Appendix 7:

A Plan for Monitoring Shorebirds During the Non-breeding Season in Region Utah – BCR9 (Great Basin)

Ann Manning, Catherine Wightman and Jon Bart

Version 0.2

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Summary

This monitoring plan is designed to provide good estimates of the average number of shorebirds present in Utah's Great Basin region during the non-breeding season. These estimates will be used by Utah Division of Wildlife Resources (UDWR) to analyze trends in populations of individual species of shorebirds. Most of this document focuses on sampling plans for obtaining average estimates of shorebirds using ground surveys. A few species (i.e., American Avocets, Black-necked Stilts, Wilson's Phalaropes and Red-necked Phalaropes) are difficult to survey accurately from the ground and separate surveys are discussed for these exceptions at the end of the document. To facilitate planning, Bird Conservation Region-Great Basin (BCR9) in Utah has been divided into nine domains. Each domain is divided into one or more strata, which are the sampling units for these surveys. Habitat in each stratum is classified based on the amount of shorebird use. Unless casual observation suggests shorebirds are using these areas in moderate numbers, habitat of little to no shorebird use (Type 3 habitat) will not be surveyed. Areas with moderate use are classified as Type 2 habitat. Periodic, flexible surveys are recommended for these areas, primarily to verify that only a small proportion of the population uses these areas. More detailed and comprehensive surveys are recommended for habitat with substantial shorebird use (Type 1 habitat). Data collected from these surveys will be used in the trend analyses of shorebird populations. Out of 51 strata, 20 include some Type 1 habitat. Of these, 10 strata require additional information or a pilot study before survey recommendations can be made. In the other 10 strata, complete counts of shorebirds are possible in all Type 1 habitat

This plan is a collaborative effort among local, regional, and national biologists. Local biologists have been particularly important by providing habitat information and survey recommendations. Implementation of this monitoring plan relies on their continued support and involvement.

Introduction

Shorebird Monitoring Region "Utah – BCR9 (Great Basin)," includes western Utah west of Interstate Routes 80 and 15 (Figure 14). The most important shorebird area in this region, and one of the most important in the western United States, is the Great Salt Lake-the fourth largest terminal lake in the world. The Great Salt Lake (GSL) is an aggregation of ecosystems each driven by different concentrations of brine as a result of anthropogenic activities and structures on and around the lake. The north, east, and south sides of the lake are the most modified and receive the most avian use. Human population density is also greatest along these edges. More than 23 species of shorebirds use the GSL ecosystem during migration stopovers, and for some it is a breeding ground. In mid-summer an abundant food source of brine flies and brine shrimp attracts the continent's largest staging concentrations of Wilson's phalaropes and significant numbers of red-necked phalaropes. The largest breeding and migratory populations of snowy plovers are typically found on mudflats in the summer months. American avocets and blacknecked stilts also stage in large numbers, and a portion of them breed at the Great Salt Lake. The delta-formed wetlands also attract tens of thousands of long-billed dowitchers, marbled godwits, and western and least sandpipers during migration in spring and late summer. Other notable sites in the Region include Fish Springs NWR and Utah Lake.

The monitoring plan for the northern portion of this Region was designed using the knowledge gained during the Great Salt Lake Waterbird Survey (WBS; Appendix A). Three separate surveys are suggested: (1) ground-based counts for all species; (2) aerial surveys for avocets and black-necked stilts; (3) a survey for phalaropes using methods still to be determined. Separate counts of avocets, stilts, and phalaropes are needed because these species often occur in extremely large numbers (individual flocks with tens of thousands of birds) which are difficult to count accurately from the ground and are present too far from land to be counted accurately by ground-based surveyors. In many areas, however, especially the Wildlife Management Areas (WMAs), it may be possible to count avocets and stilts accurately from the ground. If so, since counts will be made here anyway for other species, ground counts may be a more cost-effective method for surveying avocets and stilts in these areas than covering these areas by the aerial survey. This issue will need attention as the sampling plan is developed. In this draft, however, we assume that avocets and stilts will be counted on ground counts and that aerial surveys will not cover selected areas that are well enough covered from the ground. Phalaropes are less likely to be covered to any significant extent on the ground-based counts because they are much more abundant in the open water portions of the GSL. Most of this document is focused on the ground surveys, but are included at the end of the report short sections suggesting needed development work on the other two surveys.

Delineation of Strata and Survey Areas Within Strata

The monitoring plan was designed to provide good estimates of the average number of shorebirds present during the "study period" for each "focal species." Final selection of the study period should not be made until several investigations, identified in this document, have been carried out and monitoring plans for other groups have been developed. We have carried out a preliminary analysis, however, and suspect that the study period will be July and August (Appendix B). We use this period below, while acknowledging that it may be changed before the final plan is adopted. The focal species include species that occur in the study area during the study period in high enough numbers that trends in the mean number of them present might be important in making management decisions at the regional, national, or international level. Trends for some additional species may be important at the local (e.g., a Wildlife Management Area) level, but we assume that local biologists would develop monitoring efforts for such species. We would be willing to provide advice for such efforts, however. Our tentative list of focal species for this planning region is given in Table 20.

We use the "shorebird-day" as a unit of measurement. A shorebird-day is one shorebird spending 24 hours within the study area during the study period. The value of this unit derives from the fact that the mean number of shorebirds present in the study area during the study period (the quantity we are trying to monitor) equals the total number of shorebird-days during the study period divided by the number of days in the study period. In deciding which areas to focus survey efforts on, we use rules based on the fraction of the shorebird-days that occur within different portions of the study area. This approach is explained in the next paragraph.

		CONSERVATION
CODE	SPECIES	VALUE ¹
AMAV	American Avocet ²	5
AMGL	American Golden Plover	1
BASA	Baird's Sandpiper	1
BBPL	Black-bellied Plover	2
BNST	Black-necked Stilt ²	5
COSN	Common Snipe	3
GRYE	Greater Yellowlegs	3
KILL	Killdeer	3
LESA	Least Sandpiper	4
LEYE	Lesser Yellowlegs	2
LBCU	Long-billed Curlew	5
LBDO	Long-billed Dowitcher	5
MAGO	Marbled Godwit	4
RNPH	Red-necked Phalarope ²	4
SAND	Sanderling	1
SNPL	Snowy Plover	5
SOSA	Solitary Sandpiper	2
WESA	Western Sandpiper	4
WHIM	Whimbrel	1
WILL	Willet	4
WIPH	Wilson's Phalarope ²	5

Table 20. Important shorebird species in Utah - BCR9

¹U.S. Shorebird Conservation Plan - Intermountain West Region 5=critically important, 4=very important, 3=important, 2=slightly important, 1=unimportant

²Important shorebird species in the region that are not adequately monitored by ground surveys and are, therefore, not considered focal species in the ground survey section of this report

The Region has been divided into 9 "domains" (Figure 14). All areas within each domain were assigned to one of the following types: Type 1 – shorebirds present during the study period in substantial numbers; Type 2 – shorebirds present but in small numbers; Type 3 – virtually no shorebirds present during the study period. The goal in assigning habitat types was that >75% of the shorebird-days for each focal species in the region would occur in Type 1 strata; <20% of the shorebird-days in the region would occur in type 2 strata, and <5% of the shorebird-days in the region would occur in Type 3 areas. A sample of plots in Type 1 habitat will be surveyed each year using a detailed protocol that provides an estimate of the mean number of shorebird-days for each focal species. Type 2 habitat will be surveyed every few years, using more flexible methods, to verify the assumption that <20% of the shorebird-days for each focal species areas. Type 3 habitat will not be surveyed regularly but bird watchers and biologists will be notified that we consider these areas virtually devoid of the focal shorebirds during the study period, and they will be asked to contact us if they find evidence that this assumption is wrong.



Figure 14. Utah-BCR9 (Great Basin) Domains

Delineated areas were defined by starting with shorebird concentration areas. When these areas were distinct and isolated from other areas (e.g., a Wildlife Management Area), they became "domains" (groups of strata). The borders between domains were chosen to follow a readily recognizable feature such as a road or river. Domains were defined for larger, continuous areas, such as the shore of the Great Salt Lake, by identifying portions of the area that would probably be surveyed using similar methods or that were in a single ownership. Sizes of domains were made small enough so that all the strata within each one could be displayed clearly on one-page maps.

Domains were then sub-divided into strata in such a way that a single sampling plan would be appropriate for all Type 1 habitat in each stratum. The sampling plan might be simple, such as "cover the entire stratum" or "cover a systematic sample of plots," or it might be more complex involving, for example, a two-stage process of rapid surveys of a large sample of plots and intensive surveys on a sub-set of these plots. The guiding principle, however, was that a single sampling plan be applicable to all Type 1 habitat. For example, if part of an area needed to be covered by aerial surveys and photography, and the rest could be covered by ground surveys, then the two areas would be placed in different strata since the sample selection and estimation methods would be quite different.

