STATE OF WASHINGTON January 2017

Periodic Status Review for the Sandhill Crane

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FISH AND WILDLIFE
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The Washington Department of Fish and Wildlife maintains a list of endangered, threatened, and sensitive species (Washington Administrative Codes 232-12-014 and 232-12-011). In 1990, the Washington Wildlife Commission adopted listing procedures developed by a group of citizens, interest groups, and state and federal agencies (Washington Administrative Code 232-12-297. The procedures include how species listings will be initiated, criteria for listing and delisting, a requirement for public review, the development of recovery or management plans, and the periodic review of listed species.

The Washington Department of Fish and Wildlife is directed to conduct reviews of each endangered, threatened, or sensitive wildlife species at least every five years after the date of its listing by the Washington Fish and Wildlife Commission. The periodic status reviews are designed to include an update of the species status report to determine whether the status of the species warrants its current listing status or deserves reclassification. The agency notifies the general public and specific parties who have expressed their interest to the Department of the periodic status review at least one year prior to the five-year period so that they may submit new scientific data to be included in the review. The agency notifies the public of its recommendation at least 30 days prior to presenting the findings to the Fish and Wildlife Commission. In addition, if the agency determines that new information suggests that the classification of a species should be changed from its present state, the agency prepares documents to determine the environmental consequences of adopting the recommendations pursuant to requirements of the State Environmental Policy Act.

This document is a Periodic Status Review for the Sandhill Crane. It contains a review of information pertaining to the status of the Sandhill Cranes in Washington. It was reviewed by species experts and was available for a 90-day public comment period from September 24 through December 23, 2016. All comments received were considered during the preparation of the final periodic status review. The Department presented the results of this periodic status review to the Fish and Wildlife Commission at a meeting in Vancouver on January 13, 2017, and the Commission voted to retain the Sandhill Crane on the state list of endangered species.

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Cover background photo of Conboy Lake National Wildlife Refuge and Mt. Adams by Sara McFall; Sandhill Crane photo by Joe Higbee

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EXECUTIVE SUMMARY

The Sandhill Crane was listed as an endangered species by the state of Washington in 1981. Sandhill Cranes are represented in the state by a small number (<100) of Greater Sandhills that breed in Klickitat and Yakima Counties, much larger numbers of Lesser Sandhills (~25,000) that stop in eastern Washington during migration, and Canadian Sandhills (up to 3,000–5,000) seasonally present on lower Columbia River bottomlands. Most of the cranes seen in Washington winter in California, but up to 1,400 Canadian Sandhills have wintered on the lower Columbia bottomlands of Washington and Oregon in recent years. The Greater Sandhill Cranes that breed in Washington are part of the Central Valley Population, so called because they winter in California's Central Valley; most of this population nests in Oregon, northeastern California, and interior British Columbia; those that breed in British Columbia migrate through eastern Washington among large flocks of Lesser Sandhill Cranes. These migrating Lesser Sandhills of the Pacific Flyway Population stop during spring on their way to breeding grounds in Alaska, and during fall on their way to wintering areas in California. The Pacific group of Canadian Sandhills that is seasonally present on lower Columbia River bottomlands may be the smallest discrete migrant population of Sandhills.

Historical accounts suggest cranes once bred more widely in Washington. Crane numbers were severely reduced due to market hunting, particularly on the wintering grounds, and widespread habitat loss with Euro-American settlement and agricultural conversion. The species was extirpated as a breeder from the state after 1941. Cranes resumed summering in Klickitat County in the 1970s. Nesting was confirmed there in 1979, and they have steadily increased since then. The known summer population in Washington in 2016 was 37 territorial pairs and a total of 98 birds. Most of the crane nesting occurs on and around Conboy Lake National Wildlife Refuge (NWR) in the Glenwood Valley.

Factors potentially affecting Washington's Sandhill Cranes include water availability and management, habitat loss and degradation at staging and wintering areas. Crane use of breeding sites is also affected by human disturbance. Public lands, including refuges and wildlife areas, private hunting clubs and agricultural lands in the Columbia Basin, and on the lower Columbia River, provide essential staging and wintering habitat for Pacific Flyway cranes. Crane habitat, particularly on the lower Columbia bottomlands between Vancouver and Woodland, is affected by industrial development and conversion of agricultural lands to incompatible crops and uses.

A state recovery plan was completed in 2002. Effective water management control at Conboy Lake NWR was a recovery objective, and this situation is much improved. The breeding population has been increasing, and may be expanding to nest in isolated meadows in the Cascades, but additional survey efforts will be required to determine if and where this is occurring. Current recovery objectives for down-listing from endangered to threatened call for a breeding population of at least 65 territorial pairs with an average annual recruitment rate of >8%, although these objectives may be revised if the recovery plan is updated. With a breeding population of <40 pairs and <100 individuals, essential staging and wintering habitat threatened by development or incompatible uses, the mix of Greater and Lesser subspecies at stopover sites during migration, and the similarity of appearance of all three subspecies, it is recommended the species remain on the Washington list of endangered species.

INTRODUCTION

Sandhill Cranes (*Antigone canadensis*) are large birds, standing about 4 ft tall, and often weighing over 10 lbs (Fig. 1). The sexes are similar in appearance with pale slate gray, ashy gray, and brownish-gray body, wing, and tail feathers and a bare red forehead, lores, and crown. Three forms of Sandhill Cranes occur in Washington and have traditionally been considered subspecies, Greater (*A. c. tabida*), Canadian (*A. c. rowani*), and Lesser (*A. c. canadensis*) (Fig. 2). Greater and Lesser Sandhills are relatively easy to distinguish from each other with experience, but Greater and Canadian Sandhills can be difficult or impossible to distinguish. The Sandhill Crane was listed as an endangered species by the state of Washington in 1981, and a recovery plan was completed in 2002 (Littlefield and Ivey 2002). The cranes in Washington are not listed under the federal Endangered Species Act.

Figure 1. Sandhill Crane (*photo by Joseph V. Higbee*).

Taxonomy

Recent analyses of the mitochondrial genomes of the family Gruidae (Krajewski et al. 2010) suggested the genus *Grus* was not monophyletic, which has resulted in Sandhill Cranes being reassigned to the genus *Antigone* (Chesser et al. 2016). At the subspecific level, some genetic studies did not support recognition of the Canadian subspecies as distinct (Petersen et al. 2003, Jones et al. 2005). However, the samples did not include any from the Pacific Flyway, and Tacha et al. (2014) pointed out that there was no reason to expect differentiation in the neutral markers examined by these studies, especially if divergence was recent. Recent DNA analysis revealed a more complicated structuring than is reflected by the taxonomy of two or three subspecies (Hayes et al. 2015). The British Columbia coast 'Canadians' are more than a hybrid between Pacific Flyway Lessers and Central Valley Greaters; the results suggest a common ancestry with a portion of the Central Valley Population, but divergence on separate evolutionary pathways (Hayes et al. 2015).

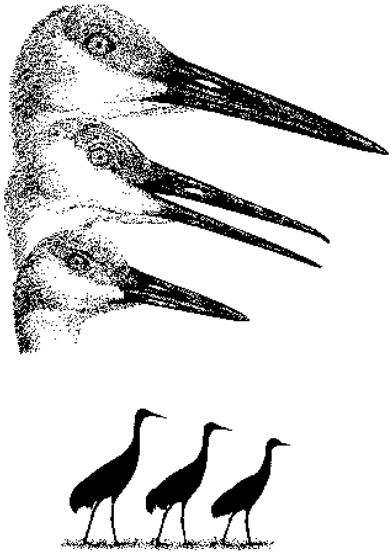

Figure 2. Relative size and bill morphology of typical Greater (top and left), Canadian (middle), and Lesser Sandhill Cranes (bottom and right) (illustration by Darrell Pruett).

Regardless of their genetic and morphological uniqueness, and how the taxonomic question is settled, populations of these birds differ in a variety of ways including breeding range, and timing and routes of migration (Ivey et al. 2005, Johnson et al. 2005, Petrula and Rothe 2005). Ivey et al. (2005) recommended that Pacific Flyway Canadians be managed as a unique population due to their limited numbers, distinct coastal migration route, and habitat issues at breeding, staging, and wintering areas. For simplicity,

this report hereafter refers to the population of cranes that use the lower Columbia bottomlands as Canadians, and refers to the three forms as 'subspecies'.

