152	140	205	257	253	
1990	175	215	108	155	201	265	14 broods, 27 young, Aug 1 (A.E. Burger)
1991			144	165	247		31 broods, 57 young, 25 Jul & 8 Aug (D.& F. Kime, D. Munro)
1992				232			28 broods, 44 young, no date given (D. & F. Kime)
1993		130	270	284	290		44 broods, 65 young, 19 and 29 July (D. & F. Kime)
1994	244		245	288	314		87 broods, 145 young, 21 July (D. & F. Kime)
1995				298			59 broods, 103 young, 21 July (D. & F. Kime)
Mean	153	141	115	180	184	144	
Years	4	4	11	11	14	4	

Data from the B.C. Nest Record Scheme (BCNRS) and Sight Record Cards (SRC) at Royal B.C. Museum, Forbes (1984), Campbell et al. (1990), and unpublished data from A.E. Burger, D. and F. Kime, D.A. Munro, and J.H. Shaver.

marina. In 1995 seven pairs nested near there, in a small lagoon on Christmas Island (a dredge deposit island colonized by Ring-billed Gulls (*Larus delawarensis*).

5.4.3 Factors affecting the grebes

Dropping water levels, which tipped nests, contributed to the virtually complete breeding failure in 1964 (Buffam 1964). Predators, including American Crows, Ring-billed Gulls, Bald Eagles (*Haliaeetus leucocephalus*) and Black-billed Magpies (*Pica pica*), are common on the Salmon Arm waterfront and could take grebe eggs, particularly when adults leave their nests at the approach of boaters (Munro and Munro 1987; R.W. Campbell, pers. comm.). The gulls are of particular concern because they can attack small chicks on the water. At present the gulls eat primarily garbage at a nearby dump, and appear to have little impact on the grebes, but improvements at the dump are likely to reduce the availability of garbage, and the gulls might then make more effort to take the grebes' eggs and chicks.

Radcliffe et al. (1990) identified the following existing or potential threats to Western Grebes at Salmon Arm: disturbance from boaters; changes in nesting and foraging habitat due to dredging, and the construction of wharves and berms; road-building on the foreshore; fuel leaks at the marina; disturbance due to increased wildlife viewing and photography; potential development on the Indian Reserve; destruction of nesting habitat by cattle; and upland housing construction.

Human disturbance is the most critical risk. A large 60-berth marina has been constructed within the grebes' usual nesting areas. A boom erected by the Salmon Arm Bay Nature Enhancement

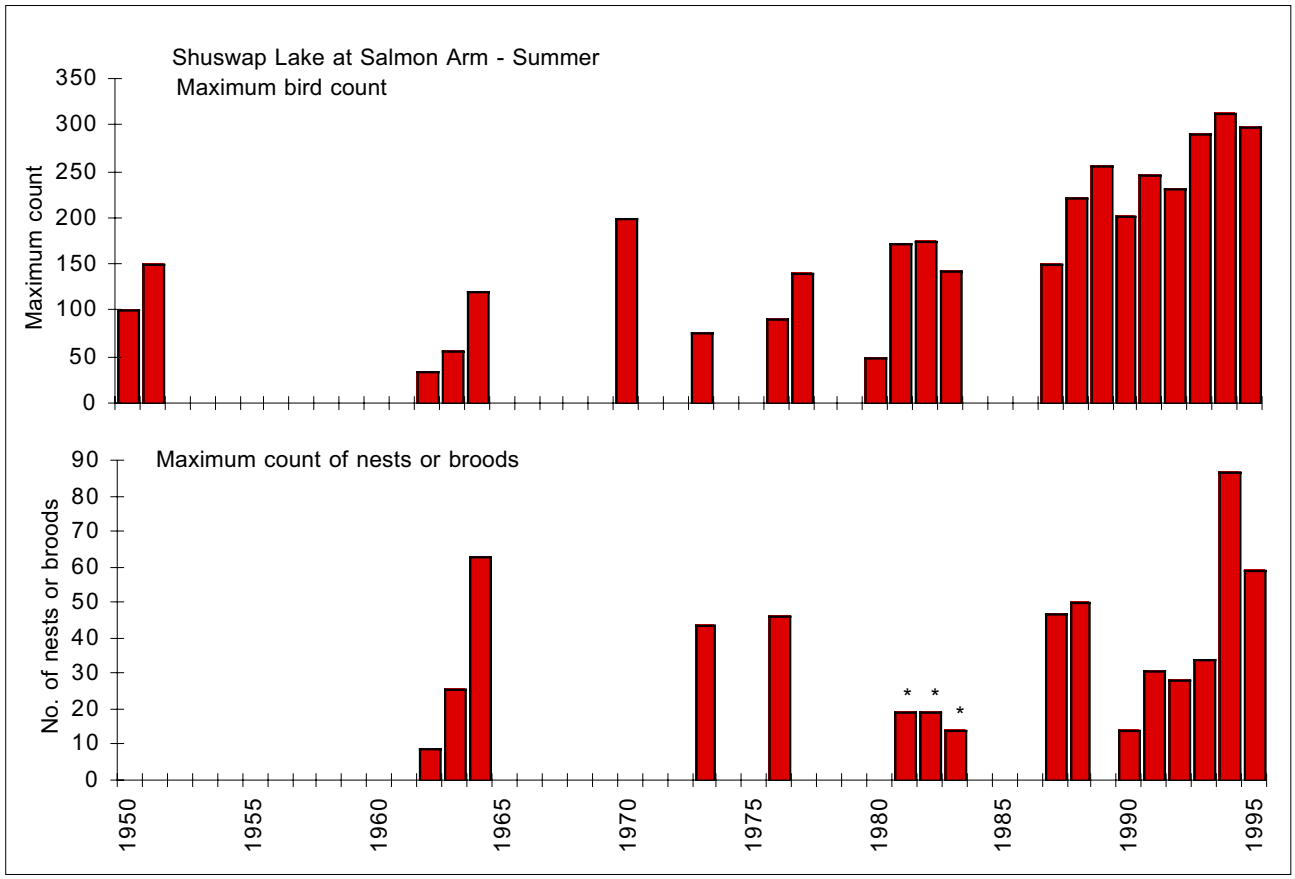

Figure 4. Counts of Western Grebes at Salmon Arm, Shuswap Lake, during the summer.

Society (SABNES) keeps power boats out of the nesting areas, but nesting birds are still vulnerable to errant canoeists. There has been considerable development along the waterfront adjacent to the marina, including offices and townhouses. Some effort was made by developers to protect the marshes and nesting areas, but the increased human traffic cannot fail to affect the grebes and perhaps also the habitat.