Development of Survey Protocols

A short description of each stratum was prepared reporting the species and approximate numbers present during the study period and discussing possible survey approaches. The most important part of these descriptions was the discussion of difficulties likely to be encountered in obtaining an accurate count. These descriptions included discussion of potential sampling plans but did not present a detailed operational plan. Detailed plans specifying the sample size, sample selection method, and field survey methods, will be prepared after special studies identified in this document have been completed and plans for monitoring other waterbirds have been developed. Many of the needed special studies, however, may require surveys to investigate the extent of problems in getting accurate counts and ways of solving these problems. Thus, surveys should probably be conducted in the near future in selected areas.

The description of each stratum contained two other sections intended to help us develop the survey methods and evaluate reliability of collected data. The first section was "Measurement Error and Measurement Bias:" Measurement error means not counting all the birds present in a plot at the time of the survey. Measurement bias is a long-term trend in the degree of measurement error. Measurement error does not necessarily cause serious problems because the proportion of birds detected might be constant through time so that the trend estimate would be accurate. However, any time detections rate are well below 100% (e.g., <80%), then it is possible that a long-term trend might occur in the detection rate (e.g., it might fall from 80% to 50%) thus generating spurious trends in the mean number of birds present in the stratum. We use the phrase "measurement error" rather than detection rate because in some cases (e.g., aerial surveys) the number recorded might exceed the number present. Measurement error – the ratio of number recorded to number present – is thus a more general term.

If measurement error was considered potentially serious (defined as an estimate that is not within 20% of the true number present at the time of the survey) then a discussion was provided of ways to minimize the error. Frequently, this discussion identified special studies that will need to be carried out before a final survey plan is adopted. If it seemed unlikely that substantial measurement error could be avoided, a discussion was also provided of the potential for measurement bias and of ways to determine whether this problem occurs during the coming years.

The second section for each stratum was a discussion of the potential for "selection bias." At the level of the stratum, selection bias arises when some parts of the stratum cannot be surveyed, usually due to access problems. Non-surveyable areas raise two problems. Some estimate of the mean number of birds present in these areas must be made so that results from different strata can be combined. This estimate does not need to be highly accurate. Methods for making these estimates for each non-surveyable area were discussed. The second problem is that any long-term trend in the fraction of birds within the stratum that are in the non-surveyable areas generates a spurious trend in the numbers present. For example, if initially half the birds are in non-surveyable areas but these areas gradually become unsuitable so the shorebirds move to the surveyable areas, then an increase will occur in the numbers recorded even if the number of birds actually present in the stratum shows no trend. Whenever non-surveyable areas existed in a stratum, and were thought to contain substantial numbers of birds – or might do so in the future – the potential for selection bias, and ways to remove it, were discussed. Special studies were often identified in these discussions.

The potential for selection bias was also discussed at the regionwide level. Some entire strata might be in the non-surveyable category, which introduces potential for bias not discussed within the individual stratum sections. Furthermore, while there might be substantial potential for selection bias in some strata, it might be felt that spurious negative and positive trends would approximately balance each other at the regional level.

The next section provides an overview of survey recommendations and the pilot studies that are needed before a comprehensive plan can be described. Pilot studies are prioritized and cost estimates are included. A discussion of the accuracy of the proposed surveys is also reported. In the concluding sections of this report, we describe ground, aerial photography, and phalarope surveys in detail.

Recommendations and Pilot Studies

A summary of each stratum and proposed sampling plan can be found in Table 21. This table also identifies where pilot studies are needed. There are 10 strata with Type 1 habitat that require pilot studies or additional information. These are prioritized below; however, the order in which they are implemented may change according to funding and time constraints.

The highest priority pilot study is to classify all habitat by type and identify survey constraints for Bear River Migratory Bird Refuge (stratum 8.102). This pilot study needs to include estimates of accuracy and potential errors. The sampling plan for Bear River Migratory Bird Refuge (MBR) will likely involve the use of random or stratified plots; therefore, selection bias will need to be evaluated.

The second highest priority pilot study is to classify all habitat by type and identify survey constraints for Utah Lake (strata 9.104, 9.105 and 9.106). This is of secondary importance to Bear River MBR because it is likely that all Type 1 habitat, once identified, can be surveyed completely. This would eliminate the need for a detailed sampling plan.

The next highest priority is developing wetland survey protocols for the West Kaysville (7.109) and Farmington Bay WMA (7.110) strata. It is likely that all Type 1 habitat cannot be surveyed accurately in these strata and, therefore, sampling plans are needed.

For Ogden Bay (8.105) and Harold Crane WMA (8.107) strata, pilot studies are needed to assess whether all Type 1 habitat is visible and can be surveyed completely. If it is determined that all Type 1 habitat cannot be surveyed completely, then sampling plans are needed.

Table 21. Summary of Utah – BCR9 strata by habitat type and area, plus recommended survey methods and time required to conduct surveys.

ont voyo.								
			AREA	(km^2)				TIME
STRATUM	NAME	TYPE 1	TYPE 2	TYPE 3	TOTAL	HABITAT	SURVEY METHODS	REQUIRED
1.101	Northwest	0	0	6957	6957	dry desert and mountains	NONE	NONE
2.101	Northcentral	0	0	3381	3381	pinyon-juniper and sagebrush	NONE	NONE
3 101	Cutler Marsh	0	6	6	1562	mountains and river valleys	occasional aerial surveys of Type 2 habitat	V/N
3.102	Wasatch Range	0	. 0	11675	11675	mountains	NONE	NONE
							occasional ground surveys of Neponset	
3.103	Neponset Reservoir	0	8	480	488	reservoir and uplands	Reservoir	Ŷ
4.101	Northern Utah – Southwest	0	0	8357	8357	salt desert	NONE	NONE
5 101	I ocomotive Springe WMA	61	0	205	356	marsh, mudflats, uplands and	toot in the product of the product o	1 hrs
101.0		10		011	000	орон waкт	$\frac{1}{2}$	
5.102	Salt Wells Flat WHA	47	15	93	155	mudflats, ponds, uplands and open water	census mudilats by A I V, occasional surveys of ponds by foot	4 hrs
			,			shoreline, uplands and open		
5.103	Northwest Great Salt Lake	0	0	1645	1645	water	NONE	NONE
5.104	West of Promontory Mtns.	0	0	1924	1924	shoreline, uplands and open water	NONE	NONE
6.101	Westcentral Great Salt Lake	0	120	2130	2250	shoreline, uplands and open water	occasional ground surveys of shoreline	3 hrs
						evaporation ponds and		
6.102	Stansbury Bay	14	0	837	851	shoreline	census shoreline from dike road	3 hrs
6.103	Stansbury North	0	40	63	103	shoreline, uplands and open water	occasional aerial surveys of shoreline	N/A
							census shoreline by ATV, occasional	
6.104	Stansbury South	26	95	0	121	shoreline and mudflats	foot surveys of Type 2	3 hrs
						shoreline, ponds and open	periodic driving surveys of shoreline, pilot study required to assess complete	
6.105	Interstate 80 North	0	22	83	105	water	coverage of Type 2 habitat	3 hrs
7.101	Antelope Island West	0	66	362	428	rocky shoreline and open water	occasional ground survey of shoreline	3 hrs
7.102	Antelope Island Causeway	0	64	0	64	causeway and shoreline	occasional driving survey of causeway	1-2 hrs
7.103	Antelope Island Northeast	0	23	117	140	shoreline, uplands and open water	occasional aerial surveys of shoreline	N/A
7.104	West Layton	0	5	34	39	shoreline and wetlands	occasional aerial surveys of shoreline	N/A

