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SANDHILL CRANES OF COASTAL BRITISH COLUMBIA: RESULTS OF HELICOPTER SURVEYS AND PRELIMINARY OBSERVATIONS OF HABITAT USE

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Abstract: A pilot study on sandhill cranes (*Grus canadensis*) was conducted on the central coast of British Columbia in May 2006, followed by 2 summers of inventory and observation in 2007 and 2008. Fieldwork consisted of gathering local knowledge of crane locales, helicopter and boat surveys, and observations from blinds. We located 29 nest sites on 14 different islands and 1 mainland peninsula, as well as several beach foraging areas and bog roost sites. Observed average crane and nest density in areas of suitable habitat was 0.21/km^2 and 0.044/km^2, respectively, for 2007 and 2008. Nest and roost sites were found within 1.25 km of the shoreline, on the inner and outer islands between 51°38′N and 54°00′N where blanket mire complex occurs. Territory of breeding pairs we observed in the Bella Bella area consisted of beach or estuary, forest and upland bog, and nearby marshes and lakes.

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Key words: breeding habitat, British Columbia, Canadian sandhill crane, coastal bogs, Great Bear Rainforest, *Grus canadensis rowani*.

Three subspecies of sandhill crane occur in British Columbia: *Grus canadensis canadensis*, *G. c. rowani*, and *G. c. tabida*. Breeding distributions, population sizes, and migration pathways are poorly known for all subspecies in the province (Cooper 1996). Cranes summering on the British Columbia and central Alaskan coasts are thought to belong to *G. c. rowani* (Canadian sandhill cranes), which generally breed in parkland and boreal parkland ecoregions of Canada and Alaska (Herter 1982, Pogson and Lindstedt 1991, Cooper 1996, Ivey et al. 2005, Johnson et al. 2005).

All subspecies have been blue-listed (considered vulnerable) in British Columbia since 1998, with the exception of the red-listed Georgia Depression population residing in the lower mainland (British Columbia Conservation Data Centre 2007). This designation is due mainly to the paucity of information regarding their population status and lack of protection for their habitat throughout the province (Cooper 1996).

In 1990 it was estimated that 3,500 cranes migrate and potentially breed along the British Columbia coast (Campbell et al. 1990). They form part of the Pacific Flyway Population of sandhill cranes, which numbers approximately 25,000 birds. The majority of this population is made up of lesser sandhill cranes that summer in southern Alaska and winter in the Central Valley of California (Tacha et al. 1992). PTT-marked cranes (reported as *G. c. rowani* from morphometric measurements) that summered on the British Columbia and southern Alaskan coasts in 2002 staged in the Lower Columbia River region west of the Cascades in Oregon and Washington. One crane continued on to winter in California's Central Valley with sandhill cranes of other subspecies from interior British Columbia and Alaska (Ivey et al. 2005). Ivey et al. (2005) recommended that coastal breeding Canadian sandhill cranes be managed as a separate population, due to differences in morphology and breeding distribution from lesser and greater sandhill cranes. Up to 4,273 birds counted in the fall of 2002 on staging grounds on the Lower Columbia River may have represented the nesting population of coastal British Columbia and southeast Alaska at that time (Littlefield and Ivey 2002, Ivey et al. 2005).

The coastal islands and adjacent mainland coast between the northeast of Vancouver Island and Alaska have been identified as potential habitat for sandhill cranes, based on ecosystem classification and current knowledge of habitat preferences, and this area was included in the range of *rowani* described by Meine and Archibald (1996) (British Columbia Ministry of Water, Land, and Air Protection 2004). Prior to this study there were no recent nest records for the central and north coasts of British Columbia, although there are scattered records from Haida Gwaii, an archipelago separated from the central and north coasts by a wide strait, and from the north end of Vancouver Island to the south (Hearne and Hamel 2003, Cooper 2006, British Columbia Conservation Data Centre 2007).

The central and north coast region is currently the focus of extensive planning under the Central Coast and North Coast Land and Resource Management Plan and other regional planning efforts. There is a need for information on the distribution and habitat requirements of sandhill cranes in order for these to be considered in management planning for both protected and unprotected areas.

