

## WILDLIFE DATA CENTRE

### FEATURED SPECIES – FORSTER’S TERN

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Four of the eight species of terns found in British Columbia are known to breed, with Forster’s Tern (*Sterna forsteri*) (Figure 1) having the most restricted range. Although almost entirely restricted to North America throughout the year, the species is a migrant, and summer visitor, to British Columbia, where it breeds only in the marshes near Creston. In recent years, however, pioneering birds have been

exploring new wetlands in the interior as far north as the Peace River region and at one marsh, nesting looked promising.

Because the species is so similar to the Common Tern (*S. hirundo*), the Forster’s Tern was not recognized as a separate species until 1834. Since then efforts have been made to identify breeding sites that are widely scattered in fresh, brackish, and saltwater marshes throughout North America. While some studies have focused on the breeding and feeding ecology and vocalizations and behaviour, the Forster’s Tern’s year-round biology and ecology has been less studied than other species of terns on the continent.

In British Columbia, Forster’s Terns arrive at their breeding grounds near Creston during the latter half of May and three months later they have departed for wintering grounds along the Atlantic, Pacific, and Gulf coasts. In British Columbia the breeding population is small and numbers vary from year to year but may reach 10 to 12 pairs. In some years nesting may not occur. The Canadian population is estimated at between 2,133 and 4,216 pairs (Alvo and McNicholl 1996).



**Figure 1.** Although Forster’s Tern breeds only in the Creston valley of southeastern British Columbia, increasing numbers are being reported from wetlands throughout the rest of the interior of the province as well as on the extreme south coast. Duck Lake, BC. 16 June 1980 (J. Paul Goossen).

Since Forster's Tern is at the top of a wetland food web it is susceptible, like other fish-eating birds, to the effects of pesticides and other toxins. While contaminants have been reported in eggs and adults in other parts of North America, natural factors appear to be the greatest threat to the annual productivity of the Creston colony. These include storms, wave action, and a potential threat of predation by the Ring-billed Gull (*Larus delawarensis*) population in the Creston valley.

#### Wildlife Data Centre Provincial Status – 2009

Forster's Tern is a peripheral species with a breeding site that is restricted presently to Duck Lake and adjacent marshes in the Creston valley of southeastern British Columbia. The provincial colony is disjunct from the largest breeding colonies in North America east in the Prairie Provinces and from much smaller, and more local breeding locations, in Washington and Idaho to the south.

Due to the local rarity of Forster's Tern in British Columbia, its low viability, erratic occurrence, small population size and restricted range, the species has been added to the provincial Red List. While we consider the Forster's Tern as *A Species of Special Concern* in British Columbia, it should be noted that 59 of the 86 species and subspecies of birds on the Red and Blue lists in the province are peripheral in nature (see Bunnell et al. 2004). While these species merit recognition, there is growing concern that conservation efforts for species that are endemic to British Columbia, or that have a significant portion of their world population or world range in British Columbia, are being undermined by attention given to peripheral species.

Forster's Tern has never been listed under the federal Endangered Species Act in the United States; in Canada the Committee on the Status of Endangered Wildlife designates the species in the category "Data Deficient" as there is insufficient scientific information on recent population numbers on which to base a status designation.

Forster's Tern is ranked globally as "demonstrably secure (G5)" by the Nature Conservancy, but the British Columbia government has *Red-listed* the species because it is found in very small numbers at a single breeding site in the province.

In British Columbia, Forster's Tern is protected under the federal Migratory Birds Convention Act and to a lesser degree by the provincial Wildlife Act (see Jones and van Drimmelen 2007, van Drimmelen and Jones 2007). The federal act prevents "the hunting, collecting and keeping in captivity of migratory birds and their eggs and nests. However, it only protects habitat while it is occupied, for example during the breeding season.

#### **At a Glance**

Other names: Marsh Tern, Sea Swallow, Havell's Tern (so named by Audubon).

Similar species: In British Columbia, the Arctic Tern and Common Tern.

A combination of field marks can be used to separate the similar Arctic Tern (*S. paradisaea*) and Common Tern from the Forster's Tern in most plumages. These include white underparts, black eye patch, white primary feathers that contrast with greyish upperparts, and the tail, which has a light outer edge and dark inner edge.

#### All Plumages at Rest

- if Common and Forster's terns are together, Forster's stands taller
- if Arctic and Forster's terns are together, Arctic appears to have no legs

#### Breeding Adult at Rest

- white below, pale grey above
- black cap and nape
- orange legs
- orange, black-tipped bill
- tail may extend beyond wingtips

#### Adult in Flight (Figure 2)

- white rump
- pale grey upper wing with silvery primaries
- white outer edges to deeply forked tail
- tail forked for half its length
- orange, black-tipped bill



**Figure 2.** Diagnostic features of an adult Forster's Tern in flight include the white body, silvery-white primary feathers, and light rump. Duck Lake, BC. 25 June 2008 (Linda M. Van Damme).

Frequent use of “stepped-hovers” in which a hunting bird hovers repeatedly at different heights within a vertical column indicates Arctic or Forster's tern (Kirkham and Nisbet (1987); lack of “stepped-hovers” indicates Common Tern.

All three hover to zero in on potential prey, seen while flying along in head-down, searching posture. Arctic use hovers frequently to search for potential prey and Forster's fairly often, probably varying according to the degree of clarity of the water.

#### Winter Adult at Rest

- plumage acquired mid-to-late August
- dark eye patch and pale nape
- all dark bill

#### Juvenile (Figure 3)

- brown cap
- dark eye patch
- mottled brown-grey back and wings
- bill mostly black

#### Length

33-36 cm ( 13-14 in)

#### Wingspan

79 cm (31 in)

#### Weight

130-190 g (4.6-6.7 oz)



**Figure 3.** From first flight for a month or so the juvenile Forster's Tern can be identified by its brownish cap and back and dark eye patch. Duck Lake, BC. 30 July (Brent Wellander).

### **Where and When**

#### ***World Range***

Forster's Tern is the most North American of terns. Although breeding abundantly along much of the Gulf Coast of the United States, breeding records farther south are confined to northern Mexico and wintering extends their normal range south only to Guatemala, with only a few records farther south. A few winter, or have strayed, to Panama, and several Caribbean islands (three of the Lesser Antilles, the Bahamas, the Cayman Islands, Cuba, Hispaniola, Jamaica, Puerto Rico and the Virgin Islands).

The current breeding range extends primarily along the Atlantic and Gulf of Mexico coasts of the United States and northern Mexico, west in suitable habitat through the prairie provinces and plains states. Local populations occur in Ontario and several states in the United States, and often fluctuate with drought/non-drought years in marsh habitats. Significant breeding populations are also in coastal California and an area in southern Oregon, northern Utah and smaller portions of adjacent United States.

The breeding range of Forster's Tern expanded into western Washington around 1908, California in 1948, when they began nesting on dykes of salt works, British Columbia about 1976 (confirmed

in 1980; Goossen et al. 1982) and Baja California, Mexico in 1990, with several other examples of newly established (or re-established) nesting areas along the Atlantic Coast including the first confirmed, northeasternmost nesting in New England in 1991 (Petersen 1991) and at interior locations, such as the first New Mexico nesting in 1992 (Williams 1992).

Forster's Tern migrates primarily through the interior of North America. Wintering is primarily in southern portions of the breeding range, with regular occurrence in Bermuda, parts of Mexico and parts of Central America. Post-breeding dispersing birds extend the eastern portion of the range farther north into New England and occasionally into the Maritimes, with birds also straying into southern portions of coastal British Columbia, north into the Cariboo region, and into northeastern British Columbia. Forster's Terns sometimes linger in northern areas farther into autumn than related species, and have even been recorded in winter as far north as Idaho and New England.

Extralimital records include east off the coast of Brazil, the British Isles, Iceland, and the Netherlands.

### **British Columbia**

**Historical Status and Range Expansion:** The earliest record for British Columbia was an adult female collected from a group of three birds on the North Arm of Okanagan Lake (Figure 4) on 24 June 1928 (Brooks 1942). The published date given as 3 August 1938 in Munro and Cowan (1947) and Godfrey (1966) was corrected by Cannings et al. (1987) as the record referred to a Franklin's Gull (*Larus pipixcan*) specimen.

There were no records during the 1930s and only three during the 1940s, all observed by Glenn R. Ryder. Two birds were on Okanagan Lake at Kelowna on 9 September 1944 and one bird on 30 June 1945. Three years later a single bird was documented on Shuswap Lake, near Celista, on 16 June 1948.

We are not aware of any reports of Forster's Terns throughout the province during the 1950s, 1960s, and early 1970s.

The earliest records for the Creston valley, all from the vicinity of Duck Lake, occurred in 1974,



**Figure 4.** The first record for British Columbia, in 1928, was from an open-water lake habitat. Over 98% of all other records are from wetlands with a variety of emergent vegetation and dense surface mats of aquatic plants. Okanagan Lake, BC. 20 May 1994 (R. Wayne Campbell).

although it is suspected that they may have arrived earlier. On 21 May 1974, “two white terns” were reported to Charles J. Guiguet, curator of birds and mammals at the British Columbia Provincial Museum in Victoria. They were seen off and on through early July and it was suspected that the birds were Common Terns, so no follow up was initiated.

Goossen et al. (1982) suggest that Forster's Terns were prevented from colonizing areas near Creston due to the annual June flooding of the Kootenay River. Diking and water control activities providing stable and suitable nesting habitat in the Creston valley probably contributed to the successful establishment of the small breeding colony. Impoundment of the marsh at Duck Lake was initiated in 1970-1971 and by 1973 major stands of Common Cattail (*Typha latifolia*) and Reed Canary Grass (*Phalaris arundinacea*) had appeared in wet sites (B.G. Stushnoff pers. comm.). The latter date is close to the first observation of “white terns” in the area.

Over the next five years “white terns” were reported frequently by Mr. Howell and Mr. Barnes (residents of the Creston valley) as well as staff of Ducks Unlimited Canada during visits to Duck Lake for waterfowl investigations. Again, no one considered that the birds may have been Forster's Terns and assumed they were the similar-looking Common Tern. Common Terns occur annually as

transients in the Creston valley and are listed as a rare spring and autumn migrant (Van Damme, in press).

Observations suggest that nesting may have occurred at Duck Lake from 1976 onwards as terns were seen standing on mounds of vegetation in weed mats in the open lake. Two empty nests were found in 1976 and 1977. On 26 July 1979, adult and juvenile Forster's Terns were first identified at the south end of Duck Lake in the company of Common Terns (Goossen et al. 1982).

During 1980, over 40 sightings of Forster's Terns were made at Duck Lake over the summer and the first identified Forster's Tern nest and eggs was found in a 370 ha *Typha* marsh at the south end of Duck Lake on 31 May 1980 (Goossen et al. 1982).

During the remaining 1980s, the colony received more attention because of its uniqueness. Graduate students, ornithologists, photographers, and birdwatchers visited the area frequently and often reported their observations. Because of its easy accessibility, the site was becoming a birding destination of life-listers throughout the Pacific Northwest.

The nearest breeding colonies are located at Stobart Lake, Alberta (310 km northeast), Ninepipe National Wildlife Refuge, Montana (270 km southeast), and Brook, Washington (280 km southwest) (Campbell et al. 1990b).

In British Columbia, records outside the Creston valley have been increasing over the past three decades. Forster's Terns have visited at least 37 different locations in the interior and 11 different locations on the south coast.

**Current Status:** In the interior, an uncommon to fairly common summer visitant and local breeder only in the Creston valley; very rare elsewhere through the central interior from the United States border north through the Cariboo and Fraser-Nechako region and also in the southern Peace River region from Swan Lake (Dawson Creek) north to Charlie Lake. Breeding has been confirmed only at Duck Lake and Leach Lake.

On the coast, very rare from mid-summer to late October on the extreme southwest coast in the vicinity of the lower Fraser River valley and extreme southern Vancouver Island.

**Occurrence:** Due to its peripheral status in the province, the centre of abundance for Forster's Tern is restricted to the Creston Valley Wildlife Management Area in southeastern British Columbia. There are an increasing number of migration, dispersal, and vagrant records for other parts of the province, including south coastal areas (Figure 5).

The monthly distribution for all records compiled for Forster's Tern in British Columbia, from 1974 through 2008, with numbers of birds is shown in Figures 6 to 12. Noteworthy comments and distribution locations are discussed in each of the following figure captions starting with the Creston valley.

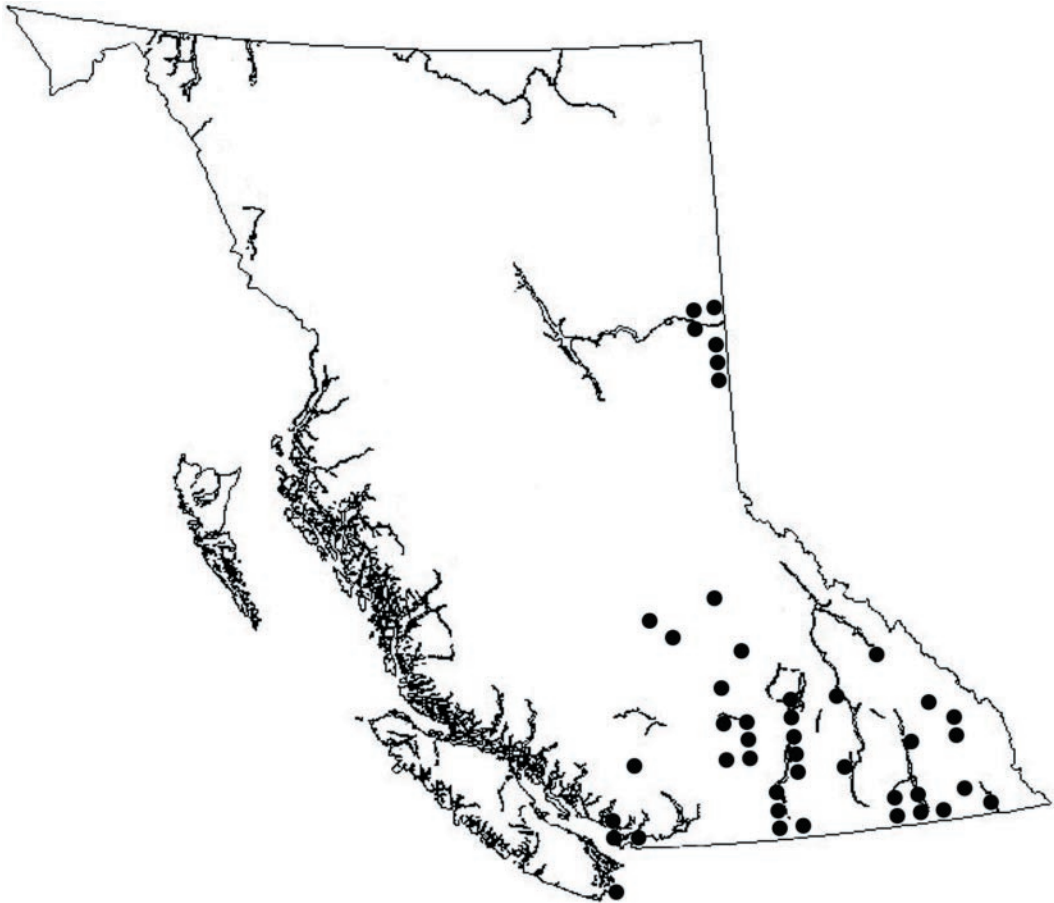
Extreme dates for three regions in British Columbia are: Creston valley (2 May to 26 September); interior excluding Creston valley (12 May to 22 September); and coast (6 June to 9 November).

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*“It seems to me that the name Marsh Tern might much more properly have been applied to this species, for Forster's Tern is, during the breeding season at least, essentially a bird of the marshes.”*

Arthur Cleveland Bent  
Life Histories of North American Gulls and Terns, 1921

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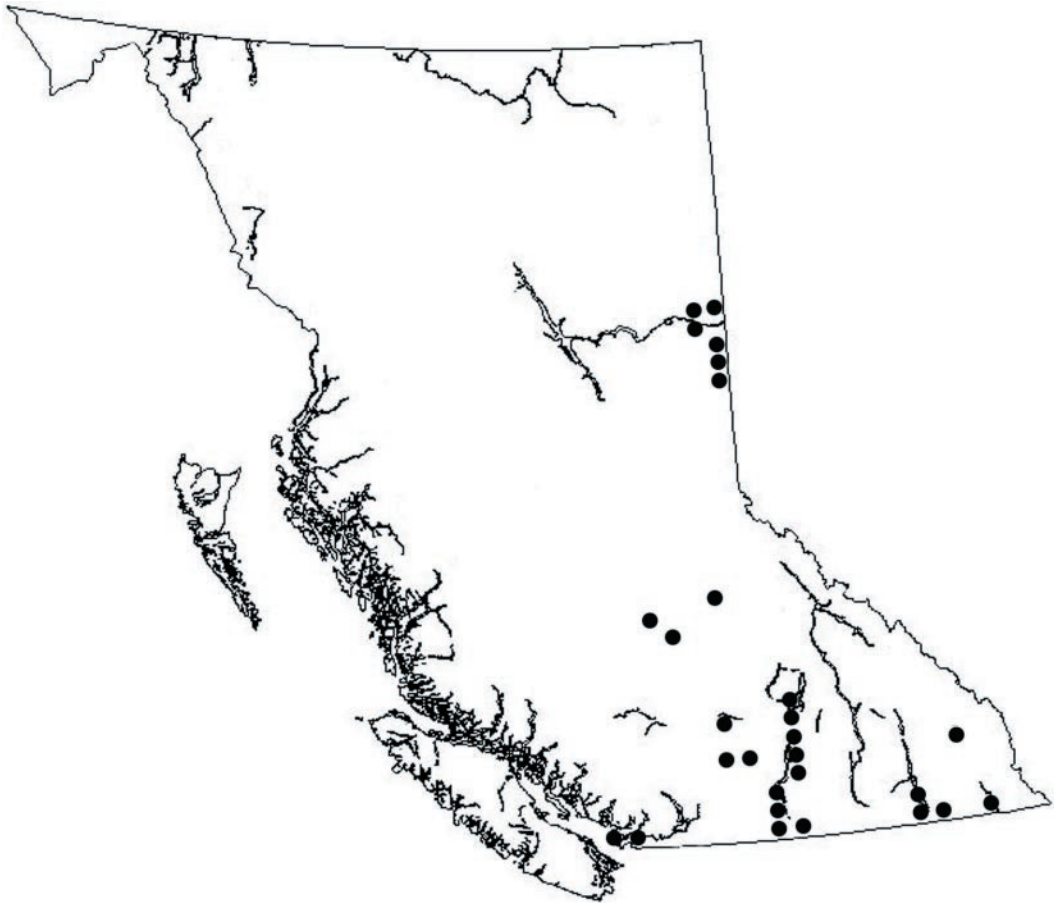
**Figure 5.** The locations (dots) of confirmed Forster's Tern occurrences in British Columbia, 1928-2008.



**Figure 6. May:** Most terns return to the breeding colony in the northern Creston valley during the second and third week with first arrival dates ranging from 2 to 30 May. Courting, pair-bonding, nest-site selection, and nest-building commence. A few nests may contain fresh clutches during the last week.