Most nests have been among reed canarygrass (*Phalaris arundinacea*), an introduced rhizomatous perennial species that is favoured by cattle (Radcliffe et al. 1990). Prior to 1994 grazing and trampling by cattle reduced the preferred nesting habitat around the mouth of the Salmon River (Radcliffe et al. 1990). In 1994 the affected area was leased by SABNES for the protection of the grebes, and nesting is now more successful there (F. Kime, pers. comm.).

5.4.4 Habitat ownership and conservation status

Radcliffe et al. (1990) reviewed the history and ownership of the Salmon Arm Bay foreshore. A large strip of the waterfront (21.5 ha) is owned by the Nature Trust. This land, along with 1.55 ha owned by the District of Salmon Arm, is managed by SABNES, with representation from the Ministry of Environment, Lands and Parks, the Department of Fisheries and Oceans, the Canadian Wildlife Service and Ducks Unlimited. Preservation of nesting and foraging habitat for Western Grebes is a major priority for SABNES.

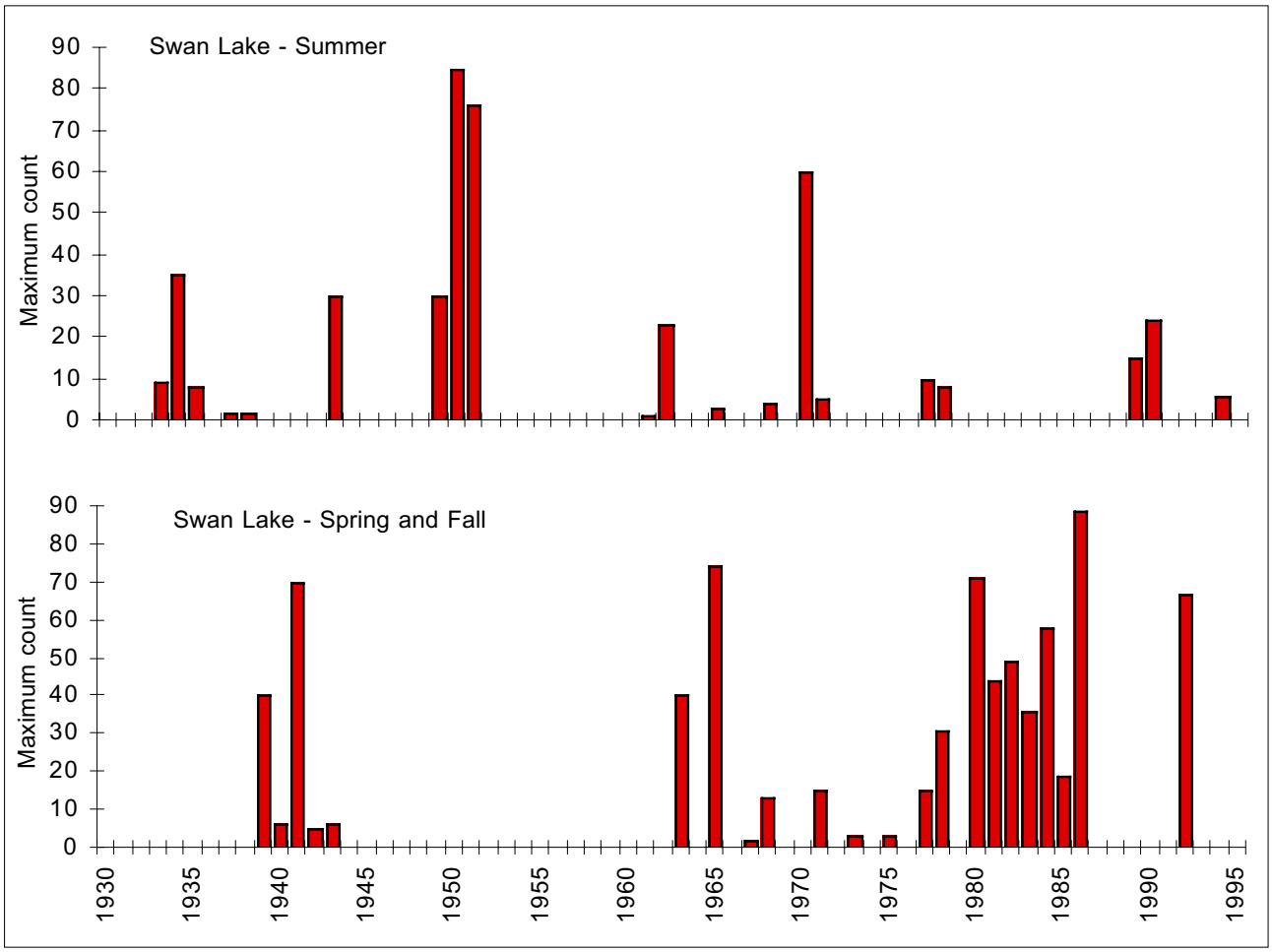

Figure 5. Maximum counts of Western Grebes at Swan Lake, Vernon, in summer, and spring or fall.

Table 6. Counts and breeding records of Western Grebes at Swan Lake, Vernon, B.C.

	Maximum number counted in each period						
Year	April	May	June	July	Aug	Fall	Evidence of breeding and other notes
1933				9			At least 1 pair with young, 17 July (BCNRS)
1934				35			
1935					8		7 young (half-grown), 10 Aug (Brooks)
1937			2				
1938			2				
1939		2				40	
1940		6				4	
1941						70	
1942						5	
1943					30	6	
1949					30		
1950			85		55		17 nests with eggs on East side (BCNRS)
1951			76		75		1 nest, 1 new young, 7 June (BCNRS)
1960							4 nests with eggs, 8 June (BCNRS)
1961				1			
1962			23				
1963		40					7 nests, 5 with eggs, 25 May (BCNRS)
1964							
1965		74		3			8 nests, 7 with eggs, 29 May (BCNRS)
1966							1 nest with eggs, 22 May (BCNRS)
1967		2					No nests, 23 May (Cannings et al. 1987, SRC)
1968	13	12	4				
1970			60		5		
1971					5	15	
1973						3	
1975	3						
1977				6	10	15	
1978	31	10	8		6		Breeding suspected, 21 June (Cannings et al. 1987), no young on 11 Aug 1978 (SRC)
1979							
1980	10	71				3	
1981	44	12					
1982	27	49					
1983	36						
1984	51	58					
1985	19						
1986	14	89					
1989					15		
1990					24		One brood, 2 young, 2 Aug (Burger)
1992		109				67	No evidence of nesting (Siddle)
1994				6			No evidence of nesting (Boyd)
Mean	24.8	41.1	32.5	10.0	23.9	22.8	
Years	10	13	8	6	11	10	

Data from the B.C. Nest Record Scheme and Nest Record Cards at Royal B.C. Museum, Munro (1954), Forbes (1984), Cannings et al. (1987), and unpublished data from S. Boyd, A. E. Burger, Ducks Unlimited (Kamloops), and C. Siddle.

