

ABUNDANCE, DISTRIBUTION AND TIMING OF FALL AND SPRING WATERFOWL MIGRATION ON EAGLE RIVER FLATS 2012-2013

USACE Contract W911KB-11-D0005 Task Order 4, Bird Aircraft Strike Hazard (BASH) Survey.

Final report to Jacobs Engineering Group, Inc.

Dennis Marks and Julian Fischer

U.S. Fish and Wildlife Service, Anchorage, AK

INTRODUCTION

Aerial surveys to estimate waterfowl numbers and movement on Eagle River Flats (ERF) during late fall 2012 and early spring 2013 were conducted by the U.S. Fish and Wildlife Service to fulfill contract obligations with Jacobs Engineering Group, Inc. (JEG). Surveys were conducted to provide data to assist Joint Base Elmendorf-Richardson (JBER) better plan activities that might significantly affect Air Force air crews and birdlife on ERF and surrounding areas. Specifically, the objective for this study was to identify and document the end of fall waterfowl migration and the initiation of spring waterfowl migration to ERF in 2012-13, within an accuracy of three days to help document patterns of high Bird Aircraft Strike Hazard (BASH). Survey data from other large-bodied birds are included for BASH consideration and include eagles, gulls, and cranes.

STUDY AREA

Eagle River Flats is an 870 hectares (ha) salt marsh complex on the south side of Knik Arm, approximately 10 kilometers (km) east of Anchorage, Alaska. Sedge marshes, permanent and temporary ponds, mudflats, river channels and sloughs provide ample habitat for the fish and invertebrates, emergent and upland plants needed to support the more than 100 species of birds found on the ERF (Steele et al. 2005). A detailed description of this area is presented in Racine and Cate, Eds. (1996).

METHODS

In fall, aerial surveys were flown 8-29 October 2012. Fall surveys ended when persistent ice cover was 100% over all freshwater ponds. In spring, aerial surveys were flown 28 March-8 May 2013 and terminated when bird numbers approximating previous spring peak numbers were observed (Marks and Fischer 2010). Surveys were planned for at least twice a week, with actual dates and times dependent on weather and other JBER flight restrictions. Surveys were conducted from a fixed-wing aircraft flown with at an airspeed of 130 to 170 km/hr and an altitude of 30 to 75 m. Total coverage of ERF was obtained by completing counts from overlapping transects. Numbers of waterfowl as well as any other identifiable birds were counted or estimated and recorded by species or species group with a voice recorder. Bird numbers were then classified by locations on ERF using standardized study areas developed for the ERF database by the Cold Regions Research and Engineering Laboratory (CRREL, Fig.1).



Figure 1. ERF study area with standardized survey areas, ponds, sloughs and Eagle River.

RESULTS AND DISCUSSION

Environmental Conditions

Wetlands during the fall survey period were influenced by heavy snowfall experienced during the prior winter 2011-2012 that resulted in a large amount of fresh water in the ERF area and greatly expanded the area covered by ponds. Above average rainfall from August through early October also added to the water levels on ERF; the wetland remained wetter than usual through summer and fall 2012 (H. Griese, JBER, pers. comm.). Flood tides in mid-August, mid-September and mid-October further increased water levels. Air temperatures dropped rapidly in mid October and water bodies on ERF froze earlier than in past years (Fig. 2, top). While no ice was observed on 10 October, the first ice was observed on 12 October and covered approximately 80% of ponds. A slight warming and thawing occurred in subsequent days, but by 18 October, 80% of the ponds were again frozen. By 22 October, all ponds on the ERF were completely frozen, and remained frozen, with only Eagle River and larger tidal sloughs containing open water.

In 2013, spring came late to south-central Alaska, and in the ERF vicinity, temperatures were below average for much of late March and April (Fig. 2, bottom). On 18 April, ERF was still 98% covered with ice and snow. On 22 April, ponds were approximately 95% ice covered, and with a significant warming trend and influx of birds in early May, the final survey was conducted on 8 May when ponds were 60% covered with ice.