In the interior, outside the breeding colony, spring migrants have been reported from Osoyoos Lake, Okanagan River, Swan Lake (Vernon), Vernon Creek, Okanagan Lake (north end at Vernon), Rush Lake, Douglas Lake, Beaver Ranch Flats (Guichon Creek), Kamloops Lake (Tranquille), Elizabeth Lake (Cranbrook), Burges and James Gadsen Park (Golden), McQueen Slough (Dawson Creek), Fort St. John, and Charlie Lake.

There are no records for the coast.



**Figure 7. June:** Most nest-building, egg-laying, and incubation occurs throughout the first three weeks of the month. Replacement clutches, the result of local storms and wave action, may commence during the last week. In some years hatching may occur as early as the third week.

In the interior, early summer records outside the Creston valley have been reported from Osoyoos Lake, Okanagan Lake, Penticton, Vaseux Lake, Kelowna, Swan Lake (Vernon), North Arm (Okanagan Lake), Beaver Ranch Flats (Guichon Creek), Rush Lake, Kamloops Lake (Tranquille), Shuswap Lake (Salmon Arm), Shuswap Lake (Celista), Lake Koochanusa, 130 Mile Lake, Williams Lake, Brunson Lake, Swan Lake (Tupper), One Island Lake, McQueen Slough (Dawson Creek), Comstock Marsh (Rolla), Fort St. John, Cecil Lake, Boundary Lake, and Charlie Lake.

On the coast terns have been reported from Iona Island (Richmond) and Surrey.





**Figure 8. July:** In normal years most hatching occurs during the second and third weeks. Replacement clutches may occur as late as the third week but none of these were successful. Chicks grow steadily and most remain in the vicinity of their nests being fed by their parents.

In the interior, mid-summer records outside the Creston valley have been reported from Swan Lake (Vernon), Beaver Ranch Flats (Guichon Creek), Stump Lake, Shuswap Lake (Salmon Arm), Fort St. John, Cecil Lake, Boundary Lake, and Charlie Lake.

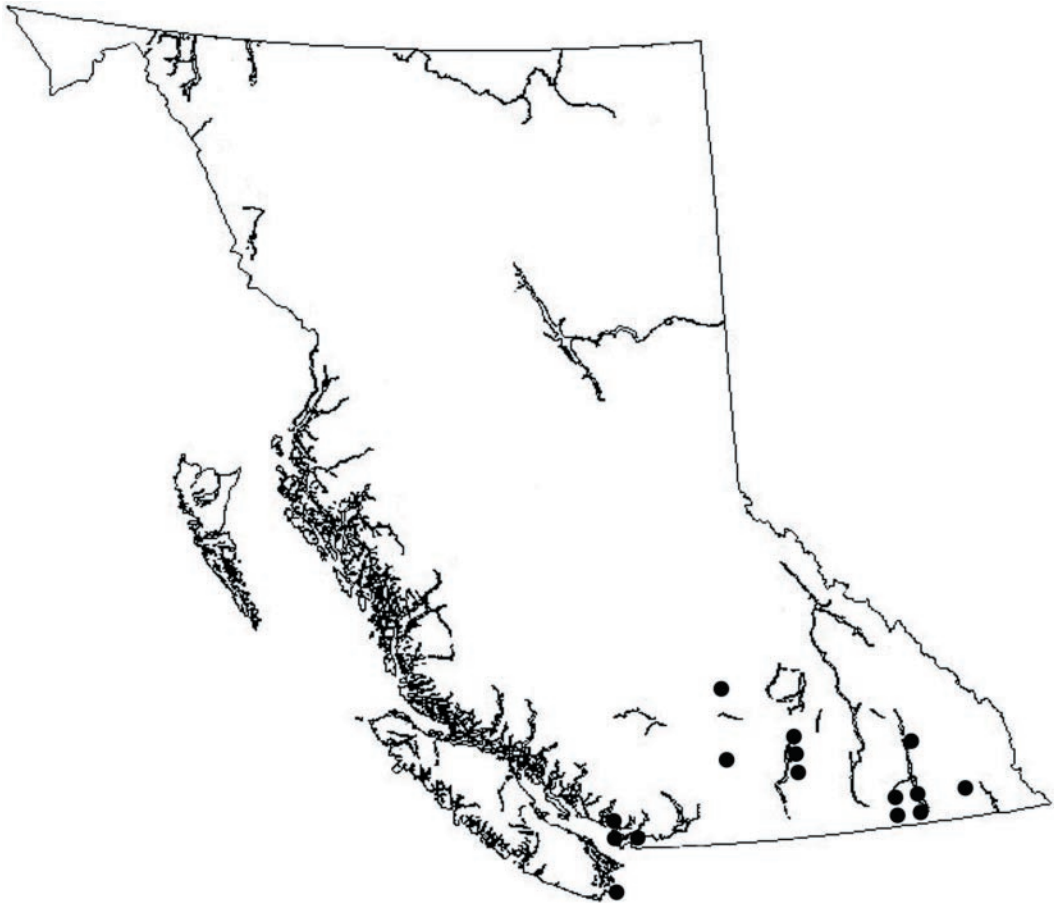
On the coast terns have been reported only from Iona Island (Richmond).



**Figure 9. August:** Some young may fledge in the first week but most first flights occur the week later. Some breeders, successful and unsuccessful, begin vacating the northern Creston valley during the third and fourth weeks of August. In some years small flocks gather at the south end of Kootenay Lake.

In the interior, late-summer and early migration records outside the Creston valley have been reported from Alta Lake, Shuswap Lake (Salmon Arm), Montana Creek, Arrow Creek, Clearwater, and Swan Lake (Tupper).

On the coast, migrant terns have been reported from Clover Point (Victoria), Crescent Beach, Blackie Spit (Surrey), and Iona Island (Richmond).



**Figure 10. September:** The main autumn departure of adults and family groups leaving the northern Creston valley occurs during the first week of September. Some flying young are still being fed by adults until final departure. The latest departure date is 26 September. The longest length of continuous stay was 117 days.

In the interior, autumn migration records outside the Creston valley have been reported from Kelowna, Swan Lake (Vernon), Kalamalka Lake, Nicola Lake, Erie Lake (Salmo), Kootenay Lake (Nelson), Meadow Creek, and Moyie Lake.

On the coast, migrant terns have been reported from Clover Point (Victoria), Boundary Bay, Crescent Beach, and several locations within the Vancouver area.



**Figure 11. October:** The only record for British Columbia is from the coast on southern Vancouver Island. A single bird frequented the Victoria waterfront being reported from Ogden Point east to Oak Bay including Holland Point, Clover Point, Gonzales Bay, and McMicking Point.



**Figure 12. November:** The only record for British Columbia is from the coast at Crescent Beach in the Boundary Bay area.

**Breeding:** Forster's Tern is restricted to Duck Lake and Leach Lake in the northern Creston valley (Figure 13). Breeding is also suspected at Six Mile Slough, also within the Creston Valley Wildlife Management Area, but has not been confirmed.

The increasing frequency of sightings during the breeding season in wetlands between Swan Lake (Dawson Creek) and Charlie Lake in the southern Peace River region suggests that pioneering birds may attempt nesting there in the future.



**Figure 13.** Breeding distribution (dot) of Forster's Tern in British Columbia.

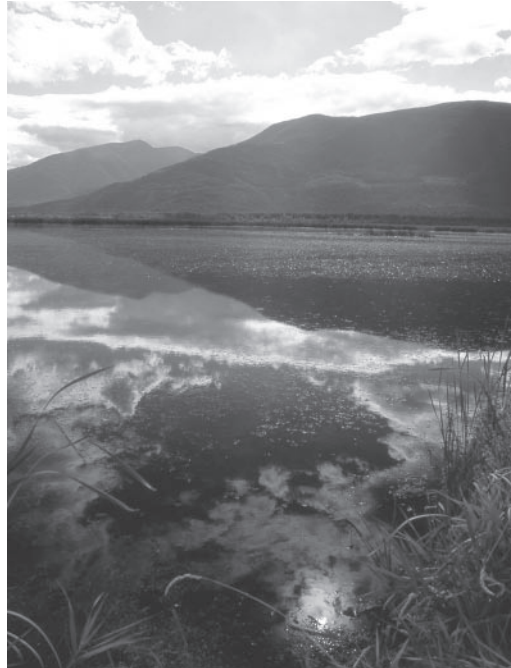
### **Habitat**

**Migration:** Forster's Terns found throughout the province outside the breeding site in the Creston valley visit a wide variety of habitats.

In the interior, this "Marsh Tern", true to its colloquial name, frequents both shallow and deep marshes, wetlands, and large sloughs usually inhabited by other marsh-nesting birds. Most wetlands have emergent stands of cattails (*Typha* sp.) and bulrushes (*Scirpus* sp.) or broad expanses of wet sedges (*Carex* sp.) and rushes (*Juncus* sp.). Often dense mats of submerged aquatic vegetation are distributed patchily over the surface of the water (Figure 14). Colonial-nesting birds, such as Western Grebes (*Aechmophorus occidentalis*), may attract Forster's Terns to larger lakes with shore emergents.

Occasionally, in migration, the sandy beaches of lakes are used for roosting and sewage lagoons for foraging.

On the coast, jetties, spits, sandy beaches, protected inlets, sewage lagoons, shallow brackish wetlands, and rocky intertidal zones are frequented.



**Figure 14.** Duck Lake, BC, with its mats of surface vegetation and open water, is the only regular breeding site for Forster's Tern in British Columbia. 22 September 1996 (R. Wayne Campbell).

**Breeding - North America:** Forster's Tern is primarily a deep-water marsh breeding tern species, nesting on active and old Muskrat (*Ondatra zibethicus*) houses, floating rafts of vegetation, and old nests of other marsh-nesting species, occasionally active nests, boards, and mucky flats. As such habitat is often cyclical in nature, fluctuating in relation to wet or dry conditions, colonies often move from one year to another, apparently returning to traditional areas in years of suitable conditions. Pairs may

nest alone, but often nest in colonies, frequently in association with other species. Documented nesting associates in British Columbia include Canvasback (*Aythya valisineria*), Redhead (*Aythya americana*), Ruddy Duck (*Oxyura jamaicensis*), Pied-billed Grebe (*Podilymbus podiceps*), Red-necked Grebe (*Podiceps grisegena*), Eared Grebe (*Podiceps nigricollis*), Western Grebe, American Coot (*Fulica americana*), Killdeer (*Charadrius vociferus*), Black-necked Stilt (*Himantopus mexicanus*), American Avocet (*Recurvirostra americana*), Franklin's Gull, Ring-billed Gull, California Gull (*Larus californicus*), Caspian Tern (*Sterna caspia*), Common Tern (*Sterna hirundo*), Black Tern (*Chlidonias niger*), Marsh Wren (*Cistothorus palustris*) and Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*). Several other species that do not breed in British Columbia have also been reported as nesting associates.

Where Forster's, and Black or Common, terns nest in close proximity to each other, Forster's sometimes use higher and drier sites compared to the other species.

Although long known to nest occasionally on firmer substrates, substantially-sized colonies are known to nest on dykes, such as in the in salt works in California, and on cobblestone islands, such as on the Columbia River in Oregon and Washington, where hatching and fledging success are sometimes considerably higher than in marsh colonies.

**Breeding - British Columbia:** Forster's Tern is known to breed in one location in British Columbia – the Creston Valley Wildlife Management Area (Campbell et al. 1990b). It occupies approximately 6,885 ha on the Kootenay River floodplain at an elevation of approximately 530 m. It is in the ICHxw (very dry warm variant of the Interior Cedar Hemlock biogeoclimatic zone) where the summers are moist and hot (Braumandl and Curran 1992). The management area is a complex of large, dyked wetland compartments, shrub and black cottonwood riparian zones, and a shallow lake, Duck Lake, that drains an active agricultural area.

Prior to the early 1970s, annual flooding of the Kootenay River caused large fluctuations in water levels, which limited the establishment of emergent vegetation, and likely prevented Forster's Terns from

nesting (Goossen et al. 1982). In the early 1970s, dykes, pumps, and water control structures began to be built with the assistance of Ducks Unlimited Canada and British Columbia Hydro (Wilson et al. 2004). These stabilized water levels during the breeding season, and allowed the growth of emergent and submergent vegetation communities, leading to the establishment of a breeding population of Forster's Tern within a few years.

Emergent vegetation communities throughout the Creston Valley Wildlife Management Area include Reed Canary Grass (*Phalaris arundinacea*), cattails (*Typha latifolia*), bulrush (*Scirpus spp.*), and spikerush (*Eleocharis palustris*). Submergent vegetation is widespread throughout the marshes as well as Duck Lake and includes Canada Waterweed (*Elodea canadensis*), White Water Crowfoot (*Ranunculus aquatilis*), Bladderwort (*Utricularia vulgaris*), Coontail (*Ceratophyllum demersum*), Milfoil (*Myriophyllum sibiricum*), Common Mare's Tails (*Hippuris vulgaris*), and numerous pondweeds (*Potamogeton spp.*) including Floating Pondweed (*P. natans*), Perfoliate Pondweed (*P. perfoliatus*), Sago Pondweed (*P. pectinatus*), Crisped Pondweed (*P. crispus*), and others (Brayshaw 1985, Ohanjanian and Teske 1996).

The Creston Valley Wildlife Management Area is divided into five large units which are, in turn, subdivided into compartments. The five units are Corn Creek Marsh, Leach Lake, Six Mile Slough, Duck Lake Nesting Area and Duck Lake.

All units are eutrophic, shallow, rich in nutrients and have well-developed submergent and emergent vegetation communities. Water levels in these compartments are controlled with pumps and slide gates.

Forster's Tern have been observed nesting in three areas: the southeast end of Duck Lake and in Ponds 1 and 2 of Leach Lake, and breeding is suspected in Pond 4 of Six Mile Slough (Ohanjanian 1998, M-A. Beaucher, pers. comm.).

Descriptions of breeding and foraging habitats for the three units in the northern Creston valley follow.

**Duck Lake:** A large, shallow, 1,500 ha open water lake (Figure 15), with emergent communities restricted to bands along sections of the shoreline.

Ohanjanian, from her study of Western Grebes (1998) describes lake features as follows: *The northern shore is a very thick cattail stand. Along most of the eastern shore, large rocks with small clumps of cattail predominate. In the southeastern corner of the lake, a large stand of cattail occurs in a peninsula. The southern shore of Duck Lake consists of cobble-sized rocks and sediments along the cross-dyke. The western shore appears to be the only area in which nesting (relating to WEGR [Western Grebe]) could theoretically occur at Duck Lake other than on the mat of submergent vegetation in the open water.*



**Figure 15.** Aerial view of Duck Lake, BC. The other water body, in the lower left opposite the stand of trees, is Coot Bay on Kootenay Lake, where Forster's Terns roost on fallen black cottonwoods. Six Mile Slough is to the right of Duck Lake. 4 August 2005 (Cyril Colonel).

*The stem density of available bulrush stands on this shore is between 50 and 150 stems per m<sup>2</sup> making them within range of those found at Leach Lake nest sites. Depths along the edge of the vegetation stands of the western shore of Duck Lake ranged from 0.5 to 1.35 m on August 9, 1997. Water was 36 cm shallower on May 28, 1997, when first nests were initiated on Duck Lake. No Western Grebes were ever seen building in the emergent vegetation on the west shore in either year. By August, large deposits of milfoil had bent the bulrush over in Zone 1. This, plus on-site observations of the size and intensity of waves along this shore suggests that without protection, the western shore is not suitable habitat.*

*Water levels at Duck Lake were more variable and extreme than at Leach Lake. For example in 1997, a total of 61 cm change in water depths between mid-May and 24 June. These changes in*

*water levels, combined with storms, created a more unstable environment. The milfoil mat is a vital habitat component at Duck Lake.*

**Leach Lake:** Consists of seven marsh segments with small to large areas of open water, some of which are permanent wetlands (Figure 16). Some of the units are managed actively. Sedges and open beds of bulrushes dominate some of the marshes.

Wilson et al. (2004) provide brief notes for each unit as follows: Leach Lake 1 (*This unit is dominated by large areas of open water and permanent wetlands and is important for waterfowl throughout the ice-free season*); Leach Lake 2, 3 and 4 (*These are similar to Leach Lake 1*); Leach Lake 5 (*This unit is very small with little wetland surface area. It is not actively managed*); Leach Lake 6 (*This unit is largely an upland dominated by grassland and deciduous forest*); and Leach Lake 7 (*This unit is dominated by grassland and deciduous forest bordering the Kootenay River. The wetland area is relatively small and not actively managed*).



**Figure 16.** Aerial view of Leach Lake, BC, showing the extensive wetland complex where Forster's Terns breed irregularly. 13 August 2005 (Cyril Colonel).

Ohanjanian (1998), in describing habitat requirements for Western Grebes, adds the following description: *Nesting habitat at Leach Lake was clearly superior to that of Duck Lake. Water levels at Leach Lake were more stable and nests protected*



from wind events by the dykes and emergent vegetation stands. There is abundant, unoccupied bulrush habitat available in Pond 2 of Leach Lake and this pond could likely support a larger number of grebes.

No data are available on fish populations, however, so it is not known at what population level food may become a limiting factor.

Leach Lake units 1 and 2 have been used infrequently as nesting sites by Forster's Terns.

**Six Mile Slough:** This unit (Figure 17) is dominated by five shallow ponds, the northernmost of which is dominated by Kootenay Lake's water regime and is considered unmanaged. The dynamics of Kootenay Lake water levels currently maintain the productivity of habitats there (Wilson et al. 2004).

Breeding is suspected by Forster's Terns but the area has been used only occasionally as a foraging site.

#### *Annual Occurrence*

Forster's Tern is a migrant and summer resident in British Columbia, breeding only in the northern Creston valley. Wandering individuals also frequent other south and northeast interior and south coastal areas in migration (see Figures 6 to 12). The summer period, June through late July, is the main residence period (Figure 18).

Forster's Tern has been recorded from 2 May (Duck Lake) to 9 November (Crescent Beach), a total of 192 days (Figure 19). On its breeding grounds it has been recorded from 2 May to 26 September, although in most years the length of stay averages just over three months (Figure 19).

Outside its summer breeding range, Forster's Tern has been observed infrequently in the interior of the province from 12 May to 22 September. Most occurrences are from early June to early July (Figure 19).

On the coast, seven summer occurrences ranged from 6 June to 19 July, and 16 autumn occurrences ranged from 3 August to 9 November (Figure 19).

The breeding period, from first egg to latest known fledging, is from 21 May to 16 August (Figure 19).