A pilot study to establish the scope of a research project on sandhill cranes on the central coast was initiated in May 2006. The study consisted of gathering local knowledge, conducting boat and helicopter surveys, and observations from blinds to determine the feasibility of a multi-year study. We repeated helicopter surveys in May of 2007 and 2008, expanding the survey area to parts of the north coast in 2008. Sightings of cranes on the central coast were followed up by boat and on foot to confirm suspected use sites in both years. Our objectives were to locate cranes and their nests and to identify habitat types used by summering cranes.

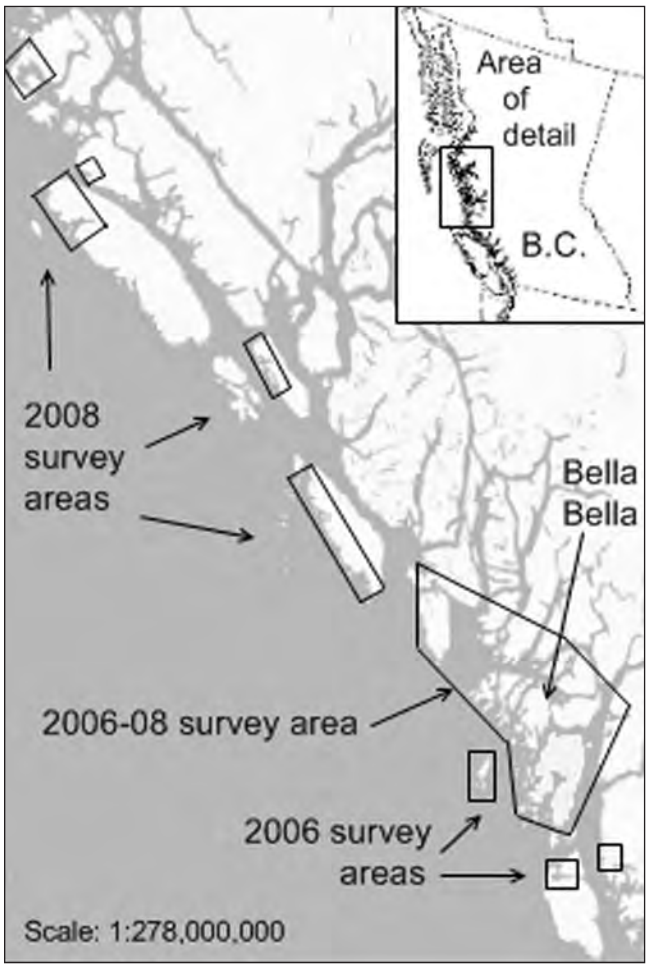

Figure 1. Study area and survey areas on the north and central coast of British Columbia.

STUDY AREA

The study area (Fig. 1, 51°38′N, 128°05′W-54°00′N, 130°37′W) lies within the Hecate Lowlands Ecosection (HEL) of the Coastal Gap Ecoregion. The HEL is a narrow band of island archipelago and lowlands along the central and north coasts of British Columbia with rough, low topography, convoluted shorelines, and productive estuaries (Province of British Columbia 1996). The dominant ecosystem type in the HEL is the Coastal Western Hemlock very wet hypermaritime subzone, under British Columbia's Biogeoclimatic Ecosystem Classification system (Meidinger and Pojar 1991, Province of British Columbia 1996). Due to the influences of a hypermaritime climate and mineral-poor bedrock, large expanses of blanket mire complex have formed on the outer coast of British Columbia. The blanket mire complex is a mosaic of open, shrubby, and woodland bog types, with vegetation that is distinct from interior and boreal regions (MacKenzie and Moran 2004). Many islands in the archipelago feature large productive estuarine lagoon systems, fringes of old-growth forest (<30 m tall), and upland mosaics of bog and fen wetlands and scrub bog forest (Fig. 2, Province of British Columbia 1996).