DISTRIBUTION

Sandhill Cranes are represented in Washington by a small number of nesting pairs of Greater Sandhills. Most nest at Conboy Lake National Wildlife Refuge (NWR) in the Glenwood Valley of Klickitat County, and a few nest on state and private lands in the area and the Yakama Reservation. In addition, large flocks of Lesser Sandhills stop in eastern Washington during migration, and a few thousand Canadian Sandhills and possibly some Lessers stop on lower Columbia River bottomlands (Littlefield and Ivey 2002, Engler et al. 2003); some Canadians winter there, primarily at Ridgefield National Wildlife Refuge (NWR), Washington, Sauvie Island Wildlife Area, Oregon, and surrounding areas (Littlefield and Ivey 2002). The remainder of the cranes seen in Washington winter in California (Ivey et al. 2005, Petrula and Rothe 2005).

The Greater Sandhills that nest in Washington belong to the Central Valley Population, so named because the entire population winters in California's Central Valley, particularly the Sacramento Valley and the San Joaquin-Sacramento Delta (Ivey et al. 2014a, 2015). Members of this population also nest in Oregon, northeastern California, Nevada, and the southern interior of British Columbia (Fig. 3). The Pacific Flyway population of Lesser Sandhills that migrate through eastern Washington, breeds primarily in the lowlands of Alaska's Bristol Bay and Upper Cook Inlet. Canadian Sandhills that migrate through western Washington breed in coastal British Columbia and the Alaska panhandle (Ivey et al. 2005).

Littlefield and Thompson (1982) and Littlefield (1999) reported evidence for a 'coastal segment' of Lesser Sandhills that used the lower Columbia stopover sites, and further suggested that these migrants included about 3,800 Lessers, 330 Greaters, and 300 Canadians. However, Littlefield's (1999) identification of subspecies depended on observations, including second-hand reports of flocks in flight. Ivey et al. (2005) captured eight cranes on lower Columbia sites that were identified, at least morphometrically, as Canadians. All of the 22 Lesser Sandhills captured by Petrula and Rothe (2005) in

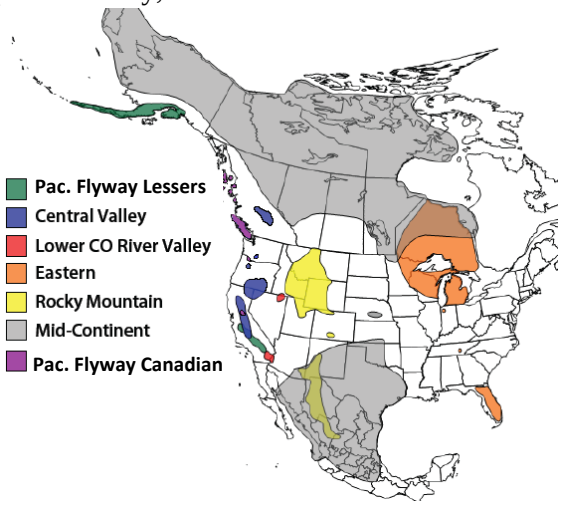

Figure 3. Breeding and wintering ranges of seven migratory Sandhill Crane populations (modified from AFWA 2009 with data from Cooper 1996, 2006; Ivey et al. 2005).

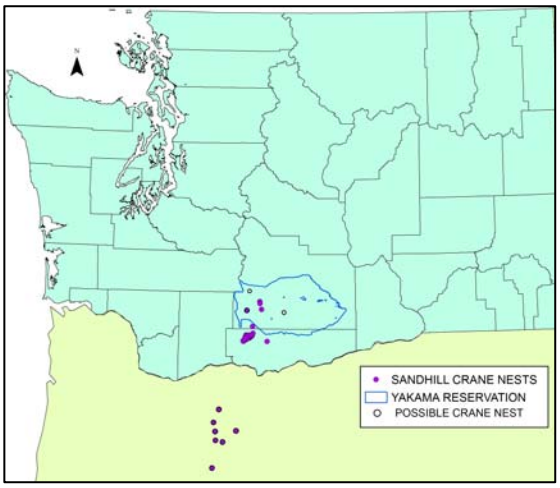

Figure 4. Confirmed and possible Greater Sandhill Crane nesting territories in Washington and the Mt. Hood region in Oregon (WDFW data; C. Corkran, pers. comm.)

upper Cook Inlet and Bristol Bay, Alaska, migrated through eastern Washington, and they suggested the 'coastal segment' described by Littlefield (1999) were likely Canadians.

NATURAL HISTORY

Diet and foraging. Sandhill Cranes are opportunistic omnivores feeding on a variety of foods including roots, bulbs, grains, berries, snails, earthworms, insects, amphibians, lizards, snakes, mice, and greens (Tacha et al. 2014). In spring, cranes primarily eat macroinvertebrates, particularly insects and earthworms (Davis and Vohs 1993). The diet of Greaters at Conboy Lake NWR has not been described, but the behavior of cranes foraging in pastures prior to nesting suggests that they were eating worms and beetles; they may also occasionally eat frogs, tadpoles, snakes, and mice or voles (Littlefield and Ivey 2002, J. Engler, pers. comm.). During spring, migrant cranes in the Columbia Basin, often forage in corn or wheat stubble.

In autumn and winter, Sandhills feed on waste grains, particularly rice and corn, but also milo, wheat, oats, and barley (Tacha et al. 2014). Cranes using the Ridgefield/Sauvie Island area have been observed feeding on corn, barley, green grasses, and chufa (nutsedge) tubers (*Cyperus esculentus*) (G. Ivey, pers. obs.). During winter in California, Lesser Sandhills use alfalfa fields more often than Greaters to obtain protein from invertebrates found in alfalfa fields and pastures (Littlefield and Ivey 2000, Ivey et al. 2015).

Reproduction. Sandhill Cranes have a life history strategy that involves a low reproductive rate but a long reproductive life, a high investment in the pair bond and in defending the breeding territory (Tacha et al. 2014). Greater Sandhill Cranes generally form lifelong pair bonds. Birds usually defer first breeding until $\geq$ 3 years of age (Drewien et al. 1995), with most nesting for the first time at age four. They may nest for several years before successfully raising a chick, and nesting success probably improves as the birds mature.

Sandhill Cranes defend exclusive nesting territories and return annually to the same site (Drewien et al. 1999, Tacha et al. 2014). They usually arrive at Conboy Lake NWR between late February and mid-March. Cranes pile nesting material into a mound, usually in shallow water, and a typical clutch of 2 eggs is incubated for ~30 days (Tacha et al. 2014). At Conboy, incubation of early nests typically begins in early April and brooding in May; late nests may be incubated into early July with brooding extending into August. Both parents tend the young and the birds remain as a close family unit through the brooding period. The fledging period lasts from 66–75 days, but it takes a few more weeks for chicks to become strong fliers. After fledging, colts remain with their parents in migration and winter, usually returning together to breeding grounds the following spring. Annual recruitment in this long-lived species typically averages 5–14% (Drewien et al. 1995), and 7–9% is likely needed for population stability (Littlefield and Ivey 2002

Survival and sources of mortality. Greater Sandhill Cranes can live up to 40 years (Littlefield and Ivey 2002, Drewien et al. 2010). Primary causes of Sandhill Crane mortality are predation of young and collisions with powerlines. If young survive the brooding period, mortality rates decline dramatically once they develop sufficient flying skills (Littlefield and Ivey 2002). Annual adult survival of Sandhill Cranes is typically 0.82–0.96 (Johnson and Kendall 1997). Predation on healthy adults is fairly rare, but Golden Eagles (*Aquila chrysaetos*), Bald Eagles (*Haliaeetus leucocephalus*), Coyotes (*Canis latrans*) and Bobcats (*Lynx rufus*) occasionally kill adults (Tacha et al. 2014). Coyotes may be the primary predator on eggs and young at Conboy Lake NWR (Engler and Brady 2000). Of 64 colts killed by known predators at Malheur NWR in Oregon during 1991-1995, predation was attributed to American Mink (*Mustela vison*; 26), Great Horned Owls (*Bubo virginianus;*10), Golden Eagles (9), Coyotes (5),

unidentified raptors (5), and Northern Harrier (*Circus cyaneus*; 1), and Raccoon (*Procyon lotor;*1)(Ivey and Scheuring 1997). Ravens (*Corvus corax*) and Raccoons take a large number of eggs at Malheur (Littlefield 2003). Besides predation, intraspecific aggression (fratricide), drowning, starvation, parasites, and accidents such as fence entanglements contribute to losses.