TIME	REQUIRED	5 hrs	2-3 hrs	N/A	N/A		4 hrs	4 hrs	- 0 0	2-3 hrs	3 hrs	8-10 hrs	N/A	8_10 hrs	SIII 01-0	4 hrs	CH	2 hrs		5 hrs		4 hrs		4 hrs	6		NONE	NONE			
	SURVEY METHODS	simultaneous counts from both sides of stratum, ATV if helpful	pilot study to assess accuracy of airboat survevs of shoreline	occasional aerial surveys of shoreline	occasional aerial surveys of shoreline	census shoreline by foot, pilot study	need for wetlands	pilot study for wetlands needed	census shoreline from vehicle and by	toot	census shoreline and wetlands by foot	census wetlands by foot and boat	occasional aerial surveys of wetlands	pilot study needed to classify habitats	allu uevelop sallipillig plali	census or winard spur by an oral, occasional aerial surveys for rest	occusional foot or ATV menors of	occasional 100t of A1 V surveys 01 shoreline	pilot study needed to determine	whether all Type 1 habitat is visible	ground surveys of drawn down pond,	occasional aerial surveys for rest	pilot study needed to assess feasibility	of censusing all Type 1 habitat	pilot study needed to assess habitat type		NONE	NONE	pilot study needed to assess habitat type	and ability to census all 1 ype 1	pilot study needed to assess habitat type and ability to census all Type 1
	HABITAT	shoreline and mudflats	shoreline and open water	shoreline and open water	shoreline and uplands	shoreline, wetlands, and open	water	wetlands and uplands	· · · ·	shoreline and open water	shoreline, wetlands, open water and shallow ponds	wetlands and uplands	wetlands and uplands	opuvu mvlledo pue opueltem	wettanus and snanow points	wettatius of ury uepenuing on water level	10 10 I I	shoreline and open water	wetlands, open water and	uplands	wetlands, open water and	uplands	wetlands, open water and	uplands	marchae and calt daeart		salt desert	mountains and sagebrush	playa, marsh, shoreline and	open water	playa, marsh, shoreline, mountain and open water
	TOTAL	58	54	87	12		208	66		34	37	207	1122	100	71	663	600	46		269		188		279	670	010	13298	7834		185	721
(km^2)	TYPE 3	i	ė	82	i		ė	71	00	73	ż	i	i	6	;	د		39		244		180		240	611	110	13298	7834	d	<i>.</i> :	ć
AREA	TYPE 2	i	ė	5	i		ė	0.5	¢	0	i	i	i	6	;	ډ		٢		3		4		9	¢	(0	0	c	i.	i
	TYPE 1	i	12	0	0		j	27.5	•••	11	Ŷ	0	0	6	;	82	10	0		22		4		33	٢	- · (0	0	d	i.	è
	NAME	Antelope Island Southeast	Crvstal Lakeside	Farmington Bay Lakeside	West Farmington		West Kaysville	Farmington Bay WMA		Saltair	Kennecott	Associated Duck Clubs	Salt Creek	Rear River NWP	DCal MVCI IN WIN	Bear River Bav	and to the inco	Ogden Bay North		Ogden Bay		Howard Slough WMA		Harold Crane WMA	Rline I alzee	DIUC LUNCS	Great Salt Lake Desert	Oquirrh Mountains		North Utah Lake	Central Utah Lake
	STRATUM	7.105	7.106	7.107	7.108		7.109	7.110	t	/.111	7.112	7.113	8.101	6 100	0.102	8 103	201.0	8.104		8.105		8.106		8.107	0 101	101.7	9.102	9.103		9.104	9.105

TIME	REQUIRED	6	NONE		j	NONE	NONE	i	i	NONE	NONE	ć	NONE
	SURVEY METHODS	pilot study needed to assess habitat type and ability to census all Type 1	NONE	pilot study or more info needed to assess detection rates on vehicle	surveys	NONE	occasional ground census of Topaz Slough and Sevier River in wet years	occasional ground census	occasional ground census of Minersville Reservoir	NONE	NONE	occasional ground census of Quichapa Lake in spring and fall	NONE
	HABITAT	playa, marsh, shoreline and	dry desert and mountains		marshes and small ponds	dry desert and mountains	dry desert and mountains	marshes	dry desert and mountains	dry desert and mountains	dry desert and mountains	wetlands or dry depending on water level and upland	mountains
	TOTAL	213	6268		91	7330	4423	31	7062	18248	1478	146	6173
(km ²)	TYPE 3	6	6268		0	7330	4422	0	7052	18248	1478	139	6173
AREA	TYPE 2	6	0		0	0	1	31	10	0	0	L	0
	TYPE 1	6	0		912	0	0	0	0	0	0	0	0
	NAME	[[tah I ake Wetland Preserve	Eastern Juab County		Fish Springs NWR	Big Spring Complex	Sevier River	Clear Lake WMA	Central Utah	Sevier and Escalante Deserts	Parowan Valley	Cedar City	Southwestern Utah
	STRATUM	9 106	9.107		9.108	9.109	9.110	9.111	9.112	9.113	9.114	9.115	9.116

A pilot study is also necessary to assess the accuracy of airboat surveys of the shoreline in the Crystal Lakeside stratum (7.106). Additionally, habitat type and ability to census the marsh at Blue Lake (stratum 9.101) needs to be evaluated. Pilot studies at these two strata are of lower priority because they cover relatively small areas (e.g., 12-km² of Type 1 habitat in stratum 7.106).

Finally, the occasional aerial surveys that are recommended for surveying for all focal species in much of the Type 2 habitat need to be evaluated for accuracy and cost-effectiveness. An alternative method may be necessary if accuracy is low. Similarly, a pilot study may be needed to evaluate survey methods for the Type 2 habitat in the Interstate 80 North stratum (6.105). Sampling protocols for Type 2 habitats are lower priority than all surveys in Type 1 habitat.

Cost estimates of implementing these pilot studies will be added.

Accuracy of the Proposed Surveys

Precision

In strata where all Type 1 habitat can be accurately sampled, precision of these surveys should be relatively high. It is important for the proportion of shorebirds counted to the actual number present to be relatively constant. Observers need to evaluate constantly their ability to cover Type 1 habitat, as a change in the amount of Type 1 habitat covered could decrease precision in numbers counted. This may be an important consideration in the proposed surveys because water levels fluctuate among years and may impede access to certain areas.

More complex sampling plans for some of the strata have yet to be developed. The precision of the surveys will depend on the sampling plan.

Bias

For many strata in this region, all type 1 habitat is surveyed. Therefore, there is no potential for bias associated with selected survey areas. More complex sampling plans for some of the strata have yet to be developed. However, bias associated with these sampling plans needs to be evaluated.

In very wet years, the availability and location of suitable habitat for shorebirds may change substantially in western Utah. This is an important consideration in designing shorebird surveys for this region. Occasional surveys of dry basins (e.g., Sevier Lake) and other Type 3 habitats are recommended in years of very high precipitation to detect possible shifts in habitat suitability, and thus, use by shorebirds. These periodic surveys would reduce regional selection bias caused by the movement of birds from a surveyed area to an unsurveyed area. If these movements went undetected, trend analysis might indicate a population change, even if there is no change in numbers of shorebirds in the region.

Ground Surveys

This section describes each stratum in the study area providing the information described above. Strata are grouped into nine domains for convenience. A separate map is provided for each domain.

Domain 1. Northern Utah – Northwest



Figure 15. Domain 1, Northern Utah – Northwest

Description: Domain 1 is bordered on the west and north sides by the Utah State border. The southern border is State Rt. 30 on the west side and a straight line from the bend in Rt. 30 to the southeast corner of the Domain, which is in the uplands of the Hogup Mountains. The east border lies along small roads. The domain includes a single stratum (1.101).

Land Ownership: This domain consists of public and private lands.

Classification: The entire domain is Type 3.

Survey Method: None needed unless casual observations suggest a change in shorebird use.

Measurement Error and Measurement Bias: None.

Selection Bias: None.

Pilot Studies Needed: None.



Domain 2. Northern Utah – Northcentral

Description: Domain 2 includes the area between the north end of the Great Salt Lake and the northern Utah border. The western border is State Rt. 30 and a small road from a bend in Rt. 30 to Kelton. The southern border is small roads, lying completely north of the Locomotive Springs WMA, and SR 83 on the east side except that the border skirts Salt Wells Flat WHA (Wildlife Habitat Area), which is in Domain 5. The southeast corner of the domain is the intersection of SR 83 and I-15. The eastern border is I-15. The domain includes a single stratum (2.101).

Land Ownership: This domain consists of public and private lands.

Classification: The entire domain is Type 3 habitat.

Survey Method: None needed unless casual observations suggest a change in shorebird use.

Measurement Error and Measurement Bias: None.

Selection Bias: None.

Pilot Studies Needed: None.

Domain 3. Northern Utah – Northeast



Figure 17. Domain 3, Northern Utah – Northeast

Description: The northern and eastern boundaries of this domain are the Utah State border. The southeastern border is I-80; the western border is I-15. There are 3 strata in this domain.



Stratum 3.101. Northern Utah – Cutler Marsh

Description: This stratum is bordered by Idaho to the north and I-15 to the west. To the east and south, it is bordered by State highway 91 to Brigham City and highway 83 to I-15. It is primarily mountain and river valley habitat.

Land Ownership: This stratum consists of public and private lands.

Classification: The Bear River Portions of Cache Valley, including Cutler Marsh and Bear River Oxbow, are Type 2 habitat. The rest of the stratum is Type 3.

Survey Method: Occasional aerial survey to confirm low numbers of shorebirds in the Type 2 portions of this stratum.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 3.102. Northeastern Utah – Wasatch Range



Description: This stratum is bordered to the west by I-15, highway 83 and highway 91. To the north is the Idaho border and to the east is the Wyoming border to highway 16. The stratum boundary follows Hwy 16 to Woodruff, then turns south and follows the Saleratus River to the Wasatch Range. The border then cuts southeast to the town of Wahsatch. The southern boundary of this stratum is I-80. The habitat is primarily mountains.

Land Ownership: This stratum consists of public and private lands.