This largely intact region is under increasing pressure from an array of ecological threats, including industrial logging, oil and gas extraction, overfishing, aquaculture, mining, sport hunting, recreation activities, marine traffic, and climate change (Paquet et al. 2004). The study area is within the traditional territories of the Heiltsuk, Kitasoo/Xaixais, Gitga'at, and Gitxaala First Nations, and Port Simpson and Metlakatla bands of the Tsimshian First Nation.

METHODS

Interviews were conducted in Bella Bella and on neighboring Denny Island over a 3-day period in May 2006 to identify crane locales on the central coast. These

Figure 2. Estuaries on the west coast of Aristazabal Island, with fringe forest and upland bog complex (photo by Briony Penn, 2008).

Table 1. Results of helicopter surveys for sandhill cranes on the central and north coast of British Columbia. B = bog, E = estuary, M = marsh, T = total.

	2006				2007				2008			
	B	E	M	T	B	E	M	T	B	E	M	T
No. of nests	0	0	0	0	3	0	0	3	19	0	0	19
Total sightings	5	2	0	7	15	18	1	34	49	15	2	66
No. of cranes sighted	13	5	0	18	16	39	1	56	58	32	2	92
Survey area (km^2)				180				260				430
Total time (hrs)				12				10.5				13.5
Mean effort (min/ km^2)				4				2.4				2
Mean no. cranes/km^2				0.10				0.20				0.22
Mean no. nests/ km^2												0.044

were marked on laminated 1:50,000 topographic maps, which were used to navigate as well as to record surveyed areas during helicopter surveys. Most aerial photography for the north and central coasts is at a 1:60,000 scale and dates to the early 1980s or before. There is no landcover mapping available for this area, however shoreline typing maps were available and proved useful for locating estuaries and beaches.

Helicopter surveys were used to locate sandhill cranes and their nests between 13 and 18 May 2006 (Table 1). Initially, searchers travelled to known crane locales and surveyed shorelines and estuaries where crane sightings had been reported. If cranes were spotted, they landed and surveyed the upland bog and forest on foot for evidence of cranes. This search pattern was followed by reconnaissance of coastal areas with no reported crane sightings. During 14-17 May 2007, we rechecked sites where cranes were located in 2006, and surveyed shorelines and upland bog within 0.5-1.5 km of the shore in new areas of the central coast by helicopter. Following the nesting period in 2007, helicopter sightings within a 25-km radius of Bella Bella were visited by boat and on foot to confirm the locations of nests and roost sites, as only 2 nests were seen from the air. Cranes were observed opportunistically during these surveys, and locations of cranes, tracks, and droppings were recorded with a handheld GPS, and vegetation and other site characteristics were noted. We documented crane behavior and habitat using video, still photography, and written notes.

We rechecked crane locales identified in previous years during 15-21 May 2008. We also covered new survey areas with high potential, based on habitat associations and new sightings reports from locals and mariners. Analysis of satellite imagery (SPOT 5 and GoogleEarth), shoreline typing maps, and topographic maps were used to locate high potential habitat for surveys. Upland wetlands were given priority over shorelines as the principle objective was to locate nests and important roost sites.

An R-44 helicopter was used for surveys in all years. Flights were based out of Shearwater on Denny Island for central coast surveys and out of Prince Rupert for north coast surveys. Reconnaissance surveys were flown at 100-200 m elevation, and shoreline and bog surveys were flown at 35-50 m at speeds between 55 and 65 km/hr. Only low altitude surveys were included in calculations of survey effort. Searchers flew along shorelines at approximately 100 m, descended to 50 m at estuaries and inlets, and circled over nearby upland wetlands. Surveys were done at mid to low tide levels because shoreline sightings of cranes appeared to be less frequent at higher tide levels. Surveys were generally carried out between 0939 hours and 1730 hours to avoid low solar angles that reduced visibility. Cranes were observed in situ or when flushed. When a crane was sighted during the 2007 and 2008 surveys, the helicopter would circle once to check for a nest (if necessary), and to record the location using the helicopter's GPS, and then leave the area. Video and still photographs were taken of the habitat. Three or 4 people were present in the helicopter at all times during the surveys to improve detection and to help with recording and navigation. Permissions were obtained from all of the First Nations councils whose territories we planned to visit prior to commencing surveys in all years.