Young fledglings are prone to collisions with utility wires, particularly in windy or foggy conditions. Paulson (1989) and McFall (2016b) report powerline-killed cranes at Conboy Lake NWR. Even in adulthood, utility wires pose a threat, and collisions are considered one of the major mortality factors, particularly at staging areas and on the wintering grounds (Littlefield and Ivey 2002). For example, 22 were killed leaving a California roost on a foggy morning (Schlorff 2005) and at a staging site in southwestern Colorado, 15% of 597 powerline mortalities were Sandhill Cranes (Brown and Drewien 1995). Collisions and entanglements with barbed-wire fences have also resulted in crane deaths, most often on the breeding grounds.

Diseases, including avian cholera (*Pasteurella multocida*), botulism (*Clostridium botulinum*, Type C), aspergillosis (*Aspergillus fumigatus*), salmonella (*Salmonella tiphimurium*), and avian tuberculosis (*Mycobacterium avium*) have killed Sandhill Cranes (Littlefield and Ivey 2002, Tacha et al. 2014). Illegal shooting of cranes frequently occurred historically, but seems to be less common today (Littlefield and Ivey 2002). A severe hail storm killed 1,000 cranes in New Mexico in 1985, and mycotoxin in waste peanuts occasionally kills cranes, including one occasion in Texas when 5,000 cranes died. Other lethal factors have included blizzards and lightning; incidences of lead poisoning seem to be very rare (Tacha et al. 2014).

Habitat requirements. Generally, Greater Sandhill Crane nesting habitat varies from open meadows to deep bogs and marshes (Armbruster 1987). Most pairs select sites rather isolated from human activity (Fig. 5). At Conboy Lake, a 9 mi (14 km) long prairie-like wetland, breeding territories include dry grass uplands, partially timbered uplands, emergent marshes, and wet meadows (Engler and Brady 2000). Where cranes nest the vegetation includes native and introduced grasses, rushes (*Juncus* sp.), sedges (*Carex* spp.), and spikerushes (*Eleocharis* sp.); about half the territories included some trees and shrubs, but heavy encroachment by woody vegetation may preclude nesting. Water depth data are not available for Washington nests, but nests in Oregon and northern California study sites typically averaged 10–15 inches (25–38 cm), but ranged from 0–40 inches (0–105 cm) (Littlefield and Ivey 2002).

Spring and fall migration stopover and staging areas (staging indicates a longer stay, e.g. weeks; Warnock 2010) are sites between breeding and wintering ranges where Sandhill Cranes stop during migration to rest and feed to restore energy before resuming their trip (Krapu and Johnson 1990, Krapu et al. 2004). Tradition and security from disturbance are key factors in the selection of areas used (Ivey et al. 2015). Industrial agriculture has increased the density and predictability of food in the form of high-energy waste grains (Clark and Sugden 1990, Iverson et al. 1987, Tacha et al. 2014), and stopover areas now occur primarily near croplands where waste grains are available near

Figure 5. Sandhill Crane breeding habitat in Trout Lake Natural Area Preserve, Klickitat County, Washington (*photo by D. Anderson*).

wetlands. Wetlands are important during migration for roosting, loafing, and drinking. Essential habitat components include grain crops for obtaining sufficient carbohydrates, and grasslands, pastures, or alfalfa for obtaining protein from macro-invertebrates, calcium, and other essential nutrients and secure roosting sites in close proximity to fields (Davis and Vohs 1993). In addition, the availability of small gravel for grit is another important element particularly for cranes feeding on waste grains (Littlefield and Ivey 2000).

During 2007-2009, cranes wintering in the Sacramento-San Joaquin River Delta region of California generally avoided dry corn stubble, but selected dry rice stubble early in the season, and mulched corn ranked high in comparison to other corn treatments (Ivey et al. 2015). Cranes roost at night standing in open water areas of wetlands or flooded agricultural fields. Water depth at 69 roost sites in California averaged 4 inches (10 cm; range 1.2–8.3"; 3–21 cm) and was similar between subspecies (Ivey et al. 2014b). Cranes avoided sites that were regularly hunted or had high densities of hunting blinds. In the Delta region, roosts were usually within 2–4 km (1–2.5 mi) of feeding fields (Ivey et al. 2014b).

Migration movements. Greater and Lesser Sandhills both depart from California wintering areas from 15 January to 13 March (Ivey et al. 2015). Adult Greaters usually do not stopover during spring migration, except during inclement weather, but subadults spend some time at traditional spring staging areas. In eastern Washington, small numbers of Greaters have been observed along Lower Crab Creek in Grant County, near Waukon in Lincoln County, and with flocks of Lesser Sandhills in Adams County. The Lesser and Canadian subspecies migrate through the state primarily from February through April. Lesser Sandhills primarily follow an inland route east of the Cascades (Fig. 6), stopping in large numbers at staging areas in the Columbia Basin. Petrula and Rothe (2005) reported satellite telemetry data from 22 Lesser Sandhills captured in breeding areas of Bristol Bay and Upper Cook Inlet, Alaska. These birds spent an average of 25 days in Washington during spring, and 6 days during fall. Marked birds spent more time in Washington (up to 6 weeks), than at other locations along the 4,000 km (~2,500 mi)

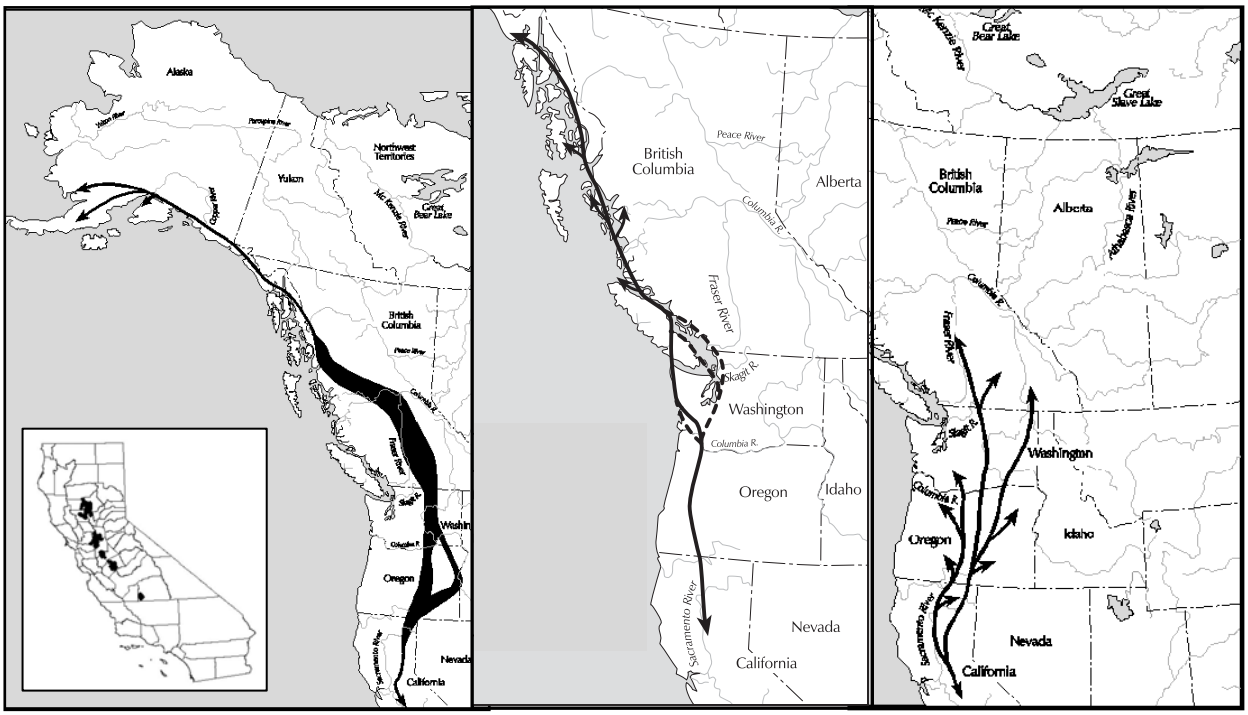

Figure 6. Approximate migration routes of (left to right) Pacific Flyway Lesser, Canadian, and Greater Sandhill Cranes (Littlefield and Ivey 2002), and wintering areas in California (inset; Ivey 2015).

migration corridor. Stops by cranes in British Columbia and Alaska were infrequent during the spring suggesting that foraging opportunities may be limited further north on their migration route (Petrula and Rothe 2005).

