

AMERICAN WHITE PELICAN

Pelecanus erythrorhynchos

Original¹ prepared by William L. Harper

Species Information

Taxonomy

The American White Pelican (*Pelecanus erythrorhynchos*) is one of two species from the family Pelecanidae that occurs in British Columbia; the other is the Brown Pelican (*P. occidentalis*). No subspecies of the American White Pelican are recognized (Evans and Knopf 1993; Cannings 1998).

Description

A very large white bird (150–188 cm in length; wingspan of 240–300 cm), with black wingtips and a long, orange-pink pouched bill (Godfrey 1986). The bill has a conspicuous gular pouch that is used to hold captured fish and sieve them from water. During the breeding season, an upright horny plate grows on the top portion of the culmen. Feet and legs are a bright orange; bare skin found around the eyes is orange and eyelids are red. Adult males and females are similar in appearance; females are noticeably smaller. Immatures are similar to adults; however, feathers are typically more greyish and bill and feet duller.

Distribution

Global

American White Pelicans only occur in North America (Evans and Knopf 1993). They breed from central British Columbia, extreme southwestern Northwest Territories, central Saskatchewan, southern Manitoba, and western Ontario, south locally to California, Nevada, Utah, Wyoming, South Dakota, and southeastern Texas (Godfrey 1986;

Evans and Knopf 1993). Their winter range includes California, Arizona, and the Gulf States south through Mexico to Guatemala (Cannings 1998).

British Columbia

Pelicans nest at only one location in British Columbia—Stum Lake, 70 km northwest of Williams Lake. Birds from the Stum Lake colony forage in lakes, rivers, and streams over a broad area of the Fraser Plateau, approximately 30 000 km² (Harper and Steciw 2000). Little is known about the size or behaviour of non-breeding pelican populations that occur in British Columbia; however, it is thought that many of them forage within the same area as breeding birds. A substantial population of unknown breeding status forage at Nulki and Tachick lakes, 15 km southwest of Vanderhoof. In the Kootenays, pelicans regularly occur within the Creston Valley Wildlife Management Area south of Kootenay Lake (Gowans and Ohanjanian 2000). Pelicans do not typically winter in British Columbia, although individuals occasionally stay during winter months (Campbell et al. 1990).

Forest region and districts

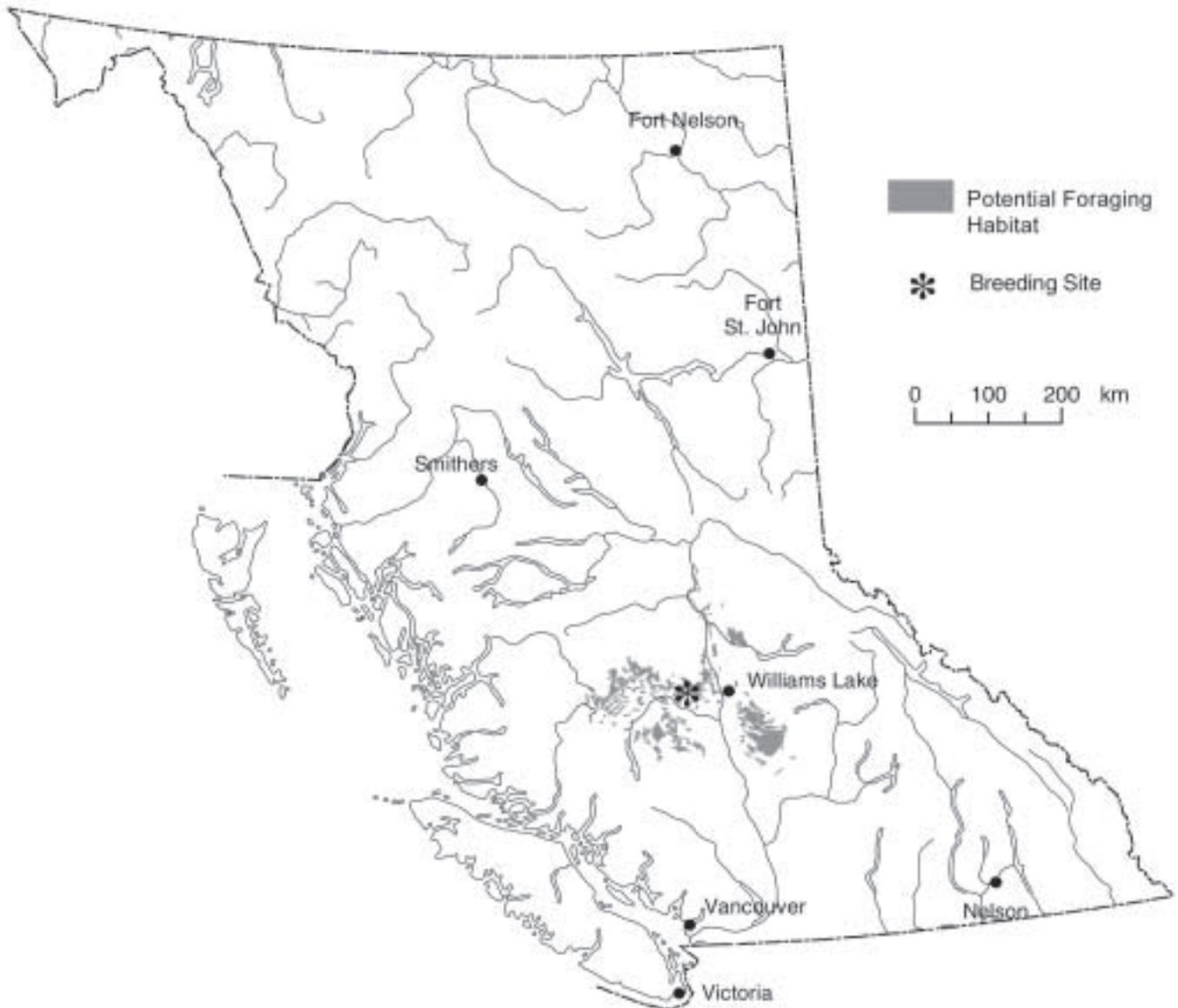
Coast: Chilliwack, South Island, Sunshine Coast