In 2008, weekly visits to 4 nests with 2 eggs each were made in the Bella Bella area during May and early June to ascertain approximate hatching dates. Nest habitat and diet studies, based on fecal analysis, were also conducted within a 30-km radius of Bella Bella in 2008 (data not reported in this paper). Fieldwork for these studies allowed for opportunistic observations from boats, on foot, and from blinds, which were recorded as in 2007 and are summarized below.

RESULTS

During the 2006 helicopter survey 18 cranes were sighted in 7 locations (Table 1, Fig. 1). In the 2007 helicopter survey we counted 56 cranes in 34 separate sightings. Fifteen sightings were in bogs (16 cranes total) and the remainder were on beaches or estuaries except for 1 bird sighted in a sedge marsh. Two nests with 2 eggs each were observed by helicopter, and 1 nest that was located in 2006 was rechecked on foot and found to contain 2 eggs. Nine of 13 bog sites recorded during the helicopter survey were surveyed on foot after the nesting period, and we tracked cranes from beach, bog, or forest sightings on foot. In total 15 nests and many roost and foraging sites were identified on 10 different islands.

In 2008 we located 19 active nests with eggs on 11 islands and 1 on a mainland peninsula during helicopter

surveys. Sixteen of the nests held 2 eggs, 2 nests held 1 egg, and 1 nest was uncertain.

Bog sightings in all years were generally associated with nearby estuary sightings when only 1 crane was seen in the bog. Nests were situated closer to each other on the outer coast near large lagoon and estuarine systems. For example, 3 nests were found within 2 km on the outer coast of Aristazabal Island in 2008, whereas 2 nests on the north end of Denny Island, an inner coastal island, were 5.6 km apart.

We rechecked 9 nest sites in 2008 that had been active in 2007. Only 2 of the nest sites were still active in 2008. However 3 nests were found within the same wetland complex (within 300 m) as the 2007 sites, and 1 nest was 1 km away from a 2007 nest site.

Of the 4 nests that were monitored for hatched eggs, 3 were vacant in the last week of May, and 1 nest was vacant in the second week of June, leaving 1 egg behind. Eggshell fragments were found in all nests and chicks were later seen nearby.

From helicopter, boat, and foot surveys we found that crane locales were generally consistent from year to year. Cranes tended to be found along sheltered shorelines near estuaries, or in estuaries, where there was upland bog nearby (within 0.25-1.25 km) and forest cover in between shoreline and bog. Nest and roost sites in bog pools also tended to be associated with nearby (within 500 m) marshes, fens, or lakes, where tracks, droppings and feathers were often found.

Beach foraging habitat was most commonly gently sloping pebble or rocky beaches with abundant cover of rockweed (*Fucus* spp.) in the intertidal zone, where cranes were observed (on the ground or from a boat) feeding on small mussels and periwinkle snails on the surface of the rockweed. Estuary foraging habitat was commonly salt marsh with abundant sedges (*Carex* spp.), Pacific silverweed (*Potentilla anserina pacifica*), and mudflats merging with rockweed-covered beaches. Cranes on the beach often stopped feeding and retreated to the forest edge when approached on foot or by boat. We observed them feeding on salal berries (*Gaultheria shallon*) at the forest edge, and loafing in the forest above the beach at high tide on hot afternoons. Cranes with young and non-breeding cranes appeared to share these patterns of habitat use and behavior.

Bogs where cranes or evidence of crane use were found almost always had pools with small moss islets (on average 4 m^2 in size). Pools where we found nests or evidence of roosting (droppings, feathers, and tracks) were under 1 ha in size, 0.25 m-1.25 m deep with 0.15-0.75 m of mud and decomposing plant material, although some nests were found on islets in small beaver-made lakes. In almost all cases nests were made of a single layer or layers of twigs laid on the moss surface.