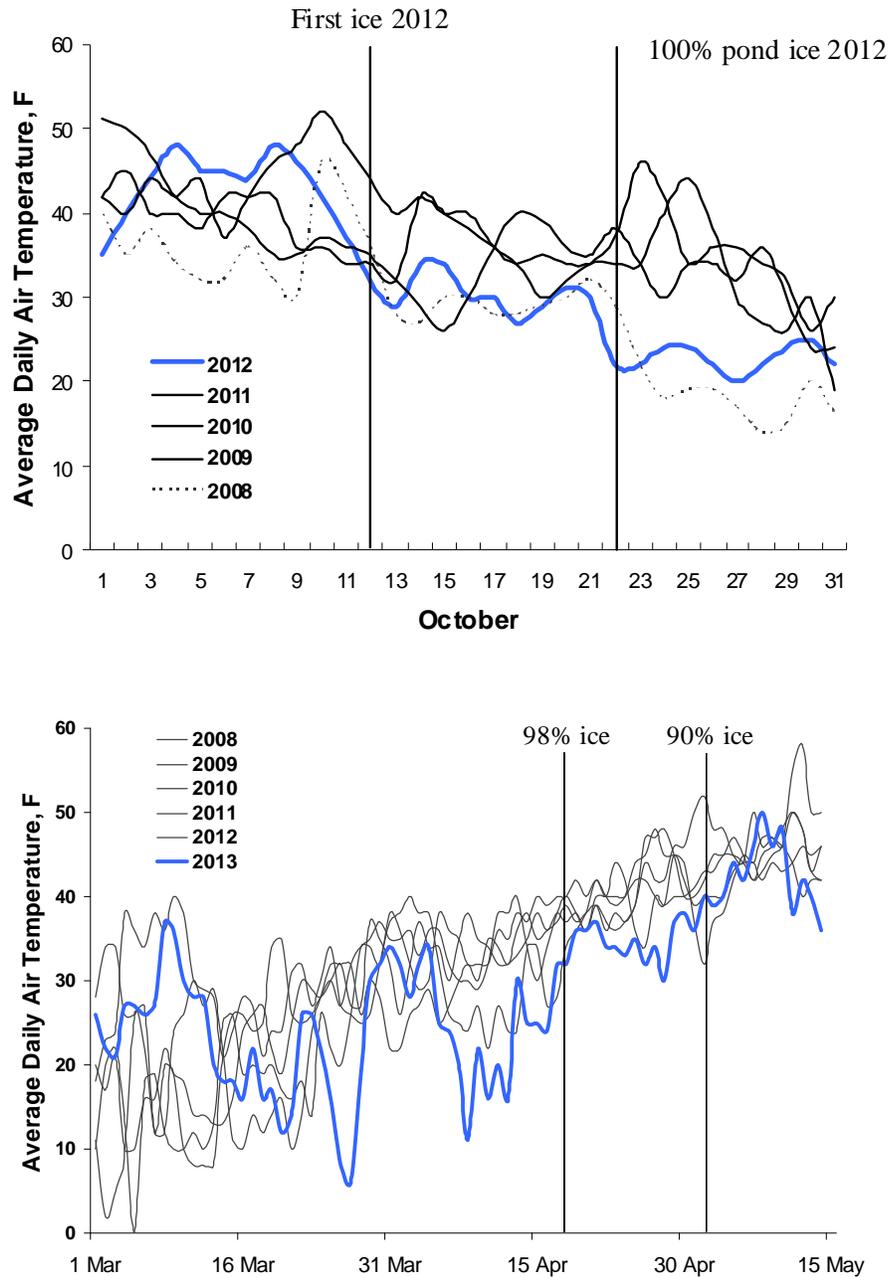


Figure 2. Mean daily temperatures for October 2012 (top) and spring 2013 (bottom) at the Birchwood Alaska airport, approximately 9 miles northeast of ERF. Vertical lines are dates of pond ice formation and spring melt. Temperature data from Weather Underground, www.wunderground.com/history/airport/PABV.

Abundance and Distribution of Waterfowl on ERF

Waterbirds known to occur on the ERF are listed in Appendix A with status and typical habitat occupied. Eight aerial fall and nine spring surveys were conducted for the JEG study in 2012-13 (Table 1). Of all birds counted, nearly 99% were identified to species.

Eleven species of large-bodied birds were counted during fall surveys, including six species of duck, one goose, red-necked grebes, swans (potentially two species), bald eagles and ravens (Table 2, Fig. 3). In all, twenty species of large birds were counted during spring 2013 surveys, including large shorebirds (Table 3, Fig. 3). Survey results are presented in Appendices B and C.

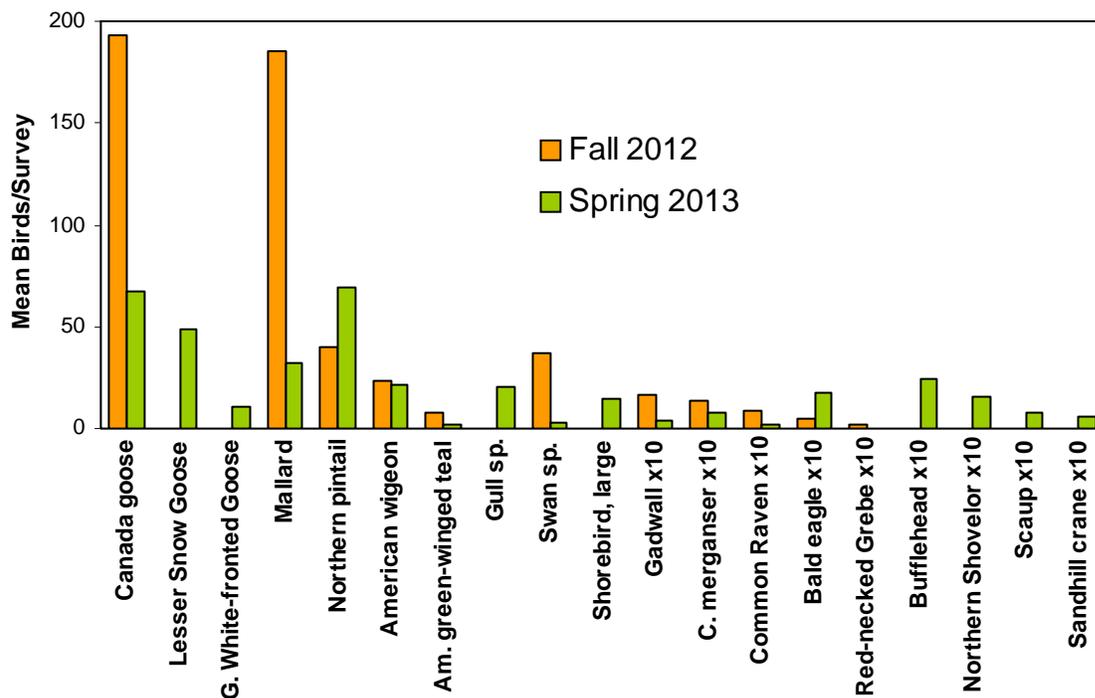


Figure 3. Relative abundance (#birds/survey) of all species or species groups for fall and spring surveys. Surveys with 100% ice cover were not included in averages. For better resolution, bars of less common species were multiplied by 10 (noted on axis).