Northern Interior: Fort St. James (substantial population of unknown breeding status), Vanderhoof

Southern Interior: 100 Mile House, Arrow Boundary (non-breeding and migratory), Central Cariboo, Chilcotin (breeding and foraging), Kamloops, Okanagan Shuswap, Quesnel

¹ Volume 1 account prepared by R. Dawson.

American White Pelican (*Pelecanus erythrorhychos*)



Note: This map represents a broad view of the distribution of potential habitat used by this species. The map is based on several ecosystem classifications (Ecoregion, Biogeoclimatic and Broad Ecosystem Inventory) as well as current knowledge of the species' habitat preferences. This species may or may not occur in all areas indicated.

Ecoprovinces and ecosections

CEI: BUB, CAB, CHP, FRB, NAU, QUL, WCU

GED: FRL, GEL, NAL, SGI (migratory), SOG

SBI: BAU

SIM: SFH

SOI: NOB, SOB, STU, THB

Biogeoclimatic units

BG, IDF, SBPS, SBS – all subzones (breeding)

ICH (non-breeding and migratory), PP

CDF (migratory), CWH

Broad ecosystem units

FE, GB, LL, LS, ME, OW

Elevation

Sea level to 1220 m (Campbell et al. 1990)

Life History

Diet and foraging behaviour

American White Pelicans are mainly piscivorous (fish-eating), foraging both singly and in co-operative groups (Johnsgard 1993). Group foraging includes flocks of pelicans driving schools of fish toward shallow water by dipping their bills into the water while slowly swimming forward (Anderson 1991). Pelicans appear to be able to shift feeding strategies to optimize foraging efforts in lakes and streams depending on the availability of prey resources (McMahon and Evans 1992).

Analysis of regurgitates from nestlings showed that minnows (Cyprinidae – *Cyprinus*, *Gila*, *Pimephales*, *Richardsonius*, *Rhinichthys*, *Ptychocheilus*) and suckers (Catostomidae – *Catostomus*) dominate the nestling diet at many pelican colonies (reviewed in Harper 1999). Other prey species found include stickleback (Gasterosteidae – *Pungitius*, *Culaea*), sunfish (Centrarchidae – *Archoplites*, *Pomoxis*), bullhead (Ictaluridae – *Ameiurus*), perch (Percidae – *Perca*, *Stizostedion*, *Etheostoma*, *Micropterus*), salmon and trout (Salmonidae – *Oncorhynchus*), salamanders (Caudata – *Ambystoma*, *Necturus*), and crayfish (*Orconectes*, *Astacus*). Bones from seven fish estimated to be 30–40 cm long were discovered at the Stum Lake breeding colony. These were

determined to be from six suckers (*Catostomus* spp.) and one northern squawfish (*Ptychocheilus oregonensis*) (Dunbar 1984).