Part of the upland area on the foreshore, adjacent to the marshes where Western Grebes sometimes nest, is privately owned and partly developed with condominiums and offices. Much of the nesting colony is in the Indian Reserve, leased by SABNES from the Niskonlith and Adams Lake bands.

SABNES has positioned marker buoys and a boom along the southeast and southwest portions of the bay to warn boaters against disturbing the birds. In addition, the wildlife viewing plan commissioned by SABNES recommends fencing to exclude dogs, screening of sensitive areas, strict control of development, and the possible use of permits to regulate research and photography in the colony (Radcliffe et al. 1990).

Western Grebes have a high public profile in Salmon Arm. The efforts of SABNES and the Shuswap Naturalist Club to protect this population are an excellent example of inter-organizational co-operation, which should be fully supported and emulated at other colonies of Western Grebes.

5.5 Swan Lake, Vernon

5.5.1 Historical review

Western Grebes were reported nesting in 1933, and for several years in the 1950s and 1960s. The highest counts were of 17 nests and 85 adults in 1950 (Table 6), although approximately 40 pairs were reported to have nested between 1950 and 1966 (Cannings et al. 1987). In 1965 the grebes abandoned their colony in the southeast corner of Swan Lake due to disturbance from boats and float planes, and established a new colony in the northeast corner (Cannings et al. 1987). Prior to 1990, nesting was last reported at Swan Lake in 1965 (8 nests) and 1966 (2 nests) (Table 6, Forbes 1984), although Cannings et al. (1987) reported possible breeding in 1978.

Censuses of the Swan Lake population have been sporadic (Figure 5). Summer populations have declined since the 1950s and counts average 15 birds in the 1990s. Many migrants continue to visit in spring and fall.

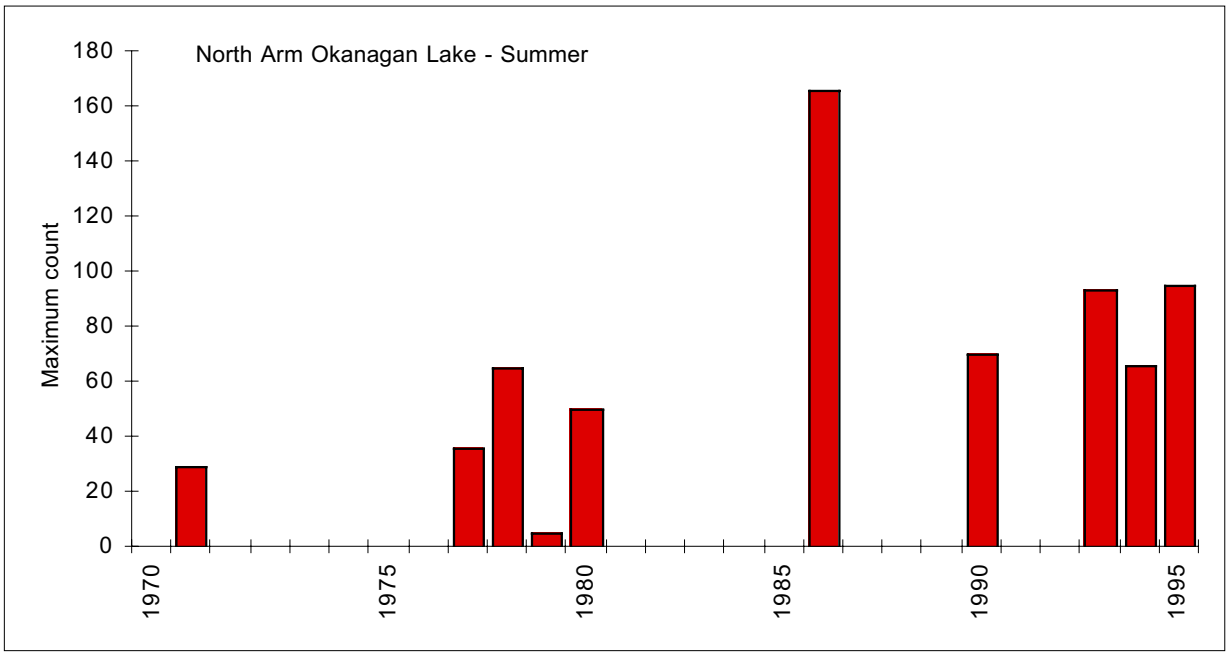

Figure 6. Maximum counts of Western Grebes at the North Arm of Okanagan Lake in summer.

Table 7. Counts and breeding records of Western Grebes at the North Arm of Okanagan Lake, B.C.

	Maximum number counted in each period						
Year	April	May	June	July	Aug	Fall	Evidence of breeding, and other notes
1971					29		
1977				34	36	72	Minimum 2 broods, 4 Aug (BCNRS)
1978	56		65	26	26	10	29 nests, 20 June (BCNRS)
1979				5			
1980		325	50				14 pairs with eggs or chicks (Swift - SRC)
1981		200					
1982	4						
1986		166					83 nests, 56 with eggs, 17 June (BCNRS)
1990					70		17 broods, 33 young, Aug 2 (Burger)
1993				93			56 adults and 37 young, 17 July (Siddle)
1994				56	66		43 adults and 23 young, 11 Aug (Siddle)
1995				37	95	155	32 adults and 5 young, 28 July (Siddle)
Mean	56.0	176.3	93.7	41.8	58.6	79.0	
Years	1	3	3	6	5	3	

Data from the B.C. Nest Record Scheme (BCNRS) and Sight Record Cards (SRC) at Royal B.C. Museum, Cannings et al. (1987), and unpublished data from A.E. Burger and C. Siddle.

5.5.2 Recent observations

On 2 August 1990, 1 brood of 2 chicks, two-thirds grown, was seen with 24 adults (Table 2). This represents the only breeding record since 1966. Only 6 adults were counted on 30 July 1994.

5.5.3 Factors affecting the grebes

Human disturbance continues to be a significant problem at Swan Lake. Power-boats and other recreational craft are common in summer. The eastern shore has a large trailer park, a float-plane and boat launch, and increasing industrial and commercial development on upland areas. The western and southern shores and parts of the eastern shores border extensive agricultural areas, and destruction of potential nesting habitat by cattle and horses is a problem.

