The Decline of Geese and Swans on the Lower Fraser River

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Since white settlement most of the larger species of geese and swans traditionally wintering in the lower mainland have declined to a small remnant of their former numbers. Loss of habitat is not the only factor contributing to this loss. Historical evidence indicates that the decline of the larger water birds began before the major dyking and draining operations began. Furthermore, the clearing of farmland provided an increase in winter feeding opportunities for grazing geese. Even today 10,000 hectares of intertidal marsh still remain on the Fraser delta, and almost 1,500 hectares of marsh, swamp and bog in the Pitt Valley. However, these lands are no longer intensively used by the larger, warier species of waterfowl that have been subjected to increasing disturbance since the 1850s. In spite of this trend, pressure to provide public hunting has made the wildlife management agencies reluctant to establish sanctuaries on the wetlands of the lower Fraser.

The first historical record of wild geese on the Fraser delta was made by John Work, a member of the Hudson's Bay Company expedition that came to the lower mainland in 1824. On December 20 the explorers noted that "on the low land at the entrance to the river, geese, particularly white ones, were very numerous and were by no means shy, they allowed themselves to be approached easily. Mr. McKay killed 3 of them" (Work, 1824). Four years later, in December 1828, Francis Annance, a clerk of the Hudson's Bay Company, and six men discovered Sumas Lake and described the "prairie" beside it as "well adapted for wild fowl." They spent three days hunting there, bagging three cranes (herons), forty ducks, four swans and ten geese (Gibbard, 1937).

A more explicit account of the species present was given in 1866 by John Keast Lord, veterinary surgeon and naturalist with the British North American Boundary Commission, who camped in the lower mainland in 1858 and 1859. Lord's observations were confirmed by the lists of British Columbia birds published by John Fannin and Francis Kermode, who were curators of the Provincial Museum at the turn of the century

(Fannin, 1891; Kermode, 1904). But the most important contributions to our knowledge of the past status of birds in the lower Fraser Valley were made by Allan Brooks, who lived near Sumas Lake between 1887 and 1898, and shot 253 species of birds there. Later he published several articles and lists based upon his collection and observations. The subsequent records of an increasing number of naturalists were used by J. A. Munro and Ian McTaggart Cowan in their *Review of the Bird Fauna of British Columbia*, published in 1947. The publications of these men confirm that most of the species of geese and swans formerly common or abundant in the lower Fraser Valley became transients or rarities between 1858 and 1947.

THE FIELD-FEEDING GEESE

The first loss was that of the White-fronted Goose, *Anser albifrons frontalis*. In 1858-59, John Keast Lord saw "immense flocks" arrive during the spring and fall migration on the open grasslands or "prairies" around Sumas Lake. They were subjected to intensive shooting by the local Indians, who had quickly learned to apply their newly acquired trade-guns to their traditional hunting methods. They killed "great numbers" from "a kind of lair" made of arched sticks covered with grass. Here the hunter lay "until a flock of geese pitch within shot; then bowling over as many as he can, he loads again; the geese just circle round and pitch as before, and so he continues until enough are slaughtered" (Lord, 1866).

By 1917 Brooks described the White-fronts as "usually scarce." However, he recalled that they had been numerous in the fall of 1904 when some may have remained all winter. In 1925 this goose was still described as a "common migrant along the coast where a few winter" (Brooks and Swarth, 1925). At present it is classed as "rare," which means it is "of regular occurrence but seldom seen" (Campbell, Shepard and Drent, 1972). Occasionally, flocks of twenty or thirty White-fronted Geese occur, particularly since the establishment of sanctuaries at Reifel Island and Serpentine Fen, but most sightings are of one, two or three birds, evidently stragglers from the main migration which now bypasses the delta.

In the autumn of 1858 Lord saw "very large flocks" of medium-sized Canada Geese feeding at the entrance to the Fraser River, and at Sumas and Chilliwack Prairies. He called them "Hutchin's Geese," but they are now named Taverner's Canada Geese, *Branta canadensis taverneri*. This goose remained abundant during spring and autumn migratory visits until

the turn of the century, when some still wintered on the coast (Kermode, 1904). But in 1917 Brooks commented that the "Hutchin's Geese" were "common and at times very abundant but getting scarcer, though few are killed. The vast flocks that used to remain on Sumas Lake and prairie . . . mostly pass over now . . . a few remain with the 'Honkers' all winter. . . ." (Brooks, 1917). A year later he stated that the "Hutchin's Goose" was still the commonest goose in British Columbia, but that most flights " . . . pass through between 1st October and 25th November and again from 10th April to 20th May" (Brooks, 1918). By 1925 Brooks and Harry S. Swarth listed it as ". . . a common migrant, a number remaining throughout the winter on the south-west coast."