Species composition and peak abundance for numbers of waterfowl surveyed in late fall 2012 and early spring 2013 (Fig. 3) was comparable to that of previous years and peak numbers for those periods were similar to the corresponding 12-year peak averages for 1999-2009 (Fig. 4, Marks and Fischer 2010). Differences in timing are evident, however, in both late fall 2012 and early spring 2013, periods where weather and ice cover dramatically affect pond use.

Waterfowl counts on ERF in fall 2012 showed a marked drop in abundance after 12 October, though some numbers of ducks and geese, important BASH species, remained until after 22 October (Fig. 5). By 22 October, however, birds were only observed in creeks or sloughs in areas B and Coastal East. By 26 October, only mallards (*Anas platyrhynchos*), birds that often remain until late fall/early winter in coastal sloughs, were present on ERF.

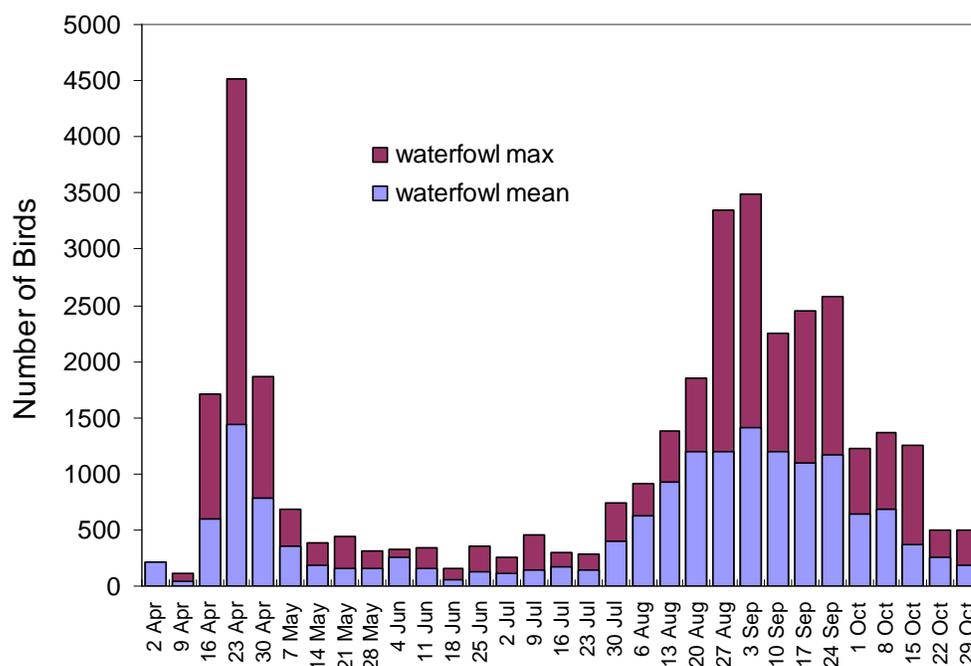


Figure 4. Average of waterfowl (ducks, geese, swans) on the Eagle River Flats wetland, 1998-2009. Date refers to the first day of a given week. From Marks and Fischer 2010.

In spring 2013, first waterfowl were two trumpeter swans (*Cygnus buccinator*) observed on 16 April in a small area of open water in Area B. As compared to previous years, similar numbers of ducks, geese and swans were present in early spring 2013 surveys but arrived on ERF later than average (Fig. 6). Ponds were still 90% frozen on 2 May and large numbers of waterfowl did not appear until 8 of May when approximately 40% of the pond surface was open water (Fig. 6, Table 3).

Ducks-Fall 2012 and Spring 2013

Six species of duck were identified on eight ERF surveys in fall 2012 (Fig. 3, Table 2). Dabbling ducks comprised more than 99% of all identified ducks; common mergansers (*Mergus merganser*) comprised the remaining ducks observed. Mallard (*Anas platyrhynchos*), northern pintail (*A. acuta*), American wigeon (*A. americana*) and American green-winged teal (*A. crecca*) accounted for about 99% of dabbling ducks recorded; gadwall (*A. strepera*) made up the remainder. The highest count in fall 2012 was 565 ducks on 12 October, comparable to the 12 year mean for October (Fig. 7, Marks and Fischer 2010). Duck numbers declined after the 12 October survey. Areas A and D contained ponds with consistently high numbers of ducks and together had over 50% of the total ducks counted in all surveys combined (Table 4). Areas C, Bread Truck, and Racine Island had, by far, the fewest ducks, with less than five percent of all ducks observed. After October 18, no ducks were observed in ponds, though mallards continued to use tidal sloughs through the final survey on 29 October.

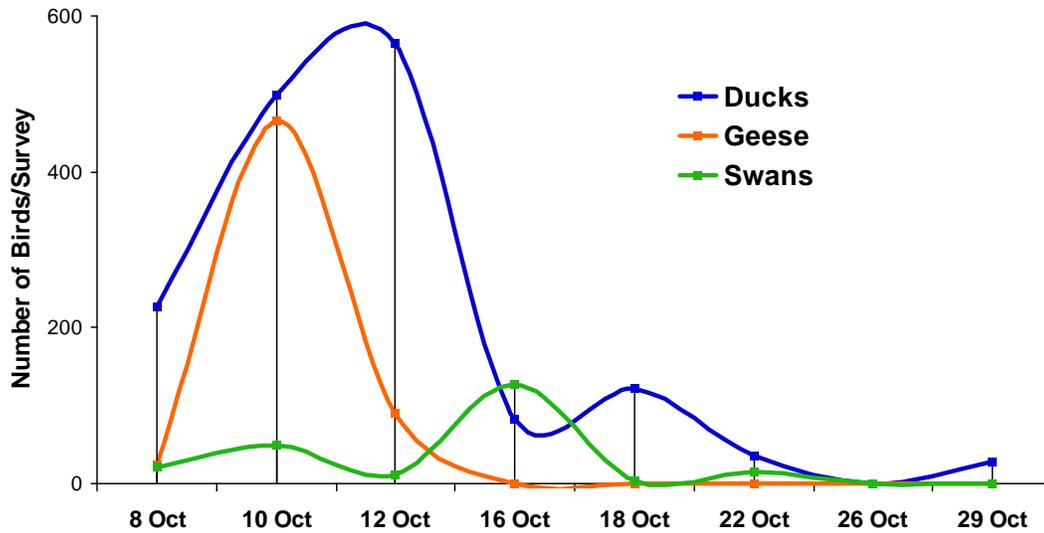


Figure 5. Fall 2012: numbers of swans, geese, and ducks counted on ERF during eight aerial surveys in 2012. Vertical lines mark survey dates.