5.5.4 Habitat ownership and conservation status

McAllister (1983) reviewed the ownership of land around Swan Lake and the efforts made to preserve and enhance the wetland habitat. The lake was identified as a significant wetland for waterfowl in 1922, and since then there have been numerous efforts to establish wildlife reserves. Hunting and shooting have been prohibited since 1970. Much of the foreshore is Crown land, but upland areas are privately owned. The privately owned Anderson properties at the south end of the lake probably include the early colony site. The exclusion of cattle and reduced disturbance from people might induce Western Grebes to breed here once more. The north end is an Indian Reserve, and is still largely undeveloped, with extensive beds of cat-tails, and this is probably where breeding occurred in 1990. A Wildlife Management Area was proposed for Swan Lake in 1994 (O. Dyer, pers. comm.). The Nature Trust of British Columbia has acquired property along the eastern shore, and habitat enhancement programs are underway. Immediately to the south is a Crown land reserve for wildlife conservation.

5.6 North Arm of Okanagan Lake

5.6.1 Historical review

Okanagan Lake is an important staging ground for spring and fall migrants, but there has been no evidence of breeding in the main body of the

lake, except for the doubtful record from Summerland in 1905 (Cannings et al. 1987). Brooks (1973) reported 2 young among 7 adults on the North Arm in 1971, but the colony might have existed prior to that year (Cannings et al. 1987). The most thorough investigation, by J.M. Cooper and M. McNall, yielded 83 nests (56 with eggs) at three sub-colonies in 1986 (Table 7). Numbers of birds counted in the 1990s seem slightly higher than in the 1970s (Figure 6).

5.6.2 Recent observations

Breeding appears to be regular in the 1990s, with 23-37 young counted (Table 7). This is a difficult colony on which to take a census, with few vantage points on shore, and so these are likely to be minimum estimates. This was the most productive Western Grebe colony in British Columbia in 1990. There are insufficient data to assess population trends or breeding success of this population. It is the most neglected colony of Western Grebes in British Columbia and urgently requires study and protection.

5.6.3 Factors affecting the grebes

The two greatest threats are disturbance from recreational boaters (power-boaters, water skiers and jet skiers) and foreshore development. There are campsites, trailer parks and boat ramps near the nesting areas, and the nesting grebes are undoubtedly affected by human activities. The effects of cattle and other livestock are not known.

5.6.4 Habitat ownership and conservation status

Land adjacent to the three sub-colonies on the east side of the lake is Indian Reserve, and currently undeveloped, apart from several cabins. The west and north shores are also in the Indian Reserve, but many sites have been leased for cabins, a trailer park on the north shore and a large campsite-trailer park at Newport Beach. Most of the shoreline is undeveloped, with extensive beds of emergent vegetation bordering the lake, and meadows and farmland on higher ground.

There are no formal measures to protect the grebe colonies or reduce disturbance from boaters. The proliferation of cabins and recreational boating in this area could cause the extinction of this breeding population. Studies and conservation measures are urgently needed, in collaboration with the local First Nations band. Local naturalists and wildlife officials need to pay more attention to these grebes.

5.7 Creston Valley Wildlife Management Area (CVWMA)

5.7.1 Historical review

Western Grebes nest regularly in the CVWMA, usually on Duck Lake, but occasionally on the south end of Kootenay Lake and on Leach Lake. The history of this population has been reviewed by Forbes (1984, 1988). Prior to 1950, Western Grebes were common transients in this area, but there was no evidence of breeding (Johnstone 1949; Munro 1950). Diking, regulation of water levels, and enhancement of emergent vegetation in the 1950s and 1960s led to the colonization of Duck Lake by Western Grebes in the 1960s (Forbes 1984; Butler et al. 1986). The construction of the Libby Dam in Montana reduced flooding of the Kootenay River after 1977.

Census data are patchy because the grebes were not included in the annual waterfowl censuses made by the CVWMA staff. Fifteen nests (with 200 adults) were reported in 1968, 40 in 1973, 65 in 1976, 48 in 1978 and 75-90 in 1981-83 (BCNRS; Rodgers 1973; Forbes 1984; CVWMA, unpubl. reports). A sub-colony of 4 nests was found at the south end of Kootenay Lake in 1982 (Forbes 1984), and one pair with a brood was seen on Leach Lake in 1990 (A.E. Burger and R. Dooley, unpubl. data).

5.7.2 Recent observations

Seventy-four aerial censuses made in 1988-1990 showed that 96% of the Western Grebes were on Duck Lake, 2% on Leach Lake, 1% on Kootenay Lake and 1% on other smaller lakes (CVWMA, unpubl. data). Censuses in the 1990s yielded 80-117 birds, but breeding success appears to have been consistently poor. Only one brood was reported in both 1990 and 1991, no nests in 1994, and 20-30 possible nests (viewed at a distance) in 1995 (unpubl. data from S. Boyd, A.E. Burger, S. Cannings and B. Stushnoff).

5.7.3 Factors affecting the grebes

Fluctuating water levels continue to be a problem for Western Grebes on Duck Lake, despite the dikes and somewhat controlled flow. Floods that affected grebes occurred in 1974, 1983, 1990 and 1991 (CVWMA, unpubl. data; Ohanjanian 1986). The usual site of the colony, on the southeast corner of Duck Lake is exposed to destructive winds and waves. A summer storm destroyed 65 nests in 1976 (B.G. Stushnoff, BCNRS). The cat-tail beds bordering Duck Lake might have become too dense for grebes, forcing them to nest in more exposed sites.

Duck Lake and Leach Lake are heavily infested with milfoil weed. This provides an anchor for nests, but also restricts areas of open water used for foraging. Fluctuating densities of preferred fish in 1982 and 1983 in Duck Lake did not affect breeding success, although the parents spent more time foraging during the poor year of 1982 (Forbes 1985). Natural predators include ravens, crows, owls and mink (Ohanjanian 1986).

The effects of boaters and anglers on the grebes is not known. Power boats are banned from the CVWMA, and anglers usually launch rowboats and canoes at Sirdar, which is >1 km from the usual grebe colony.

5.7.4 Habitat ownership and conservation status

This is the most protected nesting site of Western Grebes in British Columbia. All nesting sites on Duck Lake, southern Kootenay Lake and Leach Lake fall within the CVWMA, and are therefore protected under the Creston Valley Wildlife Act and subject to management practices of the CVWMA staff. However, water levels are controlled by an International Joint Commission, which uses Duck Lake to buffer against flooding in the Kootenay River. The CVWMA managers have little control over water levels in Duck Lake during spring and summer.