In 1932 this goose was still described as "a common winter migrant" (Cumming, 1932), but by 1947 Munro and Cowan were "unable to substantiate the statement (by Brooks and Swarth) that a number winter on the coast." In the early 1960s a large flock of 2,000 Lesser Canada Geese wintered in the Lower Fraser Valley at a private sanctuary a few miles east of their roost in Mud Bay (Leach, 1972). More recently, smaller flocks of up to 200 birds have been attracted to the meadows in and around the sanctuaries at Reifel Island and at Serpentine Fen. Their visits to the latter are of short duration; the lack of undisturbed roosts on the foreshore seems to prevent these geese from settling into regular annual and daily patterns of behaviour firmly related to the favourable habitat in south Surrey.

The historical records show that large Canada Geese were also formerly common winter visitors. According to Fannin, the "Honker" appeared "in great flocks along the lower Fraser River during the winter and affords fine sport for gunners" (Fannin, 1891). A sportsman who published a short account of waterfowl-hunting in the Fraser Valley recalled that in 1867 "the commonest kind of goose about Mud Bay was the Canada variety" (Hare, 1897). In 1904 it was "an abundant winter resident on the coast" (Kermode, 1904), and in 1917 Brooks reported it as still common at Chilliwack and Sumas Lake, even throughout the coldest winter (Brooks, 1917). Six years later, Sumas Lake was drained and the last great freshwater marsh in the valley suitable as a roosting area for Canada Geese was lost. By 1947 the number wintering on the coast was "relatively small" (Munro and Cowan, 1947).

The "Honker," which once visited the coast in large numbers, was probably the Great Basin Canada Goose, *Branta canadensis moffitti*. But Brooks described how on several occasions he had seen "flocks of the light and dark 'Honkers' feeding just out of gunshot . . . and keeping apart

from each other." The dark goose, called the White-cheeked Goose, *B.c. occidentalis*, in the early lists (Fannin, 1891; Kermode, 1904), was later divided into two subspecies, the Vancouver Canada Goose, *B.s. occidentalis*, and the Dusky Canada Goose, *B.c. fulva*. The dark "Honkers" seen by Brooks could have been either subspecies. There is some evidence that Vancouver Canada Geese were much more widely distributed along the coasts of British Columbia than they are today (Pearse, 1968). Dusky Canada Geese now winter in the Willamette Valley, Oregon, where, in contrast to the Fraser Valley, various subspecies of migratory Canada Geese find protected winter sanctuaries in National Wildlife Refuges (Pacific Flyway Council, 1973).

THE SHORE FEEDING GEESE

The geese of the foreshore have fared a little better than those of the grasslands of the lower Fraser Valley. Fannin described the Lesser Snow Geese, *Chen caerulescens*, as "tolerably abundant," for in his day they were evidently outnumbered by Canada Geese (Fannin, 1891; Hare, 1897). In 1932 Cumming reported that the Snow Geese at the mouth of the Fraser River "had greatly diminished in recent years." During the 1950s and 1960s the wintering population avoided hunters by sitting offshore in the open waters of the Strait of Georgia or by shifting south to the less disturbed estuary of the Skagit River, Washington (British Columbia Game Commission, 1951-56). An attempt in the early 1960s to keep the Snow Geese on the Fraser delta by closing the hunting season on them in mid-winter was not successful. The Reifel Migratory Bird Sanctuary, established on the delta marshes in 1964, at first proved too small to stabilize the wintering flocks, but since 1971 the Snow Geese have made increasing use of its protection during the shooting season and several thousand now remain throughout the winter (Leach, 1970 and 1972; Edwards, 1971). Prior to their spring departure for Wrangel Island between 10,000 and 20,000 congregate on Roberts and Sturgeon Banks.