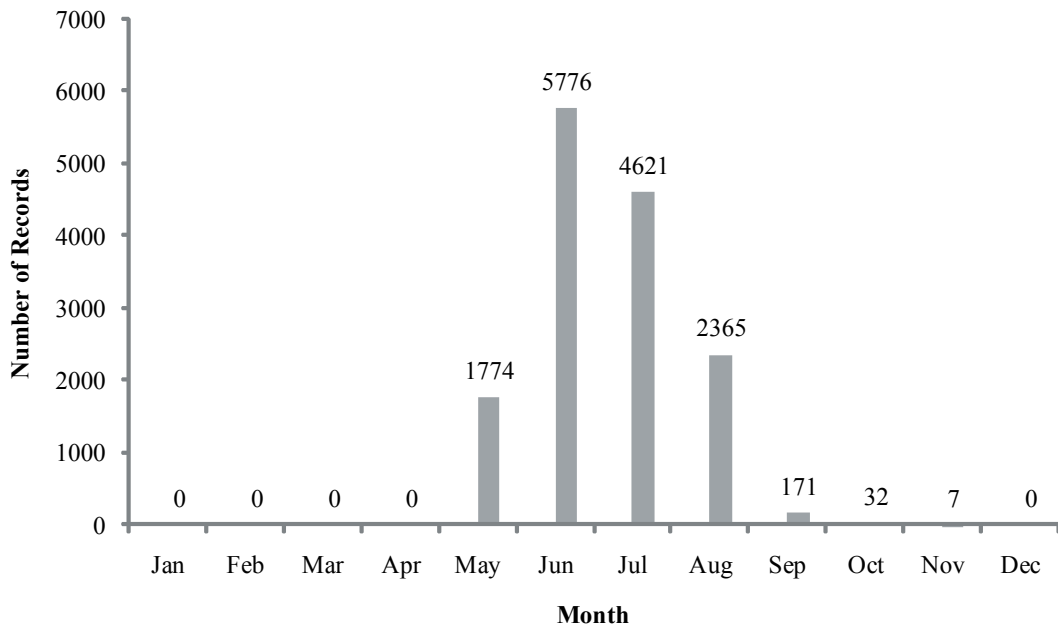
**Figure 17.** Aerial view with Kootenay Lake at top of photos and Six Mile Slough below to the left with Duck Lake and marshes to the right, separated by the east channel of the Kootenay River. All habitats are used for foraging by Forster's Terns, and in some years, the complex of adjacent wetlands is where terns are suspected of breeding. 13 August 2005 (Cyril Colonel).

#### *Migration*

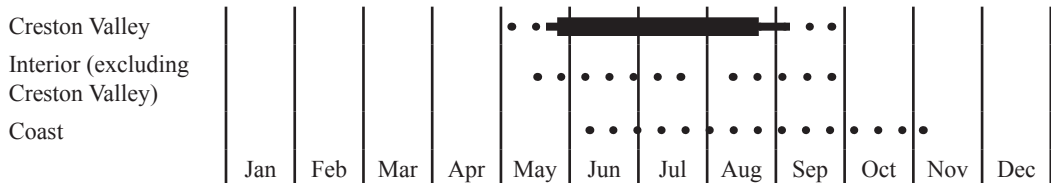
Forster's Tern is a medium-distance migrant, arriving in the Creston valley from wintering grounds mainly in the southern United States, although the specific origin is unknown. It is likely that terns in the southern Peace River region of the province arrive from northwestern Alberta.

Although it is known whether Forster's Tern migrates in small groups, birds arriving in the Creston valley appear as singles or in groups of up to 19 birds (Figure 20). The largest early spring group (21 birds) was reported on 25 May 1980. The largest autumn group (98 birds including juveniles) was reported on 18 September 2004.

Migration periods are now better defined than those reported by Campbell et al. (1990b). Early arrival dates for the Creston valley ranged from 2 to 15 May and late dates from 18 to 30 May with an overall 35-year average of 16 May (Table 1). Early departure dates for the Creston valley ranged from 22 to 26 August and late dates from 31 August to 26 September with an overall 35-year average of 31 August (Table 1).



**Figure 18.** Total occurrence records, by month, for Forster’s Tern in British Columbia, 1928-2008.



**Figure 19.** Annual occurrence and breeding chronology of Forster’s Tern in three regions of British Columbia, 1928-2008. Thick bars: common and breeding; Thin bars: uncommon; Dots: rare.

Length of Stay

The length of time Forster’s Tern remains in the northern Creston valley as summer visitor on its breeding grounds ranges from 76 to 145 days with an overall average of 110 days, or about three and a half months (Table 2).

The average length of stay by decade for 35 years between 1974 and 2008 ranged from 101 (1974 and 1980) to 117 days (1991 and 2000) (Table 2).

Most migration, dispersal, and extralimital occurrences are short, the longest being 26 and 27

consecutive days at Boundary Lake (Peace River) and Rush Lake (Chapperon Lake), respectively. Recently, however, from one to three terns were seen with some regularity over 40 days at Beaver Ranch Flats (Guichon Creek). On the coast there were almost daily reports for 12 days from Crescent Beach in Boundary Bay.

Because information has not been consistently gathered each year the results should be interpreted cautiously.



**Figure 20.** Forster's Terns migrating to the northern Creston valley, BC. Each spring they arrive singly or in small flocks. Duck Lake, BC. 7 July 2006 (Linda M. Van Damme).

### Summer Population

**Maximum Annual Number of Adult-like Terns:** More Forster's Terns certainly visit the Creston valley than breed (Figure 21). Numbers fluctuate greatly between years, probably due more to weather conditions than other factors, such as those found in Washington state (*e.g.*, food supply and breeding conditions at nesting colonies). From 1992 to 2008 (*i.e.*, 17 years of reliable and continuous information), maximum annual numbers of adult-like Forster's Terns ranged from 10 to 46 birds with an average of 27 birds (Figure 22). The lowest number (10 terns) was recorded on 26 May 1996; the highest (46 terns) on 1 and 15 July 2003. Annual maximum numbers were recorded from May through August with most (44%) counted in July.

Between 1988 and 1991, stratified aerial surveys for waterfowl of the Creston valley were conducted by Creston Valley Wildlife Management Area staff (see Wilson and Stushnoff 1992). Calculated estimates for Forster's Terns ranged from 57 to 119 birds. Since these totals include the entire Creston

**Table 1.** Early, late, and average arrival and departure dates for Forster's Tern in the northern Creston valley, BC, by decade, 1974-2008. The average date was calculated using Julian days (1 January = 1; 31 December = 365) and then back-converted to a Gregorian (modern) calendar date.

Period	Total Years	Migration					
		Spring Arrival			Autumn Departure		
		Early	Late	Average	Early	Late	Average
1974-1979	6	15 May	21 May	18 May	22 Aug	31 Aug	26 Aug
1980-1989	10	7 May	24 May	16 May	24 Aug	14 Sep	1 Sep
1990-1999	10	4 May	18 May	12 May	23 Aug	26 Sep	5 Sep
2000-2008	9	2 May	30 May	16 May	26 Aug	18 Sep	31 Aug

**Table 2.** Shortest, longest, and average length of stay for Forster's Tern in the Creston valley, BC, by decade, 1974-2008.

Period	Total Years	Length of Stay (days)		
		Shortest	Longest	Average
1974-1979	6	97	105	101
1980-1989	10	99	122	111
1990-1999	10	99	145	117
2000-2008	9	76	140	108

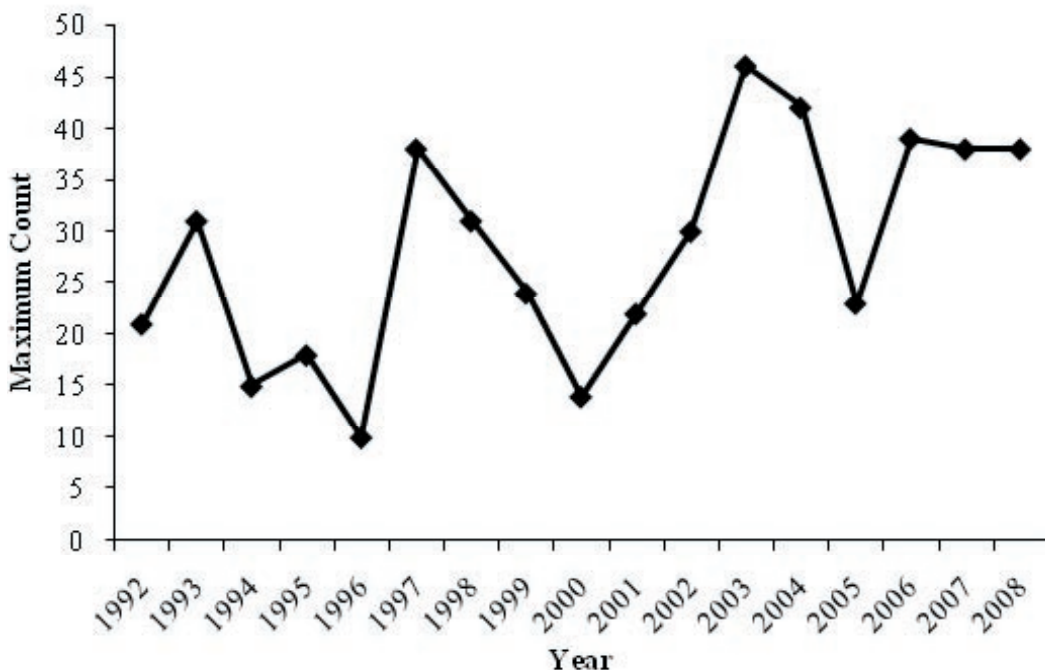


**Figure 21.** The maximum number of adult-like Forster's Terns visiting the northern Creston valley, BC, each year fluctuates between 10 and 46 birds. 29 June 2008 (Linda M. Van Damme).

valley and our maximum counts refer only to Duck Lake, they have not been included in this section.

**Annual Summary of Breeding Status:** Due to the Forster's Tern's restricted breeding site, peripheral distribution in the province, and widespread interest in the bird's future in British Columbia, we have briefly highlighted breeding events that have been documented annually between the bird's first nesting attempt in 1974 through the 2008 breeding season in the northern Creston valley.

All surveys and field observations are by the authors from Duck Lake or Leach Lake, unless otherwise acknowledged, and most nesting activity has been obtained from observations with a telescope from shore (Figure 23). During the 35 years since the nesting colony was discovered, it has been completely surveyed only three times (1980, 1983, 1984).



**Figure 22.** Maximum number of adult Forster's Terns, excluding young-of-the-year, recorded at Duck Lake, BC, 1992-2008.



**Figure 23.** Annual monitoring of Forster's Terns in the Creston valley by Linda Van Damme was carried out by scanning the lake surface using a car window-mounted telescope. Duck Lake, BC. (Marcia Long).

### 1976

In late May, four adults were observed flying over Duck Lake and on 1 June two completed, but empty, nests were located atop dry, dense vegetation on the lake surface (Goossen et al. 1982, C.J. Guiguet pers. comm.). No further details were available for the outcome of the nests or seasonal occurrence.

### 1977

The only report was an empty nest found on 7 June with two adults present (Goossen et al. 1982, C.J. Guiguet pers. comm.).

### 1978

No breeding information.

### 1979

Two nests were reported, without further details, on 1 June (Goossen et al. 1982). At least one pair was successful, as a fledged young was observed with an adult in company of Common Terns on 25 July (Goossen et al. 1982, D. Stirling pers. comm.).

### 1980

The first nest with eggs was reported by Goossen et al. (1982). At least 10 pairs attempted nesting. Of five nests monitored in the marsh immediately south of the south end of Duck Lake (Figure 24), one was empty, one was predated, one was lost, one held three abandoned eggs, and one three-egg clutch pipped on 19 June and hatched two chicks the following day. On 23 June the chicks were dead in the nest. At least five other nests, some with eggs, were located in another part of the south end of Duck Lake on 9 June by Brian G. Stushnoff (Goossen et al. 1982).

A fledged young was seen at Duck Lake on 12 and 13 August and 15 more at the south end of Kootenay Lake (Goossen et al. 1982).

It appears that nesting on Duck Lake itself was successful.

### 1981

At least 11 pairs attempted nesting in the Creston valley. Nine nests were located on Duck Lake and an additional two on Leach Lake. Six nests held three eggs, two held two eggs, one completed nest remained empty, and the contents of the remaining nests were unknown (Goossen et al. 1982, S. Roberts pers. comm.). On 19 July only two nests held a single chick, but one later died.

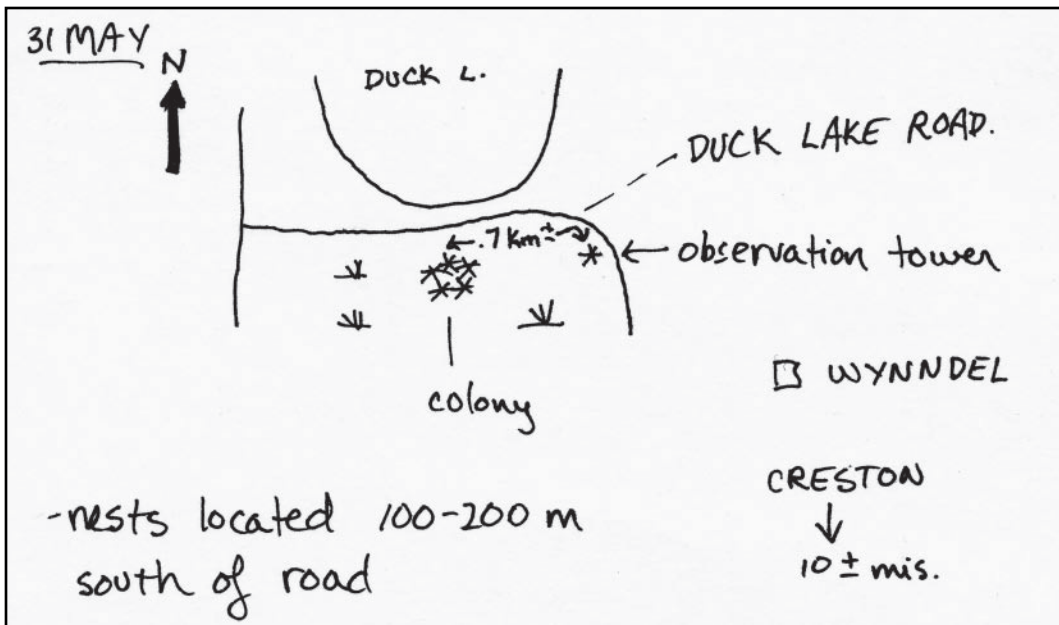
One young was observed on Duck Lake on 28 July (B.G. Stushnoff pers. comm.).

### 1982

Sixteen nests were found during a search by canoe on 13 July. Eleven nests were located on Duck Lake and five on Leach Lake. The survey showed nests with: 1 egg (1), 2 eggs (7), 3 eggs (3), 1 chick (2), and 2 chicks (3). The chicks were newly hatched.

### 1983

At least 12 pairs nested, nine at the south end of Duck Lake and three on Leach Lake. On 26 and 27 June four nests were found (1 empty, 1 with 2 eggs (Figure 25), 1 with 3 eggs, and 1 unknown; M. Nyhof pers. comm.). On 7 July a survey by canoe



**Figure 24.** Diagram of the location of the first colony of Forster's Tern nests with eggs in marshes immediately south of the south end of Duck Lake, BC. Sketches that accompany nest record cards are useful for long term analysis of annual, site-specific, nesting conditions. 31 May 1980 (J. Paul Goossen).

found nine nests on Duck Lake (4 with 2 eggs, 2 with 3 eggs, and 1 with 2 chicks) and three nests on Leach Lake (2 with 2 eggs, 1 with 3 eggs). All clutches were two-thirds incubated.



**Figure 25.** Forster's Tern nest with two eggs. Duck Lake, BC. 27 June 1983 (Mark Nyhof).

#### 1984

At least six pairs nested on Duck Lake. Six nests were found by a canoe search of the northeastern corner. Five nests were empty and one nest held a single fresh egg. It appeared that nest-building was still in progress and the late start may have been the result of an earlier storm.

On 16 August at least four families (1 with 1 young, 3 with 2 young) were seen flying together or feeding fledged young on weed mats (B.G. Stushnoff pers. comm.).

#### 1985

No nests were reported. Two families were observed at Duck Lake in the late summer and early autumn that probably represent different records. On 13 August an adult was observed feeding a large fledged young a "silvery fish" on a weed mat (B.

Johnson pers. comm.) and on 14 September three unaccompanied juveniles were seen on the lake (G.S. Davidson pers. comm.).

### 1986

No nests were reported. Five separate broods of fledged young (2 with 1 young, 2 with 2 young, 1 with 3 young), with one or two attendant adults, were counted on vegetation mats on Duck Lake (R. Hay pers. comm.). Two broods were being fed fish.

### 1987

No nests were reported. Eight separate broods of fledged young (3 with 1 young, 3 with 2 young, 2 with 3 young), with one or two attendant adults, were counted on vegetation mats on Duck Lake (B.G. Stushnoff pers. comm.). Five broods were being fed fish.

### 1988

In early July, at least 10 nest mounds were visible with adults in full breeding plumage sitting in incubation posture, some with mates attending (M. Wynja pers. comm.). In August, five family groups of fledged young (3 with 1 young, 2 with 2 young), with one or two attendant adults, were counted on vegetation mats on Duck Lake and one fledged young was flying with an adult low over the lake (B.G. Stushnoff pers. comm.).

### 1989

Three separate family groups of "large" young (1 with 1 young, 2 with 2 young) were observed sitting on mats of lake vegetation "in the middle of the lake" being fed by one or two adults on 16 August (K. Albright pers. comm.).

### 1990

No nests were reported. Four separate broods of fledged young (2 with 1 young, 2 with 2 young), with one or two attendant adults, were counted on floating mats of vegetation on Duck Lake or flying over the

lake in a family group in late August (B.G. Stushnoff pers. comm.).

### 1991

No breeding information.

### 1992

No breeding information.

### 1993

The entire nesting colony, on weed mats at the south end of Duck Lake, was surveyed by canoe on 23 June. Twenty-one nests were counted as follows: empty = 9 (nine nests started but only three well constructed); 4 with 1 egg, 5 with 2 eggs, and 3 with 3 eggs. One two-egg clutch also contained a fresh Red-necked Grebe egg (Figure 26). Three of the tern nests were constructed among the Western Grebe colony. No eggs appeared to have been predated. Total number of eggs was 23 and all were intact.

There were no further visits.

Thirty-one adults circled the colony site.

### 1994

On 5 June, the nesting colony was located in the marsh immediately south of the lake, where a maximum of 10 nest sites was counted. Twelve adults were flying about. No chicks, or feeding behaviour of adults were seen in this area on 22 June. On 17 June, no adults were visible on Duck Lake as high water levels may have discouraged nesting.

There were no further visits.

### 1995 - 1996

No breeding information.

### 1997

On 11 May, the arrival date, 16 adult terns were at Duck Lake feeding. Between then and the end of July between 10 and 38 terns were counted in the



**Figure 26.** Occasionally eggs of other marsh-nesting waterbirds, such as Red-necked Grebe, are deposited in Forster's Tern nests. Duck Lake, BC. 23 June 1993 (R. Wayne Campbell). BC Photo 3673.

vicinity of the lake and some nesting was attempted. On 19 July a nest mound had an incubating adult and on 28 July two more adults were seen on nest mounds in incubating position. No incubating birds were seen on subsequent visits on 8 and 22 August.

A maximum of five nests was recorded but the number of eggs was unknown and no young were seen the rest of the summer.