In response to a 1989 biological review, the CVWMA placed a high priority on research on Western Grebes. Plans included a study of the effects of boaters on nesting grebes and thinning of dense cat-tail beds to promote nesting. These plans were shelved when the federal government withdrew its funding of the CVWMA, and no work has been done on grebes since 1990. The cause of the low breeding success in the 1990s needs to be resolved.

5.8 Westham Island, Delta

Weber and Ireland (1992) report the sightings from two years of a pair tending downy chicks in a marsh in the George Reifel Bird Sanctuary (29 August 1986; 14 September and 2 October 1988). These birds must have nested in the brackish marshes off Westham Island in the Fraser River delta. The area is subjected to tidal flux averaging 3.1 m, making this a precarious nesting site. This appears to be the first tidewater breeding record for Western Grebes. A flock of 30-100 Western Grebes is present off Westham Island during most summers, but there have been no previous signs of breeding prior to 1986 (Weber and Ireland 1992) or since 1988 (J. Ireland, pers. comm.).

5.9 Significant Summer Sightings of Western Grebes

Many inland lakes that might contain suitable nesting habitat for Western Grebes have not been adequately checked. Groups of grebes have been observed during the summer months (June through August) at the following lakes (maximum summer count in parentheses): Charlie Lake (7), Bowron Lake (7), Stum Lake (2), Summit Lake, Cariboo (4), Columbia Lake (~12), Little Shuswap Lake (4), Vaseux Lake (3), Skaha Lake (20), main body of Okanagan Lake (44), Nicola Lake (65), Windemere Lake (9), and Baynes Lake, Waldo (27) (Data from the Sight Record Cards, and M.J. Sarrel).

6 TRENDS IN THE WINTERING POPULATION

6.1 Coastal Distribution

Surveys made from boats and aircraft in coastal British Columbia in winter (1977 and 1978) revealed the greatest concentrations of Western Grebes in the southern Strait of Georgia, the Gulf Islands, the Strait of Juan de Fuca near Victoria, and inlets on the west of Vancouver Island (Vermeer et al. 1983; Vermeer and Ydenberg 1989). The southern Strait of Georgia and adjacent Puget Sound (Washington) are believed to support the greatest winter densities in the species' range. Exposed coastlines on the west

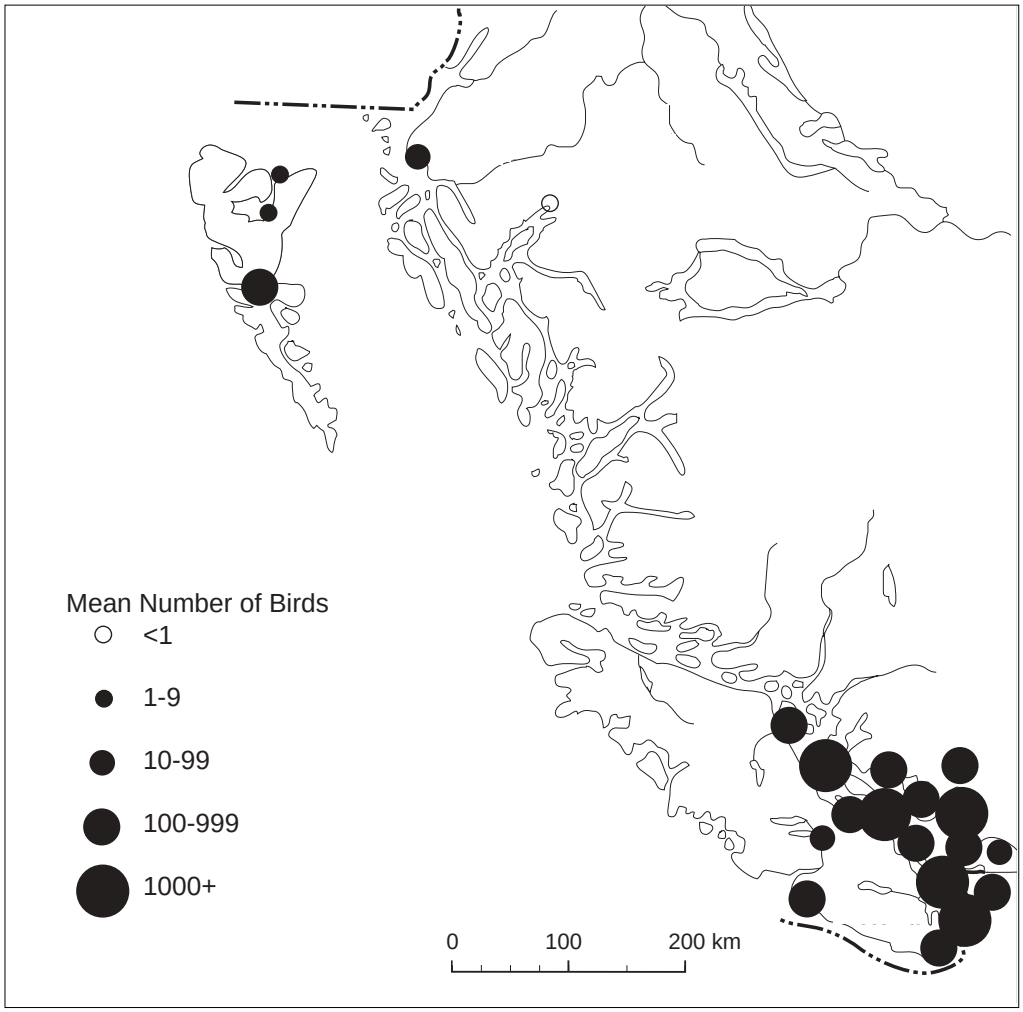

Figure 7. Mean numbers of Western Grebes reported in Christmas bird counts at coastal sites in British Columbia between 1985 and 1994.

of Vancouver Island, the Queen Charlotte Islands and the northern mainland coast support very few wintering grebes (Vermeer et al. 1983). Six banded birds recovered in British Columbia had come from colonies in Manitoba (5 birds) and Saskatchewan (1 bird; Eichhorst 1992).

Christmas Bird Counts (American Birds, vols. 12-49) provided population estimates between 1957 and 1994 for 25 coastal sites in British Columbia (see Appendix 1). Western Grebes are conspicuous birds and their tallies within a count area are unlikely to be affected by variable observer effort (party-hours), which was relatively constant for most sites (see Appendix 1). An average of 19 355 Western Grebes were at these sites in the 10-year period 1985-94, with the biggest concentrations in the southern Strait of Georgia (Comox, Deep Bay, Duncan, Nanaimo, Vancouver), the Gulf Islands (Pender Island) and off Victoria (Figure 7). Relatively few grebes were reported from the northern coast (Kitimat, Prince Rupert) or the Queen Charlotte Islands (Port Clements, Rose Spit), with the exception of Skidegate Inlet.