In contrast, the decline of the Brant, *Branta bernicla nigricans*, has continued unchecked. In 1891 this goose was "an abundant winter resident" along the coasts of the lower mainland and Vancouver Island. Harry Weaver, a former market hunter, recalled that when he began fowling in 1895, the shores of Mud and Boundary Bays were at times "solid with flocks of Brant." They came in so continuously to decoys that 128 birds were shot from a single blind in one morning (Weaver 1975). Market hunters on Vancouver Island were especially busy in December shooting Brant for the Christmas market. In one year two market hunters

sold 2,500 Brant to a Victoria trader before New Year's Day (Munro, 1977). By 1925 the Brant was described as a common winter visitant, although "in former years more generally distributed than at present" (Brooks and Swarth, 1925). In 1932 it was still "abundant in winter on Boundary Bay" (Cumming, 1932), but by 1947 it was much more abundant as a spring transient, and, while the numbers seen in March were in thousands, only two hundred or three hundred were observed in the December counts (Munro and Cowan, 1947). During the following decades the reports of the Provincial Game Commission and of observers conducting winter counts traced a steady decline of the wintering population (British Columbia, 1951-1956; Holdom, 1945-65). The Christmas bird counts in Delta, for example, reported the number of Brant as follows: 1959-511; 1960-600; 1961-384; 1962-83; 1963-36; ... 1968-17; 1969-Nil; 1970-37 (Erskine, 1970). Since 1974 the Christmas counts have recorded no Brant in Semiahmoo and Mud Bays (National Audubon Society, 1974-8). In 1972 the Brant was given the status of "rare winter" (Campbell, Shepard and Drent, 1972).

The numbers of Brant stopping to feed on the Eel-grass, *Zostera marina*, in Boundary, Mud and Semiahmoo Bays during the spring migration between March and May are still in the thousands. These are birds which breed in Alaska and winter on the coasts of Mexico and Southern California. The Brant which formerly wintered on the coasts of the Strait of Georgia and Puget Sound, Washington, are believed to be a separate population. The banding of 1,513 and the collaring of 557 Brant nesting on Melville, Prince Patrick and Eglinton Islands in the Canadian Arctic has supplied evidence to support this belief. By March 1977, 190 birds had been recovered and a further 87 sighted (Munro, 1977). One hundred and seventy-six (92.6 percent) of the recoveries and 59 (almost 68 percent) of the sightings of these Canadian Arctic birds were made in Puget Sound, Washington. One collared Brant was seen in British Columbia, nine birds were recovered and seven seen in California, and two recovered in Mexico. The remainder comprise recoveries or sightings in the U.S.S.R., in Iceland and on the coasts of Western Europe of birds which evidently migrate eastwards together with the Brant nesting on the central and more easterly Canadian Arctic islands, Bathurst and Axel Heiberg. Thus the great majority of Brant from the westerly Arctic islands appear to winter on Puget Sound. A few wander south as far as Mexico and mingle with the Brant which migrate directly there from Izembek Bay, Alaska (Munro, 1977; Einarsen, 1965; Bellrose, 1976; Palmer, 1976). Nevertheless, the Canadian Arctic island birds seem to be a dis-

crete breeding population which divides between two wintering areas, one on the European coast and the other on the Pacific coast of Washington. It is logical to conclude that the Brant which once wintered on the coasts of British Columbia were part of the Canadian Arctic island population, a small remnant of which still returns annually to Puget Sound.

THE SWANS

Past records suggest that the Trumpeter Swan, *Olor buccinator*, was always a rare visitor to the lower Fraser Valley. However, the Whistling Swan, *Olor columbianus*, occurred as a common migrant and winter visitor. They were a favourite quarry of the Katzie Indians in the large marsh south of Pitt Lake where Wapato or Duck Potato, *Sagittaria latifolia*, grew in profusion (Suttles, 1955). Lord observed adults with young on the Fraser River and at Sumas Lake. Brooks also reported these swans on the lake sometimes in large numbers. In November 1894, for instance, he saw "a dozen large flocks" (Brooks, 1917). In 1925 the Whistling Swan was "a fairly common migrant remaining all winter on the coast" (Brooks and Swarth, 1925). Cumming listed it in 1932 as "an irregular winter visitor." By 1947 Munro and Cowan classed it as a transient on the coast and stated that specimens taken there in winter were "obviously sick birds, or birds which had been wounded earlier and thus prevented from migrating." The appearance of a single swan at the mouth of the Nicomekl River in 1951 caused the local vicar to recall that his older parishioners had spoken of flocks of swans settling from time to time in the marsh between the Nicomekl and Serpentine Rivers (Holdom, 1951). In 1965 a large number of Whistling Swans reappeared in this area, where over a score were illegally shot (Leach, 1972).