Canadian Sandhills migrate through western Washington en route to breeding sites along the coast of British Columbia and southeast Alaska. Canadians equipped with satellite transmitters departed the lower Columbia area in late March to mid-April and flew out to the coastline, then northward to Cape Flattery, crossing central Vancouver Island and continuing along the British Columbia and Alaska coasts (Ivey et al. 2005). Some cranes at least occasionally travel through the Puget trough (WDFW data; eBird 2016).

Departures of Greater Sandhills from Conboy Lake NWR occur from late August until mid-to-late September, and occasionally in early October (Engler and McFall 2001, Engler et al. 2003, Stocking et al. 2006, 2007, McFall 2016a). Most Greater Sandhill pairs return to the same wintering areas as long as habitat conditions remain suitable (Drewien et al. 1999, Ivey et al. 2015). Color-banded birds from Conboy have been observed at Wickiup Reservoir in Deschutes County, Oregon, and Lower Klamath NWR, in Siskiyou County, California. Greaters that breed in interior British Columbia migrate through eastern Washington, perhaps with regular stops in Lincoln County (Littlefield and Ivey 2002), and observers have noted 'larger' individuals in autumn flocks of Lesser Sandhills in the Columbia Basin (eBird 2016).

During fall, Canadian and Lesser Sandhill Cranes migrate through the state in late September and October using the same general routes and stopping in the same areas used for staging in spring. Birds using the western portion of the state migrate south through Oregon's Willamette Valley before moving south to California. Sandhill Cranes begin arriving in the Sacramento-San Joaquin River Delta region of California in early September, but average arrival date for both subspecies was mid-October (Ivey et al. 2015).

POPULATION AND HABITAT STATUS

Historical. Sandhill Cranes in the Pacific Flyway region were dramatically reduced by market hunting in the 19th and early 20th centuries until the Migratory Bird Treaty Act of 1918 (Littlefield 2008). Cranes were not described as locally 'common' in California again until the 1940s (Littlefield 2008). Cranes were also abundant during migration in the Willamette Valley of Oregon in the 1800s and may have wintered there before extensive wet prairies (~300,000 ac) were replaced with agriculture (Taft and Haig 2003); these wet and dry prairies extended into Clark County, Washington (Caplow and Miller 2004).

Sandhill Cranes were historically more widespread in Washington and bred, at least in small numbers both east (Greaters) and west (likely Canadians) of the Cascade crest (Suckley and Cooper 1860, Littlefield and Ivey 2002). Suckley and Cooper (1860:227-228) reported that Sandhill Cranes were abundant on the south Puget Sound prairies during autumn migration. Due to the market hunting on wintering grounds and widespread habitat destruction, crane numbers in Washington were severely reduced and the species was extirpated as a breeder from the state by 1941 (Jewett et al. 1953, Littlefield and Ivey 2002). Greater Sandhills were again found summering on Conboy Lake NWR, Klickitat County, in 1972 and nesting was confirmed in 1979. Numbers of breeding cranes have slowly increased since then, re-colonizing sites on the Yakama Reservation beginning in 1994 (Leach 1995).

Greater Sandhill Cranes-current. The population of Greater Sandhills in Washington, has slowly increased to ~98, from <10 in 1994 (Fig. 7). In 2016, this included 37 known territorial pairs;

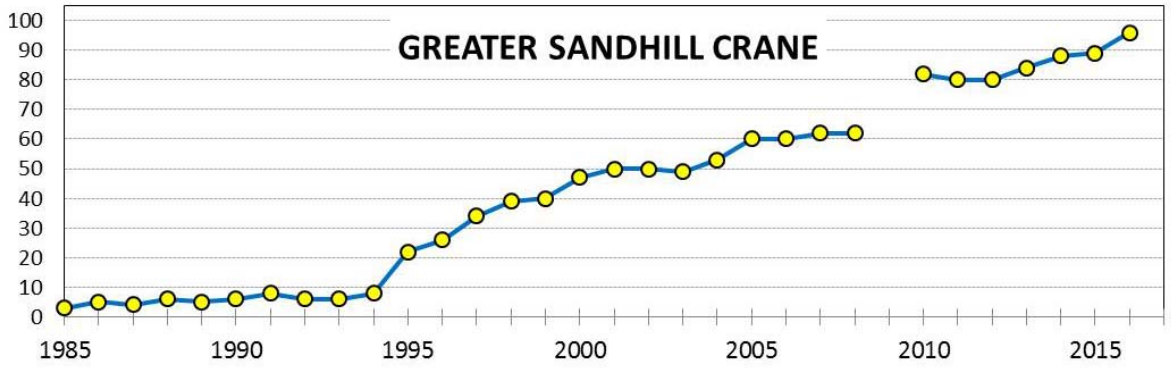

Figure 7. Population estimate of Greater Sandhill Cranes in Washington, 1985-2016 (does not include possible Yakama Reservation birds, 2011-2015; McFall 2016b).

32 of these pairs were confirmed nesting and they produced 10 colts that survived to migrate (McFall 2016b, S. McFall, pers. comm.). Additional pairs may be nesting on the Yakama Reservation or in Gifford Pinchot National Forest west of Mt. Adams, but have not yet been documented. Nest success at Conboy Lake NWR varies considerably between years due to weather, water and habitat conditions, and predation. From 1995-2000, nest success was 67% (n = 69; Engler and Brady 2000). Recruitment (calculated using known breeding pairs and counts of fledged young) has generally been good from 1990-2016 (average 11.7%; range: 0–37%; Table1). Annual recruitment in Sandhill Cranes typically averages 5–14% (Drewien et al. 1995), and 7–9% is likely needed for population stability (Littlefield and Ivey 2002).

Washington's Greater Sandhill Cranes belong to the Central Valley Population. The best estimate of the Central Valley Population was a coordinated roost count that tallied 13,940 in fall 2000, but this number included an undetermined number (perhaps 4,000–5,000) of 'intermediate-sized' Canadian cranes (West Coast Crane Working Group 2000), and did not include counts of two known roosts. More recently, breeding abundance has been estimated at about 1,150 pairs in central and eastern Oregon, about 465 pairs in northeast California, and perhaps 1,500 pairs in the southern half of interior British Columbia (Schlorff 2005, Stern et al. 2006).

Greater Sandhill Cranes–future. As the Washington breeding population expands, cranes may re-occupy available sites, but breeding habitat is somewhat limited compared with eastern Oregon, northeastern California, and British Columbia. Littlefield and Ivey (2002) suggested that Conboy Lake NWR (6,353 ac, plus 718 ac of easements) could perhaps accommodate 50 to 75 pairs if managed specifically for cranes. However, the current ~33 territories cover most of the refuge, and many more would mean much smaller territories, and probably lower recruitment; small territories often require foraging away from the nest which compromises defense of eggs and chicks from predators (S. McFall, J. Engler, pers. comm.). There are another 5,000 acres of private irrigated pasture in Glenwood Valley that could potentially accommodate additional territories, although land use practices sometimes affect their suitability to cranes. Reaching recovery objectives will likely require colonizing additional sites and expansion beyond their current breeding range. Some cranes banded as colts on Conboy, stopover during spring migration, but then move on, perhaps to territories on the Yakama Reservation, Gifford Pinchot National Forest, or further north (S. McFall, pers. comm.).

Canadian Sandhill Cranes-current. Canadian Sandhills may also nest in the Lower Columbia River region in very small numbers (Johnson 1990, Littlefield and Ivey 2002, D. Hauswald, pers. comm.). Coordinated counts of cranes on the lower Columbia bottomlands conducted annually on a day in late

Table 1. Greater Sandhill Crane pairs, productivity, and population estimates in Washington, 1990-2016.