6.2 Variations in Local Winter Populations

There are considerable year-to-year variations in local wintering populations; Christmas counts at Vancouver, for example, show 15-fold fluctuations (see Appendix 1). Christmas bird counts are

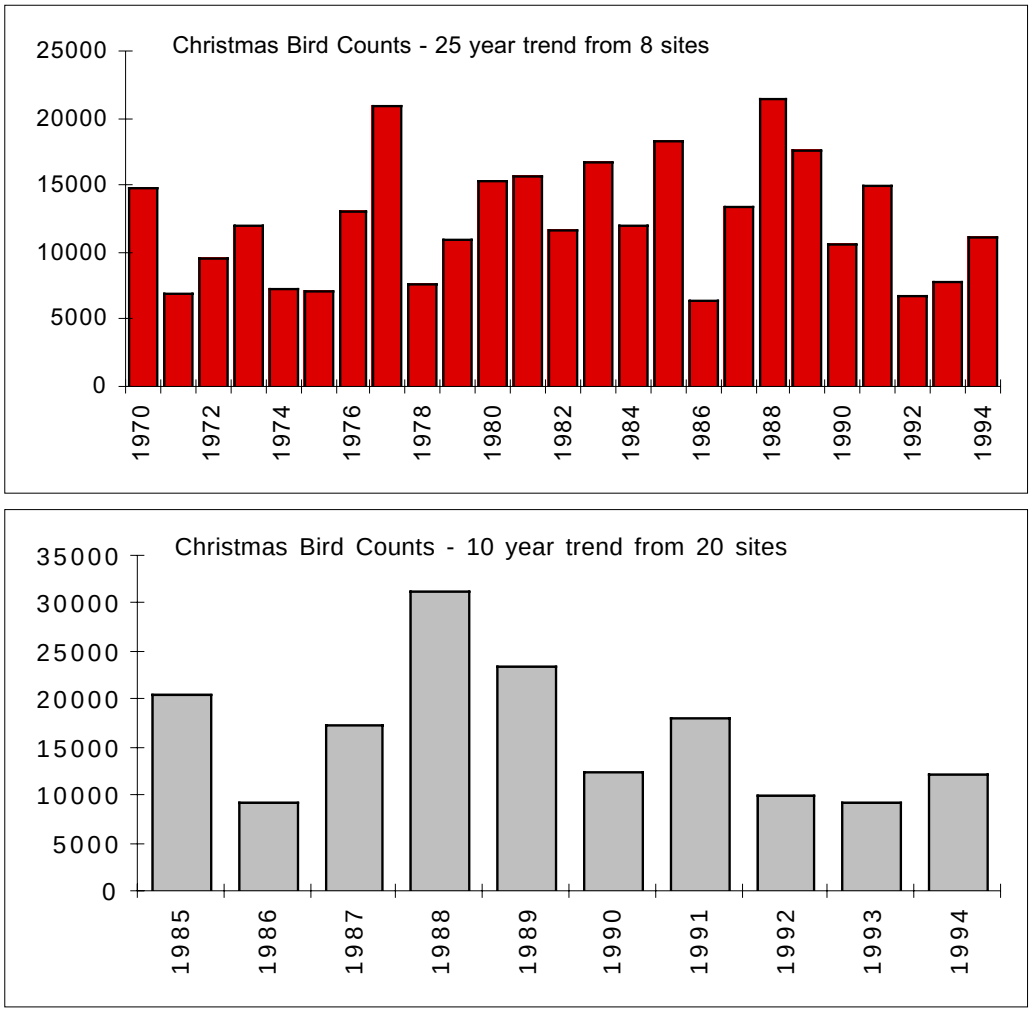

Figure 8. Trends in the total numbers of Western Grebes in Christmas bird counts from coastal British Columbia over 25 years (upper histogram) and 10 years (lower) histogram.

no substitute for systematic, coast-wide censuses, but they do provide data from the same areas over long periods of time. Pooled samples from eight count areas over 25 years (1970-94) and from 20 areas over 10 years (1985-94) showed no significant changes (Figure 8; Pearson correlation, $P>0.05$ in both cases). A tentative conclusion is that wintering populations of Western Grebes in British Columbia show no evidence of decline or increase.

7 LEGAL PROTECTION

The Western Grebe is protected federally under the *Migratory Birds Convention Act* (1994) and provincially under the *British Columbia Wildlife Act* (1982). Breeding Western Grebes and riparian habitats on Crown land are provided special management under the Managing Identified Wildlife and Riparian Management guidelines of the *Forest Practices Code of British Columbia Act* (1995).

8 LIMITING FACTORS

Factors limiting the B.C. population have not been clearly identified. Western Grebes are long-lived (many likely to exceed 10 years), but have relatively low recruitment (average annual fledging success of 0.79 young per adult; Forbes 1988), and mortality of independent juveniles is likely to be high. The potential for population growth is thus low. Populations in California that were drastically reduced by plume hunters at the turn of the century were slow to recover (Kraft 1983).

Overall, factors affecting breeding success seem likely to set population levels. Management efforts should be directed at improving nesting conditions and reducing disturbances at inland colonies.

9 SPECIAL SIGNIFICANCE OF THE SPECIES

9.1 Significance and Status in North America

Western Grebes are conspicuous, readily identified waterbirds, well known to people at their breeding sites and winter aggregations. Their numbers were drastically reduced due to plume hunters at the turn of the century (Ehrlich et al. 1988; Storer and Nuechterlein 1992), and more recently by DDT and other organochloride pesticides (Herman et al. 1969). The Western Grebe was on every North American “Blue List” from 1973 to 1982, with habitat loss cited as a problem in 1980 (Arbib 1979; Tate 1981; Tate and Tate 1982). In 1982, the population was “stabilizing at a reduced level,” and it was downlisted in 1986 to a species of special concern (Tate 1986). Western Grebes presently have no direct commercial use, but are attractive and conspicuous birds and contribute to the wildlife viewing economy.

9.2 Significance and Status in British Columbia

The species is listed in the British Columbia Wildlife Branch’s Red List of species that have, or are being considered for, Endangered or Threatened status. The wintering population is very large and under no immediate threat, although there are potential threats to localized aggregations (see section 5.3). The breeding population requires intensive monitoring; it is small and important colonies have become extinct or are declining.