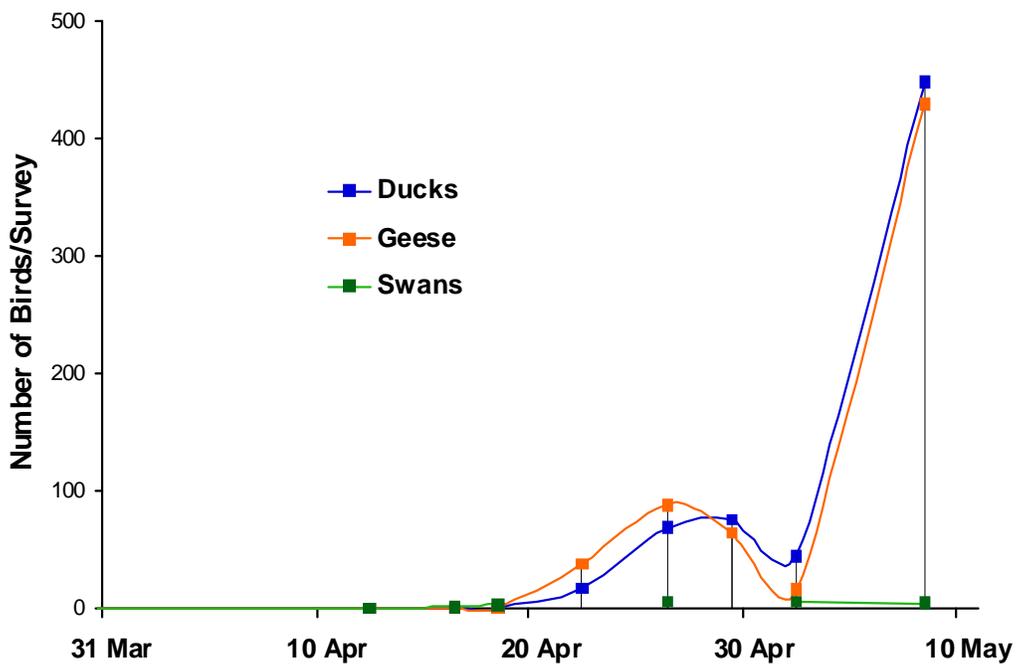


Figure 6. Spring 2013: numbers of swans, geese, and ducks counted on ERF during nine aerial surveys in 2013. Vertical lines mark survey dates.

Eleven species of duck were identified on nine ERF surveys in spring 2013 (Fig. 3, Table 3). Dabbling ducks comprised 96% of all identified ducks counted, with scaup (*Aythya sp.*), bufflehead (*Bucephala albeola*), common goldeneye (*B. clangula*), canvasback (*Aythya valisineria*), and common mergansers comprising the remaining ducks observed. Probably a result of abnormally cool temperatures and a persistent ice cover, only two ducks were observed on ERF through the 22 April survey. On three surveys, 26 April through 2 May, between 45 and 75 ducks were observed on each survey. On the final survey of 8 May, 408 ducks were counted, the highest count for any survey in spring 2013, comparable to the 12-year mean peak (Fig. 7, Marks and Fischer 2010). On average, in 1999-2009, large numbers of ducks arrived on ERF between the third week of April and first week of May and large numbers have arrived as early as the last week of March (Marks and Fischer 2010). In 2013, first ducks appeared on 22 April in the small open water of Area B. Areas A and B contained ponds with consistently high numbers of ducks and combined had 68% of the total ducks counted in all surveys combined (Table 4). Areas C, D, Coastal East, Bread Truck, and Racine Island had, by far, the fewest, with less than five percent of all ducks observed. No waterfowl were observed in Area D during early spring surveys in 2013.