### 1998

Terns nested among the colonial Western Grebes and semi-colonial Red-necked Grebes. This season four artificial nesting platforms (see Figure 52) were placed in the southeast section of Duck Lake to determine their use by Western Grebes. The terns were attracted to three of these platforms, where they successfully reared young.

Detailed comments were extracted from field notes for the artificial nesting platforms:

**Nest # 1:** 24 July – adult Forster's Tern sitting on nest mound on wooden platform placed for Western Grebe, two downy, yellow-grey chicks visible from under breast of brooding adult, second adult arrived and switched duties, so young clearly seen; 28 July - adult still sitting on platform, no chicks observed; 1 August - 2 adults with 2 chicks on nest platform; 6 August - two young in nest with adult on wooden platform; 10 August - young exercising wings while on wooden platform with one adult, second adult

brought fish and fed one chick; 15 August - young able to fly, adults on wooden platform; and 21 August - fledged young on wooden platform, adult fed one chick.

**Nest # 2:** 24 July - adult in incubating position on wooden platform placed for Western Grebe, mate arrived and switched places; 28 July - adult on nest platform with one chick; 1 August - one chick on wooden platform with adult; 6 August - two young on wooden platform with one adult, one stretching wings; 10 August - large young on platform with an adult, second chick observed awkwardly climbing out of water back on to platform; and 15 August - young able to fly, on platform with adults.

**Nest #3 :** 24 July - adult in incubating position on nest platform for grebes, mate nearby resting with bill in scapulars; 28 July - two downy chicks with adults on nest mound; 6 August - two young on nest mound with one adult; 10 August - two larger young on nest mound with adult; 15 August - two young able to fly with adults on vegetation mound; and 21 August - two young able to fly resting on Western Grebe nest mound with one adult.

On 24 July, seven other nests built on mats of aquatic plants were active and observations are as follows:

**Nest #4:** adult sitting high on nest mound built on aquatic vegetation mat; second adult arrived and switched places, adult spread feathers and settled into nest cup as though incubating eggs.

**Nest #5:** adult sitting on high-walled nest mound on floating mat of aquatic vegetation; second adult standing nearby, then switched places and sat in nest, settling in as though incubating eggs; pulled more nesting materials to build up sides.

**Nest #6:** adult sitting on high-walled nest mound on floating mat of aquatic vegetation; second adult resting nearby with bill tucked into scapulars.

**Nest #7:** adult on nest mound with two small chicks, brooding them; second adult standing nearby preening.



**Nest #8:** adult on low nest mound situated behind one of the floating wooden platforms, one chick visible.

**Nest #9:** adult sitting on low nest mound, begging calls to mate standing on mound.

**Nest #10:** adult standing on high-walled nest mound, one chick actively walking on nest edge and out onto floating vegetation, scrambled back to be brooded.

Over the course of the season, a maximum of 10 nests were observed and 10 young were fledged.

### 1999

On 31 May, during a nest spotting survey, no Forster's Terns were seen on Duck Lake, although they arrived in the valley two weeks earlier. The unusually high water levels may have discouraged early nest site selection.

On 13 July, 24 adults were counted on Duck Lake and another two were standing on a Red-necked Grebe nest mound south of the dyke but no nesting activities were observed. On 27 July only four adults were observed and again there was no evidence of nesting.

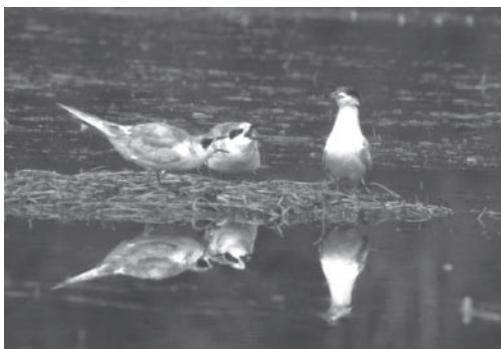
By 7 August, 13 adults were foraging along with two juveniles and two more fledged young were begging for food while standing on a floating mound of aquatic vegetation (Figure 27). On 23 August six adults were foraging over the lake.

Four young were fledged, representing two successful nestings.

### 2000

Small numbers of adults were seen on Duck Lake from early May through July, the maximum of 14 counted on 15 July. On 19 July it was very windy, with whitecaps on the lake, and only two adults were seen. On 27 July six adults were observed.

Two pairs must have found a secure site to nest because on 13 August two broods were seen. Two fledged young were standing on a vegetation mat with one adult, and two fledged young giving begging calls were being fed by an adult in the air.



**Figure 27.** Pre- and post-fledged Forster's Tern young will return to their nest mound and beg for food from their parents. Duck Lake, BC. 7 August 1999 (Linda M. Van Damme).

By season's end, five fledged young were counted.

### 2001

Two adults returned to Duck Lake during very windy weather on 11 May at a time when Red-necked Grebes were starting to build nests. A maximum of 22 adults were seen on 16 May and during the following month eight terns was the maximum observed.

The first evidence of nesting occurred on 6 July, when two adult terns were observed standing on a small mound of vegetation among nesting Western and Red-necked grebes. The only other evidence of breeding occurred on 15 July, when an adult was observed sitting on a nest mound.

No fledged young were recorded.

### 2002

A maximum of 30 adult terns was recorded in early June but nesting activities were not observed on visible portions of Duck Lake being surveyed by telescope. However, three separate broods of fledged young were observed in August. Two young were standing on a vegetation mat being fed fish by an adult on 5 August. On 29 August three adults with four young were also standing on vegetation mats begging loudly. One adult delivered a three inch fish but the juvenile dropped it and a second delivery of a

smaller fish was accepted.

A total of six young fledged.

### 2003

Some of the highest numbers of terns, and nesting attempts, were recorded in this season. Because all nests under observation were abandoned, a brief summary of the chronology of the nesting season is presented below.

**16 June** - 24 adults were counted in the air at one time and one adult was sitting on a nest mound; **20 June** - 26 adults were counted. Two adult terns were standing on a nest mound containing a single Western Grebe egg and a single adult was also on a mound with a grebe egg. Eleven other mounds, probably all grebe nests, contained one or two adult Forster's Terns either standing or sitting on shallow mounds of vegetation that appeared like grebe nests; **25 June** - 40 adult terns were counted of which 13 were sitting on nest mounds. One Western Grebe egg was still in one nest; **27 June** - 38 adults were counted of which eight were sitting on mounds. Two pairs copulated at nests as strong north winds were blowing. Adults representing all 13 pairs, were standing in ones or twos, on shallow vegetation mats among the Western Grebe colony facing into the wind; **1 July** - 46 adults were counted in the vicinity of the colony. Eleven were sitting in nests. One pair copulated at a nest for 95 seconds as the male stood on the back of a female with seven attempts at cloacal contact. One additional nest was located south of the dyke; **6 July** - 37 adults were in the colony site of which seven were sitting in nests. A big wind storm on 5 July resulted in a nest being blown closer to shore; **8 July** - 22 adults were counted in the colony of which three were sitting on mounds. One pair copulated on a mound; **11 July** - 40 adults were counted. Six were sitting on mounds and one pair copulated. An adult sitting on a Western Grebe nest mound was chased off the nest; **12 July** - 13 adults were counted of which three were sitting in nest mounds; **15 July** - 46 adults were counted of which four were sitting on mounds and another six standing on mounds recently vacated by Western Grebes. Adult terns were still copulating. No young had been seen to date; **18 July**

- 38 adults were counted. Two were sitting low on a nest mound as if incubating, one pair was copulating, one pair engaged in "mate feeding", and one pair was modifying a Red-necked Grebe nest mound. Other terns were standing or sitting on mounds in the Western and Red-necked grebe colony. No young terns were observed; **20 July** - two adults of the 39 counted were sitting on nest mounds and one pair refurbished a Red-necked Grebe nest; **22 July** - 34 adults were counted. One adult was sitting on a refurbished Red-necked Grebe nest mound; **24 July** - 28 adults were counted in the Western Grebe nesting area sitting on nest mounds and vegetation mats. There was no evidence of young terns or any other activity to suggest nest success; **26 July** - 22 adults were counted. One pair of terns was observed on a nest mound with abandoned or predated grebe eggs; **27 July** - 19 adults were counted of which two appear to be sitting on a nest mound. Still no evidence of successful breeding up to this date; **1 August** - 6 adults counted over Duck Lake but none were on nest mounds. A systematic scan of the nesting site revealed no young terns; **3 August** - 2 adults were standing on vegetation mat; **11 August** - two fledged young, fully feathered, on nest mound with an adult, mate brought fish; **13 August** - no activity on mound recorded on 11 August but two fledged young seen closer to southeast shore on grebe mound being fed by parents; **19 August** - adult fed a small fish to one of two fledged young standing on vegetation mat; and **25 August** - one juvenile-plumaged fledged young with two adults on a vegetation mat, two fledged young with two adults resting on vegetation mat, and two fledged young standing on a shallow old nest mound with one adult.

The 13 nesting attempts observed on Duck Lake were abandoned. Three broods, comprised of five fledged young were observed, but the location of the nest sites was not known.

### 2004

There were three nesting attempts noted, all of which were abandoned. On 2 June adults were sitting on two nests but by 5 June the nests were gone. On 16 June two adults were sitting on a mound built by a Red-necked Grebe and the following day a tern was

observed in an incubating posture. On 22 June an adult was observed turning an egg but two days later no adults were seen in the vicinity of the nest. The nest disappeared after storms on 25 and 26 June.

On 31 July two broods, each with a single fledged young, were standing on flattened cattails and being fed fish by adults in marshes south of Duck Lake. On 19 August, three separate fledged broods, comprising five young, were in the same area either being fed by adults or begging for food. By 29 August nine fledged young, in five family groups, were also observed in marshes south of Duck Lake. The origin of these broods is not known.

### 2005

Although small numbers of adults were observed on Duck Lake foraging, standing in pairs on Western Grebe nest mounds, or resting on vegetation mats during the normal breeding period in June and July, none nested.

On 17 August, 12 fledged young, with or without attendant adults were observed on vegetation mats, or flying, probably representing at least seven different family groups. Some young were being fed small fish. Nesting probably occurred at Leach Lake.

### 2006

On 14 May, 5 adults were flying over Duck Lake, one carrying a fish for mate feeding. Numbers of adults slowly increased over the next month and terns were recorded foraging or sitting on raised nest mounds in the Western Grebe colony. On 5 July, 14 adults were counted, seven of which were sitting on mounds varying in height and size. On the same day, two American White Pelicans (*Pelecanus erythrorhynchos*) swam close to one raised mound (Figure 28) and two adult terns continuously dive bombed them.

A severe storm overnight on 6 and 7 July, with winds up to 59 km/hr, resulted in two nests containing eggs being blown ashore. One nest that held three intact eggs (Figure 29), and another nest held two eggs. Both clutches floated high in the water, indicating advanced stages of incubation, but on 8 July they were both predated (Figure 30).

Eleven adults were counted in the area on 7 July before the storm. The following day 21 adults were in the area standing on vegetation mats. It appeared that two pairs still had nests.

From 10 to 29 July, between nine and 39 adults were counted in the vicinity of Duck Lake. They were either foraging, sitting on vacated Red-necked and Western grebe nest mounds, or resting on vegetation mats. On 15 July a pair copulated. At least three nests were active with another two nests being occupied on old Western Grebe nest mounds but the contents could not be determined. From 21 to 25 July, a family of two adults and three fledged young were resting and roosting on an old grebe mound but the young were not raised at this site as this was once an active Western Grebe nest.

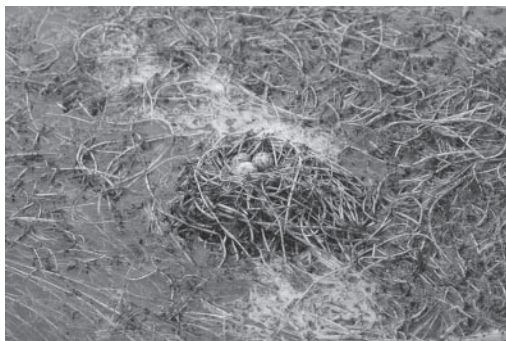
On 30 July a storm, with winds reaching 72 km/hr, raged through the Creston valley and the following day all tern nests were found to have been destroyed. Two eggs were found floating in the water nearshore, suggesting embryos were well developed (Figure 31). One well developed embryo was noticed on a vegetation mat (Figure 32).

There were no further sightings of birds in the nesting area after 14 August.

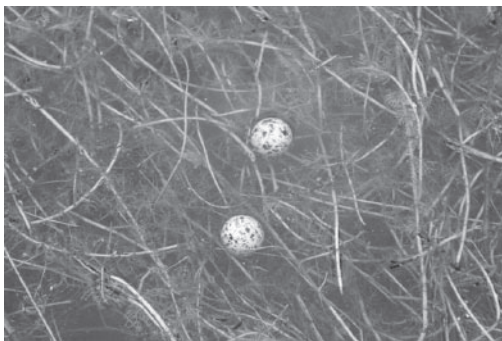
A maximum of five nests on Duck Lake produced no young to fledging. The family with three fledged young were likely reared at Leach Lake.



**Figure 28.** American White Pelicans being dived upon by adult Forster's Terns as they swam close to an active tern nest (on right). Duck Lake, BC. 5 July 2006 (Linda M. Van Damme).



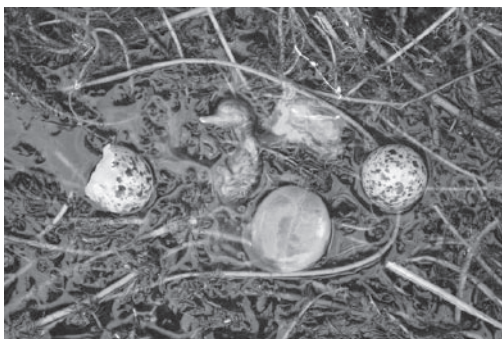
**Figure 29.** Nest with three eggs blown to shore during an overnight storm on 6 and 7 July 2006. Duck Lake, BC. 7 July 2006 (Linda M Van Damme).



**Figure 31.** Two Forster's Tern eggs found floating along the foreshore of Duck Lake, BC, following a storm on 30 July 2006. 1 August 2006 (Linda M. Van Damme).



**Figure 30.** Forster's Tern nest washed ashore during a wind storm at Duck Lake, BC, with two predated eggs. 8 July 2006 (Linda M. Van Damme).



**Figure 32.** A Forster's Tern egg broken during storm activity, exposing a developing fetus. Duck Lake, BC. 1 August 2006 (Linda M. Van Damme).

## 2007

No evidence of nesting on Duck Lake observed throughout June and July, although adults regularly foraged over the lake and infrequently were seen resting on cattail mounds or mud bars. On 6 August, two fledged young, in fresh juvenile plumage, were resting with 12 adults on cattail mounds south of the Duck Lake dyke.

On 20 August, 12 fledged young were seen loafing with 26 adults on cattail mounds in the same area. Four adults were also observed carrying tiny fish in their bills, captured in Duck Lake, to feed

their nearby young. On 29 August, eight fledged young were resting with 12 adults on flattened cattail mounds. Three or four adults were still catching fish in Duck Lake and delivering them to their young.

It is not known if terns nested on Duck Lake in 2007. A major wind storm hit Duck Lake on 29 June, and for many days afterward blustery winds with wave action continued, which may have impacted nesting. However, the late August fledglings suggest that at least six to eight pairs nested successfully somewhere in the Creston valley.

## 2008

There was no evidence of nesting at Duck Lake including courtship behaviour, adults on nest mounds, or fledged young, although up to 38 adults were counted flying over the lake in mid-summer.

Between 1997 and 2007, Forster's Terns were observed nesting at Duck Lake, in 10 of the 11 years. The birds produced a total of 66 young for an average of 6 young per year.

### Family Life

#### *Breeding*

Most of the information available on breeding ecology is from extensive studies in Manitoba and by several authors in California, Iowa, Minnesota, Washington and elsewhere summarized in McNicholl (1971, 1980, 1982, 1983).

Shortly after arriving in breeding areas in the spring, Forster's Terns begin to court in an elaborate array of aerial and ground displays that involve exchanges of fish, similar to displays of Arctic Tern, Common Tern, and other similar species. No information is available on which gender, if either, arrives first during the spring. Within a breeding season, they are monogamous. Whether or not pair-bonds extend to subsequent years has not been studied. The nest scrape is formed as part of the courtship display and if material is added to the nest, this is also done as part of courtship and/or pair-bond maintenance displays.

Once bonded, pairs stay together during the breeding season and both sexes share incubation and rearing duties. The age of first breeding may be when they are two or more years old, and adults probably breed annually thereafter. There is one brood per year but replacement clutches may be laid if the first nesting attempt fails early in the season. The time between layings is about 10 days.

Courtship, which also functions to maintain pair bonds, includes various posturing behaviours and fish-carrying and transferring activities (McNicholl 1969). Food transfer is carried on throughout the breeding cycle from arrival and copulation to fledging. During incubation one adult tern brings fish to the incubating bird, and the roles are then

reversed. In Minnesota, the feeding rate ranges from 0.53 to 1.32 fish/hr (Fraser 1994a, 1997).

Although solitary nests of Forster's Terns have been documented at numerous sites, nesting is usually in a few pairs or small colonies (two to about 100 nests, although two colonies in Louisiana contained approximately 2,750 nests). Inter-nest distances tend to be closer than necessitated by the amount of nesting substrate available, whether this substrate consists of floating vegetation, Muskrat houses or cobblestone islands. This suggests strong social ties.

The original nest-defended territory shrinks to the immediate vicinity of the nest itself during incubation. The number of Forster's Terns that arrive each year on the breeding territory in the Creston valley far exceeds the number of successful breeders. Reproductive success is often low and varies among years. The influence of weather appears to be the single most significant factor affecting success rate. In Manitoba, 65-70% of clutches were lost to wave action in 1968 and 1969. Wave action impacted nest mounds by slowly pulling apart nesting materials, causing eggs to fall into the water. Nests and eggs were also lost when accumulated piles of vegetation blew into the nests.

Other factors cited as impacting nesting success include food availability, flooding, and predation.

Like most terns, Forster's are very aggressive in driving potential predators from the vicinity of nests and young. Their many nesting associates are believed to benefit from their aggression, while Forster's no doubt also benefit by some of these species joining in the attacks. Species occurring regularly in British Columbia that Forster's Terns have been observed to actively chase from the vicinity of colonies in other North American studies include Western Grebe, American White Pelican, Double-crested Cormorant (*Phalacrocorax auritus*), American Bittern (*Botaurus lentiginosus*), Great Blue Heron (*Ardea herodias*), Black-crowned Night-Heron (*Nycticorax nycticorax*), Red-tailed Hawk (*Buteo jamaicensis*), American Coot, Ring-billed Gull, Herring Gull, Western Gull (*Larus occidentalis*), Caspian Tern, Short-eared Owl, American Crow (*Corvus brachyrhynchos*) and Common Raven (*Corvus corax*). Forster's Terns also attack human intruders.