This grebe has attracted special attention in Salmon Arm, where the nesting colonies are close to the town. There have been several articles in local newspapers (e.g., Munro and Munro 1987),

and the grebe is featured on the advertising for the foreshore housing developments. Protection of grebe habitat is an important concern of the Salmon Arm Bay Nature Enhancement Society.

10 RECOMMENDATIONS AND MANAGEMENT OPTIONS

10.1 Investigation of the Effects of Recreational Boating, and Implementation of Boating Restrictions where Necessary

Power boats have negative impacts on Western Grebes at Williams, Shuswap, Swan and Okanagan lakes, but the severity and timing of these impacts is not well known. A study of this problem during the incubation and chick-rearing phases of breeding should be done, leading to the control or restrictions of boating where necessary in sensitive areas. The situation at Okanagan Lake is particularly critical, and a collaborative study involving wildlife biologists, local naturalists and First Nations is needed urgently.

There are several publications on the effects of boating on birds, but none deal specifically with Western Grebes (National Biological Survey 1994). The booms and signs erected at Shuswap Lake appear to be effective and provide a model for other British Columbia colonies.

10.2 Annual Monitoring of Populations and Breeding Success

The data on population trends and reproductive output of Western Grebe colonies are patchy. All extant colonies should be monitored for 3-5 years, including: monthly censuses through the breeding season; counts of nests completed and clutches laid; counts of chicks at 10-day intervals; estimating fledging success; observations of natural and human-related causes of breeding failure; and observations on habitat use, including nesting and foraging space.

10.3 Intensive Studies where Problems have been Identified

The basic observations outlined in section 10.2 should reveal if additional intensive studies are required at the breeding colonies, e.g., monitoring of prey abundance and diets; measurements of organochloride or other chemical contaminants in eggs and tissues; a more detailed look at habitat use and changes; and studies on the impacts of Ring-billed Gulls at Shuswap Lake.

10.4 Improvements to Control Water Levels

Fluctuating water levels appear to cause breeding failure in some seasons at Duck Lake and might be a factor at Swan Lake. At Duck Lake there are already dikes and pumps designed to regulate water levels to promote nesting by waterfowl, which might be improved to boost nesting success of the Western Grebe. Nuechterlein (1975) and Kraft (1983) reviewed the importance of regulated water levels as a management tool to enhance Western Grebe breeding.

10.5 Habitat Rehabilitation

The exclusion of cattle from beds of emergent vegetation has improved breeding success at Shuswap Lake. Similar exclusion should be applied at the Okanagan Lake colony, and potential breeding sites on Williams, Kamloops and Swan lakes. Control or prevention of foreshore development is also required for Shuswap, Williams, Okanagan and Swan lakes. The success of SABNES at Salmon Arm provides a valuable model for dealing with cattle, development and boaters.

10.6 Involvement of First Nations Bands

Much of the suitable habitat at nesting colonies falls within or adjacent to Indian Reserves (e.g. Williams, Shuswap, Swan and Okanagan lakes), and the participation of First Nations bands in

protecting or rehabilitating these colonies is essential. The successful negotiations between SABNES and local bands to protect the Shuswap Lake colony provides a useful precedent.

10.7 Rehabilitating Old and Creating New Colonies

Protection from boaters, other human disturbances, development and cattle could allow Western Grebes to resume breeding at Williams and Swan lakes, and might create suitable conditions at Kamloops Lake. The grebes regularly visit these lakes during the breeding season. At each lake, areas needing protection should be mapped, and ways found to implement protection without alienating local people.

11 EVALUATION

The Western Grebe should remain as a Red-listed species, due to the small size and restricted locations of the breeding population, uncertainty over the trend in population size, the existence of threats to the colonies, and incomplete or lack of protection for some important colonies. Downlisting would require the following.

1. Securing habitat protection at all three main colonies by purchasing or leasing foreshore wetlands, or protective covenants (the Okanagan Lake colony is particularly vulnerable).
2. Adequate protection from disturbance by boats and people at each major colony.
3. A 3-5 year study that identified the limiting factors in population dynamics at each major colony, and showed that recruitment was sufficient to maintain stable populations.
4. Addressing colony-specific limitations to breeding (especially fluctuating water levels and milfoil encroachment at Creston, and the threat of gull predation at Shuswap Lake).
5. Evidence that the provincial breeding population was not declining.

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The following groups and individuals provided information for this study and should be consulted in further research and management on Western Grebes.

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Canadian Wildlife Service: Sean Boyd and Rob Butler (Delta); Malcolm Dennington (Creston).

Creston Valley Wildlife Management Area (Creston): Brian Stushnoff (Manager); Steve Wilson (Biologist) and Don Grayson (Operations).

Ducks Unlimited: Ian Barnett (Kamloops) and Alvin Cober (Creston; now Ministry of Environment, Queen Charlotte City).

L. Scott Forbes and Penny Ohanjanian (formerly of Simon Fraser University).

George Reifel Bird Sanctuary (Delta): John Ireland.

Madrone Consulting Ltd. (Victoria): Gillian Radcliffe (re: Salmon Arm).

North Okanagan Naturalist Club (Vernon): Phil Ranson, Chris Siddle and Mary Collins.

Gary Nuechterlein (North Dakota State University).

Ralph Ritcey and Syd Roberts (Kamloops).

Royal British Columbia Museum (Victoria): Robert Cannings, John Cooper (now private consultant, Sidney) and Michael McNall.

Salmon Arm Bay Nature Enhancement Society: Karen Angove and Frank Kime.

Salmon Arm Naturalist Club: Doris Kime, Deane Munro and Jim Shaver.

Scout Island Nature Centre (Williams Lake): Anna Roberts.

Selkirk College (Castlegar): Bob Dooley (re: Creston grebes).

Wayne Weber (re: Reifel Refuge; Ministry of Environment, Lands and Parks, Kamloops).

University of British Columbia (Zoology Dept.): Richard Cannings (now private consultant, Naramata).

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Appendix 1. Christmas bird count data for Western Grebes at coastal sites in British Columbia.