Classification: Entire stratum is type 3 habitat.

Survey Method: None needed unless casual observations suggest a change in shorebird use.

Measurement Error and Measurement Bias: None.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 3.103. Northeastern Utah – Neponset Reservoir

Figure 20. Stratum 3.103, Northeastern Utah – Neponset Reservoir



Description: The northern border of this stratum is highway 16 to Woodruff. At Woodruff, the border turns south to Saleratus Creek, which it follows to the Wasatch Range. From the Wasatch

Range the border run SE to the town of Wahsatch. The southeastern border is I-80 and the eastern border is Wyoming. Neponset Reservoir is primarily surrounded by uplands.

Land Ownership: This stratum consists of public and private lands.

Classification: Neponset Reservoir is Type 2 habitat. The rest of stratum is Type 3.

Survey Method: Occasional ground surveys to confirm low numbers of focal shorebirds at Neponset Reservoir.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Domain 4. Northern Utah – Southwest



Description: The western border of domain 4 is the Utah border. The northern border is SR 30 in the west and a straight line from the bend in Rt. 30 to the southeast corner of the Domain, which is in the uplands of the Hogup Mountains. The southern border is I-80. The evaporation basin is dry, but it could fill after a major weather event like the flood years of the 80s.

Land Ownership: This domain consists of public and private lands.

Classification: The entire domain is classified as Type 3. However, if a major weather event causes the basin to fill, the area should be surveyed for shorebird use.

Survey Method: None needed unless casual observations suggest a change in shorebird use.

Measurement Error and Measurement Bias: None.

Selection Bias: None.

Pilot Studies Needed: None.

Domain 5. Great Salt Lake - North



Description: Domain 5 is the northern arm of the Great Salt Lake. The western border is a small road from SR 30 in the north to the Hogup station on the causeway. The north border is a

line through upland areas from SR 30 the Locomotive Springs area and then a small road from there to I-15. The eastern border is I-15. The southern border is the causeway. The domain includes all of the Locomotive Spring WMA and Salt Wells Flat WHA. The domain has been divided into 4 strata.



Stratum 5.101. Locomotive Springs WMA

Description: Stratum 5.101 includes the Locomotive Springs WMA and surrounding land from Monument Point on the east to the mouth of Deep Creek on the west, and from deep, open water on the south to upland areas (unsuitable for shorebirds) on the north.

Locomotive Springs WMA was surveyed on the Great Salt Lake Waterbird Survey (area 35). The mean numbers/survey (>10) recorded in July and August, for the more common species, were WIPH–50, WESA – 49, SNPL – 41, BNST – 21, KILL – 20, AMAV – 16, LBDO – 14, WILL – 10, and SAND – 8. Breeding SNPL have been documented in Locomotive Springs. Of the 20,000 acre WMA, 17% is good waterbird habitat, and 25% of this was covered in the WBS. This stratum can be covered easily on foot and visibility is good.

Land Ownership: The WMA is administered by the Utah Division of Wildlife Resources (UDWR).

Classification: When water is available, Locomotive Springs WMA is Type 1 habitat. The rest of the stratum is Type 3.

Survey Methods: Census of all Type 1 habitat, including mudflats, by foot surveys.

Measurement Error and Measurement Bias: Minimal. All Type 1 habitat surveyed.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 5.102. Salt Wells Flat WHA



Description: This stratum is a large complex of impounded water with islands of emergent vegetation. The survey area includes all established management units and outflow areas that are a part of Salt Wells Flat WHA. High shorebirds numbers occur in this area in spring when water is available. An ATV is needed for travel.

Salt Wells Flat WHA was surveyed on the Great Salt Lake Waterbird Survey (areas 36, 36A, and 36B). The mean numbers recorded in July and August, for the more common species, were SNPL – 369, BASA – 257, AMAV – 58, BNST – 27, WESA – 24, WIPH – 23, WILL – 20, KILL – 15, and LBDO – 13. All suitable habitat was surveyed (40% of total area). Visibility on the open mud flats was 100%, but approximately 65% at the ponds because tall, emergent vegetation blocked views. Access is good but an observation tower could increase visibility. Mud is often soft making it difficult to walk on flats.

Land Ownership: Salt Wells Flat WHA is managed by the Bureau of Land Management (BLM).

Classification: The mud flats are Type 1, the drainages are Type 2 habitat, and the rest of the stratum is Type 3 habitat.

Survey Methods. Conduct complete counts of mud flats using ATVs, plus occasional ground surveys of ponds and drainages.

Measurement Error and Measurement Bias: Minimal. All Type 1 habitat surveyed.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 5.103. Northwest Great Salt Lake



Description: This stratum covers the western side of the Great Salt Lake within Domain 5. It was not surveyed during the Great Salt Lake Waterbird Survey. SNPLs breed in small numbers around the seep, but there are few shorebirds present during migration.

Land Ownership: This stratum is mostly public land.

Classification: Entire stratum is Type 3 habitat.

Survey Method: None needed unless casual observations suggest a change in shorebird use.

Measurement Error and Measurement Bias: None.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 5.104. Great Salt Lake – West of Promontory Mountains

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Figure 26. Stratum 5.104, Great Salt Lake – West of Promontory Mountains

Description: This stratum covers the eastern side of the Great Salt Lake within Domain 5. It was not surveyed during the Great Salt Lake Waterbird Survey. There is a spring driven wetland at Rozel Bay that shorebirds use in moderate numbers.

Land Ownership: This stratum consists of public and private lands.

Classification: The area around Rozel Bay is Type 2 habitat, and the rest of the stratum is Type 3.

Survey Method: None needed unless casual observations suggest a change in shorebird use.

Measurement Error and Measurement Bias: None.

Selection Bias: None.

Pilot Studies Needed: None.



Domain 6. Great Salt Lake – Southwest

Description: This domain consists of 5 strata that together cover the southwestern portion of the Great Salt Lake.

Stratum 6.101. Great Salt Lake – Westcentral

Description: This stratum covers the west central portion of the Great Salt Lake from the causeway south to the western-most point of Carrington Bay. It includes the uplands in the Lakeside Mountains west to the small road that forms the domain border. It also includes a substantial portion of open lake where none of the shorebird species covered in the ground surveys (excluding avocets and black-necked stilts) occur.

This stratum was covered in the Great Salt Lake Waterbird Survey (area 43). Among the focal species for this survey, only WESAs were recorded regularly (mean of 83 during July and August). Hundreds to thousands of AMAV, BNST, and WIPH were also recorded. This area was surveyed from the ground from 3 viewpoints. The shoreline is not visible along the whole

route so counts were made from good viewing vantage points. The surveyors thought they were able to see most of the birds.

Land Ownership: The U.S. Air Force manages most of this stratum. Access is permitted only with military escort. Hat Island is owned by the State of Utah.

Classification: The stratum is all Type 3 habitat except for the narrow shoreline zone, which is Type 2 habitat.

Survey Method: Occasional ground surveys of shoreline to confirm low numbers of focal species.

Measurement Error and Measurement Bias: Minimal if detection rates are high.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 6.102. Great Salt Lake – Stansbury Bay



Figure 28. Portion of stratum 6.102 covered in the GSL WBS.

Description: This stratum consists primarily of solar evaporation ponds, with some shallow water near a dike road. This latter portion was covered in the Great Salt Lake Waterbird Survey (area 40, Figure 28) by an observer in vehicle who counted birds on both sides of the road. An employee of the industry conducted these surveys. Mean numbers recorded in July and August were WESA -357, PEEP -606, and LESA -146 as well as thousands of AMAV and WIPH. Detection rates were high. The evaporation ponds are not used by shorebirds.

Land Ownership: Everything to the south of the dike road is now primarily solar evaporation ponds that are privately owned. The area north of the dike road is managed by the State of Utah.

Classification: This stratum is Type 3 habitat except for the shallow water on either side of the dike road, which is Type1.

Survey Method: Ground surveys from the dike road are adequate to census Type 1 habitat.

Measurement Error and Measurement Bias: Minimal. All Type 1 habitat was surveyed.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 6.103. Great Salt Lake – Stansbury North

Description: This stratum covers the shoreline on the east side of the Stansbury Mountains from the north tip of the island to the pump station at their south end. Access to this area was refused during the GSL WBS but it was covered by air. A few hundred AMAVs were recorded but virtually no other shorebirds.

Land Ownership: Some of the shoreline in this stratum belongs to the BLM. However, access is through private land, which was denied.

Classification: The shoreline is Type 2 habitat. The remainder of the stratum is Type 3.

Survey Method: Occasional aerial survey to confirm the absence of birds in this Stratum.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 6.104. Great Salt Lake – Stansbury South



Figure 29. Stratum 6.104, Great Salt Lake – Stansbury South

Description: The north boundary of this stratum is an east-west line extending through the pump station at the south edge of the Stansbury Mountains. The west boundary runs along the Salt Evaporation Ponds to I-80. I-80 forms the south border, which extends east to directly south of the southernmost point of the Great Salt Lake (between ponds to the south and north sides of I-80). The east border is a north-south line extending north from the southeastern corner of the stratum.