A comparative study in Iowa indicated that Black Terns were more likely to strike models of predators than Forster's, but that Forster's were likely to attack in larger numbers (Siglin and Weller 1963). The intensity of aggression varies among individuals, but is usually less than in Arctic and Common terns, and more than in some other related species. At any one time, one member of the pair is usually more aggressive than the other. Individuals of some potentially predatory species may be tolerated within the colony provided that they stay away from the tern nests (McNicholl 1973a). For example, at Delta, Manitoba two pairs of Black-crowned Night-Herons nesting within a tern colony were attacked while descending to their nests, but not while incubating or while leaving their nests (McNicholl 1973a). Similarly, American Coots swimming or feeding in the open were usually ignored, whereas they were attacked if they swam towards a tern nest or if they engaged in displays that could endanger the integrity of terns or could displace eggs from the nests. Where they nest together, Yellow-headed Blackbird males, perched higher on *Scirpus* or *Typha* stalks, often detect potential flying avian predators before they are visible to incubating terns. The terns, recognizing the predator-alarm call of the blackbirds, fly up to attack the predator, usually causing it to change direction away from the colony. If the predator does not change course, the blackbirds join the terns in attacking it until it departs from the area. The Yellow-heads also exclude Red-winged Blackbirds (*Agelaius phoeniceus*), a species known to prey on eggs occasionally, from their territories, thereby also excluding a potential egg predator from the vicinity of tern nests. Yellow-heads have been observed foraging on tern nests without harming the eggs (McNicholl 1981).

Prolonged parental care in terns prevents them from raising more than one clutch per year. However, if a clutch is lost during incubation and perhaps after hatching, the pair appears to lay again, possibly several times. Thus, laying and hatching are apparently less synchronous in colonies with high nest loss (as usually found in marshes) than in those with higher hatching success (as found in a cobblestone nest colony), although even on Columbia River islands, they are the least synchronous of several colonial

waterbird nesting species.

### *Annual Cycle*

In British Columbia, most Forster's Terns arrive in the northern Creston valley during the second and third weeks of May. The earliest arrival date is 2 May, the latest 30 May. It is uncertain if birds form pair bonds prior to arrival but once on their breeding grounds individuals are quick to proclaim a nesting territory, and courtship activities, especially mate-feeding, are commonplace. If optimal water level conditions prevail, nest-building commences within 10 to 14 days after arrival, with both the male and female involved in the nest-building process. The nesting season, however, may be protracted as terns wait for aquatic vegetation mats to develop on which they build their nests.

Nests with eggs (Figure 33) have been found from 24 May to 28 July. The latter date was a clutch that was well-incubated but abandoned. The initial peak egg-laying period occurs during the first two weeks of June. After nests are lost to storms, replacement clutches can occur any time between late June through the second week of July.

In 1984, egg-laying was just beginning on 10 July, when six complete but empty nests were found as well as a nest with a single, fresh egg (Campbell et. al 1990b).

Nests with newly hatched chicks have been found from 20 June to 24 July. Chicks may leave the nest within four days and fledging (to first flight) takes another 32 days. Both parents feed the young, from nestlings to recently fledged young on the wing through to departure of family groups.

The full breeding period for the province extends from 18 May (earliest nest-building) to 16 August (latest known fledging), a period of 91 days. The peak breeding period occurs between 9 June and 7 July (Figure 34). Adults have been observed feeding fully-fledged, and flying young, as late as 11 September.

Only one brood is raised per season.

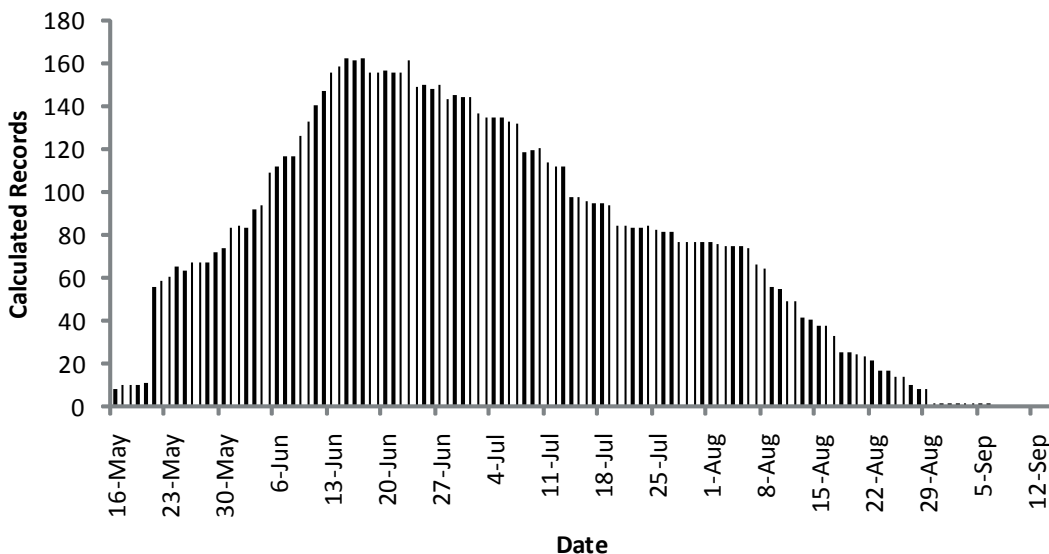


**Figure 33.** Three Forster's Tern nests on Duck Lake, BC. 22 June 1993 (R. Wayne Campbell). The nest in the foreground contains two tern eggs and a fresh Red-necked Grebe egg.

### Nests

Vegetation mats created by wind and wave action is an important characteristic of nest site selection, as is the creation of new mats resulting from rapid aquatic plant growth that occurs in mid-summer (Figure 35). Ohanjanian (1998), during her study of Western Grebes, noted: *the mat of submergent vegetation [on Duck Lake] builds up in late June and July. The mat is comprised mainly of native milfoil (Myriophyllum sibiricum), that grew up and broke the surface of the water. It was a broad oval in shape, measuring 360 x 400 m in size, and covering an area of 12 ha. Fragments of milfoil that had been broken off by wave action or the nest building activities of both Red-necked and Western grebes accumulated in the mat and became entangled in the growing stems. The effect of this was to anchor the nests and to effectively dampen the waves that blew across the lake during storm events.*

In some years, grassy hummocks and Muskrat (Figure 36) feeding platforms and lodges may provide a suitable nest substrate for Red-necked and Western grebes.



**Figure 34.** Nesting chronology for Forster's Tern in British Columbia showing the peak breeding period between 9 June and 7 July. The figure is based on calculated dates from 131 breeding records.



**Figure 35.** Dense, buoyant mats of wind-generated and new growth aquatic plants provide the necessary nest substrate for Forster's Terns nesting in the northern Creston valley. Duck Lake, BC. 16 July 2003 (Linda M. Van Damme).

Of the 107 nests with location information, 94 (88%) were built over open water on a submergent mat of vegetation (see Figure 33). Others were constructed on natural Red-necked and Western Grebe nest mounds (seven nests), artificial wooden Western Grebe nest platforms (three nests), Muskrat feeding platforms (two nests), and a Muskrat lodge (one nest).

In Washington, a pair of Forster's Tern appropriated an occupied Western Grebe nest, even covering up grebe eggs with vegetation on which to lay its own eggs (Bent 1921). In a flooded grain field in California, several Forster's Terns "appropriated" several nests of Western Grebes (Van Rossem 1933).

In British Columbia, nests have been described by various authors as: *composed of Equisetum sp. stems located in 12-22 cm of water* (Goossen et al. 1982), *plant stems and a few feathers, a base of sedges and grasses lined with finer grasses eight to 10 cm deep, marsh grasses, and small pads of submerged aquatics pulled together into a shallow scrape four centimetres deep* (Campbell et al. 1990b; Figure 37), and *a well built, deep-walled cup nest, neatly built anchored to submergent aquatic plants in open water (mainly milfoil Myriophyllum sibiricum,*



**Figure 36.** Muskrats are mainly vegetarians and may influence the composition of plant communities in the Creston valley that impact other wildlife. When present in an area, they are indicators of good habitat. Duck Lake, BC. 8 April 2006 (Linda M. Van Damme).

*not the Eurasian water milfoil*) (Ohanjanian 1998). All nests were neatly lined with dry, and often damp, vegetation.

Damaged nests, by climatic events or predators, are rarely rebuilt in Delta Marsh, Manitoba (McNicholl 1971), but wave/high tide-damaged nests were repaired routinely in a tidal marsh colony.

Dimensions for two nests in British Columbia were: outside nest diameter 23 cm (9 in) and 28 cm (11 in), inside nest diameter 7 cm (4 in) and 9 cm (3.5 in), and inside depth 2.5 cm (1 in) and 3.8 cm (1.5 in).

The nearest inter-nest distances at Duck Lake, BC were 5.6 m, 7.0 m, 7.8 m, and 26.0 m (mean 11.6 m; Goossen et al. 1982).

### **Eggs**

Eggs are oval, short-oval, sub-elliptical or long-oval, with greater variation in shape in two-egg than in three-egg clutches. Their background colour is olive to buff, sometimes pinkish-buff, generally with numerous small spots, blotches and/or crooked lines of dark brown, umber or chocolate, often wreathing the larger, blunter end (see Figure 37). Their surface texture is smooth and not glossy.

Eggs range in size from 33.5-47.0 mm x 29.0-



32.5 mm, averaging 42.9 mm x 30.9 mm among 158 Manitoba eggs and 43.4 mm x 30.8 mm among 31 Kansas eggs. An egg in the Creston area in 2006 measured 41.9 mm x 29.8 mm, fitting within this range (L.M. Van Damme pers. comm.). Mass of 11 Manitoba eggs ranged from 18.6 to 23.7 g. A clutch of three eggs is about 40% of the total female body mass (McNicholl et al. 2001). The actual egg volume is approximately 20.9 +/- 1.4 cc (McNicholl 1973b).

Clutch sizes are typically two to three eggs, with one-egg “clutches” probably usually representing incomplete clutches or clutches from which one or more egg(s) have been lost. Four to six-egg clutches are much rarer, and probably represent the laying of eggs by two birds in the same nest. In British Columbia, the number of eggs recorded in a single nest ranged from one to three eggs with the most common being two-egg clutches (n = 52; 44%; see Figure 30).

Egg-laying intervals are usually one to two days. Incubation starts the day after the first egg is laid and usually lasts 23 to 25 days (rarely up to 28), averaging 24 days at colonies studied in Iowa, Manitoba, and Washington. Both sexes incubate and the eggs are covered 97% of the time. Each adult usually changes incubation duties every 69 minutes (McNicholl 1983).

In British Columbia, eggs of Red-necked and Western grebes have been found in the same nest with Forster’s Tern eggs (see Figure 33). Western Grebe eggs have also been found in nests in California and Washington (Bent 1921, Van Rossem 1933).

Forster’s and Caspian tern eggs have also been found in the same nests in a multi-species waterbird colony in Oregon.



**Figure 37.** Forster’s Tern nests are typically constructed of a variety of submergent aquatic plants that are obtained near the nest site and pile in a small mound. Duck Lake, BC. 7 July 2006 (Linda M. Van Damme).

## **Young**

Hatching begins with “early pip” cracks at the larger end of the shell and peeping sounds inside the egg.

After the first sign of pipping begins, hatching extends from one to five days before the wet young emerges from the shell. Chicks hatch during daylight hours. In three-egg clutches, hatching intervals in a California colony averaged slightly longer between second and third eggs (2.0 days) than between first and second days (1.8 days).

Like all terns, the young are semi-precocial at hatching, covered in down with open eyes, but staying in the nest, though able to walk. The chicks hatch with egg-teeth on both mandibles. These are lost within three to five days of hatching. Once dry, the down of newly hatched chicks varies in colour from pale stone to cinnamon buff or pinkish-buff, darkening to brown on the throat but not as dark as on the Common Tern. The underside is similar but paler, almost white on the belly. Body upperparts are spotted or streaked in blackish-brown, heavier on back where it forms large irregular aggregations or longitudinal bands (Harrison 1997).

The young remain in the nest for only a few days (usually two or three) after hatching, crouching if disturbed by human observers and probably predators. Young of marsh nests often hide in the water under strands of vegetation, while those from nests located on more substantial substrate seek cover a short distance from the nest. Within two days of hatching, the young generally return to the nest after the disturbance is over, but after four days they generally do not return to the nest after a disturbance. The fledging period is thus difficult to measure without telemetry and remains poorly documented, but young in a Wisconsin study were able to fly at about 30 days after hatching and those in Washington at four to five weeks.

Little has been documented on behavioural growth of young in the wild, but one in captivity (Nice 1962) yawned 5 minutes after hatching, napped for most of its first four hours, and was on its feet at 18 hours. Both sexes feed the young and appear able to recognize them individually by calls as they move away from the nest-site. A Minnesota study indicates that the size of the fish brought to the young

increases as the young grow. Young are apparently brooded until at least three days old, possibly more during stormy periods. One-day old chicks on cobblestone islands in Washington were brooded about 95% of the time. Fledging age is difficult to determine, but Washington chicks started to fly about four or five weeks after hatching. Few details are known on duration of parental care, but it appears to continue well after the terns leave the nesting area, as documented for some related species, with at least one observation of fledged young begging for food during migration in Florida.

Limited data suggest that at least some immatures may spend their first or even second summers after hatching in southern parts of their range. Thus, first breeding may occur when at least two years old in at least some birds.

Although a single brood of four young was reported in British Columbia, this may have represented two different families. In British Columbia, broods of one and two-young accounted for nearly 90% (n=139) of all single family groups (Figure 38). Of these, 54% (n=44) were two young.

## **Lifespan**

Forster’s Tern is a relatively long-lived bird but longevity and the annual adult survivorship is poorly known. The oldest bird in North America, banded 12 June 1972 at Moffet Field in San Francisco Bay, CA,



**Figure 38.** Adult Forster’s Tern with two fledged young on mat of aquatic plants at Duck Lake, BC, on 7 August 1999 (Linda M. Van Damme).

and found dead of disease on 19 June 1984 at Tulare Lake in Alpaugh, CA. The bird was 12 years eight days old. Notably however, of 9,512 banded terns, only 73 dead birds have been recovered (Klimkiewicz and Fitcher 1989).

### **Feeding and Diet**

We are not aware of any research that has been done on the diet of the Forster's Tern in British Columbia. Elsewhere in North America the species is generally considered piscivorous in its food habits throughout the year and seasonally, and infrequently, captures insects on the wing (McNicholl 1971) or less commonly on water (Bent 1921) or picking insects from land while in flight (King 1980).

When foraging (Figure 39), usually over shallow water and close to shore, Forster's Terns crisscross the surface flying with their bill pointed downward and making shallow plunges into the water for prey. Sometimes the bird's entire body may be submerged. They also pluck prey from the water surface.

At inland breeding sites the diversity and size of prey species varies between mate feeding during courtship and chick feeding. In Minnesota, courtship feeding of mates included Yellow Perch (*Perca flavescens*), shiners (*Notropis* spp.), sunfish (Centrarchidae) and Northern Pike (*Esox lucius*),



**Figure 39.** Forster's Tern foraging in bill down position. Duck Lake, BC. 13 July 2006 (Linda M. Van Damme).

while chicks were fed Yellow Perch, shiners and stickleback (Gasterosteidae). Adults feed on fishes up to 10 cm in length, while one-week old chicks are fed fishes about 3.3 cm long and older chicks consumed fishes 5.2 cm long. Yellow Perch was the species fed most frequently during both courtship feeding and chick-rearing (Fraser 1994a, 1997).

Large populations of non-native warm water fishes occur throughout the marshes of the Creston Valley Wildlife Management Area. These include Pumpkinseed (*Lepomis gibbosus*), Yellow Perch, Largemouth Bass (*Micropterus salmoides*) and Black Bullhead (*Ictalurus melas*). Other fish species known to be present in Duck Lake and/or old channels of the Kootenay River include Northern Squawfish (*Ptychocheilus oregonensis*), Redside Shiner (*Richardsonius balteatus*), Largescale Sucker (*Catostomus macrocheilus*), Peamouth (*Mylocheilus caurinus*), and Longnose Sucker (*C. catostomus*). (Forbes 1985, Ohanjanian 1986).

Fish populations in the Creston Valley Wildlife Management Area have created a stable prey base for numerous other fish-eating birds including Osprey, Great Blue Heron, Black Tern, and six species of grebe: Western Grebe, Clark's Grebe (*Aechmophorus clarkii*), Red-necked Grebe, Eared Grebe (*Podiceps nigricollis*), Horned Grebe (*P. auritus*) and Pied-billed Grebe (Ohanjanian 1986). Double-crested Cormorants nest in the Creston Valley Wildlife Management Area, and non-breeding American White Pelicans arrive each year in June and feed throughout the summer, until they depart in late September or early October (Gowans and Ohanjanian 2000).

Anecdotal evidence from field observations suggests that the introduced Yellow Perch (Figure 40) is the predominate fish in the diet of Forster's Tern in the Creston valley, the same species that was fed most frequently to young Red-necked Grebes there (Ohanjanian 1986).

Little is known about the biology or ecology of the Yellow Perch in the province, but McPhail (2007) has reviewed the species in British Columbia. The Yellow Perch is a hardy and adaptable lacustrine species that can survive low oxygen levels (e.g., in Duck Lake, which is eutrophic and nutrient rich) and overwinter in deeper parts of lakes. It is a gregarious



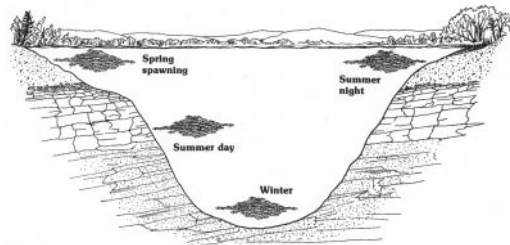
**Figure 40.** Adult Forster's Tern flying with Yellow Perch at Duck Lake, BC. 22 July (Brent Wellander).

species that is active during the day when it can be seen in spindle-shaped schools of up to 200 fishes (Figure 41). Yellow Perch spawn in the spring (usually April and May) soon after lakes are ice-free and water temperatures rise above 7°C. While adult Yellow Perch show a seasonal migratory pattern (Figure 42), and feed primarily near the surface at dawn and dusk in summer, young perch school in shallow waters during daylight hours and become available for foraging Forster's Terns. Young-of-the-year reach 25-59 mm by September (Chisholm et al. 1989).

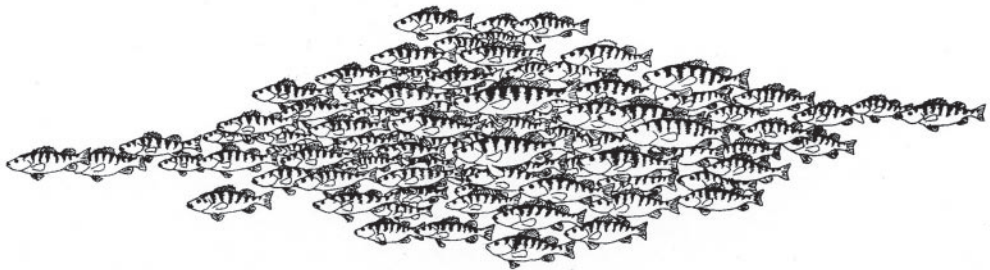
While Forster's Tern has been observed foraging up to 10 km from the nesting colony (e.g., Wisconsin (Mossman 1989)) all activity in the Creston valley is restricted to wetlands at the north end, including

Duck Lake, Leach Lake, Six Mile Slough, and in marshy areas at the south end of Kootenay Lake. Adult terns usually forage singly, or in twos or threes, rarely in flocks. McNicholl (1980) suggests that Forster's Terns may maintain feeding territories at regularly visited sites.