Year	No. breeding pairs[1]		Total breeding adults	Subadults[2] (known)	No. young fledged	Recruitment[3] (%)	WA pop. estimate (adults & subadults)
	Conboy Lake NWR	Yakama Nation, WDNR & private					
1990	3	-	6	-	1	16.7	6
1991	3	-	8	-	1	12.5	8
1992	3	-	8	-	3	37.5	8
1993	3	(1)	8	-	0	0	6
1994	3	1	8	-	0	0	8
1995	7(2)	1(1)	22	0	1	4.5	22
1996	8(2)	(1)	26	0	3	11.5	26
1997	12	3	30	4	5	16.7	34
1998	14	(2)(1)	34	5	5	14.7	39
1999	13(1)	3(1)	36	4	5	13.9	40
2000	13(3)	2(1)	38	9	6	15.8	47
2001[4]	14(2)	1(3)	40	10	0[4]	0[4]	50
2002	11(5)	2(2)	40	10	2	5.0	50
2003	15(2)	3(1)	42	7	6	14.3	49
2004	18(1)	1[5]	40[5]	15	5	12.5	53
2005	15(5)	3(2)	50	10	5	10.0	60
2006	18(3)	1(2)	48	12	7	14.6	60
2007	20(2)	3	50	12	6	12.0	62
2008	20(1)	3	48	14	7	14.6	62
2009	-	-	-	-	12	-	-
2010	16(8)	3(3)	60	22	1	5	82
2011	21(6)	1(2)[6]	60	20	11	18.3	80
2012	20(7)	1(3)[6]	62	18	12	19.4	80
2013	21(7)	3(?)[6]	62	22	5	8.1	84
2014	24(5)	3(?)[6]	64	24	6	9.4	88
2015	27(4)	2(?)[6]	66	23	3	4.5	89
2016	29(4)	3(1)	74	24	10	13.5	98

[1] Data include the numbers of confirmed nesting pairs and unconfirmed pairs (i.e., territorial pairs without confirmed nesting data, in parentheses). 1990-1994 data is based on incidental observations (*from* Engler and Brady 2000). Systematic surveys of breeding cranes began in 1995. [2]Subadults = ≥1–3 years old (Nesbitt 1992).
[3] Recruitment = number of fledged young / number of breeding adults X 100 (excludes subadults).
[4] Drought conditions in 2001 negatively affected production; 1 pair was assumed to be present on the Yakama Reservation, which was not surveyed (Engler and McFall 2001).
[5] Unable to confirm 2 traditional pairs at Deer Creek and Panakanic Valley based on limited surveys.
[6] No data available for Yakama Reservation sites, 2011–2015.

September to mid-October since 1991 typically detect 3,000–4,000 birds (range: 1,000–5,000; M. Stern,pers. comm.). Up to 1,400 Canadian Sandhills now winter in the area (ODFW 2012), an increase since the 1980s when about 100 began wintering there (Engler et al. 2003).

Pacific Flyway Lesser Sandhill Cranes-current. Although a statistically robust estimate is not available,

Lesser Sandhill Crane numbers in the Pacific Flyway seem to have increased in the last 30 years. The Mid-winter Waterfowl Survey in January 2015 resulted in a total of 19,326 (396 in Washington, 1,475 in Oregon, and 17,455 in California), and 3-year average of 26,548 (Olson 2015). However, these counts are not considered very accurate for cranes (Littlefield 2008; D. Kraege, pers. comm.) and from 2005 to 2015, the total counts have varied from 15,000 to 63,000 birds (Olson 2015). Littlefield (2008) suggested there were around 35,500 total cranes in the flyway, with ~70% of these (25,000) being Lesser Sandhills. Winter roost counts in the Sacramento-San Joaquin Delta region suggest this is a reasonable estimate (Ivey et al. 2014a).

Habitat Status in Washington

Historically, there was more nesting habitat available to cranes, such as wet prairies and estuaries. However, the locations in lowland areas where cranes may have nested have long since been drained for agriculture, or are developed.

Breeding habitat. Most crane nesting territories in Washington are currently on public conservation lands, including Conboy Lake NWR, Trout Lake Natural Area Preserve, and Klickitat River Natural Resource Conservation Area. A few territories are on private pastureland in the Glenwood Valley or on Yakama Nation forestlands. Although disturbance is an occasional issue at some sites, they are relatively secure from other threats. The private lands in Glenwood Valley are managed wetlands that can be affected by haying, livestock, and water management (See *Factors Affecting* below). One site on the Yakama Reservation was affected by the Cougar Creek Fire in 2015, but this may have little lasting effect on crane use. Additional potential meadow sites exist for population expansion, particularly in Gifford Pinchot National Forest, although only a few (<8?) could accommodate more than one crane pair. Some of these meadows are near roads and likely get too much disturbance from recreational traffic, but more isolated sites may eventually be used by territorial pairs.

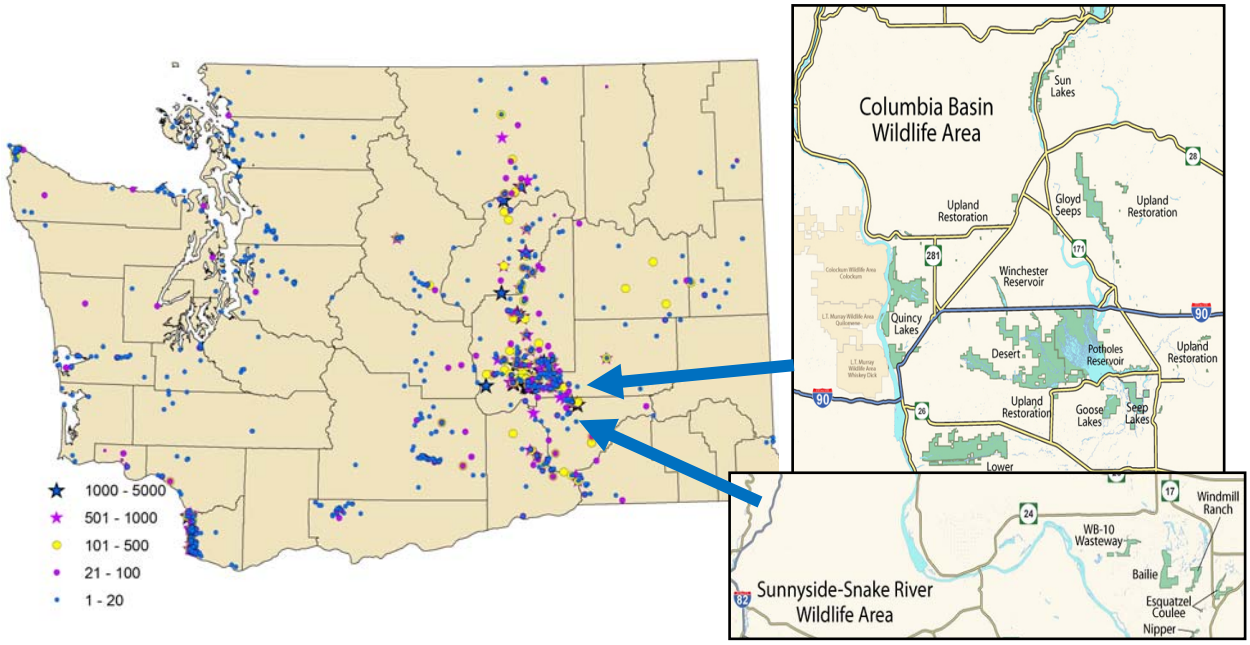

Figure 8. Sandhill Cranes counted in eBird and WDFW observation records as of February 2016 (left; records with no number counted were categorized as 1-20 birds; data is affected by road access and notoriety), and right, wildlife area units.

Columbia Basin staging areas. In contrast to natural wetland and grassland habitat that would have been available historically, most staging areas used today are managed water bodies, wetlands, or agricultural lands. These staging areas in Washington are important to cranes because they likely provide a large proportion of the nutritional resources used for the energetic demands of migration. The combination of wetland roost sites and the mix of pasture and corn make the Potholes area, particularly areas west of Othello on the Royal Slope and the Crab Creek area, the most important staging area during migration for the Pacific Flyway Population of Lesser Sandhill Cranes (Fig. 8). Cranes use both private land and public conservation lands, including agricultural fields and wetlands at several locations; these include the Columbia National Wildlife Refuge, Scooteney Reservoir, and several units of the Columbia Basin Wildlife Area, including the Potholes Reservoir, Lower Crab Creek, and Desert units, and the Windmill Ranch and Bailie units of the Sunnyside Wildlife Area. Agricultural fields of private waterfowl hunting clubs, including the Barker Ranch near West Richland, and Eagle Lakes Ranch south of Othello, have become important foraging sites. The Barker Ranch is a 2,000+ acre duck hunting club that is conducting a multi-year restoration project to enhance wetland and upland areas for waterfowl, cranes, upland birds, and other wildlife species. Cranes also stage on the Waterville Plateau in the Mansfield/St. Andrews area (Littlefield and Ivey 2002). Suitability of private agricultural lands could be affected by changes in crops planted and wetlands are affected by invasive vegetation (See *Factors Affecting* below).