The shoreline of this stratum was surveyed in the GSL WBS (area 3). Significant numbers of the focal shorebirds were recorded including (means for July and August) WESA 1767, PEEP 970, LESA 306, SNPL 150, BASA 68, and LBDO 38. Most, or all, suitable habitat for the focal shorebirds is along the shoreline but birds sometimes roost well up on the beach so these areas should be checked occasionally to confirm that few birds are present.

Visibility along the shoreline is good, although at times soft mud prevents close approach to the shore making identification of small shorebirds difficult. The survey is conducted on an ATV.

Land Ownership: The land in this stratum is managed by the BLM and the State of Utah.

Classification: The shoreline is Type 1 habitat and the rest of the stratum is Type 2.

Survey Method: Ground census of shoreline habitat using ATV or airboat with occasional ground surveys of Type 2 habitat.

Measurement Error and Measurement Bias: Minimal. All Type 1 habitat is surveyed.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 6.105. Great Salt Lake – Interstate 80 North



Description: The southwest corner of this stratum is just west of the small pond west of the Salt Evaporator. From that point, the boundary follows I-80 east to Black Rock. The north boundary is well out into the Great Salt Lake (Figure 27).

The area was surveyed on the GSL WBS with separate counts being made for the shoreline (area 5a) and the area between the railroad and I-80 (area 5b). Neither area had many shorebirds (WESA 107, KILL 22). Most of the WESAs were in the ponds; most of the KILLs were along the shore. Visibility was reported as moderate or poor for the ponds due to long viewing distances. On the north side, all shoreline was visible. However, looking to the south, some areas of the shoreline habitat are too far away to accurately identify shorebirds.

Land Ownership: Access to this stratum is through the Union Pacific Railroad. The area between the railroad and I-80 is privately owned.

Classification: The shoreline and ponds are Type 2 habitat. The remainder of the stratum is Type 3.

Survey Methods: Periodic driving surveys along the railroad will cover most of the shoreline. If appropriate for Type 2 habitat sampling, a pilot study is needed to determine how to survey the shoreline areas with long viewing distances and how to survey the ponds.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None needed unless Type 2 habitat sampling requires complete coverage. In which case a pilot study is needed to determine the best method for surveying the southern shoreline and ponds.



Domain 7. Great Salt Lake – Farmington Bay

Description: Domain 7 includes Farmington Bay and surrounding area east to I-15, south to I-80, west to Gilbert Bay (including Antelope Island), and north to Ogden Bay. Important shorebird areas in this domain include the Farmington Bay shoreline including the Antelope Island Causeway, Farmington Bay WMA, private duck clubs, and the southeast shore of Gilbert Bay. There are thirteen strata in this domain.

Stratum 7.101. Great Salt Lake – Antelope Island West

Description: This stratum covers the west side of Antelope Island from its northern tip to its southern tip and some open water of the Great Salt Lake. A small portion of this stratum (near the road from the Antelope Island State Park) was surveyed as part of the GSL WBS. The only means >10 for the focal shorebirds were for SAND (16) suggesting that this stratum has minimal numbers. No other data were gathered, but the majority of the west side is rocky with little beach and is unsuitable for shorebirds. Larger shorebirds, such as avocets or stilts, are also absent from the west side observations.

Land Ownership: Managed by Antelope Island State Park.

Classification: The shoreline is Type 2 habitat and the rest of the stratum is Type 3.

Survey Methods: Occasional ground surveys of the shoreline.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 7.102. Great Salt Lake – Antelope Island Causeway



Description: This stratum lies along the Causeway extending well out into open water (farther than the focal shorebirds would occur). The area was surveyed in the GSL WBS (area 16) but none of the focal birds were recorded in appreciable numbers. It is possible that appreciable numbers of birds were missed because the observer usually drove the causeway without stopping to cover portions of the shore not visible due to rocks.

Land Ownership: Managed by Antelope Island State Park. The access road belongs to Davis County.

Classification: This stratum is Type 2 habitat.
Survey Methods: Driving the causeway and stopping anytime the shore is not visible will provide essentially complete coverage.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 7.103. Great Salt Lake – Antelope Island Northeast

Description: This stratum includes the northeast shore of Antelope Island from the northern tip to the tip of Sea Gull Point. This area was surveyed in the GSL WBS (area 14) from the road. Distances were often too great to detect small shorebirds. Mean survey counts for the focal shorebirds were all <10.

Land Ownership: Managed by Antelope Island State Park.

Classification: The shoreline is Type 2 habitat; the rest of the stratum is Type 3.

Survey Methods: We used occasional aerial surveys to document low numbers of focal shorebirds along the shoreline, although if deemed necessary the area could be covered more thoroughly on the ground.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 7.104. Great Salt Lake – West Layton

Description: The Antelope Causeway and SR 127 border this stratum to the north and I-15 borders it to the east. The line is perpendicular from I-15 and passes though the peregrine hacking tower on the Layton Preserve; it has open water to the west. Suitable shorebird habitat includes the shoreline and a small area of wetland. The stratum was surveyed in the GSL WBS (area 18) but the only means >10 for the focal shorebirds were WESA 14 and WILL 15. The Miller ponds were not included in the GSL WBS but could be accessed and viewed easily. Visibility on the GSL WBS was good but in some cases that soft mud in the south prevented complete counts. Detection rate for the shoreline was approximately 95%. If observers walk into the ponds for viewing, there is an estimated 85% detection for the wetlands.

Land Ownership: Land in this stratum is publicly and privately owned.

Classification: The shoreline is Type 2 habitat and the rest of the stratum is Type 3.

Survey Methods: We conducted occasional aerial surveys to document low numbers of focal species on the shoreline. If deemed necessary an airboat might provide better complete coverage.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 7.105. Great Salt Lake – Antelope Island Southeast

Description: In this stratum, the southern border along the shore is the Goggin Drain; the eastern border is the west end of the Crystal Unit of the Farmington Bay WMA. The western border follows Antelope Island North to Sea Gull Point. This stratum was covered by the GSL WBS (areas 9a, 9b, and the southern end of 14). After the survey, it was decided to combine these areas. The means >10 for focal shorebirds were WESA 278, SNPL 74, PEEP 60, and BASA 12. The extent of suitable shorebird habitat between the shore of the mainland and Antelope Island varied substantially. Although soft mud was sometimes a problem, birds could usually be surveyed completely from one or both sides of the stratum.

Land Ownership: This area is managed by the Antelope Island State Park and the State of Utah.

Classification: The entire stratum is Type 1 habitat, although in any given year some areas will be unsuitable for shorebirds.

Survey Methods: Surveyors counting simultaneously from both sides would provide complete coverage. An ATV may permit closer approach when mud is soft.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 7.106. Great Lake Salt – Crystal Lakeside



Figure 33. Strata 7.106 and 7.107, Crystal Lakeside and Farmington Bay Lakeside

Description: This stratum includes the shoreline from the southernmost major drainage on the Crystal Unit of Farmington Bay WMA to the southwest elbow of the Turpin dike. The Farmington Bay WMA is immediately inland, so this stratum does not include any unsuitable uplands. It was surveyed as area 10 in the GSL WBS. Mean survey counts >10 for focal shorebirds were WESA 465, PEEP 121, GRYE 23, and BBPL 24. This survey was a total count conducted from an airboat.

Land Ownership: The Utah Division of Wildlife Resources manages the Wildlife Management Area. There are also privately owned duck clubs and agricultural areas in this stratum.

Classification: The shoreline is Type 1 habitat and the rest of the stratum is Type 3.

Survey Methods: Uncertain. Pilot study or more information needed.

Measurement Error and Measurement Bias: Uncertain.

Selection Bias: Uncertain.

Pilot Studies Needed: The airboat worked fairly well, though some concerns were expressed about the completeness of counts. More work is needed to evaluate the airboat surveys.

Stratum 7.107. Great Salt Lake – Farmington Bay Lakeside

Description: The shoreline and associated narrow beach form the southeast side (the Farmington Bay WMA lies immediately inland) of this stratum. The shoreline extends from the southwest elbow of the Turpin dike to the Egg Island observation point. It was surveyed as area 10 in the GSL WBS. The only mean for focal shorebird >10 was for WILL (11). Visibility was good.

Land Ownership: The State of Utah manages most of this stratum.

Classification: The entire stratum is Type 2.

Survey Methods: Occasional aerial surveys to confirm low numbers of focal species in the stratum.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 7.108. Great Salt Lake – West Farmington

Description: This stratum includes the shoreline from the Egg Island Observation point to the drainage due west of the north end of the Davis County Sewer Plant. It was surveyed in the GSL WBS (area 13). None of the mean survey counts for focal species were >10.

Land Ownership: This stratum consists of public (state and county) and private lands.