Bent (1921) reported Forster's Terns catching insects on the wing. The Creston valley hosts a variety of damselflies and dragonflies (Order Odonata), which could be a source of food for Forster's Terns during their emergence and subsequently when flying. Fraser (1994a) observed a tern chick rejecting a dragonfly offered by the parent. Aquatic invertebrate fauna observed in dipnet surveys of Corn



**Figure 42.** Cross-section of a lake showing daily and seasonal migrations of schools of Yellow Perch. Generally, perch spawn near shore in spring, feed nearshore at dawn and dusk in summer but retreat to deeper water as temperatures increase, and in winter migrate to deeper waters (Reprinted with permission from Holton 1990).



**Figure 41.** Aggregation of Yellow Perch in a typical spindle-shaped school (Reprinted with permission from Holton 1990).

Creek Marsh, Leach Lake, and Duck Lake carried out in 1995, include backswimmers, dragonfly and damselfly larvae, aquatic snails, water boatmen, predacious diving beetles, leeches, and giant water bugs (Ohanjanian and Teske 1996). In Minnesota, Fraser (1994a) observed Forster's Terns "surface-skimming" on emerging caddisflies (Tricoptera) and King (1980) observed a Forster's Tern hover above a Florida beach catching insects on the sand.

The fish populations in the Creston valley have created a stable prey base for numerous fish-eating birds, including Osprey, Great Blue Heron, Black Tern, Forster's Tern and six species of grebes: Western Grebe, Clark's Grebe, Red-necked Grebe, Eared Grebe, Horned Grebe (*Podiceps auritus*) and Pied-billed Grebe (Ohanjanian 1986). Recently breeding Double-crested Cormorants, and a small flock (up to 45 individuals) of non-breeding American White Pelicans, also depend on a fish diet each year.

A report of Forster's Terns eating carrion (Peabody 1896) is vague, and reported destruction of eggs (Van Rossem 1933) refers primarily to usurpation of nests, rather than egg consumption.

### **Mortality**

Forster's Terns, like so many other birds in British Columbia, face tremendous challenges to their survival each day. While most of these threats are related to human activities, there are some that occur naturally. Little is known about direct mortality and indirect threats to Forster's Terns in the province but we have listed several categories for consideration.

### **Nest and Egg Loss**

**Flooding:** In most colonies studied in North America, flooding of nests has been responsible for the majority of egg loss. When Paul Goossen and his co-authors documented the first British Columbia nesting at Creston (Goossen et al. 1982), they hypothesized that recent dyking and water control may have allowed Forster's Terns to nest there by eliminating former June flooding by the Kootenay River. Even the cobblestone island-nesting colonies in southern Washington are somewhat susceptible to artificial control of water levels.

Rises in water levels following periods of heavy

rains may flood nests directly or pull strands of floating vegetation apart. Nests may be re-built after egg loss in some areas and refurbished during nest-relief by the non-incubating bird. Nests on the higher parts of Muskrat houses are safe from most waves, but their eggs are sometimes lost by falling into the houses when they are rebuilt by the Muskrats after heavy rains.

Artificial manipulation of water levels through damming, drainage, dyking, and channelization threatens many marshes, but increases the suitability of others. Stabilizing such water bodies reduces their suitability over time through stagnation. Floating nests of grebes within a stand of vegetation are more likely to remain intact than those closer to the edge of the stand, and this is likely also true of Forster's Tern nests.

**Wind:** Where nests are on raised surfaces in open, sparsely vegetated areas, such as the dykes on San Francisco Bay, some eggs are blown out of nests when parents are absent (Malcolm C. Coulter, unpublished MS).

**Storms:** The degree to which nests are lost to waves in natural waters varies with frequency and intensity of storms and high waves. Single storms are sometimes responsible for considerable loss of eggs and even young (e.g., McNicholl 1979), but loss is often ongoing and depends partly on the density of adjacent vegetation and the direction of prevailing winds (see Allen et al. 2008a, 2008b). Also, nests may be displaced considerable distances, as happened to two during a storm at Duck Lake in 2006 (Van Damme 2006).

Seasonal summer storms passing through the Creston valley each year (Figure 43), accompanied by heavy winds and rain, often result in the single highest mortality factor for nesting Forster's Terns. In some years, nesting (including re-nesting attempts), may be wiped out completely.

Most mortality is from egg loss due to wave action on nests that are built close to the water and often in exposed situations. Immediate nesting success (or failure) is often difficult to detect from shore situations. If eggs are fresh, they sink and are undetected; otherwise, well incubated eggs often



**Figure 43.** Most mortality to Forster's Terns nesting in the northern Creston valley each year is from storms accompanied by strong winds and heavy rain. Duck Lake, BC. 18 July 2008 (Marcia Long).

float on the lake surface and travel around with the prevailing winds. Extended periods of high winds may also dislodge poorly anchored nests with many being washed ashore (see Figures 29 to 32). This, of course, depends directly on the lake's water level which is cause for concern in managed impoundments.

Breeding season storms impact the reproductive success of terns on Duck Lake differently each year. On 7 July 2006, a heavy rain storm with winds gusting up to 59 km/hr created strong wave action on Duck Lake. Forster's Terns had nested on the open lake surface among the Western Grebes and Red-necked Grebes approximately 200 m from shore. In total, 11 nests with eggs intact were blown to shore, including Forster's Tern (2), Western Grebe (6), and Red-necked Grebe (3) (Van Damme 2006).

Although this species is known to have low reproductive success due to unfavourable weather conditions throughout its North American breeding range (e.g., McNicholl 1971, Storey 1987, Russell and Harris 1990, Cuthbert and Louis 1993), numbers seem to fluctuate within a range that allows some long-term stability.

### Predation

**Direct:** Direct predation has not been reported in British Columbia. Although predators are usually driven away, predators observed to kill eggs, young and/or adults elsewhere in North America are fire

ants (*Solenopsis* sp.), Snapping Turtle (*Chelydra serpentina*; Fraser 1994b), Black-crowned Night-Heron, Herring Gull (*Larus argentatus*), Great Horned Owl (*Bubo virginianus*), Short-eared Owl (*Asio flammeus*), American Crow, Marsh Rice Rat (*Oryzomys palustris*), American Mink (*Neovison vison*), and Raccoon (*Procyon lotor*) (McNicholl et al. 2001).

A Peregrine Falcon (*Falco peregrinus*) has also been observed chasing two Forster's Terns without catching them (Nichols 1941).

Most such predation is opportunistic and minor, probably with little effect at the population level, but Mink predation is sometimes substantial. Rice Rats predated 100% of 25 Laughing Gull (*Larus atricilla*) nests and 50% of Forster's Tern nests in one Atlantic Coast colony (Brunjes and Webster 1992) and losses from Great Horned Owls in Minnesota and Wisconsin were considerable, probably resulting in colony abandonment (Mossman *et al.* 1988; Fraser 1997).

Potential predators observed by L.M. Van Damme at Duck Lake include Largemouth Bass (*Micropterus salmoides*) [observed eating a shorebird, D. Grady pers. comm.], Ring-billed Gull [observed eating eggs of other species], Great Horned and Short-eared owls, American Crow, Common Raven and American Mink. These undoubtedly pose potential threats to Forster's Terns. On the other hand, potential predators at tern colonies, once spotted, are dived and swooped on, often striking the intruder's back, until it departs. Species reported attacked like this include: Western Grebe, American Bittern, Black-crowned Night-Heron, Great Blue Heron, Red-tailed Hawk, American Coot, Ring-billed Gull, Herring Gull, Caspian Tern, Short-eared Owl and American Crow (McNicholl 1971, Fraser 1994a). At Duck Lake, an adult Forster's Tern was observed on 20 July 2006 diving and calling as it followed a Common Raven into the nesting area (L.M. Van Damme pers. obs.).

**Indirect:** Herring Gulls have been identified as nest competitors. Eggs of Red-necked (see Figure 26) and Western grebes, American Coots and Caspian Terns found in Forster's Tern nests may represent nest parasitism, but more likely are "dump eggs," laid at times when the laying bird loses its own nest or is prevented from reaching it by the presence of

a potential predator or a human observer. They may also represent nest usurpation by either Forster's Tern or the other egg-layer in substrate-sparse areas. For example, Forster's Terns in California and Washington have been observed to build nests on top of Western Grebe nests before the grebes had finished nesting.

When parent terns are off nests in response to predators, eggs and young are also vulnerable to chilling or over-heating. Hunting Ospreys, diving into Duck Lake for fish near tern nests, sometimes cause adults to leave nests, making eggs and newly hatched chicks vulnerable to chilling, over-heating, and predators. There is also one observation of an adult Painted Turtle (*Chrysemys picta bellii*) basking on a Forster's Tern nest (S. Roberts pers. comm.).

### Parasitism

At least one fluke species and three lice species have been documented in Forster's Terns, but no data are available on their effects and no diseases have yet been documented.

### Shooting and Vandalism

Although Forster's Terns were among the many waterbird species shot for the millinery trade around the turn of the 19<sup>th</sup> and 20<sup>th</sup> centuries, shooting became illegal with the 1919 Migratory Bird Treaty and enabling legislation, and has not usually been a major mortality factor in recent decades. However, some have been reported shot in recent years in Manitoba by fishermen culling cormorants and vandalism has also been reported there at one colony (Alvo and McNicholl 1996).

### Hypothermia

Hypothermia, induced by lack of brooding during disturbance by humans or gulls on wet, cold days, was believed responsible for the deaths of some young chicks at nests on cobblestone islands in Washington. Marsh-nesting terns likely receive less disturbance by humans, but nest and egg losses in Texas have been attributed to fishermen wading out into the marsh. Inattentiveness by researchers may sometimes increase the chances of reproductive failure due to chilling or heating of eggs or young or predation.

### Miscellaneous Sources

The thrashing activities of spawning Common Carp (*Cyprinus carpio*) have dislodged some eggs from floating nests in Manitoba, Minnesota, and Wisconsin, providing at least an occasional, localized threat. Animals using floating vegetation for any purpose also threaten nests with accidental breakage of eggs or disruption of the substrate that could cause eggs to fall into the water. Aggressive and courtship displays by coots in Manitoba were believed to be one of the reasons that coots were attacked near Forster's Tern nests there even though the coots nest among the terns.

In the Creston area, Western Painted Turtles hauling out on the edges of nests and Great Blue Herons and coots walking on floating vegetation (see Figure 44) also pose such a threat in addition to the potential predation by the herons.

Several Forster's Terns were killed by vehicles when feeding from a bridge in Virginia (Reed 1985).



**Figure 44.** Great Blue Herons frequently land on vegetation mats in Duck Lake, BC, and wander about, much to the concern of nesting Forster's Terns. Notice the nest mound under the heron's tail. 1 August 2006 (Linda M. Van Damme).

### Incidental Behavioural Observations

#### Interspecific Interactions

Forster's Terns regularly nest within Western Grebe colonies and they have been observed to usurp grebe nests (Van Rossem 1933) and prey on grebe

eggs (Gould 1974 cited in Nuechterlein 1975). While inflated numbers of Forster's Terns within the colony may have a negative impact on the Western Grebes, this does not appear to be the case in the Creston valley, possibly due to the small size of the Forster's Tern population there, compared with other breeding locations. Western Grebes respond to Forster's Tern alarm calls, which serve to alert them to approaching danger (Nuechterlein 1981). This is of particular value in Leach Lake (Pond 2), where both species nest in emergent vegetation.

Some specific observations of note are as follows:

1) 12 July 1997 - 35 adult Forster's Terns were roosting on vegetation mats in Duck Lake when a Great Blue Heron landed on a vegetation mat in the tern's territory. It was continually dive-bombed by terns and the heron kept ducking, then started to open its bill and extend its neck and jabbed into the open air to defend itself. The terns never got too close and eventually the heron had been harassed enough and flew off.

2) 3 September 1998 - an American Coot was resting on one of the wooden nesting platforms (set out for Western Grebes and successfully used by a pair of Forster's Tern) when two adult terns dive-bombed the coot until it finally left the platform, whereby the terns landed there and started preening.

### **Feeding**

1) 10 August 2008 - a group of fledged young terns were roosting on a trampled cattail mound. An adult flying towards the mound carrying a fish and calling, elicited a response from the young which flew out to meet the adult and be fed a fish. Usually the fish was transferred to a young after it landed on the surface of the water. Twice a Ring-billed Gull was observed taking flight to get the fish from the terns but both times it was unsuccessful.

2) 10 August 2008 – a family group of two adults and two fledged young was observed for a few minutes foraging 15-45 m from the south shore of Duck Lake. The adults plunged into water in a steep dive, whereas the young made shallow but repeated

dives. One young was seen catching a fish among a milfoil mat.

3) 10 August 2008 – Forster's Terns are very vocal while fishing and flying about during the late summer period. One adult caught a yellow perch and immediately a fledged young landed on the water for transfer of the fish.

### **Roosting**

1) each year Forster's Terns roost at the north end of the Creston valley and the south end of Kootenay Lake on big fallen trees with bare branches. At the latter location they share roosting sites with Double-crested Cormorants and American White Pelicans.

2) in recent years American White Pelicans trample cattail stands south of the Duck Lake dyke, known as Duck Lake nesting area, creating suitable roosting areas for the terns. Flocks of 14 to 38 terns, a mix of adults and fledged young, frequented this area in August 2007.

3) floating mats of aquatic vegetation (milfoil mats) are common roost sites for Forster's Terns throughout each year in the vicinity of the breeding colony (Figure 45). In some years, high water levels may prevent these mats from forming until later in the season.

4) vegetation mats are often shared with Black Tern, Bonaparte's Gull (*Larus philadelphia*) and resting waterfowl, such as Mallard (*Anas platyrhynchos*) and Redhead and their broods.

5) Forster's Terns also roost on abandoned Red-necked and Western grebe nests.

6) at Leach Lake terns roost on islands, mud bars, and bales of cattails created from scheduled drawdowns.





**Figure 45.** During the nesting season Forster's Terns prefer to roost on floating mats of aquatic vegetation where they preen and rest. Duck Lake, BC. 29 June 2008 (Linda M. Van Damme).

## Conservation and Management

### Forster's Tern Populations and Trends

The breeding and wintering range of the Forster's Tern is more or less restricted to North America. No population status information is available for the tern's wintering grounds but some estimates have been made for breeding populations. These range from a low of 30 pairs to a maximum of 23,096 pairs for six geographical areas included on the continent (Figure 46). The minimum total population is estimated at 42,145 pairs. Almost 55 percent of the total population occurs along the United States Gulf Coast (Figure 46).

Although the British Columbia population contributes very little to the estimated continental population (0.01%), and the Creston colony is peripheral, we have stewardship responsibilities within British Columbia, not only to maintain biodiversity but also to assure that pioneering individuals have suitable habitats that can be used as breeding sites in the future.

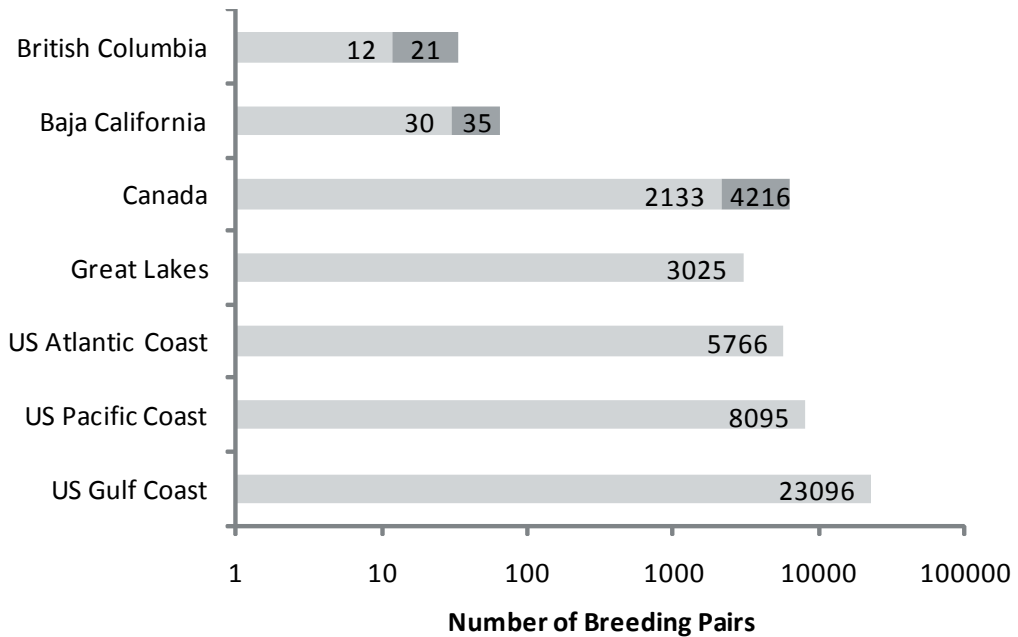
McNicholl et al. (2001) suggest that North American breeding bird survey results are "not well suited for censusing colonial waterbirds." That tern populations are susceptible to the vagaries of weather makes determining trends all the more difficult.

The Creston valley is home to at least 15 species of piscivorous birds including the colonial-nesting Great

Blue Heron. Recently, however, a potential conflict involving fish-eating birds has been simmering ever since Double-crested Cormorants established a viable and growing breeding colony (Van Damme 2004, 2007), and a significant population of non-breeding American White Pelicans (Figure 47) are spending the summer in the area (Ohanjanian 1998). For example, a recent study estimated that American White Pelicans consume 6,375 kg (14,000 lbs) of fish in three distinct areas: Six Mile Slough, Leach Lake and Duck Lake (Ohanjanian 1998). It is not known if the pelicans are having a negative impact on the food supply of other fish-eating birds in the valley. In 1999, pelicans fed primarily at Leach Lake and Six Mile Slough (P. Ohanjanian pers. comm.) but in 2008 over 100 pelicans were seen regularly feeding at Duck Lake (L.M. Van Damme pers. obs.).

The entire breeding population of Forster's Tern in British Columbia occurs in wetlands within the mandate of the Creston Valley Wildlife Management Area. To date there has not been a management plan developed specifically for the Forster's Tern, although a habitat management report for the Creston Valley Wildlife Management Area has recently been prepared (see Wilson et al. 2004).

Some direct, and indirect threats, to Forster's Tern in British Columbia are discussed in the following section.



**Figure 46.** Estimated numbers of breeding pairs of Forster’s Terns by major geographic region. Note: where two values appear, these represent minimum and maximum breeding pair estimates.



**Figure 47.** The impact of a recently established non-breeding, summering population of American White Pelicans on fish stocks in the northern Creston valley remains unknown. Duck Lake, BC. 6 September 2006 (Linda M. Van Damme).