Lower Columbia River staging and wintering areas. Many migrating Sandhill Cranes stop on the lower Columbia River bottomlands (Fig. 9), roosting and foraging on agricultural fields, pastures, and wetlands on conservation and private lands (Littlefield and Ivey 2002). The Lower Columbia River region is the only major stopover site for Canadian Sandhills between wintering sites in California and northern breeding areas (Ivey et al. 2005). A total of 19,064 ac are owned by wildlife agencies including Ridgefield National Wildlife Refuge, Shillapoo Wildlife Area, and Oregon Department of Fish and Wildlife's Sauvie Island Wildlife Management Area. Public lands, though protected from development, occasionally have levels of disturbance or management objectives that affect use by cranes (see *Factors Affecting*). In 2015, 541 ac adjacent to Shillapoo WLA and west of Vancouver Lake was transferred to Columbia Land Trust, by the Port of Vancouver as mitigation for development of 450 ac of the Columbia Gateway property; these land trust acres will be managed specifically for Sandhill Cranes and other migratory birds. Areas without any conservation designation that are important to cranes include private agricultural fields on the bottomlands near Woodland (Woodland bottoms), and between Ridgefield NWR and Shillapoo WLA. Private lands are at risk for development or conversion to incompatible crops.

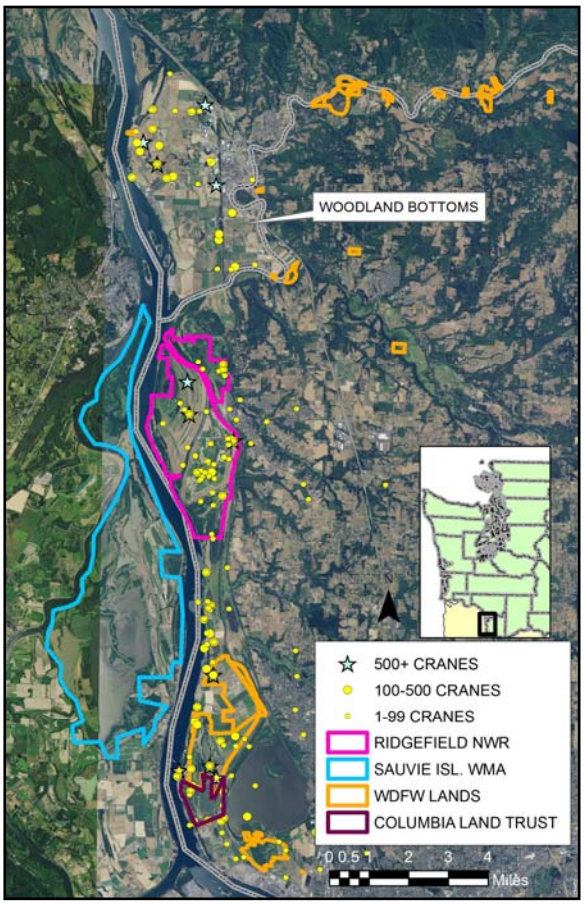

Figure 9. Observations of Sandhill Cranes (eBird 2016; Washington records only) during migration and winter, and conservation lands on the lower Columbia River.

Historically, the Shillapoo Wildlife Area was a part of the floodplain, and water levels fluctuated seasonally with the rise and fall of the Columbia River (USACOE 1998, Burns 2007). The landscape of the area has been dramatically altered by dams and the placement of levees, roads, ditching, draining, filling and grading for agricultural purposes. A project proposed by the U. S. Army Corps of Engineers with a main purpose to expand habitat for out-migrating and rearing of juvenile salmonids would have re-established a direct connection of the lakebed and adjacent wetlands to the hydrology of the river. However, the increased water depths would have reduced the area useable for cranes during winter and spring by ~700 ac. However, this proposal was shelved due to the extreme costs associated with re-locating a petroleum pipeline, as well as the presence of private lands. A current proposal (*see* Factors Affecting, *Lower Columbia bottomlands*) would affect wetlands in the South Unit.

FACTORS AFFECTING SANDHILL CRANES

Adequacy of existing regulatory mechanisms. The Sandhill Crane was first granted federal legal protection under the Migratory Bird Treaty Act of 1918. Currently, the species, its nests, and its eggs are protected from unlawful direct persecution in the United States and Canada under the Migratory Birds Convention Act of 1994.

The Sandhill Crane is protected from 'take' as an endangered species in state law in Washington (RCW 77.12.020, RCW 77.15.130). Their habitat receives protection through county or municipal critical area ordinances. Under the state's Growth Management Act, counties are required to identify critical areas and can also select species of local significance. Many counties have adopted the state's list of endangered, threatened, and sensitive species, and require review and mitigation before issuing permits for projects that would impact the species or its habitat. Under the Washington Forest Practices Act, Sandhill Cranes are also protected from disturbance. In particular, timber harvest, road construction, aerial application of pesticides, and site preparation are restricted within 0.25 mile (0.4 km) of a known active nesting area, unless an environmental review concludes the activities will not impact cranes (WAC 222-16-080). Forestry guidelines on the Yakama Reservation also provide protections for nesting cranes. These state that, "No harvest activities, road building, or other noise-generating activities will take place within a 0.25-mile buffer around known nesting meadows between April 1 and August 10" (G. King, pers. comm.).

Habitat loss and degradation: ***breeding areas.*** Sandhill Cranes are vulnerable to changes in hydrology, for example early drying of wetlands and irrigated fields can lead to increased chick mortality from predation or starvation. Historically, the water level in Conboy Lake remained high later into the season, and portions held more or less permanent water, but ditching and agricultural development in the early 1900s speeded annual drying (Littlefield and Ivey 2002). Improvements in water control infrastructure on the refuge since 1999 allow better water retention and stabilization, and water now gradually recedes during early summer as Camas Ditch empties into Outlet Creek (J. Engler, pers. comm.). Grazing has not been permitted on Conboy NWR for >30 years, and mowing/haying is generally delayed until 1 August (J. Engler, pers. comm.). The few nesting territories on private lands can be affected by water and livestock management decisions of landowners. For example, the presence of cattle on meadows until late spring can prevent nesting at a site (Littlefield and Paullin 1990). In addition, early drying of meadows in June for hay harvest can result in reduced availability of invertebrates sometimes causing chick starvation. Late June and July meadow mowing can kill crane chicks as they hide in dense vegetation. Winter livestock grazing of wetlands can remove residual cover, leaving crane nests more exposed to predators in April and May (Littlefield and Ivey 2002). Loss of habitat through drainage of wetlands, replacement of flood-irrigated meadows with sprinkler or pivot irrigation, building

construction, and conversion to row crops have affected breeding territories elsewhere in the flyway (Littlefield 2002, 2008, Littlefield and Ivey 2000, 2002).

Habitat loss and degradation: staging and wintering areas. In eastern Washington, conservation lands or waterfowl hunting clubs often protect wetlands used by cranes for roosting, but much of the foraging occurs on agricultural fields on nearby private farmland. These foraging sites are generally only protected from development by their farmland value and rural locations. These sites may be threatened in the future by residential development or conversion to incompatible crops. Farming practices after harvest frequently determine the amount of waste seed available for cranes (Anteau et al. 2011, Sherfy et al. 20011). Improvements in harvesting efficiency since the 1980s has reduced the amount of waste grains available to birds (Anteau et al. 2011, Sherfy et al. 2011, Duvuvuei and Finger 2016), although the total acreage of grain corn has increased in Grant County.

Programs intended to improve habitat for waterfowl can sometimes have negative effects on Sandhill Crane foraging habitat (Littlefield and Ivey 2002). Flooded grain fields are generally avoided by cranes, except for infrequent use for roosting and loafing. In contrast to ducks and geese, feeding cranes visually surface-glean seeds, and are highly inefficient in finding small unexposed seeds; generally it is only a short time before cranes abandon a grainfield after flooding (Ivey 2015: ch.4).