Pelicans are surface feeders, typically foraging in shallow water near shore, but they are also known to forage in the upper metre of the water column over deeper open waters (Findholt and Anderson 1995). Measurements of bill and neck lengths suggest foraging is restricted to the upper 1.25 m of the water column (Anderson 1991). Fish are typically caught with a rapid dip of the bill, with the gular sac held open in the form of a scoop.

Nocturnal foraging is common during the breeding season, but apparently not in winter (Evans and Knopf 1993). In the daytime, prey is probably located visually. At night, bill contact combined with an increased rate of bill dipping is thought to help locate prey. Besides possible advantages in capturing prey at night, nocturnal foraging allows pelicans to travel during the day to take advantage of rising thermals to save energy while soaring (O'Malley and Evans 1984). Recent studies have confirmed the importance of nocturnal foraging to pelicans in British Columbia (Harper and VanSpall 2001).

Reproduction

American White Pelicans are colonial breeders, with nesting generally synchronized across an entire colony (Baicich and Harrison 1997). Pelican colonies are often mixed with nesting Double-crested Cormorants (*Phalacrocorax auritus*), as is the case at Stum Lake with approximately 13 nesting cormorant pairs (Fraser et al. 1999).

Pelican courtship begins shortly after birds arrive at the nesting island. In British Columbia, nest building is typically initiated within 3–4 days after pelicans arrive at the nesting colony (Campbell et al. 1990). Both adults build the nest over 3–5 days (Baicich and Harrison 1997). Most nests are made from mounds of dirt, sticks, reeds, and debris, although occasionally shallow depressions in sand are used (Campbell et al. 1990).

In British Columbia, clutches are laid between early May and late July, peaking during the second and third weeks of May (Dunbar 1984). Clutch size

ranges from one to four eggs, with an average clutch size of 1.95 in years with no disturbance, and 1.69 in years with disturbance (Dunbar 1984). Although two eggs may be laid, only 1% of nests are likely to fledge two young, because the second-hatched chick is killed either directly by the elder sibling or indirectly through starvation (Evans 1996).

Incubation period is 29–36 days and is done by both sexes (Baicich and Harrison 1997). Adults brood young for 15–18 days and are fed mostly a liquefied diet of regurgitated fish matter. Most young in British Columbia are hatched by late June and are fledged by late July to early August (Campbell et al. 1990). Mobile young pelicans form overnight creches (close aggregations of juveniles) beginning at about 17 days of age, after which both parents begin leaving the nest at the same time to forage (Evans 1984). Creching is thought to provide both thermo-regulatory (i.e., reduce resting metabolic rate by at least 16% at 10°C) and antipredator advantages to young juveniles (Evans 1984). Young typically fledge at 7–10 weeks of age (Baicich and Harrison 1997).

Site fidelity

American White Pelicans exhibit a very strong fidelity to breeding sites, returning to the same nesting islands annually (Evans and Knopf 1993). Human or natural disturbance at nesting colonies during the previous year typically does not deter birds from returning the following year. Only catastrophic disturbance (e.g., island flooding, desecration, or destruction) will cause pelicans to abandon a nesting area. However, under such circumstances, pelicans generally establish a new nesting colony close to the original site. It is believed that pelicans breed every year at Stum Lake, although the location of the colony was not identified until 1939 (Munro 1945).

Home range

American White Pelicans have large home ranges. Pelicans are highly mobile (up to 50 km/hr) and efficient flyers allowing them to shift foraging sites to take advantage of temporarily abundant food supplies (Evans and Knopf 1993). Pelicans routinely fly 50–100 km from their nesting islands to feed at

outlying foraging lakes (Johnson and Sloan 1978; Evans and Knopf 1993; Derby and Lovvorn 1997).