Classification: The shoreline is Type 2 habitat. The remainder of the stratum is Type 3.

Survey Methods: Occasional aerial or airboat survey to confirm low numbers of focal species.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 7.109. Great Salt Lake – West Kaysville

Description: This stratum extends from the drainage ditch due west of the north end of the Davis County Sewer Plant to the peregrine hack tower on The Nature Conservancy property. It includes the wetlands between the shoreline and I-15. It was covered as areas 17a (interior wetlands) and 17b (shoreline) in the GSL WBS. Mean survey counts in July and August for interior wetlands were: WESA 22, PEEP 130, LESA 14, WILL 22; and for the shoreline were: WESA 474, LESA 224, WILL 23. Visibility was good along the shoreline but not on the wetlands due to vegetation and lack of access.

Land Ownership: Primarily owned by Davis County, The Nature Conservancy, and the State of Utah.

Classification: The shoreline and wetlands are Type 1. The uplands are Type 2 habitat.

Survey Methods: Walking survey is effective for the shoreline; methods to be determined for the wetlands. Depending on the lake elevation the shoreline/mud toe may be better accessed by airboat.

Measurement Error and Measurement Bias: Minimal for the shoreline; uncertain for the wetlands.

Selection Bias: NA for the shoreline; uncertain for the wetlands.

Pilot Studies Needed: Survey methods need to be developed for the wetlands.

Stratum 7.110. Farmington Bay WMA

Description: This stratum includes the Farmington Bay WMA and surrounding areas. It was surveyed in the GSL WBS (area 12). Mean survey counts for focal species >10 were: LBDO 1516, WESA 975, UNYE 197, PEEP 25, LESA 25. Surveys were made from the dikes. Visibility is often poor due to long distances and tall vegetation. Substantial areas in the eastern part of the WMA were not surveyed but probably do not have many birds.

Land Ownership: The WMA is administered by UDWR.

Classification: The wetlands are Type 1 habitat, and the rest of the stratum is Type 3.

Survey Methods: A better "interior wetlands" survey method needs to be developed.

Measurement Error and Measurement Bias: Uncertain.

Selection Bias: Uncertain.

Pilot Studies Needed: Develop an interior wetlands survey for this area.

Stratum 7.111. Great Salt Lake – Saltair

Description: The shoreline in stratum 7.111 extends from Black Rock to the old Saltair railroad grade. It was surveyed as area 6 in the GSL WBS. Mean survey counts for focal shorebirds >10 were: PEEP - 41, WESA - 23, KILL - 17.

Land Ownership: This area is primarily public with some private lands. Both require administrative access at times.

Classification: The shoreline is Type 1 habitat, and the rest of the stratum is Type 3.

Survey Methods: Survey from road with occasional walking needed for complete coverage.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 7.112. Great Salt Lake – Kennecott

Description: This stratum includes the shoreline between the old Saltair railroad grade and the Goggin Drain and all ponds on the Kennecott Inland Sea Shorebird Reserve. It was surveyed as areas 8A (shoreline) and 8C (interior wetlands) in the GSL WBS. Mean survey counts >10 for focal shorebirds for the shoreline were: WESA 99, PEEP 12 and for the interior wetlands were: WESA 530, PEEP 54, SNPL 83, WILL 12.

Land Ownership: This stratum consists of public (state) and private lands.

Classification: The shoreline and interior wetlands are Type 1 habitat. The rest of the stratum is Type 2 habitat.

Survey Methods: Survey shoreline and wetlands by foot.

Measurement Error and Measurement Bias: Minimal. All Type 1 habitat was surveyed.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 7.113. Associated Duck Clubs

Description: This area includes all Ambassador Duck Club and Harrison Duck Club properties, and any other property where access is obtained within the Associated Duck Club area. Approximately 90% of this stratum is appropriate waterbird habitat, as there is some ephemeral, upland playa.

The Ambassador and Harrison Duck Clubs were surveyed in the GSL WBS (area 7), which covered 15% of the area. Mean survey counts for focal species (>10) were: PEEP – 41, WESA – 23, KILL – 17. It is possible to cover the entire area and access is good. Permission from the various duck clubs is necessary, and observers may need to use a boat to navigate the North Point Duck Club.

When the lake elevation is low and water isn't coming into the ponds, tall vegetation (e.g., *Phragmites*) takes over. Some of the clubs get rid of it and manage for the shorter wetland vegetation. Visibility was uninhibited for most of the surveyed area, though in some cases (large ponds) viewing distances were too great to have 100% detectability. It would be possible to walk around ponds to get better views. In areas with tall vegetation, one could probably see into the ponds from an observation platform.

AMAV and BNST are well distributed throughout the surveyed portion of this stratum. There is no known area with good habitat for PEEP. When the lake elevation was higher there were more SNPL. WESA are usually near the large western pond.

Land Ownership: The entire stratum is managed by the Associated Duck Clubs.

Classification: There are some scattered Type 2 areas but the rest of the stratum is Type 3.

Survey Methods: Census periodically with ground and boat surveys to confirm low numbers of focal species.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Domain 8. Great Salt Lake Northeast



Description: Domain 8 includes the Bear River and Ogden Bay areas of Great Salt Lake. Important shorebird areas in this domain are the Bear River NWR, and the Harold Crane and Ogden Bay Wildlife Management Areas. There are seven strata in this domain.

Stratum 8.101. Great Salt Lake Northeast – Salt Creek



Description: This stratum includes Public Shooting Grounds WMA, Salt Creek WMA, Bear River Duck Club, Chesapeake Duck Club, Sulphur Creek, and the Reeder Overflow. Fifty–five percent of the Salt Creek WMA is good waterbird habitat, but tall vegetation reduced GSL WBS survey coverage to only 35% of the WMA (area 33). Mean survey counts (>10) for focal species were WIPH – 18, LBDO – 14, KILL – 10, and GRYE – 12. There were also hundreds of AMAV and BNST. Detection rate for the larger shorebirds is estimated at 99%; however, tall vegetation reduces detection of smaller shorebirds. An observation tower might increase detection in these areas. The 12,000 acre Public Shooting Grounds WMA also has 70% good waterbird habitat, but only 20% was covered in GSL survey (area 32). Mean survey counts (>10) for focal species were WIPH – 17 and GRYE – 17. There were also hundreds of AMAV and BNST. There is a large expanse of potholes that is not visible from the dike roads, but would be visible from a plane. Chesapeake, Sulphur and Reeder have not been included in previous survey efforts.

Land Ownership: The WMAs are managed by UDWR. The rest of the stratum is privately owned.

Classification: The WMAs, Duck Clubs and associated wetlands, and flood irrigated pastures are Type 2 habitat. The rest of the stratum is Type 3.

Survey Methods: Occasional aerial surveys to verify absence of substantial numbers of focal species.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 8.102. Great Salt Lake Northeast – Bear River NWR



Description: Bear River National Wildlife Refuge (NWR) is a large, important area for shorebirds; however, the habitat changes dramatically due to management regimes and flood events that remove vegetation. Visibility is often low, and access to all areas of the refuge is questionable.

This area was surveyed on the GSL Waterbird Survey (areas 29a and 29b). Area 29b was along the refuge road and had low numbers (<10) of focal species. Mean survey counts (>10) for focal species for areas 27 and 29a were WIPH – 3684, WESA – 4619, LBDO – 3510, MAGO – 4938, GRYE – 11, and LEYE – 12. Tens of thousands of AMAV and thousands of BNST were also counted.

Land Ownership: The NWR is administered by the U.S. Fish and Wildlife Service.

Classification: Much of the refuge is Type 1 habitat, although there may be areas of Type 2 or 3 habitat. More work is needed to identify all Type 1 habitat.

Survey Method: A pilot study is needed.

Measurement Error and Measurement Bias: Unknown.

Selection Bias: Unknown.

Pilot Studies Needed: A pilot study is needed to classify all areas by habitat Type and to assess whether there are areas of inaccessible Type 1 habitat. If all Type 1 habitat cannot be surveyed, then a sampling plan will be needed where a small, random sample of the inaccessible Type 1 habitat is surveyed each year.

Stratum 8.103. Great Salt Lake Northeast – Bear River Bay



Description: This stratum is sandwiched between the Harold Crane WMA on the south and the Bear River Migratory Bird Refuge D-line dike to the north. This area can be dry or wetlands, depending on the lake level and the amount of fresh water inflow into Bear River Bay and the Willard Spur.

Bear River Bay (area 37), Willard Spur (area 28), and South Bear River (area 27) were surveyed on the GSL Waterbird Survey. Mean survey counts (>10) for the Bear River Bay were

WIPH – 8215, LBDO – 212, MAGO – 22, PEEP – 1428, and PHAL – 63. Mean survey counts (>10) for Willard Spur were WIPH – 965, LBDO – 2373, MAGO – 1398, and PEEP – 231. There were also thousands of AMAV and BNST on both surveys. These areas were surveyed by transects from the air. The count data were extrapolated to cover the whole area; therefore, the entire stratum was not covered completely. Detection rates were relatively low because of fast travel speeds of the aircraft and some shorebirds hide in the vegetation.