HABITAT CHANGES IN THE LOWER FRASER VALLEY

Since the middle of the nineteenth century, when the settlement of land followed the gold rush of 1858, environmental changes have been both drastic and rapid. However, it would be an oversimplification to accept the decline of the wintering geese and swans as an inevitable consequence of the conversion of most of the Fraser's flood plain and delta into agricultural and urban-industrial land. Before white colonization, the quantity of habitat available to waterfowl was strictly limited to the inter-tidal and meltwater flood zones. It is evident that agricultural developments have in fact *increased* habitat suitable for certain species of wintering waterfowl, especially the field-feeding geese and the American Wigeon, *Anas americana.*

A recent study by Margaret North has provided a valuable record of the vegetation present on the Fraser delta prior to white colonization (North and Teversham, 1976). It is based upon the notes made during the land surveys of 1859 and 1873, and upon observations of areas, such as tidal marshes, peat bogs, river banks and beach ridges, which have remained uncultivated and in a fairly natural state. From this study it can be deduced that the best waterfowl habitats lay in areas where regular flooding ensured the survival of aquatic food plants or fostered the predominance of short-stemmed, fine grasses. These comprised: (1) the narrow inter-tidal zone; (2) the zone of variable width between the normal high-tide line and the abnormal or storm-tide line; and (3) the upstream flood-zone that was subjected to regular mountain snowmelts. These three zones were of comparatively limited size in relation to the valley as a whole, because they were usually bounded on the landward side by extensive bogs, scrublands (predominantly *Spiraea douglasii*, willow, and crab apple), and swampy forests whose plant communities persistently invaded and colonized the marshes as they were raised in elevation by the accumulation of dead plant material and by river sedimentation.

The successive zones of salt, brackish, and fresh marshes, and grasslands (called "prairies" by the settlers) were found along the estuarine shores and across the deltaic islands of the Fraser, along the tidal shores of Boundary and Mud Bays and up the tidal reaches of the Serpentine and Nicomekl Rivers. Farther up the valley, the flood plain, deltaic islands and deposits of the Pitt River and the flood plains of the Chilliwack and Sumas Rivers and of other tributaries of the Fraser all provided fresh marshes of great value to waterfowl. These were the feeding habitat of the geese and swans of the lower Fraser. On the saline tidal flats, Eelgrass and Sea Lettuce, *Ulva spp.*, provided the entire diet of the Brant. The tidal, brackish marshes at the river's mouth supported large stands of bulrush, *Scirpus spp.*, and cattail, *Typha spp.* Here the Lesser Snow Geese used their strong bills for grubbing up rhizomes as they still do today in these localities. Farther inshore, north of Boundary Bay, east of Mud Bay, and Chilliwack and Sumas Prairies were the "wet grass" and "red top grass prairies" (North and Teversham, 1976). The observations of the early naturalists confirm that these were the very areas on which the White-fronted and Lesser Canada Geese gathered to feed (Lord, 1866; Hare, 1897; Brooks, 1917).

The fresh marshes and the wetter grasslands around shallow lakes were the places most favoured by the Whistling Swan. This bird is both a

grubber and a grazer, but it usually prefers to feed on wet locations and is far more dependent upon equatic plants than the field-feeding geese (Owen and Kear, 1972). The early records confirm this preference, most commonly reporting swans at Sumas Lake and in the fresh marshes of the Fraser and Pitt Rivers (Lord, 1866; Brooks, 1917; Suttles, 1955).

When white settlers began to pre-empt land in 1859, the natural "prairies" and wet grasslands were the first areas to be drained and dyked. After the great flood of 1894, a continuous system of dykes was constructed along the Fraser, Nicomekl and Serpentine Rivers and along the delta coast. The larger deltaic islands were also dyked. The dykes were usually located along the beach ridges and on the natural levees of the rivers (Winter, 1968). They had, therefore, little effect on the inter-tidal plant communities of the foreshore, the eelgrass community of Boundary Bay and the bulrush-cattail community of the deltaic banks and islands. In contrast, the landward wet grass and red-top grass communities were almost entirely enclosed by dykes. However, this change does not explain the decline of the field-feeding geese, for the clearing of shrubs and trees from the swampy lowlands resulted in the addition of wide areas of cattle-grazed pasture and arable land. In spite of the dykes and ditches, the heavy rainfall continued to cause puddling and, sometimes, extensive flooding in the agricultural lands (Winter, 1968). Thus the winter feeding habitat suitable for grazing geese was greatly *increasing* at the time of their decline. The draining of hundreds of sloughs, ponds and small lakes, which also took place at this time, undoubtedly contributed to changes in the habits and distribution of ducks and swans, but it probably had less effect upon the geese, which show a preference for feeding on the open grasslands and roosting on the tidal flats. The two inland waters extensive enough to provide secure roosts for large numbers of geese were the Pitt marshes and Sumas Lake. But, although attempts to drain the Pitt marshes began in 1911, it was not until the Dutch Pitt Polder Company began work in 1951 that the marshes were effectively reduced. Sumas Lake was drained between 1920 and 1924, but even this took place after the decline of the grazing-geese and of the Whistling Swan in the lower Fraser Valley (Brooks, 1918; Siemens, 1966).