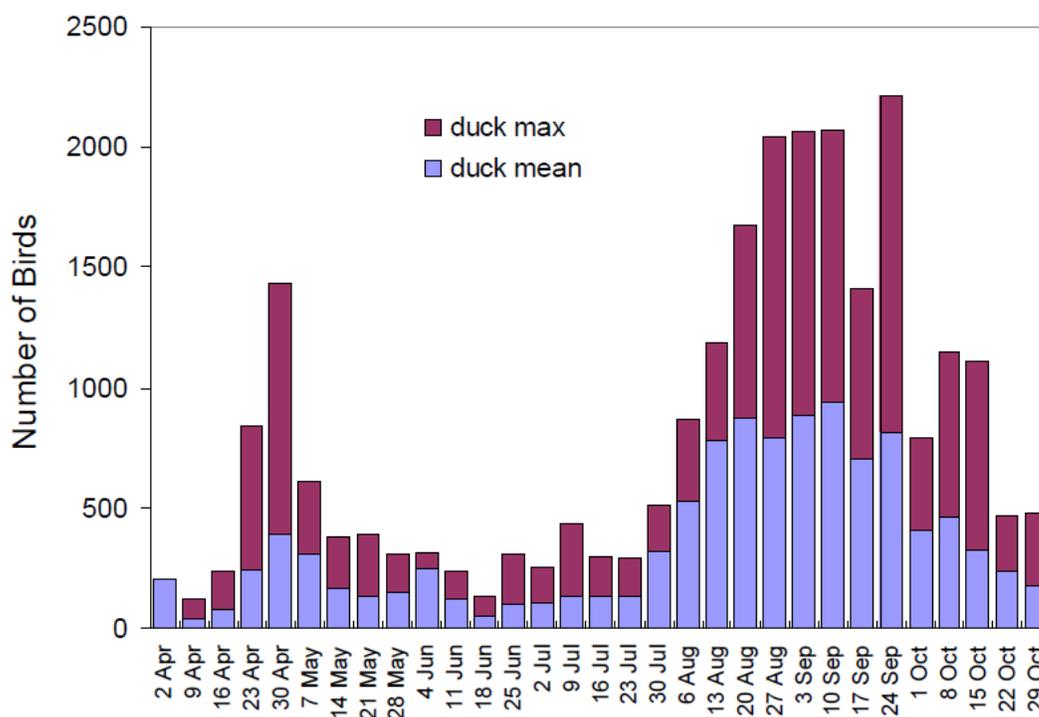


Figure 7. Average of ducks on the Eagle River Flats wetland, 1998-2009. Date refers to the first day of a given week. From Marks and Fischer 2010.

Geese-Fall 2012 and Spring 2013

In fall 2012, geese arrived mid to late August (Marks and Eldridge 2012), and persisted through early October; geese were last observed on 12 October. Canada geese (*Branta canadensis*) were the most abundant of all fall goose migrants in 2012 and were the only goose species observed on ERF on any of the eight late fall surveys. The heaviest used areas by geese on the ERF were coastal, with highest numbers observed in areas CE, CW, A and BT, particularly in the upland grass and the mud banks of Eagle River.

In spring 2013, geese first arrived on 22 April. Canada geese were the most abundant goose migrants to ERF in early spring 2013. Though lesser snow geese (*Chen caerulescens*) were also numerous, all but one were observed on the last survey, two weeks later than the average mean peak observed previously. Small flocks of greater white-fronted geese (*Anser albifrons*) were observed on surveys from 26 April (Table 3). Many geese on ERF in spring were observed near the coast in Coastal East and in areas C and A.

Swans

Both trumpeter swans (*Cygnus buccinator*) and tundra swans (*C. columbianus*) occur on ERF. While the two species cannot be distinguished from the air, trumpeter swans are more common on ERF; tundra swans were considered uncommon on the ERF by Steele et al. (2005). Swans were abundant during fall 2012 and numbers peaked at 127 birds on 16 October and last observed on 22 October. They were primarily observed, frequently with cygnets, on ponds in areas D, CD and B, though small groups were also consistently observed on ponds in area C (Table 4).

In spring 2013, swans, some identified as trumpeters by photographs, were the first waterfowl to arrive (on 16 April) and were observed in a small area of open water in Area B. Swans appeared as early as is typical for ERF but were few and confined in the first weeks to a small pond in area B. Swans were observed intermittently throughout the survey period, never numbered more than five, far below the 12-year mean. All but one were seen in area B.

Bald Eagles, Other Raptors and Corvids

In fall, bald eagles (*Haliaeetus leucocephalus*) were seen in three of the eight surveys though only a single bird was recorded on any flight. Northern harriers (*Circus cyaneus*) normally common on earlier surveys of ERF, were not observed in October of 2012. Common ravens (*Corvus corax*) were observed on two surveys (a group of four in one observation) and are generally only sporadically recorded in the open terrain of ERF. In spring, one eagle was observed on a nest in Area Coastal West, and several adults and juvenile were seen intermittently in areas B and A.

Sandhill Cranes

Sandhill cranes (*Grus canadensis*) are regularly observed on ERF and in numbers up to 100 individuals from spring through early fall (Marks and Fischer 2010). Cranes generally leave the area prior to October and none were observed in the study area in October of 2012. Cranes are known to nest on ERF and two nesting pairs were observed in 1978 (H.Griese, JBER, pers. comm.). In spring 2013, a total of 11 cranes were counted on 29 April and 2 on 8 May and were first sighted in the Bread Truck portion of ERF.

Gulls and Terns

Both gulls and terns generally leave ERF prior to September, and only two gulls were observed on the late fall surveys in October of 2012. Gulls were first observed on 26 April though were present in more significant numbers on 29 April (Table 3). The most common species of gulls were mew gulls (*Larus canus*), herring gulls (*L. argentatus*) and Arctic terns (*Sterna paradisaea*) though glaucous-winged (*L. glaucescens*) and Bonaparte's gulls (*L. philadelphia*) were also common occupants of ERF.

Shorebirds

In 2012, no shorebirds were observed during October surveys. Shorebirds generally occupy ERF in large numbers only in summer, yet they typically remain common in small numbers through early fall. They have not previously been recorded in aerial surveys after mid October (Marks and Fischer 2010). In spring 2013, groups of shorebirds were first observed on 29 April, around the time they typically appear, and were present in the two last surveys. Common species previously identified on ERF are listed in appendix A; large-bodied shorebirds counted here were probably the greater and/or lesser yellowlegs (*Tringa* spp.).