### Effects of Human Activity

**Pesticides and chemical contaminants:** It is estimated that at least 72 million birds die annually as the direct result of chemical poisoning (United States Fish and Wildlife Service 2002).

As a primarily fish-eating bird, Forster’s Terns are “top of the food chain/web predators,” likely to concentrate chemical contaminants in their eggs and tissues (Figure 48). High contaminant levels of organochlorines (including DDE and polychlorinated biphenols), mercury and selenium have been documented in eggs sampled in colonies in California, New Jersey, Texas and Wisconsin. The effects of these contaminants are little known, but comparisons and egg exchanges between a colony with high contaminant levels and one with lower contaminant levels in Wisconsin suggested reduced hatching success, longer incubation periods, abnormal embryos, lower masses at hatching and zero chick survival in the more contaminated colony. Eggshell thickness in California and Texas was

correlated negatively with DDE levels, and selenium concentrations appeared to be associated with lower hatching success in Texas.

There is no information for British Columbia.



**Figure 48.** Waterbirds are a diverse group of species that are dependent on aquatic habitats for their survival. Unfortunately these habitats are conduits for chemical contaminants that enter prey, such as fishes, and are manifested along the food chain to top level predators like the Forster's Tern. Duck Lake, BC. 22 May (Brent Wellander).

**Habitat alteration and degradation:** Like all habitat specialists, changes to habitat probably pose the most significant threat to Forster's Terns. As a deep-water nesting specialist, permanent or long-term changes in water levels, through such activities as manipulating water levels for hydro-electric generation, draining and dyking pose a significant threat, although this may be offset if other water bodies in the area become more suitable at the same time. Deeper waters are suitable for nesting only if suitable nesting substrate is available and if sufficient numbers of nest-sites are sheltered from waves.

Declines of tern populations in the United States portion of the Great Lakes were attributed partially to damage to vegetation through high water levels and ice heave (Blokpoel and Scharf 1991).

Strong group adherence (social attraction) appears to aid in colonizing suitable areas rapidly and to recolonize former nesting areas when they become suitable again (McNicholl 1975a). Thus, apparent desertions of specific nesting areas cannot

be considered as losses of nesting sites without checking the site for several years.

In the Creston area, water levels of Duck Lake are more variable than at Leach Lake, suggesting that nesting at Duck Lake may be less frequent, and possibly less successful, than at Leach Lake. Recent research on grebes indicates that nest location in relation to the lee side of waves was more likely to affect nest integrity than density of surrounding vegetation. This likely also applies to Forster's Terns.

The milfoil mats of vegetation, especially on Duck Lake (Figure 49), are a vital habitat for nesting Forster's Terns. Management activities that reduce (e.g., fluctuating water levels) or remove (e.g., channeling or mowing) contribute to degradation of critical habitat.

The mats of aquatic vegetation also provide loafing platforms for Forster's Terns and foraging and resting sites for a host of resident and migratory species including many duck species (and their broods), American Coots, Spotted Sandpipers (*Actitis macularius*), Black Terns, and Painted Turtles. In 1997, up to 40 Forster's Terns regularly utilized the mats even though no breeding activities were observed at Duck Lake that year.



**Figure 49.** The milfoil mats of vegetation on Duck Lake, BC, vary in size and location each year but nesting waterbirds, such as Red-necked and Western grebe and Forster's Tern (in the distance) utilize them for nesting. 10 July 2006 (Linda M. Van Damme).

**Availability of food sources:** Some marshes with appropriate water depth, shelter and substrate lack access to sufficient food sources for nesting terns. Although Forster's Terns and similar species sometimes fly considerable distances from nesting sites to hunt for food, recent research with radio-telemetry in California indicates that this distance tends to increase as the young grow (Bluso-Demers et al. 2008), suggesting limitations on how far a suitable food source needs to be. Thus, management efforts for nesting populations need to consider both nesting habitat and availability of adequate food supplies. However, although Forster's Tern is primarily piscivorous, it is fairly flexible in its food habits, eating more insects than most tern species of similar size. For example, the "Havell's" Terns shot by Audubon were eating floating insects and they are sometimes caught in flight.

Nevertheless, Forster's Terns may have to compete with other fish-eating birds in the Creston area for food, especially as such highly piscivorous bird species as American White Pelican and Double-crested Cormorant appear to be fishing in the area in increasing numbers.

Whether or not food supplies are adequate, water clarity may be insufficient to allow enough food to be captured. For example, Trick and Harris (1983) attributed differences in growth rates of chicks at two Green Bay, Wisconsin colonies to greater search times required by birds to capture prey in murky waters near one colony to times required by birds near a colony by clearer water.

**Recreational boat traffic:** Long-time visitors to the Creston valley have noticed an increase in recreational use of waterways that includes rowboats, canoes, paddle boats, kayaks, and fishermen casting from inflated tubes. While some areas allow motorized boats, there are restrictions on Duck Lake (Figure 50).

Duck Lake is a popular bass-fishing destination and in some cases, when on the lake, anglers may remain stationary for several hours while they cast their lures. The recreational boat activity here is greatest from late May to mid-June after which numbers taper off during the rest of the summer. Ohanjanian (1998), during her work on Western



**Figure 50.** This sign, one of three posted along Duck Lake dyke in 1998 by Penny Ohanjanian, lasted only a short time. New signs should be posted that list other "Red-Listed" species, including Forster's Tern, and extend the disturbance-free period to include June (Linda M. Van Damme).

Grebes at Duck Lake, noticed that boating activity caused grebes (and Forster's Terns) to leave their nests, which could result in overheating of eggs and chicks due to exposure to the sun. In an example of Western Grebe disturbance in 1997, she reported that four incubating grebes at the colony site were flushed off their nests when a boat was put in the water from the south dyke and on two occasions in 1998, birds flushed off nests by boaters as far away as 400 m. Up to 30 birds were off nests at one time and three birds remained off eggs for 45 minutes.

In one study, Forster's Terns were reported to habituate to fishermen within 100 m of the colony (McNicholl et al. 2001).

Excessive wakes from boat traffic were thought partially responsible for declines in nesting habitat for Forster's Tern in Wisconsin (Blokpoel and Scharf 1991).

The maintenance of the non-motorized only regulation on Duck Lake is vital to the conservation of not only Forster's Tern but also many other species who use that water body.

**Human disturbance on breeding grounds:** Many human disturbances are unintentional as people may not be aware of the sensitivity of their presence near colonial-nesting birds or that the colony of Forster's Terns at Creston is unique.

Hall (1989) and Fraser (1994a) report that researchers can have an impact when they are at, or near, nests. Their disturbance increases parental inattentiveness and may cause hypothermia-induced deaths of chicks that leave the nest and enter the water.

**Aircraft over-flights:** Low aircraft flights, especially helicopters, over tern breeding grounds during the egg and young chick stage (late May through mid-July) can indirectly impact nesting terns through predation. Unattended nests with eggs and small chicks are vulnerable from a variety of avian predators, including Ring-billed Gulls, that often rest each summer on nearby milfoil mats.

### Interspecific interactions

Although the focus has been on Forster's Tern, it should be noted that terns have been observed to predate Western Grebe eggs (Gould 1974 cited in Nuechterlein 1975). Inflated numbers of Forster's Terns within the colony may have a negative impact on the Western Grebes, a red-listed species nesting on Duck Lake.

**Competition for food resources with other piscivorous birds:** Where sympatric, some fish-eating birds have similar diets although they have different foraging techniques. For example, in the Creston valley Double-crested Cormorants dive to pursue fish, American White Pelicans scoop fish, and kingfishers and terns plunge-dive for prey. While a fish population may be exploited differently, the combined impact may be great.

The numbers of colonial fish-eating species in the Creston valley is changing dramatically with the arrival of breeding Double-crested Cormorants

(Figure 51) and summering non-breeding American White Pelicans. The number of pelicans using the Creston Valley Wildlife Management Area has increased during the 1990s, with the greatest influx occurring during July and continuing through early August, when young terns are being reared.

Gowans and Ohanjanian (2000) estimated that approximately 6,375.62 kg (6.4 metric tons) of fish were consumed by pelicans at the Creston Valley Wildlife Management Area in 1999. The pelicans were reported to use the same management units as the terns (e.g., Ponds 1 and 2 of Leach Lake and Pond 4 of Six-Mile-Slough), with some excursions to Duck Lake.

It is not known if the pelicans and other piscivorous species are having a negative impact on the food supply of Forster's Terns and other fish-eating birds in the area, such as Hooded Merganser (*Lophodytes cucullatus*) and Belted Kingfisher (*Megaceryle alcyon*). This will have to be considered carefully as there are conflicting opinions on enhancing breeding habitat for pelicans in the Leach Lake unit. Ohanjanian (1998) states: *No enhancement activities directed at American White Pelicans are recommended at present. Western Grebes and Forster's Terns, both "Red-listed", fish-eating birds, are currently nesting at the Creston Valley Wildlife Management Area. It*



**Figure 51.** The arrival of nesting Double-crested Cormorants in the northern Creston valley in 2003 puts additional pressure on fish resources from other fish-eating animals. Leach Lake, BC. 26 June 2006 (Linda M. Van Damme).

would be premature to attempt to entice the pelicans to nest or to artificially increase their numbers at the Creston Valley Wildlife Management Area prior to understanding the extent and reliability of the prey base, and the potential impacts that increased numbers of pelicans may have on other “Red-listed” birds. Little is known about the prey base of the pelicans and other piscivorous birds in the Creston Valley Wildlife Management Area. Fish studies are recommended.

However, in the 2004 Habitat Management Plan developed for the Creston Valley Wildlife Management Area, Wilson et al. (2004) state: *consider encouraging pelicans to nest by providing a combination of fine gravel, sand, and soil with no shrub or tree cover on existing islands.*

It should also be remembered that fish-eating birds reduce competition for food resources where they co-exist by foraging on different sizes, and kinds, of fishes (Knopf and Kennedy 1981).

### **Management Recommendations**

The Forster’s Tern is protected by the international Migratory Bird Treaty Act. Provincially it is considered a “Red List” candidate by the British Columbia Government due to lack of data on ecology, distribution, population size, and uncertainties regarding the effect of anthropogenic habitat changes. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) classified the species as of “Indeterminate Status” in 1996 and the British Columbia Conservation Data Centre has ranked it as S1 (critically imperiled).

It has the smallest breeding population of any colonial water bird species in British Columbia (Campbell et al. 1990a, 1990b).

Wilson et al. (2004) suggest the following prescription for managing habitat within the Creston Valley Wildlife Management Area for unique or sensitive nesting species:

- minimize the rapid rate of water level increase in Duck Lake during spring and early summer;
- restrict boat access near nest colonies to create disturbance-free zones of 400 m around nest sites;

- provide artificial nesting platforms; and
- explore provision of nesting platforms at other sites such as the south end of Kootenay Lake.

Since Forster’s Terns have habitat requirements similar to Western Grebes, a stable water regime appears essential for the success of the nesting colony. Water levels must be suitable to provide a stable base for nest mounds to prevent flooding during sudden increases in water levels caused by storms.

T. Antifeau (pers. comm.) suggests that by maintaining relatively low water levels in Duck Lake the milfoil mat may grow more quickly and attain a critical mass suitable to protect colonial-nesting bird nests earlier in the spring.

At Leach Lake, water levels are more stable and there is far less human disturbance.

### ***Human Access to Colony Sites***

As prolonged or frequent human activity also can pose a significant threat, access to marshes with nesting populations or the portions of the marshes used by the terns should be curtailed or limited during the breeding season. Fishing, boating, and related activities should not be permitted in the vicinity of any colonies when nesting birds are present and where boating is permitted nearby, speeds should be low enough to minimize wave action. In the Creston area, boating activities at Duck Lake, including loading boats into the water, have been observed to disrupt grebe incubation and also pose a potential disturbance effect to nesting terns.

### ***Artificial Nesting Platforms***

Nesting platforms are usually set out for marsh-nesting birds as a management tool to compensate for decrease, or decline, of natural nesting habitat. Nesting habitat in the northern Creston valley, especially at Duck Lake, appears secure so nesting platforms may enhance reproductive success due to the impact of fluctuating water levels and seasonal storms.

Nest platform programs have been operated successfully in Wisconsin in the 1980s (Techlow and Linde 1983, Mossman et al. 1988, Mossman 1989) and in North Carolina salt marshes in the 1990s

(Dennis 1996).

Dimensions for the platforms are discussed in the various reports, but most were 60 x 64 cm wooden structures. The researchers, however, recommended a liberal coat of paint on all wood surfaces to prevent warping, a ramp to the platform, so that chicks could return to the safety of the platform, and a small shelter over part of the platform so chicks could “hide” from predators when parents are off foraging.

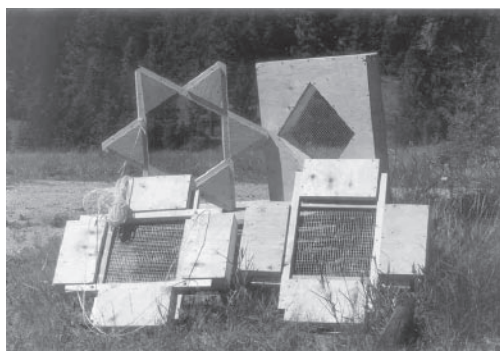
In British Columbia, Penny Ohanjanian (1998) set out four floating wooden platforms in Duck Lake on 20 June for Western Grebes to monitor their effectiveness for nesting. Three different designs were developed and constructed (Figure 52). The artificial nesting platforms were occupied immediately and defended by Forster’s Terns, who copulated on them, and laid eggs and fledged young from two of them (50% success). Both Forster’s and Black terns used the platforms as loafing sites throughout the summer.

The possibility that aerial predators might use the platforms as perches was considered, but no Common Ravens or raptors were seen at the colony in 1998. The other potential predator, the Ring-billed Gull, was present but the species prefers to float on water. Penny recommended that future research and experimentation on the use of platforms for Forster’s Tern enhancement should be considered.

Such a mitigation program, however, requires monitoring and annual maintenance, which is unlikely. Similar rafts provided by the Canadian Wildlife Service for Common Terns in Toronto have been successful, but have required considerable hands-on effort, including removing the rafts annually and re-assembling them when the terns arrive so that earlier-nesting Canada Geese and Ring-billed Gulls don’t use them. The use of chick shelters is also necessary to reduce mortality arising from attacks by adult terns from neighbouring territories when their chicks begin to wander (M. K. McNicholl experience with Hans Blokpoel and colleagues).

The concern of the impact of storms may be partially solved by the strategic placing of a floating log breakwater to lessen wave action, but this may in turn attract some predators who will use the sites for loafing perches.

The successful nesting, with two of three chicks



**Figure 52.** Artificial nest platforms have been used successfully as a mitigation tool for the conservation of a wide variety of waterbirds in North America. At Duck Lake, Forster’s Terns utilized the structures that were originally set out for Western Grebes. 1 June 1998 (Penny Ohanjanian).

fledging, of a nest in a waterfowl nest basket in New Mexico (Williams 1992) suggests that these structures may also be suitable artificial nest-sites, although the earlier nesting schedule of waterfowl may reduce their availability to the terns without time-consuming “hands-on” management efforts.

### ***Submergent Vegetation***

It appears that the submergent vegetation mats in Duck Lake provide valuable nesting habitat for Forster’s Terns, Western Grebes, and Red-necked Grebes. Without them, successful nesting could not occur, except in rare years when winds and storms are virtually non-existent. Their presence in a lake that is rich in prey species may contribute positively to the energy budgets of the fish-eating birds that use them, allowing them to nest near their food source. The mats, with or without added platforms for Forster’s Terns, should be examined over several years, under differing weather regimes to determine whether it is providing adequate habitat over the long-term, or if it is, in fact, a population sink. While it is thought that by maintaining relatively low water levels in Duck Lake the milfoil mat may grow more quickly and attain a critical mass suitable to protect both tern and grebe nests earlier in the spring, this measure may not always be a practical option. Such management on Duck Lake will continue to be beyond the control

of the Creston Valley Wildlife Management Area, as pumping efforts to lower the lake early in the season is costly, and the rate at which they rise will always be a function of precipitation, the Kootenay River (as controlled by the Libby Dam), the size of the snowpack and the timing of the spring run-off.

### ***Environmental Pollutants***

As terns are high up on aquatic food chain or web, they would be expected to be highly susceptible to the effects of biomagnification of several pollutants, as suggested by the research summarized in the Mortality section above. Further research on the immediate and longer-term effects of such pollutants on Forster's Tern is desirable for management of their populations as well as those of their nesting associates.

### ***Range Expansion and Potential Breeding Sites***

Since Forster's Terns move opportunistically into new areas when water depths and marsh habitats become suitable, deep-water marshes and marshy edges of lakes in British Columbia should be monitored as regularly as feasible for possible new nesting areas, especially those where such nestings have been suspected.

There are a number of potential nest sites in the Okanagan and Thompson valleys and the southern Peace River region where Forster's Terns have been observed frequently during the breeding season. All of these locations possess suitable breeding and foraging habitats, and at some sites, breeding behaviour has been suspected.

The following five potential breeding sites are highlighted with physical descriptions and summary information for Forster's Tern occurrences.

#### ***Swan Lake (Vernon)***

There are at least 23 records of Forster's Tern from 10 different locations in the Okanagan valley. Of these, 39 percent are from Swan Lake between 20 May and 17 September.

The lake is located 5 km north of Vernon along Highway 97 in the northern Okanagan valley (Figure 53). The 11.3 km shoreline is developed with residences, a trailer park, nursery and a small campground with facilities. Fishes present include

Bridgelip Sucker (*Catostomus columbianus*), Burbot (*Lota lota*), Northern Pikeminnow (*Ptychocheilus oregonensis*), Rainbow Trout (*Oncorhynchus mykiss*) and Redside Shiner (*Richardsonius balteatus*).



**Figure 53.** Most occurrences of the Forster's Tern in the Okanagan valley, BC are from Swan Lake north of Vernon. Marshy habitats at the south and north end of the lake have been frequented by terns. 13 October 1991 (R. Wayne Campbell).

Dense cattail and bulrush beds at various locations around the margin of the lake could provide suitable nest sites.

On 28 May 1995 Chris Siddle noted: "2 adults at the north end ... One adult presents food to the second tern on a floating mat of vegetation. I assumed this was a nest but as the day passed and I didn't see the terns again, clearly it was just floating vegetation. Third tern also present during initial observation. Likely it was a Common Tern."

#### ***Beaver Ranch Flats (Guichon Creek)***

This site is located about 30 km north along Highway 5A from the junction of the Coquihalla Highway and Highway 5A at Merritt. The site is a reclaimed marsh with extensive dense and open beds of bulrushes (Figure 54), small, low hummocks, fallen flats of emergent and submergent mats of vegetation. The interior of the marsh is well protected from wind action.

Prior to the 1990s, this wetland was little used for nesting by marsh birds because of the lack of water in late spring and summer. The Guichon family, who



ranching the property, agreed to a program to build two dams that allowed ground water to be pumped into the lowland. Since then the site has become an important nesting area in the province for various species.