Wetlands used by roosting cranes can be degraded by invasive species, sedimentation, and wetland succession (Duvuvuei and Finger 2016). Invasion by Russian Olive (*Elaeagnus angustifolia*), the non-native variety of Common Reed (*Phragmites australis*), Purple Loosestrife (*Lythrum salicaria*), Narrow-leafed Cattail (*Typha angustifolia*), and Reed Canarygrass (*Phalaris arundinacea*), eliminate open water, decrease productivity and eliminate crane roosting habitat (Kessler et al. 2011). Control of invasive vegetation is an important management activity on conservation lands. Sedimentation and succession is relatively rapid in the Columbia Basin because of the wind-blown dust from agricultural fields, which is trapped by tall emergent vegetation such as reeds (Duvuvuei and Finger 2016).

Lower Columbia bottomlands. Habitat used for staging and wintering on the lower Columbia bottomlands is threatened by development or incompatible uses. Over time habitat has been lost as land in row-crops on Sauvie Island and Woodland bottoms has been converted to tree nurseries, cottonwood plantations, tulips, berry crops, as well as development for residential, industrial, and recreational uses (Littlefield and Ivey 2002). The availability of corn may be affected by the status of the local dairy industry, which has been declining in recent decades. The Port of Vancouver is developing 450 ac of the Columbia Gateway property, but mitigation will protect 541 ac that will be managed by the Columbia Land Trust.

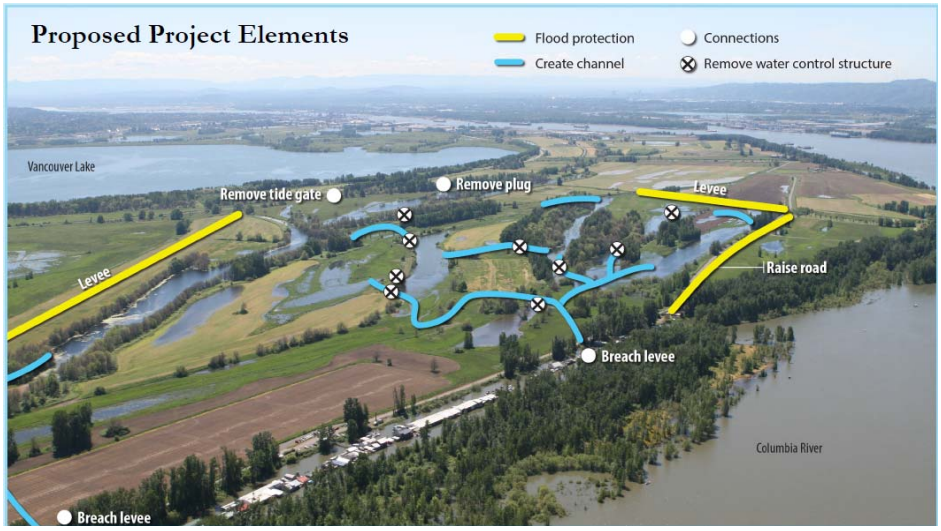

Figure 10. Proposed South Unit Shillapoo and Buckmire Slough Restoration Project.

The South Unit Shillapoo and Buckmire

Slough Restoration Project (Fig. 10) would reestablish a connection between floodplain wetlands and the Columbia River to restore habitat for threatened and endangered salmonids (e.g. juvenile Chinook), with funding from the Bonneville Power Administration. In addition to salmon habitat restoration, project goals include - minimizing impacts to flood risks, waterfowl habitat, and other threatened and sensitive species, including Sandhill Cranes, and maintaining existing hunting, birding, and other recreational opportunities. Two levees would be breached, water control structures and pumps removed, and channels created between wetlands to restore fish access. Water levels in the wetlands would fluctuate depending on river flows, and on average, wetlands would be drier, but may at times have deeper water. The area suitable for roosting by cranes may be smaller in area and suitable for shorter periods of time. The impact may be greatest during fall migration where formerly semi-permanently flooded wetlands would be drained earlier and more completely to avoid stranding juvenile salmonids. In some years, spring migration may be negatively impacted by high water levels in wetlands depending on the timing and elevation of the freshet. WDFW was soliciting public input in fall 2016.

California winter range. The winter range for Sandhill Cranes in the Sacramento-San Joaquin River Delta region has decreased since the 1980s (Ivey et al. 2014a). While establishment of some conservation areas has improved habitat conditions for wintering cranes, significant loss of foraging habitat continues on private lands in the region, primarily from development and conversion to incompatible crops (vineyards, orchards, turf farms, olives, and blueberries; Littlefield and Ivey 2000, Ivey et al. 2014a). If habitat losses continue, this may reduce the regional carrying capacity for wintering cranes in the future.

Human disturbance. Cranes seek isolation for nesting, and roads and human activity can prevent use of some potential nesting sites. In southwestern Washington, activities to reduce Canada Goose depredation of crops with hazing, propane cannons, extended hunts, dogs, field flags, and other scaring devises, have sometimes reduced the amount of usable wintering/migration habitat for cranes on private lands (Littlefield and Ivey 2002). Upland bird and waterfowl hunting in agricultural fields, pastures, and wetlands affect crane use of habitat at many sites, as does disturbance by dog training on the Shillapoo Wildlife Area. Pheasant releases at two sites result in high hunter use of some agricultural fields and pheasant season coincides with the fall peak of crane migration.

Collision hazards. At least two cranes have been killed in collisions with transmission lines on Conboy Lake NWR (Paulson 1989, McFall 2016b). Cranes can be densely aggregated at staging and wintering areas and overhead electrical transmission lines can pose substantial collision risks as birds move in flocks between roosting and foraging areas (Brown and Drewien 1995, Tacha et al. 2014). As wind power resources are developed in migration areas, interactions with wind turbines may also become important sources of mortality (Navarrette et al. 2014). However, few collisions have been reported in the Great Plains, despite the presence of nearly 10,000 turbines and 80% of the wintering mid-continent Sandhill Cranes (Pearse et al. 2016). Pearse et al. (2016) reported that nearly 90% of turbines have been constructed in habitat not often selected by wintering cranes. Wire fencing is also a hazard, particularly on breeding grounds.

Climate change. Climate models generally predict more severe and common summer droughts in eastern Washington (Snover et al. 2013). If wet meadows dry earlier, crane reproductive success may be affected by reduced food availability and higher predation on nests and colts. Climate change may be affecting the timing of Sandhill Crane migration and the location of staging and wintering. The number of Canadian Sandhills wintering on the lower Columbia has increased dramatically since the 1980s, and Lesser Sandhills seem to be arriving earlier in the Columbia Basin for spring migration (H. Newsome, pers. comm.); changes that may be related to climate change. Invasion of dried wetlands by woody vegetation may accelerate as well, resulting in a gradual loss of nesting habitat for cranes.

MANAGEMENT ACTIVITIES

Population monitoring. Nesting surveys are conducted annually by staff at Conboy Lake NWR, and territories outside the Glenwood Valley are checked by WDFW staff. A combination of ground and aerial surveys is used to monitor nesting pairs and colt production. Monitoring of pairs on the Yakama Reservation by Yakama Nation Wildlife program staff has been sporadic in recent years because there has been no dedicated funding for crane work and territories are fairly remote. Aside from the Mid-winter Waterfowl surveys (Olson 2015), and a volunteer-coordinated fall count on the lower Columbia, no coordinated monitoring of migrant cranes occurs in Washington.

Protection from disturbance. On Conboy Lake NWR, impacts to nesting cranes and developing colts is minimized by delaying mowing/haying until August. Disturbance to nesting cranes by logging and road building is minimized by a 0.25-mi (400-m) buffer in state forest practice rules. WDFW has Priority Habitats and Species (PHS) management recommendations for Sandhill Cranes intended for landowners and managers (Bettinger and Milner 2000); these may be updated in the next few years.

Management of staging areas. The Columbia Basin Corn Stubble Retention Program provides incentive payments to growers with Washington Duck Stamp funding. It was initiated to retain habitat value primarily for migratory waterfowl, but also provides foraging areas for cranes. The Shillapoo Wildlife Area is managed for migratory waterfowl, Sandhill Cranes, pheasants, and other wildlife (Calkins 2006). Sharecrop and grazing agreements with local farmers and ranchers have been used to maintain important foraging habitat.

Conservation planning. A state recovery plan was completed in 2002 (Littlefield and Ivey 2002), with the goals of restoring a healthy breeding population of cranes and maintaining flocks that winter or stop in Washington. The plan may be revised in the next few years. An informal interagency Washington Sandhill Crane working group met for the first time in April 2016 and developed a draft list of conservation actions needed/desired in the next two to three years. Management plans for the Central Valley Population of Greater Sandhill Cranes (Pacific Flyway Council 2015), and the Pacific Flyway Population of Lesser Sandhill Cranes (Pacific Flyway Council 1983) are being updated.