Conclusions

Observations of waterfowl diversity and numbers of waterfowl on ERF in late fall 2012 and early spring 2013 were not atypical but timing of fall departure was earlier than average, and spring arrival was later than average. Specifically, waterfowl using ERF in fall 2012 departed earlier than usual and by 22 October 2012 were either absent from ERF or restricted to the creek, riverbanks and sloughs. The end of fall waterfowl migration on ERF in 2012 was after 22 October but before 26 October; the end defined here as the date past which geese had departed and no ducks were observed on the ponds of ERF. Mean waterfowl numbers for 1998-2009 showed significant numbers of birds on ERF through the end of October and into early November. The early departure in 2012 was the result of an earlier than usual freeze up of ERF ponds resulting from lower than normal temperatures during the latter half of October. Mallards used the tidal mudflats and coastal sloughs of ERF well after ponds had frozen over. Mallards have been observed along the coastline in upper Cook Inlet in winter and were not considered migrants for the purposes of this project.

Ice cover on ERF persisted much later in spring of 2013 than in previous years, delaying migration to the area. Waterfowl arrival in ERF corresponded to availability of open water and with a very late thaw on local lakes and ponds in south-central Alaska and upper Cook Inlet, waterfowl arrival was delayed. The final survey on 8 May showed similar numbers of ducks as the 12-year average for peak spring. While ducks were most noticeably absent in early spring, geese and swans also appeared to be appreciably affected by the late ice and snow cover. Geese generally arrive mid-April, slightly later than ducks, and while first arrivals for geese was not appreciably later than previous years, significant numbers of geese arrived 2-3 weeks later than average. Further, the small number of swans using ERF in spring 2013 may be due to birds having waited in warmer areas and passing by ERF for feeding and nesting grounds further north.

While the fall patterns of species movements through the ERF wetland show significant consistency through the years, the precise timing of spring and fall occupancy by waterfowl and

other waterbirds on ERF vary among years and are influenced by the onset and persistence of cold temperatures and snow and ice cover. While waterfowl and other birds continued to use the area in much the same way as in prior years, the fall and spring migrations of 2012 and 2013 were clearly influenced by the atypical weather in south-central Alaska during these periods.

ACKNOWLEDGEMENTS

Thanks to Bill Eldridge, Bill Larned and Heather Wilson, U.S. Fish and Wildlife Service, Anchorage, and Paul Anderson, U.S. Park Service, Anchorage, for flying surveys and project logistics. Thanks also go to Brent Koenen and Herman Griese, JBER for funding; and Jennifer Wehrmann and Jill Derrick, Jacobs Engineering, for administrative support.

REFERENCES

- Marks, D.K. and W.D. Eldridge. 2011. Waterbird use of Eagle River Flats from Aerial Surveys, April –October, 2011. In: Remediating and Monitoring White Phosphorous Contamination at Eagle River Flats, (Operable Unit C), Fort Richardson, Alaska. M.E. Walsh and C.M. Collins, Eds. July 2012.
- Marks, D.K. and J.B. Fischer. 2010. Recommendations on Reducing Live-fire Impacts to Waterbirds in the Eagle River Flats Wetland, Fort Richardson, Alaska. Unpublished report. U.S. Fish and Wildlife Service, 1011 E. Tudor Rd. Anchorage, AK 99503.
- Racine, C.H., and D.W. Cate (Eds.). 1996. Interagency expanded site investigation: Evaluation of white phosphorus contamination and potential treatability at Eagle River Flats, Alaska. FY 95 Final Report. CRREL Contract Report to U.S. Army, Alaska Directorate of Public Works, Ft. Richardson, Alaska.
- Steele, B., L. Reitsma, C.M. Collins, M.E. Walsh, and M.R. Walsh. 2005. (from U.S. Army Cold Regions Research and Engineering Laboratory report, 2004 from web site: <http://www.crrel.usace.army.mil/erf/ecology/ecology-birds.html>)

Table 1. Survey date, time and aircraft for each of two periods for 17 aerial surveys of the ERF in 2012-2013.

Period	Survey Date	Start Time	Aircraft
Fall 2012	8 October	1515	Cessna 207
	10 October	1530	Piper Cub
	12 October	1320	Cessna 207
	16 October	1300	Cessna 184
	18 October	1415	Cessna 185
	22 October	1540	Cessna 185
	26 October	1200	Cessna 185
	29 October	1315	Piper Cub
Spring 2013	28 March	1700	Cessna 185
	12 April	1355	Cessna 185
	16 April	1050	Cessna 185
	18 April	1640	Cessna 185
	22 April	1700	Cessna 185
	26 April	1435	Cessna 185
	29 April	1430	Cessna 206
	2 May	1731	Cessna 206
	8 May	1421	Cessna 206

Table 2. Number of birds observed for each of eight aerial surveys of the ERF in fall 2012.

	10/8	10/10	10/12	10/16	10/18	10/22	10/26	10/29	All Surveys
Ducks									
Mallard	183	227	442	73	121	36		28	1110
Northern pintail	20	103	115	3					241
American wigeon		132	8						140
Am. green-winged teal	15	26		7					48
Gadwall		10							10
C. merganser	8								8
Total Ducks	226	498	565	83	121	36	0	28	1557
Geese									
Canada geese	25	465	90						580
Swans									
Tundra and Trumpeter	20	48	12	127	3	15			225
Other Birds									
Bald eagle		1		1	1				3
Common Raven		1				4			5
Red-necked grebe		1							1

Table 3. Number of birds observed for each of nine aerial surveys of the ERF in spring 2013.