It is also significant that the temporary decline of the Lesser Snow Goose and the loss of the wintering Brant both occurred in spite of the fact that their main feeding habitat on the tidal foreshores has remained largely intact. Similarly, it is relevant to note that even today the Lesser Snow Geese very seldom attempt to feed on the farmlands of the Fraser delta, and yet less than 100 kilometers farther south, on the very similar

landscape of the Skagit River delta in Washington, they have long become adapted to cultivated foods and fly regularly into the fields and meadows where they glean the remnants of harvested crops and graze on grasses.

Man-made changes of habitat farther south, notably in the Columbia River basin of Washington, in the Klamath Basin of Oregon and in the Central Valley of California, have undoubtedly had profound influences on the distribution of wintering geese and swans on the Pacific Flyway. Yet, in spite of these attractive areas of grain-producing farmland and of extensive wildlife refuges, geese and swans have continued to make attempts to revive their use of traditional areas in the Lower Fraser Valley. The failure of the most recent attempts, those of Taverner's Canada Geese and of Whistling Swans in Surrey, seem to have been due mainly to disturbance (Leach, 1972). The sole exception is that of the Lesser Snow Goose, and it is significant that its recovery took place in the decade following the establishment of a sanctuary on part of its traditional winter feeding and roosting ground.

DISTURBANCE BY HUNTING

Most wild creatures, especially geese and swans, will vacate places which become the scene of intensive and unpredictable human activities. However, even noisy intrusions like railways are soon recognized as harmless. Routine operations such as farming are also accepted by geese, provided they are conducted by people whose attention is perceptibly not directed towards them. In contrast, birds react very quickly to recognized threats, and once they have been subjected to shooting they will seldom linger to determine whether humans observing or approaching them are motivated by predatory intentions.

In view of the nature of human society in the Fraser Valley during the nineteenth century, it is safe to assume that most of the disturbance suffered by geese and swans was the result of hunting. The pioneers relied heavily upon wild game for meat, especially during the initial period of settlement. Bag limits, seasons and other restrictions were unknown. The hunter's skill lay in his ability to bring down as many birds as possible with one shot. Since providing for the pot was the main motive, large species — geese, swans and cranes — were particularly prized. Pioneers recalled that bags often exceeded what could be used and the "killing too often was for killing's sake only" (Matsqui-Sumas-Abbotsford Centennial Society, 1958; see also Hare, 1897). The trading of firearms to the Stalo Indians along the river greatly increased their impact upon the waterfowl population (Lord, 1866; Suttles, 1955). Later, as society became

more urbanized, trappers, farmers and fishermen met the continued demands for game by market hunting. The pressure upon wildlife was unrelenting, particularly in the more accessible grasslands of the natural prairies, which were both the traditional feeding places of many waterfowl and the sites of the first agricultural communities (Fenton, 1973; Weaver, 1975). In the history of his family's farm near Chilliwack, Oliver Wells recalled that in his father's day

> great flocks of Canada geese and occasionally large flocks of white-fronts would settle into a grain stubble field. Edwin, or one of the men, would use a horse and cart for camouflage and walk up close enough to make a kill, never for sport, but for food. In the fall, from the rafters in the wood-shed would hang rows of Mallard ducks and Canada geese. (Wells, 1967)

As the birds became more wary fewer were shot, but the harassment continued. In 1917 Brooks wrote that the Taverner's Canada Goose was "too much disturbed" to remain in its former haunts.