Research

Migration. During 2001-02, Ivey et al. (2005) attached satellite transmitters to 6 cranes captured at Ridgefield NWR or Sauvie Island Wildlife Area, Oregon, to discover or confirm breeding locations, migration corridors and wintering sites. Petrula and Rothe (2005) used satellite telemetry to monitor movements of 22 Pacific Flyway Population Lesser Sandhills captured in the upper Cook Inlet and Bristol Bay regions of Alaska. Chronology, routes, and stopover or staging areas were identified for fall and spring migration periods.

Figure 11 and 12. Greater Sandhill colt captured for banding (left); banded bird that returned as a breeder (*Photos by L. Wilson, S. McFall*).

Color-banding. Since 1996, 75 crane colts of ~8 weeks of age have been captured at Conboy Lake NWR and have been color-banded with unique combinations (Figs. 10, 11; McFall 2016b). Birds color-banded at Conboy have

been observed at multiple locations in Oregon and California during migration and winter and have provided data on dispersal, survival, and recruitment for the local population (McFall 2016a,b).

Systematics. Hayes et al. (2015) evaluated relationships among the three migratory populations in the Pacific Flyway using breeding location, mitochondrial DNA haplotypes, and nuclear DNA markers.

CONCLUSION AND RECOMMENDATION

Sandhill Cranes from populations of three different subspecies or forms occur in Washington. The breeding population of Greater Sandhill Cranes in Klickitat and Yakima counties is very small (~98), but has been increasing steadily since 1979. Additional Greater Sandhills that breed in interior British Columbia, migrate through eastern Washington along with large flocks of Lesser Sandhills.

In addition, the entire Pacific Flyway population of perhaps 4,500 Canadian Sandhills uses the lower Columbia bottomlands as an important staging area during migration and up to 1,400 birds have wintered there in recent years. Canadian Sandhills are considered by some researchers to be synonymous with Greater Sandhills. Although some birds in this population overlap morphologically with Greaters, many do not, and the population differs in breeding range and migration route, and is on a separate evolutionary pathway (Hayes et al. 2015). The Pacific Flyway population of Canadians is small and portions of its lower Columbia staging area are vulnerable to development or incompatible uses. The population, therefore, is deserving of continued conservation attention.

The population objective of the state recovery plan stipulated that the Sandhill Crane will be considered for down-listing from endangered to threatened when the state's overall breeding population (i.e., Greater Sandhill Cranes) reaches at least 65 territorial pairs with an average annual recruitment rate of >8% for the 5-year period prior to down-listing. In 2016, there were about 37 territorial pairs in Washington, with an average annual recruitment rate of 10.98% for the previous 5 years. A further recovery objective involves protecting habitat used by cranes for migratory stopovers and wintering. Some habitat on the lower Columbia is protected on refuges or wildlife areas, and some staging habitat in the Columbia Basin is protected on public conservation lands and private hunting clubs, but much foraging habitat remains vulnerable to conversion to incompatible crops or development.

Given the small number of Greater Sandhill Cranes breeding in Washington, the similarity of appearance of the subspecies, and the vulnerability of essential habitat, we recommend that the Sandhill Crane remain listed as endangered in Washington.

REFERENCES CITED

The references cited in the Periodic *Status Review for the Sandhill Crane* are categorized for their level of peer review pursuant to section 34.05.271 RCW, which is the codification of Substitute House Bill 2661 that passed the Washington Legislature in 2014. A key to the review categories under section 34.05.271 RCW is provided in Table A. References were categorized by the author in October 2015.

Individual papers cited cover a number of topics discussed in the report, including information on: 1) the species' description, taxonomy, distribution, and biology; 2) habitat requirements; 3) population status and trends; 4) conservation status and protections; 5) research, monitoring, and restoration activities; and 6) factors affecting the continued existence of the species.

Table A. Key to 34.05.271 RCW Categories:

34.05.271(1)(c) RCW	Category Code
(i) Independent peer review: review is overseen by an independent third party.	i
(ii) Internal peer review: review by staff internal to the department of fish and wildlife.	ii
(iii) External peer review: review by persons that are external to and selected by the department of fish and wildlife.	iii
(iv) Open review: documented open public review process that is not limited to invited organizations or individuals.	iv
(v) Legal and policy document: documents related to the legal framework for the significant agency action including but not limited to: (A) federal and state statutes; (B) court and hearings board decisions; (C) federal and state administrative rules and regulations; and (D) policy and regulatory documents adopted by local governments.	v
(vi) Data from primary research, monitoring activities, or other sources, but that has not been incorporated as part of documents reviewed under the processes described in (c)(i), (ii), (iii), and (iv) of this subsection.	vi
(vii) Records of the best professional judgment of department of fish and wildlife employees or other individuals.	vii
(viii) Other: Sources of information that do not fit into one of the categories identified in this subsection (1)(c).	viii

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APPENDIX A. PUBLIC COMMENTS ON THE DRAFT PERIODIC STATUS REVIEW

Section	Comment and response
Conclusion and recommendation	If the cranes are not genetically unique to the Midwest sandhill cranes then I would suggest lesser degrees of protection. The sandhill crane is plentiful to the point where hunting is allowed in other states. If the cranes in Washington are not genetically or geographically isolated I would not support efforts beyond current levels and some signage to notify people of nesting to prevent disturbances.
	All the 3subspecies/forms of cranes in Washington breed in different locations from each other and from cranes of the other flyways, so are isolated from other populations (see Fig.3). On a geologic time scale there was some genetic mixing, particularly of the Canadian form, but given their present isolation they would be expected to accumulate greater genetic differences. Fewer than 100 Greaters currently breed in Washington, and at least small numbers of Greaters that breed in south-central BC migrate through mixed among the Lessers. The Pacific Flyway Canadians are probably the smallest migratory population, and the lower Columbia bottomlands are a key stopover/staging and wintering area for them.
	I support the recommendation to keep the Sandhill Crane on the list of endangered in Washington.
	Comment noted, thanks.

WASHINGTON STATE STATUS REPORTS, PERIODIC STATUS REVIEWS, RECOVERY PLANS, AND CONSERVATION PLANS

Status Reports

2015 Tufted Puffin
2007 Bald Eagle
2005 Mazama Pocket Gopher, Streaked Horned Lark, and Taylor's Checkerspot
2005 Aleutian Canada Goose
2004 Killer Whale
2002 Peregrine Falcon
2000 Common Loon
1999 Northern Leopard Frog
1999 Olympic Mudminnow
1999 Mardon Skipper
1999 Lynx Update
1998 Fisher
1998 Margined Sculpin
1998 Pygmy Whitefish
1998 Sharp-tailed Grouse
1998 Sage-grouse
1997 Aleutian Canada Goose
1997 Gray Whale
1997 Olive Ridley Sea Turtle
1997 Oregon Spotted Frog
1993 Larch Mountain Salamander
1993 Lynx
1993 Marbled Murrelet
1993 Oregon Silverspot Butterfly
1993 Pygmy Rabbit
1993 Steller Sea Lion
1993 Western Gray Squirrel
1993 Western Pond Turtle

Periodic Status Reviews

2016 Bald Eagle
2016 Peregrine Falcon
2016 Marbled Murrelet
2016 American White Pelican
2016 Lynx
2016 Columbian White-tailed Deer
2016 Taylor's Checkerspot
2016 Killer Whale
2016 Streaked Horned Lark
2016 Greater Sage-grouse
2016 Snowy Plover
2016 Northern Spotted Owl
2016 Western Gray Squirrel
2015 Brown Pelican
2015 Steller Sea Lion

Recovery Plans

2012 Columbian Sharp-tailed Grouse
2011 Gray Wolf
2011 Pygmy Rabbit: Addendum
2007 Western Gray Squirrel
2006 Fisher
2004 Sea Otter
2004 Greater Sage-Grouse
2003 Pygmy Rabbit: Addendum
2002 Sandhill Crane
2001 Pygmy Rabbit: Addendum
2001 Lynx
1999 Western Pond Turtle
1996 Ferruginous Hawk
1995 Pygmy Rabbit
1995 Upland Sandpiper
1995 Snowy Plover

Conservation Plans

2013 Bats

Status reports and plans are available on the WDFW website at:
http://wdfw.wa.gov/publications/search.php