	3/28	4/12	4/16	4/18	4/22	4/26	4/29	5/2	5/8	All Surveys
Ducks										
Mallard					15	18	42	11	75	161
Northern pintail						25	25		294	344
American wigeon						20	4	32	52	108
Northern shoveler									8	8
Green-winged teal						2	4		2	8
Gadwall						2				2
Bufflehead						2		2	8	12
Canvasback									1	1
Scaup					2				2	4
Goldeneye									2	2
C. merganser									4	4
Total Ducks					17	69	75	45	448	654
Geese										
Canada goose					38	67	55	15	160	335
Gr. white-fronted goose						20	10		25	55
Lesser snow goose						1			245	246
Total Geese					38	88	65	15	430	636
Swans										
Trumpeter/Tundra			2	3		5		5	4	19
Other										
Gull, various						3	34	10	55	102
Bald eagle			4	3	1			1		9
Common Raven				1						1
Sandhill crane							9		2	11
Shorebirds, large							45	20	6	71

Gull species include mew, herring, glaucous-winged and Bonaparte's

The most common species of large shorebird observed was yellowlegs sp.

Table 4. Total number of birds, by group, for each standardized area for fall 2012 and spring 2013 on ERF.

	A	B	BT	C	CD	CE	CW	D	RI	Total
Fall:										
Ducks	490	212		11	112	188	133	405	6	1557
Geese	65	25	50			410	30			580
Swans		97		11	90		3	24		225
Eagles		1					1	1		3
Total Fall	555	340	50	23	202	598	167	430	6	2371
Spring:										
Ducks	366	190		57	28		7		6	654
Goose	367	1	25	95		120	28			636
Swans		17		2						19
Shorebirds						65				65
Cranes			8	2	1					11
Total Spring	733	208	33	156	94	120	35	0	6	1385

BT, Bread Truck; CE, Coastal East; CW, Coastal West; RI, Racine Island. See Fig 1.

Appendix A. Waterbird observed on Eagle River Flats and habitats (from <http://www.crrel.usace.army.mil/erf/ecology/ecology-birds.html>)

Species	Status	Habitat
Red-Throated Loon	r	Permanent Pond
Common Loon	r	Permanent Pond
Horned Grebe	u	Permanent Pond
Great Blue Heron	+	
Trumpeter Swan	c	Permanent Pond
Tundra Swan	u	Permanent Pond
Canada Goose	c	Vegetated Mudflat
Cackling Goose	u	Vegetated Mudflat
Brant	u	Vegetated Mudflat
Greater White-Fronted Goose	c	Vegetated Mudflat
Snow Goose	c	Vegetated Mudflat Bulrush Marsh
Mallard	c, B	Permanent Pond Permanent Pond
Northern Pintail	c	Temporary Pond Permanent Pond
American Wigeon	c, B	Temporary Pond Permanent Pond
Eurasian Wigeon	r	Temporary Pond Permanent Pond
Northern Shoveler	c	Temporary Pond
Cinnamon Teal	+	
Blue-Winged Teal	r	Permanent Pond Temporary Pond Permanent Pond
Green-Winged Teal	c, B	Temporary Pond
Ring-Necked Duck	r	Permanent Pond
Greater Scaup	r	Permanent Pond
Lesser Scaup	r	Permanent Pond
Long-Tailed Duck (Oldsquaw)	r	Permanent Pond
Common Goldeneye	r	Permanent Pond
Bufflehead	r	Permanent Pond
Common Merganser	r	Permanent Pond

c = common, **u** = uncommon, **r** = rare, **+** = casual or accidental, **B** = confirmed breeder in ERF, **b** = probable breeder in ERF

Appendix B. Number of birds observed in all late fall 2012 surveys by date, standardized area and pond number.

Date 2012	Area	Species	No. Observed	Pond No.
8 Oct	a	green-winged teal	15	283
8 Oct	a	mallard	15	246
8 Oct	a	mallard	45	258
8 Oct	a	mallard	20	246
8 Oct	a	red-necked grebe	20	138
8 Oct	b	Canada goose	25	
8 Oct	b	common merganser	8	
8 Oct	b	mallard	25	333
8 Oct	b	mallard	10	323
8 Oct	b	swan	4	333
8 Oct	b	swan	10	323
8 Oct	c	swan	6	183
8 Oct	cd	mallard	40	40
8 Oct	ce	mallard	3	69
8 Oct	d	mallard	25	5
10 Oct	a	American wigeon	20	204
10 Oct	a	American wigeon	30	243
10 Oct	a	American wigeon	15	138
10 Oct	a	Canada goose	40	river
10 Oct	a	Canada goose	25	243
10 Oct	a	mallard	22	243
10 Oct	a	mallard	4	283
10 Oct	a	mallard	2	290
10 Oct	a	mallard	5	138
10 Oct	a	mallard	4	river
10 Oct	a	northern pintail	45	243
10 Oct	b	green-winged teal	6	323
10 Oct	b	American wigeon	10	333
10 Oct	b	bald eagle	1	
10 Oct	b	gadwall	10	333
10 Oct	b	mallard	30	333
10 Oct	b	northern pintail	45	333
10 Oct	b	northern pintail	1	302
10 Oct	b	red-necked grebe	1	333
10 Oct	b	swan	30	323
10 Oct	b	swan	6	302
10 Oct	bt	Canada goose	50	river
10 Oct	c	northern pintail	11	205
10 Oct	c	common raven	1	fly
10 Oct	cd	American wigeon	7	40
10 Oct	cd	mallard	40	40
10 Oct	ce	Canada goose	350	land
10 Oct	d	green-winged teal	20	5
10 Oct	d	American wigeon	50	5
10 Oct	d	mallard	120	5
10 Oct	d	swan	12	5
10 Oct	ri	northern pintail	1	
12 Oct	a	mallard	3	290
12 Oct	a	mallard	120	258

Appendix B (cont.). Number of birds observed in all late fall 2012 surveys by date, standardized area and pond number.