In British Columbia, aerial surveys have documented pelican foraging lakes as far as 165 km (Abuntlet Lake) from the nesting colony (Wood 1990). Pelicans from Stum Lake forage at 40 different lakes over an area of 30 000 km² on the Fraser Plateau (Wood 1990; Harper and Steciw 2000; Harper and VanSpall 2001). A significant population of adult pelicans also occur approximately 200 km north of the nesting colony at Nulki, Tachick, and Stuart lakes, but the breeding status of these birds is unknown at this time (Harper and VanSpall 2001). Large numbers of non-breeding pelicans are also present throughout the summer in the Creston Valley Wildlife Management Area south of Kootenay Lake (Gowans and Ohanjanian 2000).

Movements and dispersal

American White Pelicans are highly migratory. Most pelicans arrive on the Fraser Plateau in mid-April; earliest arrival 10 March (Campbell et al. 1990). Pelicans leave for their wintering grounds in California and Mexico from September to mid-October (Dunbar 1984; Campbell et al. 1990). It is thought that Stum Lake pelicans migrate west of the Rocky Mountains towards the southwestern United States (Campbell et al. 1990). Pelicans banded at Stum Lake have been recovered in Washington, Oregon, Idaho, Utah, California, and Mexico (J. Young, pers. comm.).

Habitat

Structural stage

- 1a: sparse (nesting and loafing)
- 2a: forb-dominated herb (nesting and loafing)
- 2b: graminoid-dominated herb (nesting and loafing)
- 2c: aquatic herb (loafing)

Important habitats and habitat features

In general, American White Pelicans require undisturbed islands for nesting and isolated lakes with adequate prey fish species for foraging.

Nesting

Nests are built on islands in lakes with little natural or human disturbance (Evans and Knopf 1993). Nesting islands are typically flat, with little vegetation or large ground debris present due to physical disturbance by pelicans and high soil acidity from guano. Prey fish populations are not necessarily present at nesting lakes, but stable water levels are important to maintain productive nesting habitats. Rising water levels can result in flooding of nest sites, and falling water levels can reduce the effectiveness of the water barrier that is used as security from terrestrial predators.

The only breeding colony in British Columbia is located at Stum Lake on the Fraser Plateau, a shallow (mean depth of 2.5 m), slightly alkaline (pH = 8.6), 900 ha lake at 1220 m elevation (Campbell et al. 1990). Nesting occurs at variable levels on four different islands at Stum Lake (Dunbar 1984; Campbell et al. 1990; Harper and Steciw 2000). Three of the four islands are non-forested and very sparsely vegetated, but one contains well-spaced spruce and birch trees. These nesting islands are located 80–600 m from shore, are low in profile (up to 6.7 m in height), and range in size from 90 to 1000 m². Nests are generally closely spaced and situated on flat areas, often adjacent to dead trees, logs, and rocks (Dunbar 1984). Most nests are made from mounds of dirt, sticks, reeds, and debris, although occasionally shallow depressions in sand are used (Campbell et al. 1990). The nests are loosely lined with feathers, twigs, fish bones, or small stones.

Foraging

American White Pelicans forage in slow-moving streams and rivers, lakes, permanent or semi-permanent marshes, reservoirs, and, to a limited extent during migration, coastal bays, estuaries, and near-shore marine sites (Johnsgard 1993). Pelicans are opportunistic in their food habits, and prey species vary greatly depending on location and time of

year. Foraging waters range from nutrient-rich to nutrient-poor, muddy to clear, with various shorelines of mud, sand, gravel, and rock (Evans and Knopf 1993). There is less site tenacity than for breeding habitats; however, birds return to the same foraging lakes when prey species are present.

In British Columbia, pelicans forage in shallows along the shorelines of lakes, at creek mouths, in shallow open water in the middle of lakes, and in streams (Dunbar 1984; Harper and VanSpall 2001). Stream foraging, which was only observed in the spring, is thought to be associated with the spawning activities of coarse fish such as longnose suckers (*Catostomus catostomus*). Inlets and outlet streams are a significant component of pelican foraging habitat, not only because their deltas are often used as loafing habitat, but also because these streams provide foraging opportunities, particularly when fish are spawning.