	Bamfield		Campbell River		Comox		Deep Bay		Duncan		Kitimat		Ladner		Masset		Nanaimo		Parksville		Pender Harbour		Pender Island		Port Alberni	
	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR
Year	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.
1957													10	36												
1958													31	204												
1959													89	150												
1960													76	343												
1961					9	203							67	206												
1962					14	178							76	243												
1963					30	276							80	231			9	675								
1964					17	790							56	109			21	639					15	450		
1965													55	200			9	1065					14	150		
1966					44	86											9	652					24	364		
1967					40	1198											19	1031								
1968					36	7							90	766			10	2000								
1969					45	794							102	455												
1970					59	144			38	514			90	1067									26	647		
1971					50	903			37	572			84	284									25	188		
1972			32	364	56	1644			43	296			87	425			36	205					48	427		
1973			71	55	64	317			59	4179			106	326			180	905					33	57		
1974			45	9	68	31			55	3533	8	0	121	87			44	377					32	125		
1975			66	92	68	1058	46	3103	63	121			153	516			50	41					41	1356		
1976			48	2	72	1078	44	3479	75	1850			88	712			49	160					40	249		
1977			54	6	72	978	46	4002	76	3415			124	216			60	984					38	660		
1978			57	9	72	1345	46	2094	75	1415	10	0	120	376			54	54					35	1211		
1979			65	0	104	42	44	4023	67	2108	20	0	152	622			70	45					40	125		
1980			55	14	104	2384	42	4611	67	5650			131	525			50	306					47	154		
1981			62	0	114	1771	43	6213	42	7215	9	0	143	539			56	22					31	158		
1982			65	46	117	1110	45	5564	72	3684	22	0	123	511	48	2	51	261					24	132		
1983			66	3	108	1766	45	#####	73	6012	14	0	148	589	60	4	68	129					32	6		
1984			43	0	96	118	45	600	59	3776	19	0	185	700	41	6	59	0					49	55		
1985					96	4700	40	1131	47	2500	35	0	145	420	51	0	57	0					74	2365		
1986	23	70	60	105	96	273	32	655	78	3978	29	0	169	305	62	1	51	0					32	130		
1987	25	68			96	121	40	1542	74	2664	14	3	136	525	52	1	78	674					36	42		
1988	16	697			96	0	45	6501	93	7771	26	0	159	572	56	0	75	2079					34	520		
1989	25	159	69	149	96	4264	40	3873	110	1858	21	1	161	933	44	0	63	1235					54	434		
1990	14	521	75	40	96	364	40	106	146	4093	19	0	170	411	29	0	52	438					57	12		
1991	14	369	80	901	104	3081	40	114	129	3709	28	1	167	1495	50	2	78	359	43	1245	39	623	51	605		
1992	20	226	36	0	104	328	40	2	102	717	22	0	250	798	26	0	77	1503	37	44	32	431	41	11	81	28
1993	14	52	66	49	99	491	40	12	124	963	16	0	253	380	48	0	75	263	74	7	36	11	55	418	65	52
1994	20	128			96	1516	40	2	213	3875	15	0	187	421	28	9	108	1015	46	2	34	5	78	21	194	37
Mean (1957-94)	19	254	59	97	74	1011	42	3140	81	3059	19	0.3	122	464	46	2	56	590	50	325	35	268	40	395	113	39
No. years	9	9	19	19	33	33	20	20	25	25	17	17	36	36	13	13	29	29	4	4	4	4	28	28	3	3
Mean (1985-94)	19	254	64	207	98	1514	40	1394	112	3213	23	0.5	180	626	45	1	71	757	50	325	35	268	51	456	113	39
No. years	9	9	6	6	10	10	10	10	10	10	10	10	10	10	10	10	10	10	4	4	4	4	10	10	3	3

Appendix 1. Continued.

	Port Clements		Prince Rupert		Rose Spit		Sayward		Skidegate Inlet		Sooke		Squamish		Sunshine Coast		Surrey		Vancouver		Victoria		White Rock	
	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR	Party	WEGR
Year	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.	hours	nos.
1957																			92	491				
1958																			150	1532	64	554		
1959																			133	2003	85	1696		
1960																	20	2	115	4561	86	755		
1961																	26	10	134	1641	86	751		
1962																	16	14	94	1558	93	729		
1963																	14	34	102	3605	102	533		
1964																	10	10	66	1041	90	782		
1965																	10	13	82	2298	92	429		
1966																	8	2	156	5817	129	824		
1967																			153	5683	120	985		
1968																			200	3754	72	435		
1969																			255	15450	138	1154		
1970																			310	12206	224	351		
1971																			309	4917	133	198	80	14
1972																			278	5972	147	535	66	78
1973							9	0											293	5457	143	716	122	106
1974							6	0											285	2030	144	826	175	380
1975							16	0											367	2028	152	2055	124	24
1976							8	0											413	7331	167	1666	175	42
1977							7	0											395	11824	188	2842	184	24
1978							8	0											401	3166	167	61	193	62
1979							8	2							104	326			326	7473	178	554	128	38
1980			21	4			8	0					61	874	45	478			330	4957	224	1344	204	93
1981			16	5			8	0					56	87	52	373			381	4835	197	1116	138	42
1982			32	2			8	0	21	13			53	197	35	836			374	5948	210	45	145	42
1983			24	31			8	2	32	140	76	97	64	331	42	518			414	7055	301	1148	209	16
1984			21	38			8	0	32	227	55	14	94	925	43	761			405	6620	282	729	161	37
1985	9	0	24	40					20	704	66	124	72	123					413	7600	271	828	228	25
1986			24	0					24	422	78	456	50	425	48	563			345	1281	305	498	222	46
1987	14	4	18	26	8	0			20	615	74	363	60	393	46	834			319	7194	338	2282	296	21
1988	16	7	35	0	9	1			24	37	80	587	47	981	65	905			407	7226	313	3314	233	76
1989	21	6	32	0	9	0			46	605	50	336	58	311	57	405			363	6388	335	2441	247	45
1990	10	0	26	2	8	0			53	175	35	169	60	461	49	266			411	4332	306	1093	132	3
1991	14	2	48	46	8	0			52	781	79	118	74	375	58	455			501	3545	505	2160	194	40
1992	7	1	30	5	8	0			32	2724	60	302	-	-	51	1			456	1821	408	1539	193	33
1993	8	0	34	8	10	0			29	906	53	126	49	6	56	138			465	3311	460	2089	302	34
1994	10	1	10	1	7	0			32	737			10	1	67	12			465	3148	417	1182	296	60
Mean (1957-94)	12	2	26	14	8	0.1	9	0.3	32	622	64	245	54	366	51	458	15	12	294	4924	207	1115	185	58
No. years	9	9	15	15	8	8	12	12	13	13	11	11	15	15	16	15	7	7	38	38	37	37	24	24
Mean (1985-94)	12	2	28	13	8	0.1	-	-	33	771	64	287	48	308	50	398	-	-	415	4585	366	1743	234	38
No. years	9	9	10	10	8	8	0	0	10	10	9	9	10	10	10	9	0	0	10	10	10	10	10	10

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