Forster's Terns have been reported infrequently from this site since 1998. In 2008, however, the species was seen frequently from 30 May to at least 28 July. On 8 July, three birds behaved as if they were nesting by flying into the same portion of the marsh and settling. One bird was actually sitting in incubation posture on what appeared to be a small nest mound. No food transfer was noticed. A thorough check of the site revealed a small depression with a few sprigs of dry grasses. No eggs or chicks were seen near the site.

The marsh does not support a fish population, a requirement for nesting Forster's Terns, but foraging sites are nearby at the north end of Nicola Lake.



**Figure 54.** In 2008, several Forster's Terns behaved as if they were nesting in this reclaimed bulrush marsh but a thorough search did not reveal anything. Beaver Ranch Flats (Guichon Creek), BC. 16 June 2000 (R. Wayne Campbell).

### South Peace River Region

There are more records of Forster's Terns from the southern Peace River region than anywhere else in the province. Nearly 50 records are on file from 11 different locations found between 15 May and 26 August. The sites most visited are Boundary Lake, Cecil Lake, Charlie Lake, Fort St. John (sewage lagoons), and Swan Lake (Tupper). The three sites

with most nesting potential to date are discussed below.

### Swan Lake (Tupper)

Swan Lake Provincial Park, located 35 km southeast of Dawson Creek, is British Columbia's third oldest park, being established in 1918. It is a popular summer destination for campers, canoeists, fishermen, and recreational boaters. The lake itself has a mean depth of 3.1 m and a maximum depth of 7.6 m.

Forster's Terns have been recorded foraging over the lake in flocks of up to 12 birds between 9 June and 26 August. Ideal nesting habitat exists at the southeast end of the lake, an area that seldom is visited by humans. The protected wetland supports a significant population of Nelson's Sharp-tailed Sparrow (*Ammodramus nelsoni*), which breed in the shallow, permanent marsh predominated by sedges and mats of prostrate vegetation (Figure 55). There is only a single record, however, of three Forster's Terns flying low over this site.

Excellent foraging areas are nearby.



**Figure 55.** Suitable nesting habitat blankets a small portion at the southeast end of this large lake, where Forster's Terns have been seen. Swan Lake (Tupper), BC. 1 June 2007 (R. Wayne Campbell).

### Boundary Lake

This large, shallow lake straddles the Alberta-British Columbia border east of Fort St. John and is a significant breeding ground for waterbirds and a migration stopover site for waterfowl. The entire

wetland encompasses an area of about 518 ha (1,280 acres) and one-quarter occurs in British Columbia.

Some colonial-nesting birds breed on this lake, including Eared Grebes, and there are extensive beds of cattails, bulrushes and other emergents (Figure 56).

Up to four Forster's Terns have been reported here since 1996 between 8 June and 5 July. In 2005, adults were present on the lake from 5 June to at least 3 July. On 18 June, two adults were seen on vegetation mats; one appeared to be incubating. The site was visited by canoe and a partially completed nest was discovered. In early July there were no birds in the area.



**Figure 56.** In 2005, an incomplete nest of Forster's Tern was found on a mat of vegetation with attendant adults in an extensive marshy section of the lake. Boundary Lake (Goodlow), BC. 15 June 1990 (R. Wayne Campbell).

#### *Cecil Lake*

Cecil Lake, located about 17 km northeast of Fort St. John, is an important staging area for waterfowl during spring and autumn migration and supports the largest Eared Grebe breeding colony in the province (Campbell et al. 1990a). It is shallow with margins of cattails and bulrushes, large mats of aquatic plants and open water. In general appearance it is quite similar to Duck Lake near Creston.

Forster's Terns have been reported here infrequently since 1997 between 9 June and 19 July flying over the lake and resting on milfoil mats (Figure 57). Like Duck Lake in the Creston valley,

fluctuating water levels on Cecil Lake each year would make nesting intermittent, although extensive sedge marshes may provide alternate nest sites.



**Figure 57.** Large floating mats of aquatic vegetation provide resting and feeding sites for a host of different migrating and nesting birds, including Forster's Terns, at Cecil Lake, BC. 22 June 2004 (R. Wayne Campbell).

#### **Research and Monitoring of Forster's Tern in British Columbia**

Since Forster's Terns have started to nest in British Columbia only recently, observations on any aspects of their natural history provide new information on their biology at the northwestern extreme of their breeding range. Since nesting on natural substrates has been primarily on milfoil and nesting on floating vegetation in other areas is primarily on *Scirpus* or *Typha*, nesting on submergent vegetation mats provides an opportunity to study comparative nesting success and other aspects of natural history on another substrate and at a relatively new part of their breeding range.

McNicholl et al. (2001) mention that the biology and ecology of the Forster's Tern is less known than any other species of North American terns. Only breeding ecology, foraging, and vocalizations have received some in-depth studies.

The small breeding population in the northern Creston valley probably does not warrant specific life history research that can be better carried out at other larger colonies. There are, however, some

non-invasive research topics that can be carried out in the valley that will complement the lack of present information and assist with development of a management plan for the species.

The first priority is to determine the breeding and foraging distribution throughout the entire Creston valley. The species has not been recorded in southern parts of the valley and 98 percent of our present knowledge is from the vicinity of Duck Lake. The latter area has public vehicle access while the Leach Lake unit does not and requires a four to six kilometre walk to reach the site (Figure 58). Issuing permits for some vehicle travel to local researchers would help. Six Mile Slough is accessible only by boat but the area still requires investigation. Identifying spring, summer, and autumn foraging, roosting and staging sites would be helpful.

Knowing the foraging ecology and food habits is critical and becomes more of a concern each year as populations of other piscivorous birds inhabit the region. Field methods should be non-invasive.

The post-fledging movements and habitat selection of juveniles is unknown.

Annual monitoring by telescope, from shore, should be continued as has been done by Linda Van Damme for the past 16 years on a volunteer basis. The results should be submitted to the British Columbia Nest Record Scheme for permanent archiving (see Campbell et al. 2009).

Like many other monitoring programs for colonial-nesting waterbirds, a complete survey should be carried out every five years searching all potential habitats.



**Figure 58.** The productive wetlands in the Leach Lake unit in the Creston Valley Wildlife Management Area is poorly documented because of vehicular restrictions. Annual permits should be issued for discreet surveys each year. 27 April 1997 (R. Wayne Campbell).

### Databases

This account is based on 14,746 single occurrence records and 191 individual breeding records that include nests reported with eggs and/or chicks, developing chicks near nests, or recently fledged young being fed (Table 3).

### Did You Know?

#### *Specialists vs. Generalists*

Evolutionary forces often work in opposite directions, providing both advantages and disadvantages for specializing and for being more of a generalist. A long-recognized example among marsh birds is that of Red-winged Blackbird versus

**Table 3.** Differences in total distribution information (*i.e.*, count of occupied 1:50,000 NTS map sheets), and size of databases (*i.e.*, number of individual records), used in the Forster's Tern account published in *The Birds of British Columbia* (BBC) in 1990 with the current account from updated databases held by the Biodiversity Centre for Wildlife Studies (BCFWS) in 2008.

	Distribution		Database	
	Occurrence	Breeding	Occurrence	Breeding
<b>BBC</b>	11	1	172	16
<b>BCFWS</b>	44	1	14,746	191
<b>% Increase</b>	300	0	8,473	1,094

Yellow-headed Blackbird. Red-wings breed in a much wider array of marshes, marshy spots and even dry-land sites, whereas few observers could check a Yellow-head's nest without wearing waist-waders. Similarly, Black Terns nest in a wide array of shallow to deep marshy sites, whereas Forster's favour much deeper sites – except in those populations that nest on dry land in sites more typical of their Arctic and Common cousins!

### ***Snails, Egg Shells, and Calcium***

It is well known that some birds use terrestrial snails as a source of calcium to supplement egg formation but a study in Newfoundland on Arctic Terns suggests that snails can benefit from “eating” the eggshells of terns. Bond and Diamond (2007) found abandoned tern eggs with many snails on the surface and through electron microscopy determined that the snails were removing the outer eggshell layers. They postulated that this may be a source of calcium to supplement their own shell growth.

In British Columbia, aquatic snails (Figure 59) have been found on the nests of Forster's Terns and may, in fact, utilize abandoned or predated tern eggs.



**Figure 59.** The possibility that Forster's Terns may have some kind of relationship with aquatic snails in the Creston valley is intriguing. Duck Lake, BC. (Linda M. Van Damme).

### ***Deadly Behaviour***

Prior to the Migratory Bird Treaty protection in 1919, Forster's Terns, along with many other species of birds were shot for the millinery trade and their feathers were used to adorn men's fedoras and women's hair, hats, and dresses. Forster's Tern, unfortunately, had a habit of flying towards, and hovering over, those individuals that had been shot and were thus more vulnerable to collecting. The impact on the tern is unknown.

### ***A Water Bird that Doesn't Like Swimming***

Despite having webbed feet and living in an aquatic environment, Forster's Tern is seldom seen on the water swimming even though it is capable of the activity. During hundreds of hours of watching terns flying, foraging, fishing, courting, and nesting at Duck Lake in the Creston valley author Linda Van Damme has never witnessed them swimming.

### ***Havell's Tern***

In 1820, John James Audubon shot “several individuals” out of a flock of terns “engaged in picking up floating coleopterous insects” near New Orleans. He next “met” this species in Texas in 1837, and in 1840 named it Havell's Tern, *Sterna havellii*, in the seventh volume of his classic “Birds of America.” Robert Havell, “one of the best ornithological engravers in England” would thus have been commemorated by this species had Nuttall not have named it Forster's Tern earlier, based on a specimen in a different plumage.

### ***Forster of the Tern***

Thomas Nuttall named the tern after Forster in 1834 in recognition of Forster's comments on differences between a tern specimen and specimens of Common Terns in Europe in a 1772 paper on birds collected by Hudson's Bay Company officials. The official type specimen was apparently collected by Thomas Drummond in Saskatchewan in 1827 on a Hudson's Bay Company expedition led by Sir John Richardson.

In addition to his informal description of Forster's Tern, Forster included formal descriptions of nine bird species new to science. Forster never set foot in North America, but travelled extensively in the south

Pacific with Captain Cook, describing numerous plant, fish and bird species, and publishing important monographs on plants, penguins and albatrosses, as well as naming numerous plant, fish and bird species and publishing translations of numerous works on numerous scientific topics from 17 languages into English. *Aptenodytes forsteri* (Emperor Penguin), numerous plant species, and numerous geographic features, commemorate his many contributions to science.

*Sterna* is the latinization of the English “tern.”

### ***Cruising the Creston Valley***

Forster’s Tern is a graceful flier that can maneuver quickly to avoid danger or obstacles or when passing food items to a mate. When cruising for food, or looking for potential nest sites, it cruises along about 16 km/h (10 mph), a speed that is between a human walking and cycling.

### **The Internet**

There is very little electronic information available on Forster’s Tern in British Columbia that is current or summarizes the species’ natural history and distribution. The following sites have some accurate and useful information for British Columbia.

British Columbia Ministry of Environment (Rare Birds of BC): <http://www.env.gov.bc.ca/wld/documents/spsum/ABNNM08090.pdf>

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): [http://www.cosewic.gc.ca/eng/sct5/index\\_e.cfm](http://www.cosewic.gc.ca/eng/sct5/index_e.cfm)

Tern Colony Site Management Techniques: <http://www.waterbirdconservation.org/plan/rpt/sitemanagement.pdf>

The Terns of the Canadian Great Lakes: [http://www.on.ec.ca/.../fs\\_terns-e.html](http://www.on.ec.ca/.../fs_terns-e.html)

Waterbird Conservation for the Americas: <http://www.waterbirdconservation.org/pubs/ContinentalPlan.cfm>

### **Finding Forster’s Tern in British Columbia**

Forster’s Tern is a target species for birders’ life lists in British Columbia and the most reliable place to find them is at Duck Lake in the northern Creston valley. Leach Lake, where the species is also found with some regularity, is accessible to the public only by walking or cycling and terns flying over Six Mile Slough, a foraging habitat, are encountered only infrequently.

Outside the Creston valley the best chance to find this rare summer visitor is in the southern Peace River region at Swan Lake (Tupper), Charlie Lake (south end), and Boundary Lake.

The following bird-finding site has been extracted from *Creston Valley Birds – when and where to find them* (Van Damme, in press).

#### **Duck Lake**

This site is the most popular and well-visited birding locale in the valley. To reach the lake arriving from the west, follow Highway 3 for about 8.6 km from the Summit Creek bridge and veer right onto Highway 21; continue 0.5 km and turn left onto Lower Wynndel Road through the tunnel. Travel 6.8 km north to Duck Lake Road. Slow down to make this left downhill turn and be sure to stay to the right of this narrow lane as logging trucks exit here and visibility is reduced. If arriving from the east and travelling through downtown Creston, follow Canyon Street to the last traffic light, continue north as it turns into Northwest Boulevard, leaving the town boundary at the junction of Highway 3 and 3A. Drive north on Highways 3A about 7.5 km and turn left onto Lower Wynndel Road before the Wynndel Country Store. The Duck Lake Road turn is less than 0.4 km from this junction. Once on Duck Lake Road, continue for 1.2 km, cross the Old Goat River channel and make a right turn onto Channel Road – a sign is posted “Duck Lake 6 km”. Channel Road merges into a dyke at the south end of Duck Lake, where there are pullouts for viewing the lake and the cattail marshes to the south. Forster’s Terns can be observed as they forage over the lake, rest on cattail mounds, or perch on goose nest boxes.

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## Literature Cited and Useful References

The following list of citations is only a sample of the hundreds of articles that were used to develop our databases and write this account. We have included only literature that was a main source of records and biological information or a significant contribution to developing the conservation and management section.

Only information for specific supporting statements, or direct sources of data, are cited in the text.

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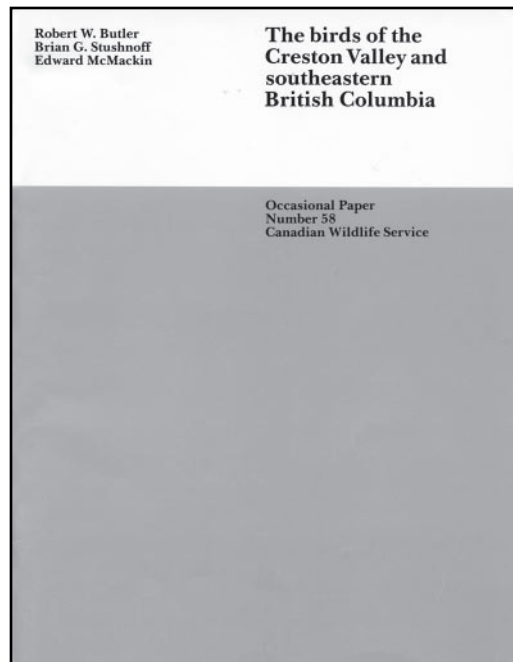
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**Figure 63.** Competition for food resources among fish-eating birds, like Great Blue Heron, may pose a threat to Forster's Terns nesting in the Creston valley in the future. Duck Lake, BC. 29 July (Brent W. Wellander).

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**Figure 64.** Most ornithologists rely on the descriptions and coloured plates provided by Colin Harrison in his book *A field guide to the nest, eggs and nestlings of North American birds* as their standard source information for Forster's Tern and other species of birds. Duck Lake, BC. 26 June 1983 (Mark Nyhof).

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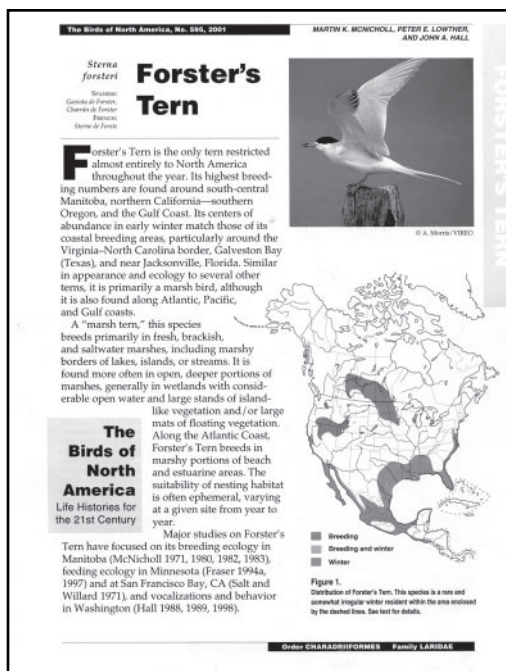
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**Figure 65.** The *Birds of North America* species accounts are usually the starting reference in preparing species summaries for birds on the continent.

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**Figure 66.** It is not known if fish-eating birds in the Creston valley, like this Great Blue Heron and Forster's Tern, are carrying significant loads of chemical contaminants in their body. Duck Lake, BC. 27 July 2007 (Linda M. Van Damme).

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**Figure 67.** The standard North American breeding bird survey is not useful in determining population trends for species like the Forster's Tern which has a restricted and very local breeding range. Duck Lake, BC. 18 May (Brent Wellander).

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### *About the Authors*

**Wayne** is a Director and Treasurer of the Biodiversity Centre for Wildlife Studies and an Associate Editor for *Wildlife Afeld*.

**Linda** enjoys birding and photography, and volunteers her time as co-author on the annual report of the British Columbia Nest Record Scheme. She is currently working on *Creston Valley Birds* – a booklet with popular birding locations and a comprehensive updated bird checklist.

While an undergraduate at the University of Manitoba, **Martin** was invited in 1967 by the late Roger M. Evans to explore possible study sites for research on grouse and larids in Manitoba and to collaborate on a more detailed study of Arctic Terns at Churchill. This experience led to a plan to undertake thesis research on a comparison between some aspect of the breeding biology of Arctic and Forster's terns, but when Martin discovered that A.C. Bent's eight-page account on Forster's Tern was the most comprehensive information on that species to date, in contrast to a rich volume of literature on Arctic Tern, his focus zeroed in on Forster's.

Although papers on the marsh bird studies of Milton Weller and his students in Iowa began to include data on Forster's Tern before Martin finished his 1971 thesis, Martin's publications on this species caused the late Herbert W. Kale II to label him "Mr. Forster's Tern" during Kale's term as Editor of *Colonial Waterbirds* (precursor to *Waterbirds*). Martin has since studied Caspian and Common terns on the Great Lakes (including raft-nesting birds in Toronto), served on the board of the Colonial Waterbird Society and served on the editorial board of *Colonial Waterbirds*.

**Penny** received a Master of Arts degree in Classics from the University of Oxford, England, and in 1980 switched her interests to biological sciences. She attended Simon Fraser University and began graduate research in 1982 on central-place foraging and reproductive success of Red-necked Grebes in Creston, British Columbia under the supervision of Dr. Nicolaas A.M. Verbeek.

She completed her Master of Science degree in 1984 and then started working as a biological consultant in the East Kootenays which she continues today. Penny specializes in rare and endangered

birds and amphibians and has prepared reports on Long-billed Curlew, "Columbian" Sharp-tailed Grouse, American White Pelican, Western Grebe, Flammulated Owl, and most recently, Williamson's Sapsucker.

Her amphibian research has concentrated on Coeur d'Alene Salamander, Western Toad, and Northern Leopard Frog.

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