In British Columbia, the average elevation of 19 main foraging lakes is 1004 m above sea level (Harper and Steciw 2000). Puntzi Lake is the largest of these foraging lakes with a surface area of 1706 ha. The other foraging lakes are much smaller, and are relatively similar in size, averaging 321 ha in surface area, 4 m in depth, and 15 million m³ in volume (Harper and Steciw 2000). Most of these lakes are fairly alkaline in nature with 8 of 11 having pH readings from 8.5 to 9.2.

Loafing areas are important as stopovers for flights from foraging lakes to the nesting colony where pelicans rest, preen, and wait for favourable flight conditions. In British Columbia, the most commonly used loafing sites are sandbars and mud flat islands at the deltas of major inlets and floating vegetation along the marshy edges of shallow lakes (Harper and Steciw 2000). Deadfall, partly submerged logs, and shorelines are also used for loafing (Wood 1990).

Conservation and Management

Status

The American White Pelican is on the provincial *Red List* in British Columbia. It is designated as *Not at Risk* in Canada (down-listed from *Threatened* in 1987 (COSEWIC 2002).

Summary of ABI status in BC and adjacent jurisdictions (NatureServe Explorer 2002)

BC	AB	NWT	WA	ID	MT	Canada	Global
S1B, S2B, SZN	S?	S1B, SZN	S1B, SZN	S2B, SZN	N4B	G3	

Trends

Population trends

The global population of American White Pelicans is estimated at approximately 52 000 breeding pairs (Johnsgard 1993). There are 50 breeding colonies in western Canada and 18 in the United States, many of which are threatened by loss of habitat and water level problems (Evans and Knopf 1993). In British Columbia, the one nesting colony at Stum Lake has been censused numerous times beginning in 1953. Counts of nests have ranged from a low of 85 nests in 1968 to a high of 423 nests in 1993 (Dunbar 1984; J. Steciw, pers. comm.). Nest counts at Stum Lake averaged 285 nests between 1997 and 2001 (J. Steciw, pers. comm.). Although population fluctuations are common, the American White Pelican breeding population in British Columbia is considered stable. Non-breeding birds in the Creston Valley Wildlife Management Area in the Kootenays have increased from a few birds in the 1980s to maximum count of 83 in 1999 (Gowans and Ohanjanian 2000). Birds of unknown breeding status at Nulki and Tachick lakes have increased from a few birds in the early 1990s to a maximum count of 77 in 2000 (Harper and VanSpall 2001).

Habitat trends

Habitats in and around the breeding colony are protected within White Pelican Provincial Park. Trends in foraging habitat quality are linked to rates of development and access to foraging lakes. Most foraging lakes are being impacted at various levels by increasing human use, including road development; lakeshore development for recreational use; boating; changes in lake water levels associated with irrigation use; and changes in fish stocks associated with introduction of game fish.

Threats

Population threats

The negative impacts of disturbance at breeding colonies are severe and well known (Dunbar 1984; Evans and Knopf 1993). Human disturbance can cause predation of eggs and chicks, nest abandonment, cooling or overheating and dehydration of eggs and chicks, accidental crushing of eggs by adults, trampling, and undue stress and regurgitation of foods (Hall 1926; Bunnell et al. 1981; Bowman et al. 1994). The timing of these disturbances is critical. Disturbance by coyotes (*Canis latrans*) or humans early in the nesting period can cause sudden and complete desertion of the nesting colony (Bunnell et al. 1981; Evans and Knopf 1993). Low flying aircraft over the Stum Lake breeding colony are known to have caused high levels of disturbance and offspring mortality (Bunnell et al. 1981; Dunbar 1984). Although causes are unknown, complete abandonment of the Stum Lake colony has been documented three times in the past 41 years: in 1960 (Dunbar 1984), 1986 (Campbell et al. 1990), and 2001 (J. Anderson, pers. comm.).

The level of tolerance at foraging sites to human disturbance is less well known. Human activities that are known to cause disturbance to pelicans at foraging areas include recreational boating; angling; water skiing; backcountry use and lakeshore activities, such as hiking and camping; vehicle traffic; and forest harvesting (Hooper and Cooper 1997; Harper and Steciw 2000). Wood (1990) found foraging pelicans responded to disturbance

(human presence, motorboats, aircraft) by flying to another area of the lake or leaving the lake entirely. Pelican responses to different levels of human disturbance can vary greatly (Evans and Knopf 1993). In British Columbia, experimental approaches by researchers elicited various reactions by pelicans, with some birds flying away when approached within 300 m, while others only swam away when approached to 50 m (Harper and VanSpall 2001). The greatest potential impact of human disturbance away from the breeding colony may be at loafing and roosting sites.