We observed seasonal shifts in habitat use among both breeding and non-breeding cranes during boat and foot surveys. Cranes were reported arriving in the Bella Bella area in the second week of April in both 2007 and 2008, and 25 cranes were seen together in Beale's Lagoon, a large estuary system on Cunningham Island in late April of 2008 (L. Jorgensen, Heiltsuk Nation, personal communication 2008). In May and June of 2007 and 2008 we commonly saw cranes feeding along beaches and in estuaries from dawn until dusk, and typically 1 bird out of a nesting pair could be found feeding on the beach close to the nest during this time. These cranes were observed defending trails leading to nest sites from the forest edge with aggressive or defensive behavior when approached. Non-breeding cranes appeared in pairs and in larger groups of up to 15 birds. From June to September crane families with young were seen feeding on beaches near to nest sites and using forest trails to walk from beach foraging areas to upland areas.

Non-breeding cranes were rarely seen on the shoreline or flying over the water in July, but cranes, fresh droppings (often containing seeds of *Empetrum nitrum*) and tracks were seen in upland bog wetlands and adjacent forested areas. In August, non-breeding cranes reappeared at shoreline foraging areas in groups of varying sizes and resumed feeding in the rockweed zone and in estuaries.

DISCUSSION

Observations and sightings suggested a distinctive pattern of habitat use by breeding pairs including: 1) upland bogs used for nesting, roosting and foraging, 2) estuaries and beaches used for daytime foraging, 3) old-growth fringe forest used for escape cover, sheltered access to nest areas from the shoreline, and foraging, and 4) upland lakes and wetlands used for foraging. Non-breeding cranes appeared to use the same habitat types.

The rise in the number of sightings during helicopter surveys each year reflected our increasing familiarity with the land and seascape and with crane habitat selection. Survey effort decreased from 2006 to 2008, but the number and average density of cranes sighted increased. The surveys focused on known crane locales and on habitat with similar characteristics, making it difficult to estimate the total number of cranes nesting on the central and north coast based on our findings. Visibility of cranes from a helicopter and their propensity to flush when they are under forest cover is unknown but probably much lower than when in relatively open shoreline, estuarine, or bog habitats. However, a minimum estimate based on our observed density of 1 crane per 5 km^2 and 1 nest per 23 km^2 could be cautiously tendered. This density extended over the land area within 1 km of the shoreline (the average width of our surveys) in the Coastal Western Hemlock very wet hypermaritime subzone of the HEL (5,900 km^2) yields an estimate of a minimum of 1,240 cranes and 260 nests. Cranes were occasionally found nesting and roosting further inland (up to 1.25 km from the shoreline) during surveys. Final summer destinations were up to 6 km inland on north coastal islands in 2002 for PTT-marked cranes tagged in the lower Columbia River area (Ivey et al. 2005). Our estimate therefore represents only a portion of the population of the central and north coasts of British Columbia, and does not include birds summering in southern Alaska. Reports of crane sightings gathered from mariners from 2006 to 2008 indicated that cranes occur on most of the islands on the central and north coasts, where they have typically been seen in pairs or small groups (<10) feeding on beaches within or near to estuaries in sheltered inlets. Cooper (2006) found 16 cranes and 4 nests on the north end of Vancouver Island, in open and lightly forested sheet bog habitat, at a density of about 1 nest per 20 km^2.

Several local people reported that they did not see cranes before the 1960s, and that their numbers have increased since then. However cranes appear in at least 1 Heiltsuk Nation tradition, and have a separate name from the Great Blue Heron in the Heiltsuk dialect (Dr. E. Windsor, Heiltsuk Nation linguist, personal communication 2008). Explorers of the late 18th century saw cranes in the course of their voyages to Haida Gwaii and along the west coast. One record from 1834 tells of early settlers robbing a crane's nest near Bella Bella, after failing to shoot 1 of the parents (Leach 1979). Biologist Ian McTaggart-Cowan and naturalist/collector Tom McCabe observed sandhill cranes on the outer islands of the central coast in 1928. At that time Dr. McTaggart-Cowan noted their different behavior and habitat use from interior cranes, specifically their use of forest trails and bog nesting areas (Dr. I. McTaggart-Cowan, personal communication, 2006). We surveyed 2 areas where he remembered seeing cranes: Spider Island and Yeo Island. There were cranes on Spider Island, but we did not see any on Yeo Island where industrial logging and associated log dumps (built on estuaries) had altered the landscape. It is possible that summering sandhill crane numbers on the coast are still recovering from population losses suffered by the species in the late 19th and early 20th centuries. Crane densities appear to be low, while the availability of suitable habitat is high.