Date 2012	Area	Species	No. Observed	Pond No.
12 Oct	a	northern pintail	5	290
12 Oct	a	northern pintail	60	258
12 Oct	b	American wigeon	8	323
12 Oct	b	mallard	30	323
12 Oct	b	mallard	4	302
12 Oct	b	swan	6	333
12 Oct	b	swan	1	323
12 Oct	c	swan	5	205
12 Oct	ce	Canada goose	60	land
12 Oct	ce	mallard	30	102
12 Oct	cw	Canada goose	30	mud
12 Oct	cw	mallard	110	tidegut
12 Oct	d	mallard	140	5
12 Oct	d	northern pintail	50	5
12 Oct	ri	mallard	5	river
16 Oct	a	mallard	25	tidegut
16 Oct	b	mallard	1	333
16 Oct	b	mallard	12	323
16 Oct	b	northern pintail	3	333
16 Oct	b	swan	20	323
16 Oct	b	swan	5	302
16 Oct	cd	mallard	25	40
16 Oct	cd	swan	25	40
16 Oct	cd	swan	65	
16 Oct	cw	green-winged teal	7	67
16 Oct	cw	bald eagle	1	
16 Oct	cw	mallard	10	67
16 Oct	d	swan	12	5
18 Oct	a	mallard	3	258
18 Oct	a	mallard	8	river
18 Oct	ce	mallard	110	tidegut
18 Oct	cw	swan	3	178
18 Oct	d	bald eagle	1	
22 Oct	a	mallard	4	138
22 Oct	b	mallard	9	slough
22 Oct	b	common raven	4	fly
22 Oct	b	swan	15	slough
22 Oct	ce	mallard	15	tidegut
22 Oct	ce	mallard	8	slough
26 Oct		no waterbids observed		
29 Oct	ce	mallard	22	tidegut
29 Oct	cw	mallard	6	tidegut

Appendix C. Number of birds observed in all early spring 2013 surveys by date, standardized area and pond number.

Date 2013	Area	Species	No. Observed	Pond No.
28 Mar		none observed		
12 Apr		none observed		
16 Apr	b	swan	2	333
18 Apr	b	swan	3	333
18 Apr	b	bald eagle	4	
22 Apr	ce	Canada goose	35	
22 Apr	cw	Canada goose	3	
22 Apr	a	bald eagle	2	
22 Apr	a	scaup	2	river
22 Apr	b	mallard	15	333
22 Apr	b	bald eagle	1	
22 Apr	c	common raven	1	
26 Apr	ce	Canada goose	30	
26 Apr	cw	gull	3	
26 Apr	cw	bald eagle	1	
26 Apr	a	Canada goose	12	
26 Apr	a	mallard	15	river
26 Apr	a	gadwall	2	river
26 Apr	a	American wigeon	20	river
26 Apr	a	bufflehead	2	river
26 Apr	a	northern pintail	25	river
26 Apr	a	Canada goose	25	river
26 Apr	a	Am. green-winged teal	2	river
26 Apr	a	gr. White-fronted goose	20	river
26 Apr	b	lesser snow goose	1	
26 Apr	b	swan	5	333
26 Apr	b	mallard	3	
29 Apr	ce	Canada goose	15	
29 Apr	ce	gr. White-fronted goose	10	
29 Apr	cw	Canada goose	25	
29 Apr	a	Canada goose	15	
29 Apr	b	northern pintail	25	333
29 Apr	b	mallard	10	333
29 Apr	b	Am. green-winged teal	4	333
29 Apr	b	mallard	12	333
29 Apr	b	American wigeon	4	333
29 Apr	b	mallard	10	323
29 Apr	b	gull	4	
29 Apr	ri	mallard	2	river
29 Apr	bt	sandhill crane	8	
29 Apr	cd	shorebird, large	45	
29 Apr	cd	sandhill crane	1	
29 Apr	cd	mallard	8	40
29 Apr	cd	gull	30	
2 May	ce	Canada goose	15	
2 May	b	swan	5	333
2 May	b	bufflehead	2	333
2 May	b	mallard	3	333
2 May	b	American wigeon	32	323

Appendix C (cont.). Number of birds observed in all early spring 2013 surveys by date, standardized area and pond number.

Date 2013	Area	Species	No. Observed	Pond No.
2 May	b	bald eagle	1	
2 May	cd	shorebird, large	20	
2 May	cd	mallard	8	40
2 May	cd	gull	10	
8 May	cw	northern pintail	7	178
8 May	a	northern pintail	70	204
8 May	a	northern pintail	95	246
8 May	a	mallard	40	246
8 May	a	lesser snow goose	150	
8 May	a	Canada goose	120	
8 May	a	gr. White-fronted goose	25	
8 May	a	gull	5	
8 May	a	scaup	2	river
8 May	a	mallard	2	river
8 May	a	northern pintail	60	258
8 May	a	mallard	15	258
8 May	a	shorebird, large	6	258
8 May	a	American wigeon	12	258
8 May	a	common goldeneye	2	258
8 May	b	swan	2	333
8 May	b	American wigeon	21	333
8 May	b	northern pintail	20	333
8 May	b	gull	19	333
8 May	b	canvasback	1	333
8 May	b	mallard	10	333
8 May	b	Am. green-winged teal	2	333
8 May	b	bufflehead	4	333
8 May	b	northern shoveler	8	333
8 May	b	c. merganser	4	333
8 May	b	gull	20	323
8 May	ri	mallard	4	river
8 May	ri	gull	2	
8 May	c	swan	2	205
8 May	c	American wigeon	4	205
8 May	c	northern pintail	42	205
8 May	c	mallard	2	205
8 May	c	sandhill crane	2	
8 May	c	lesser snow goose	95	
8 May	c	gull	5	
8 May	c	mallard	2	164
8 May	c	American wigeon	7	164
8 May	cd	bufflehead	4	40
8 May	cd	American wigeon	8	40
8 May	bt	Canada goose	25	
8 May	ce	Canada goose	15	
8 May	c	gull	4	