Habitat threats

The primary threat to American White Pelicans in British Columbia is the potential destruction and alteration of their nesting habitat (Hooper and Cooper 1997; Harper and Steciw 2000). Although the breeding colony is protected in the Class A White Pelican Provincial Park, stabilizing water levels at Stum Lake is still important to maintain the productivity of the nesting islands. If water levels are too high, then nesting islands are inundated and the nests are flooded. If water levels are too low, then nesting islands become connected to the mainland and lose their ability to act as a barrier to mammalian predators.

Alteration of foraging habitats is major potential threat to American White Pelicans (Hooper and Cooper 1997; Harper and Steciw 2000). Legal and illegal alterations of stream courses and damming of streams affect foraging lake water levels and fish abundance. Streams and lakes are often dammed for irrigation or drained to create more agricultural land (Hooper and Cooper 1997). For example, the Chilcotin River inlet to Chilcotin Lake was illegally diverted in 1975 (Harper and Steciw 2000). In the late 1980s, a number of dams constructed in the Rosita–Tautri Lakes chain altered lake levels and potentially served as barriers to the migration and spawning of Longnose Suckers, a principal prey species for pelicans. As with nesting islands, water levels can affect pelican loafing and roosting habitat. Abnormally high water levels can flood mudflat islands and low water levels cause loafing habitats to become connected to the mainland and lose their

ability to provide protection from potential predators (Hooper and Cooper 1997; Harper and Steciw 2000).

American White Pelicans in British Columbia could also be affected indirectly by negative impacts to fish prey species in foraging lakes (Hooper and Cooper 1997; Harper and Steciw 2000). Pollution from motorboats, chemical runoff from agricultural lands, and rural sewage could potentially inhibit reproduction or cause mortality fish prey species (Hooper and Cooper 1997). The introduction of game fish in foraging lakes could also potentially reduce fish prey species due to competition for food resources and/or direct predation (Evans and Knopf 1993).

Legal Protection and Habitat Conservation

The American White Pelican, its nests, and eggs are protected from direct persecution in British Columbia by the provincial *Wildlife Act*. It is also designated *Endangered* under the provincial *Wildlife Act*.

Stum Lake and the breeding colony have been protected within White Pelican Provincial Park, a Class A park of 2763 ha, since 1971 (Bunnell et al. 1981; Fraser et al. 1999). To protect nesting pelicans, the park is closed to the boating, angling, landing of floatplanes, and the discharge of firearms from 1 March to 31 August (Dunbar 1984). Transport Canada regulations restrict aircraft over Stum Lake to altitudes above 610 m (Bunnell et al. 1981).

Nazko Lakes Provincial Park (15 548 ha) and Kluskoil Lake Provincial Park (12 419 ha) are both Class A wilderness parks that encompass foraging habitat of American White Pelicans. Established in 1995, these parks effectively protect some foraging habitat values. However, unlike White Pelican Provincial Park, they are not managed exclusively for pelicans, so there is the potential that park status could lead to increased human use and higher levels of disturbance for foraging pelicans.

The Cariboo-Chilcotin Land-Use Plan (CCLUP) (Province of British Columbia 1995) generally addresses the issue of public access to pelican

foraging habitats with the direction that, “where required, roads will be planned to limit impacts on environmental values and road closure and deactivation and rehabilitation requirements for existing and future roads will be specified.” This plan identifies important foraging lakes and also directs resource managers to “provide buffers of at least 200 m and limit human disturbance around important pelican feeding lakes” (Province of British Columbia 1995).

Under the results based code, conservation of riparian forest edges at foraging lakes and streams may be partially addressed through application of riparian and lakeshore guidelines.