The coastal environment of the HEL appears to meet the needs of sandhill cranes, although they are typically known as terrestrial birds associated with wetlands. Their coloring acts as excellent camouflage on the shoreline, where they exploit protein-rich marine resources. Cranes appear to use the additional cover provided by upland bog and scrub forest areas extensively while molting and with unfledged young.

Forest use by sandhill cranes has been noted in other parts of British Columbia, including Haida Gwaii, where nesting cranes have been observed in logging slash near a mountaintop, and a family was seen in mature spruce-hemlock forest (Hearne and Hamel 2003). Cooper (1996) observed cranes with young in coniferous forests in the Chilcotin-Cariboo region, which they used for escape cover.

Cranes have also been observed nesting in estuarine tidal meadows in Haida Gwaii (Hearne and Hamel 2003). Although sandhill cranes in other regions use bog wetlands for nesting, no other population is known to forage on marine resources or nest in estuarine habitat. Sandhill cranes wintering at Aransas National Wildlife Refuge (ANWR) on the Texas coast foraged in upland agricultural and natural areas rather than in the tidally-influenced environments where they roosted (Tacha et al. 1986, Hunt and Slack 1989). Whooping cranes feed on mollusks and crustaceans on their breeding grounds, and use brackish bays, estuaries, marshes, and tidal flats on their wintering grounds at ANWR (Johnsgard 1983). The brolga crane of northern

Australia feeds on mollusks and crustaceans as well, and breeds in brackish marshes, while the red-crowned crane of East Asia feeds on aquatic invertebrates and fish found in coastal salt marshes in winter (Johnsgard 1983).

MANAGEMENT IMPLICATIONS

Under the requirements of British Columbia's Forest and Range Practices Act, the Ministry of Environment has established an Identified Wildlife Management Strategy (IWMS) for the sandhill crane, which provides management guidelines with respect to forest and range activities that may negatively affect the species (British Columbia Ministry of Water, Land, and Air Protection 2004). The IWMS allows for protection of critical breeding habitat. Twenty-one nest sites and 9 roost sites identified in this study have been proposed for Wildlife Habitat Area designation (WHA) under the IWMS. The remainder of the nest sites we located are within conservancy areas or in the Hakai Recreation Area.

Forest and range activities are restricted in WHAs, however it is unknown whether the size and design of WHAs provide adequate protection from logging for nesting cranes. The IWMS provides for only approximately 20 ha of operable area (harvestable timber) to be set aside for each WHA. However, we found that at least 50 ha of land around the wetlands were needed to encompass the forest between breeding wetlands and shoreline foraging areas and to provide a forested buffer around breeding wetlands. At most wetland nest and roost sites, the adjacent scrub forest is currently classed as inoperable, but operability thresholds may alter as market demand increases for old-growth red and yellow cedar (*Thuja plicata* and *Callitropsis nootkatensis*) (Banner et al. 2005). The primary information need identified in the IWMS is the tolerance of cranes to logging adjacent their breeding habitat (British Columbia Ministry of Water, Land, and Air Protection 2004), however we did not find any cranes in areas with active or recent logging. Conservancy area designation may not provide adequate protection for sandhill cranes as some industrial activities, such as wind farms and hydroelectric projects, are permitted within specific conservancies.

We recommend the establishment of guidelines for protecting sandhill crane habitat within conservancies, and the expansion of minimum WHA size to 50 ha outside the wetland area. We also recommend that sightings we have collected from locals and mariners be followed up with foot surveys to locate more nests, and efforts to raise awareness about cranes and their habitat be continued in coastal communities.

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