A year earlier, the Migratory Birds Convention had been signed by the governments of Great Britain and the United States. It declared closed seasons for waterfowl and game birds and restrictions on the killing of certain species. But British Columbia refused to accept these changes, and in order to save the Convention all the other states and provinces of North America agreed to exempt this province from the provisions designed to eliminate spring shooting and the hunting of cranes, swans and the Wood Duck, *Aix sponsa* (Commission of Conservation, 1916; Foster, 1978). This attitude was reflected in the pessimistic view of the Convention expressed by Allan Brooks. He felt that it had come too late for the Whistling Swan and Sandhill Crane, *Grus canadensis*, in the Fraser Valley, and stated that

> these birds suffer in their breeding haunts in the far north. Few are killed after they migrate. Both must have conditions where they are not much disturbed when at rest, large bodies of water free from pleasure craft for swans and large open plains for cranes. They mostly pass over their former winter quarters and those used on migrations formerly, as they are too much disturbed. Protection will not change this. (Brooks, 1918)

Improved access to the marshes and meadowlands had become a major factor contributing to the decline of the large waterbirds. Between 1881 and 1901, when the human population of the lower mainland rose from 6,000 to 52,000, roads and railways began to match the rivers as the main lines of travel. By 1905, after the completion of three bridges across the lower Fraser, almost every part of the valley was within two miles of a

road (Meyer, 1968). The adverse effect of the use of the automobile to pursue geese aroused the complaint that "unrefreshed and hopeless of rest they hurry off on their migratory way, refusing to tarry . . . where they are so mercilessly harried" (Taverner, 1926), but by then grazing geese had left the fields of the Fraser Valley.

In the mid-1950s the situation on the foreshore marshes was officially described as follows:

> Waterfowl generally seem to be holding their own extremely well. This is quite remarkable when one considers the tremendous hunting pressure to which these birds are subjected. With such a large human population in the Lower Mainland and with more and more people turning to hunting as a form of recreation, all available waterfowl-shooting grounds can be considered to be put to maximum use. (British Columbia Game Commission, 1956)

Yet, in spite of this optimistic tone, the report went on to describe Brant as "scarce during the open season." Snow Geese, though "abundant during the early part of the season," were "as usual . . . to be seen in offshore rafts," and they provided such poor morning and evening flights that "few were bagged by sportsmen." Throughout the decade these reports consistently described the same situation: heavy hunting pressure and declining wintering populations of Brant and Snow Geese. On one occasion a conservation officer discovered approximately 40,000 Snow Geese wintering "a few miles from Boundary Bay in the State of Washington" and he advised that the "present closed season down there is undoubtedly responsible for their poor showing here" (British Columbia Game Commission, 1951).

Even after the establishment of a sanctuary had stabilized the wintering population of Snow Geese, the pressure on Brant continued unchecked. A Vancouver sports columnist wrote in 1967 that "Beach Grove Brant spit (on Boundary Bay) is still known the length and breadth of the continent. There have been ends of the season brant kills there that are [*sic*] little less than slaughter" (Cramond, 1967). Yet two years earlier a definitive study of the Brant had sounded a clear warning that they "could be wiped out within a few years unless . . . [their] desperate needs (food, grit and undisturbed loafing) are supplied" (Einarsen, 1965). Finally, over a decade later, a report issued by the provincial Fish and Wildlife Branch stated:

> We no longer have a wintering population of brant in historic brant areas. . . . If recent trends continue few if any brant will appear in B.C. prior to the

last day of the open season ... and wildlife agencies may justifiably be accused of systematically eradicating wintering brant in B.C. (Munro, 1977)

The report attributed the loss "primarily to hunting, firstly by gradually killing or harassing wintering birds and secondly, by systematically killing paired adult birds." Of over 3,000 Brant shot between 1967 and 1977 on Vancouver Island, 96 percent were adults. The effect of disturbance by boating, beach walkers and log booming was rejected as a major problem because Brant appear to be unperturbed by such activities in April and May when several thousand gather on the bays of Georgia Strait prior to their spring departure. A large sanctuary on Boundary Bay was therefore recommended, together with a complete closure on Brant shooting for five years. The report warned that even a ten-day shooting season in March could adversely affect the birds, especially if the sanctuary and closure succeeded in reviving a wintering population that would not be wary. Nevertheless, irate hunters demanded, and obtained, a ten-day shooting season, from March 1.