Identified Wildlife Provisions

Sustainable resource management and planning recommendations

The quality of pelican foraging habitats can be greatly affected by the level of public access, through negative impacts caused by human disturbance and introduction of pollutants. Establishing WHAs, riparian reserves, and lakeshore management zones around these habitats may not be entirely adequate for addressing these concerns. Access management must be given particular attention in forest development plans to ensure that the construction and deactivation of roads near pelican habitats is conducted in accordance with strategic planning objectives.

- ❖ Access objectives should be identified for each pelican foraging lake, beginning with provisions in the Cariboo-Chilcotin Land-Use Plan (Province of British Columbia 1995) and other applicable strategic or landscape-level plans. Objectives under the Recreational Opportunity Spectrum (ROS) as laid out in the Ministry of Forests’ Recreation Inventory can serve to describe these access management objectives (MOF and MELP 1996a).
- ❖ As much as possible, important foraging lakes should be classified as *wilderness lakes* (having a primitive ROS objective and allowing no roads within 8 km). Other pelican foraging lakes should be classified as *quality lakes* (having a semi-primitive non-motorized ROS objective

and allowing no roads within 1 km) (MOF and MELP 1996a, 1996b). Access management must then be planned to meet those objectives, addressing proximity of roads and road quality, road deactivation, trails to lakes, boating restrictions, aircraft restrictions, and recreation sites.

Wildlife habitat area

Goal

Protect foraging, loafing, and roosting habitat from human disturbance and habitat loss or alteration.

Feature

Establish WHAs on foraging, loafing and roosting sites on and adjacent to lakes, stream reaches, and other aquatic habitats used by American White Pelicans during the breeding season. WHAs should not normally be established on aquatic habitats used only during spring and fall migration unless there are compelling conservation reasons, such as the regular and predictable use of critical staging areas.

Size

Typically, 1 km around the entire aquatic area of lakes and stream reaches used for foraging, loafing, or roosting by pelicans.

Design

The WHA should include a core area and a management zone. The core area should be the reserve area designated by the CCLUP, riparian or lakeshore management guidelines under the *Forest and Range Practices Act*.

The WHA should include the lake or stream reach used for foraging, and all aquatic and riparian areas used for loafing and roosting. Maximize the size of the WHA adjacent to known foraging areas, and loafing and roost sites to maintain the quality and isolation of these habitats.

General wildlife measures

Goals

1. Maintain the isolation of foraging lakes and stream reaches, and loafing and roosting sites.
2. Minimize disturbance during the breeding season (1 April to 15 September).
3. Maintain integrity of habitats of prey species.

Measures

Access

- Do not develop any new permanent roads (e.g., forest service or main haul). Ensure temporary roads (e.g., road sections off main roads) are made impassable to vehicles from 1 April to 31 August.

Harvesting and silviculture

- Do not harvest in the core area.
- Within the management zone, do not harvest, including salvage, during breeding season (1 April–15 September).
- Maintain riparian reserves on all lakes and wetlands within WHA using the largest reserve areas as described in the *Riparian Management Area Guidebook*. Maintain riparian reserves on all streams within the WHA according to stream size as described within the *Riparian Management Area Guidebook*.
- Do not use motorized manual or heavy equipment for site preparation or other silvicultural work from 1 April to 31 August.
- Minimize vehicle use during silvicultural and other work from 1 April to 31 August.

Pesticides

- Do not use pesticides.

Recreation

- Do not develop recreation sites.

Additional Management Considerations

Disturbance of pelicans at their feeding sites can have negative consequences for breeding success. Foraging lakes that do not have permanent road access should be maintained that way by routing any new permanent roads well away from foraging

habitats used by pelicans. Floatplanes should not land or fly low over pelican foraging lakes. Operations that involve a lot of human activity (e.g., logging camps, landings) should be located as far away from WHAs as possible. Activities that alter the natural condition of feeding lakes or encourage recreational use (e.g., stocking with recreational fish, use that causes fluctuations in water levels during the breeding season, alienation of Crown land along the perimeter of feeding lakes) should be discouraged.

Draft guidelines, available for commercial recreation tenures in British Columbia, provide conservation objectives for the American White Pelican (see MELP 2000).

Information Needs

1. Specific locations of important stream and river reaches that are used at night by foraging pelicans.
2. Specific locations of loafing and roosting sites for some foraging lakes.
3. Impacts of various levels of disturbance at foraging, loafing, and roosting areas.

Cross References

Sandhill Crane

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