Land Ownership: This area consists of state and private lands.

Classification: The Willard Spur area north and east of the evaporation ponds is Type 1 habitat. West of the evaporation ponds is Type 2 habitat

Survey Methods: Surveys of the Willard Spur by airboat will provide complete coverage. Occasional aerial surveys for the rest of the stratum are adequate to confirm the absence of substantial numbers of focal species.

Measurement Error and Measurement Bias: Minimal. All Type 1 habitat sampled.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 8.104. Great Salt Lake Northeast – Ogden Bay North



Description: This stratum is a shoreline piece from the north fork of the Weber River to the railroad tracks. It was surveyed in the GSL Waterbird Surveys by airboat (area 22). Mean survey counts (>10) for focal species were WIPH - 857 and WILL - 17. There were also

hundreds of AMAV and BNST. Counts do not include gulls and other birds directly associated with Landing Rocks. Public access is good.

Land Ownership: The state, the military, and private landowners own the land in this stratum. The state leases some of their land.

Classification: The shoreline is Type 2 habitat and the rest of the stratum is Type 3.

Survey Methods: An occasional foot or ATV survey is needed to confirm low numbers of focal species.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 8.105. Great Salt Lake – Ogden Bay



Description: This area is a large complex of impounded water and emergent vegetation. It includes all of the impoundments and drivable interior dikes of the Ogden Bay WMA. Since 1997, all vegetation in Unit 3 has been dead. Stands of alkali bulrush are growing on the outside of Unit 1. Unit 3 dike is breached. This stratum is 16,700 acres, and 100% of area was surveyed in the GSL Waterbird Surveys. Eighty percent of the WMA is good waterbird habitat, but only 60% was visible. In good areas detection rates were 90+%. The WMA was subdivided into

Type 1, 2 and 3 on a map. The non-visible areas had tall vegetation and deep water; therefore, they may not be as good for shorebirds as the visible areas. Near Unit 1 there is viewing difficulty near the grass island. A spotting scope or boat might provide better viewing in this area.

This was area 20 on the GSL Waterbird Survey. Mean survey counts (>10) were WESA - 83, WIPH - 2313, LBDO - 131, MAGO - 13, PEEP -109, LESA - 16, WILL - 48, KILL - 13, GRYE - 69, LEYE - 32, and thousands of AMAV and BNST.

Land Ownership: The WMA is managed by UDWR. The rest of the stratum is privately owned.

Classification: 60% of the WMA is Type 1 habitat for shorebirds. Three km^2 of the WMA is Type 2 habitat. The rest of the stratum is Type 3.

Survey method: A pilot study is needed to determine whether all Type 1 habitat is visible.

Measurement Error and Measurement Bias: Uncertain.

Selection Bias: Uncertain.

Pilot Study Needed: Need to verify shorebird use in the areas not visible in GSL Waterbird Surveys and to assess the effectiveness of spotting scopes or boats for increasing visibility.

Stratum 8.106. Great Salt Lake Northeast – Howard Slough WMA

Description: The shoreline section extends between the Antelope Island North causeway and the WMA dike. The WMA includes the area on the lakeside of the dikes from the north end of the shoreline section to the south fork of the Weber River on the Ogden Bay, and the drivable impoundments in Howard Slough WMA. This area has a shoreline portion and large complexes of impounded water and emergent vegetation. The WMA covers 3,197 acres, of which 85% was covered by survey. Ninety–five percent of the WMA is good waterbird habitat. The outer dikes were washed out in 1997. Salt water was then able to reach the marsh vegetation. The high salinity of the water killed the plants, which resulted in increased visibility. However, due to the breach in the dike, travel was impossible. Observations had to be made at either end of the impoundment. The increased distances made visibility and identification more difficult, especially seeing PEEPs. The secondary ponds can be good for shorebirds. One pond is drawn down each year on a rotating basis.

This area was surveyed on the Great Salt Lake Waterbird Survey (areas 19a, 19b, and 19c). The only focal species that had mean survey counts >10 were LBDO – 22 and WIPH – 17. Thousands of AMAV and hundreds of BNST were also counted.

Land Ownership: The WMA is managed by UDWR.

Classification: The draw down pond is Type 1 habitat; otherwise the water is too deep and secondary ponds are Type 3. There are other areas of Type 1, 2, and 3 habitat in the WMA and these have been subdivided on a map. The rest of the stratum is Type 3 habitat.

Survey method: Ground surveys of draw down pond and occasional aerial surveys of the rest of the stratum.

Measurement Error and Measurement Bias: Minimal because all Type 1 habitat surveyed.

Selection Bias: None.

Pilot Study Needed: None.

Stratum 8.107. Great Salt Lake Northeast – Harold Crane WMA



Description: This stratum includes the Harold Crane WMA, South Harold Crane and Rainbow areas. It is a large complex of impounded water and emergent vegetation and covers 11,430

acres. Fifty percent of the stratum is good waterbird habitat. Some of the waterbird habitat is on private land. Approximately one-third of the strata (4,000 acres) has good visibility. The three areas are adjacent to one another and have been surveyed as one route. The Rainbow site includes the George East Duck club and Rainbow pond and is a total count survey from existing roads. The South Harold Crane survey is a total count within the gravel road through the UDWR gate on the east, the GSL Minerals Company canal on the north and west, and the railroad tracks on the south. The Harold Crane WMA survey is a total count from all drivable interior dikes within the WMA.

The Harold Crane WMA includes areas 23, 24, and 25 of the GSL Waterbird Survey. Mean survey counts (>10) of focal species were WIPH – 104, LBDO – 297, MAGO – 111, and LEYE – 14. Thousands of AMAV and hundreds of BNST were also counted. Some good peep areas were missed by the WBS survey. Areas not covered in the WBS are accessible by foot. The southwest corner is privately owned and may have good peep use.

Land Ownership: The entire stratum is managed by UDWR.

Classification: Approximately 50% of the WMA areas are Type 1 habitat and approximately 10% are Type 2 habitat. The rest of the stratum is Type 3 habitat.

Survey Methods: Uncertain. A pilot study is needed.

Measurement Error and Measurement Bias: Uncertain.

Selection Bias: Uncertain.

Pilot Studies Needed: A study is needed to assess whether all Type 1 habitat can be surveyed completely.

Domain 9. Southwest Utah



Description: Domain 9 is bordered by Nevada to the west, I-80 to the north, I-15 to the east and Arizona to the south. Much of the domain is dry desert habitat unsuitable for shorebirds, although there are small wetland areas interspersed throughout the domain. Fish Springs NWR and Utah Lakes are two important shorebird areas. There are sixteen strata in Domain 9.

Stratum 9.101. Southwest Utah – Blue Lakes



Figure 42. Stratum 9.101, Southwest Utah – Blue Lakes

Description: This stratum is bordered to the west by Nevada, to the north by I-80 and the town of Wendover. The Great Salt Desert is to the east and south. Much of the land is actively used Military land, and the southwestern tip of the stratum is the Military Boundary. The northeastern tip is the location of Arinosa. Blue Lake and the surrounding ponds and marshes are the only areas suitable for shorebirds in this stratum. The *Birding Utah* guide lists SEPL, MOUP, BNST, AMAV, GRYE, LEYE, and WILL in this area. There is a good observation point of the marsh area from a 10' tall rock on the west side of Blue Lake.

Land Ownership: The Blue Lake area is managed by the BLM. The rest of the stratum is primarily military land.

Classification: Blue Lakes and surrounding marshes are Type 1 or 2 habitat. The rest of the stratum is type 3.

Survey Method: A pilot study is needed to determine survey method and habitat type.

Measurement Error and Measurement Bias: Uncertain.

Selection Bias: Uncertain.

Local Contact: BLM, Salt Lake Field Office, Curtis Warick 801-977-4332 or Nate Packer 801-997-4351.

Pilot Studies Needed: This area is small and a complete survey may be feasible. A pilot study is necessary to assess the accuracy of a shorebird census and to confirm habitat type.



Stratum 9.102. Southwest Utah – Great Salt Lake Desert

Description: The entire stratum is a dry, salt basin and is unsuitable for shorebirds. It includes the Cedar Mountains, Skull Valley, and Dugway Proving Grounds. The southern border for this stratum is the southern border of Tooele County. Fish Springs NWR and Goshute Indian Reservation are not included in this stratum.

Land Ownership: This stratum consists of public and private lands.

Classification: All habitat is Type 3 for shorebirds.