Swans were given legal protection from shooting in 1916. Nevertheless, they frequently prove to be irresistible targets to unscrupulous or ignorant gunners (Palmer, 1976; Leach, 1972). In the Arctic, they are still the legitimate quarry of Indians and Eskimos, and since 1962 the State of Utah has issued annual permits to a thousand hunters to shoot one swan each. As a result, swans have remained restless and wary in areas where shooting occurs. Furthermore, their very size and conspicuousness attract human attention, so that they are probably subjected to more disturbance by pleasure boaters and by curious observers than the small waterbirds. This problem, to which Brooks drew attention in 1917, has grown with the advent of the outboard motor and the vast increase in the number of boat owners. Loss of habitat in the former fresh marshes and lakes of the Fraser Valley has made swans more vulnerable to casual disturbance than ever, so even where they are not hunted these majestic birds require protection from harassment. Furthermore, the example of the lake sanctuary near Mount Vernon on the Skagit River flood plain in Washington demonstrates that the provision of undisturbed habitat for the Whistling Swan will also encourage the less common Trumpeter Swan to winter in the coastal lowlands on the Strait of Georgia.

The reluctance of the provincial and federal wildlife management agencies to respond to the decline of geese and swans in the lower Fraser Valley can be attributed to a number of factors. The management of wildlife in British Columbia has been concerned primarily with the enforce-

ment of bag limits and seasonal regulations, and with the provision of game for hunting (British Columbia 1951-56, 1958). Rapid urban expansion in the lower mainland prompted the belief that the wildlife of the delta and estuarine marshes was doomed to disappear. This attitude prevailed well into the 1970s (Mair, 1977), especially in the Fish and Wildlife Branch, where it was fostered by inadequate budgets and a lack of personnel experienced in the management of land for wildlife. Opportunities for practical management at Serpentine Fen and in the Pitt Valley could be taken up only with considerable funding from Ducks Unlimited (Canada) and field assistance from other non-government organizations. Dependence upon such support tended to prolong the branch's adherence to its traditional priority of keeping public hunting opportunities open even when the demand, as in the case of the Brant, was clearly contrary to the biological needs of the quarry species.

Although it is responsible for the protection and management of migratory birds, the Canadian Wildlife Service appears to have been governed by similar restraints, and has not supported even the belated attempts of the Fish and Wildlife Branch to restore the Brant as a wintering species on the southern coasts of British Columbia.

CONCLUSIONS

The decline of the traditional populations of field-feeding geese, Brant and Whistling Swan indicates that there is insufficient undisturbed habitat for these birds to adhere to their daily cycles of feeding and loafing. The main source of disturbance in the past has been shooting, but a recent drop in the number of hunters is not likely to result in a recovery of wildfowl numbers because other human activities on the wetlands are increasing.

In addition to its direct impact of disturbance upon wildfowl, hunting increases the effect of other forms of human disturbance because it causes birds to assume that all human attention directed towards them constitutes a threat. The less wary reactions of birds to people outside the hunting season or within parks and sanctuaries indicates that fear of shooting is the main factor determining the behaviour of hunted species towards humans. This has made human disturbance such a major factor in determining the status and habits of migratory wildfowl in the lower Fraser Valley.

A realistic assessment of the impact of disturbance on wildlife is the first step towards the establishment of an effective conservation policy for waterfowl in this area of high human activity. For, if the decline of wintering populations is to be checked and reversed, much stricter control of

human access and of the use of wetland habitat must be accepted by the public.

It is unlikely that adjustments to bag limits or to the open season for individual species will encourage a revival. It was only after the establishment of the Reifel Migratory Bird Sanctuary that the wintering population of Lesser Snow Geese stabilizied and increased. This suggests that similar sanctuaries should be established to protect key areas of the feeding and loafing habitats required by the other species of geese and swans which occur in the lower mainland. Suitable areas of publicly owned habitat are already available on the Fraser delta, in Boundary and Mud Bays and in the Pitt Valley. When such areas are preserved, the controlled public use of the remaining foreshores and wetlands can be planned. The National Wildlife Refuge system in the United States combines hunting areas and an access system for public viewing with sanctuary areas closed to the public. It successfully demonstrates that the quality of recreation in nature parks and public shooting areas is enhanced by their combination with sanctuaries closed to public access. Applied here, such a system should be regarded not only as a means of recovering lost or declining wintering populations but also as a safeguard against further losses which must be anticipated as the pressure of recreational and commercial activity increases on the lower Fraser River.

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