Survey Method: None needed unless casual observation suggests a change in shorebird use.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 9.103. Southwest Utah – Oquirrh Mountains



Description: County road that runs through Skull Valley from Timpie to Dugway is the western border of this stratum. The eastern border is State Highway 68, just west of Utah Lake. The southern border is the southern edge of Sheeprock Mountains in the Wasatch National Forest to Tintic and Highway 6 to State Highway 68. This stratum is unsuitable for shorebirds.

Land Ownership: This stratum consists of public and private lands.

Classification: Entire stratum is Type 3 habitat.

Survey Method: None needed unless casual observation suggests a change in shorebird use.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.



Stratum 9.104. Southwest Utah – North Shore Utah Lake

Description: This stratum is bordered to the west by state Highway 68, to the north by Highway 73, and to the east by I-15. The southern boundary runs south of the cooling ponds and across the lake to Pelican Point. The habitat is primarily playa, marsh, shoreline, and open water. Good numbers of shorebirds are found in the wetlands near the mouth of the Jordan River and Spring Creek. The shoreline sees moderate use by shorebirds when the lake level is lower, which is usually in the late summer and fall. Visibility is also better during fall migration, as shorebirds congregate on the open mudflats. Early morning surveys are recommended to decrease the glare from the sun, which can decrease visibility. Access to viewing areas is good.

Land Ownership: Much of the land in this stratum is private or managed by the Bureau of Reclamation.

Classification: Casual observations suggest the wetlands near the mouth of the Jordan River and Spring Creek are Type 1 habitat and the remaining shoreline is Type 2 habitat. The rest of the stratum is Type 3.

Survey Methods: A pilot study is needed.

Measurement Error and Measurement Bias: Uncertain.

Selection Bias: Uncertain.

Local Contact: David Lee, UDWR, 801- 538-4751 or Russ Lawerence, UDWR, 801-510-7062.

Pilot Studies Needed: A pilot study is needed to confirm habitat classifications and to assess whether all Type 1 habitat can be surveyed accurately.

Stratum 9.105. Southwest Utah – Central Utah Lake



Description: This stratum is bordered to the west by state Highway 68. At the Goshen Valley, the stratum border crosses the lake to the West Mountains and turns south to Highways 141 and 6. The southern border is Highway 6 to Santaquin and the eastern border is I-15. The habitat consists of playa, marsh, shoreline, mountain and open water. Good numbers of shorebirds are

found in Powell Slough WMA, Provo Bay and Benjamin Slough. The shoreline sees moderate use by shorebirds when the lake level is lower, which is usually in the late summer and fall. Visibility is also better during fall migration, as shorebirds congregate on the open mudflats. Early morning surveys are recommended to decrease the glare from the sun, which can decrease visibility. Access to viewing areas is good.

Land Ownership: Much of the land in this stratum is private or managed by the Bureau of Reclamation. The Benjamin Slough area is being considered for preserve status.

Classification: Casual observations suggest the wetlands of Powell Slough WMA, Provo Bay and Benjamin Slough are Type 1 habitat and the remaining shoreline is Type 2 habitat. The rest of the stratum is Type 3.

Survey Methods: A pilot study is needed.

Measurement Error and Measurement Bias: Uncertain.

Selection Bias: Uncertain.

Local Contact: David Lee, UDWR, 801- 538-4751 or Russ Lawerence, UDWR, 801-510-7062.

Pilot Studies Needed: A pilot study is needed to confirm habitat classifications and to assess whether all Type 1 habitat can be surveyed accurately.

Stratum 9.106. Southwest Utah – Utah Lake Wetland Preserve



Figure 47. Stratum 9.106, Southwest Utah – Utah Lake Wetland Preserve

Description: This stratum consists of the Utah Lake Wetlands Preserve and the surrounding Goshen Valley. It includes the Warm Springs WMA. The southern border is Highway 6 to Goshen and the Long Ridge Mountains. The habitat is primarily playa, marsh, shoreline and open water. Warm Springs WMA is primarily tall emergent marsh used by large waders and rails. Good numbers of shorebirds are found in the wetlands near White Lake and the southern tip of Utah Lake. The shoreline sees moderate use by shorebirds when the lake level is lower, which usually occurs in the fall. Visibility is also better in the fall, as shorebirds congregate on the open mudflats. Early morning surveys are recommended to decrease the glare from the sun, which can decrease visibility.

Land Ownership: The Utah Lake Wetland Preserve and Warm Springs WMA are managed by the Utah Division of Wildlife Resources. The remainder of this stratum is managed by the BLM, the Bureau of Reclamation, or privately owned.

Classification: Casual observations suggest the wetlands near White Lake and the southern tip of Utah Lake are Type 1 habitat. The remaining shoreline and Warm Spring WMA is Type 2. The rest of the stratum is Type 3.

Survey Methods: A pilot study is needed.

Measurement Error and Measurement Bias: Uncertain.

Selection Bias: Uncertain.

Local Contact: David Lee, UDWR, 801- 538-4751 or Russ Lawerence, UDWR, 801-510-7062.

Pilot Studies Needed: A pilot study is needed to confirm habitat classifications and to assess whether all Type 1 habitat can be surveyed accurately.

Stratum 9.107. Southwest Utah – Eastern Juab County



Description: This stratum is west of I-15, north of Highway 132, and east of Fish Springs Mountains. It includes Fish Spring Flats, but does not include Fish Springs NWR. This area is primarily dry desert and is unsuitable for shorebird.

Land Ownership: This stratum consists of public and private lands.

Classification: The entire stratum is Type 3 habitat.

Survey Method: None needed unless casual observation suggests a change in shorebird use.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 9.108. Southwest Utah – Fish Springs NWR



Description: This stratum is comprised of the National Wildlife Refuge only. This area is marsh and small pond habitat. Beginning in early 1990s, refuge staff conducted bi-monthly surveys throughout the year. Surveys are conducted from the driving tour roads throughout the refuge. The surveys cover most of the refuge. More information is needed on detection rates. Surveys indicate 10,000-14,000 shorebird visits each year. *Birding Utah* guide reports SNPL, LBCU, GRYE (spring), WILL, SPSA, and WIPH.

Peak spring migration is between March 15 and 30 April. Fall migration peaks between late July and early September.

Land Ownership: The NWR is managed by the U.S. Fish and Wildlife Service.

Classification: The entire stratum is probably Type 1 habitat, although additional information from the Refuge Staff is needed.

Survey Method: Unless detection rates are low, driving surveys of the refuge should provide complete coverage.

Measurement Error and Measurement Bias: Uncertain.

Selection Bias: Uncertain.

Local Contact: Jay Banta, Refuge Manager, 435-831-5353, ext. 2223.

Pilot Studies Needed: A pilot study, or more information is needed to assess detection rates of vehicle surveys.

Stratum 9.109. Southwest Utah – Big Spring Complex



Description: Stratum 9.108 is bordered to the south by Highway 50 and to the east by the House Range. This area is primarily dry desert. Salt Marsh Lake and Tule Springs are small wetlands with little shorebird use; however, they may support larger numbers in very wet years.

Land Ownership: This stratum consists of public and private lands.

Classification: This stratum is classified as Type 3.

Survey Method: None needed unless casual observation indicates a shift in shorebird use.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 9.110. Southwest Utah – Sevier River



Description: Stratum 9.110 is bordered to the west by House Range to the south by highway 50 and the town of Clear Lake. Highway 6 and Clear Lake WMA border this stratum to the east. Gunnison Bend Reservoir is deep, with little wading area, and therefore does not support much shorebird use. Topaz Slough is a small wetland (1 km^2) that supports 100s of AMAV and BNST. Highest numbers are found during fall migration, when there may be up to 300-500 BNST. The area around the Sevier River in the northeast portion of the stratum is good shorebird habitat in wet years. The rest of this stratum is dry desert habitat.

Land Ownership: This stratum consists of public and private lands.

Classification: Topaz Slough is Type 2 habitat, and the rest of the stratum is Type 3, although the Sevier River area may be Type 2 in wet years.

Survey Method: Occasional ground surveys to confirm low numbers of focal species at Topaz Slough and the Sevier River in wet years.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.



Stratum 9.111. Southwest Utah – Clear Lake WMA

Description: The UDWR conducts quarterly censuses of all non-game birds in this WMA. Shorebird use is moderate. Approximate averages of shorebird numbers on surveys are BNST – 4000, AMAV – 1000, and LEYE <20. Fall migration is a little later than the GSL area, averaging between late August and late September.

Land Ownership: The WMA is managed by UDWR.

Classification: This stratum is Type 2 habitat.

Survey Method: Continue existing ground surveys of entire Management Area.

Measurement Error and Measurement Bias: Minimal. Complete counts were made.

Selection Bias: None. The entire stratum was surveyed.

Local Contact: Lynn Zubeck, UDWR, 435-864-3200.

Pilot Studies Needed: None.

Stratum 9.112. Southwest Utah – Central



Description: This stratum is east of Highway 6, west of I-70, north of Highway 21 and south of Highway 132, with the exception of Clear Lake WMA. At Minersville reservoir, there is sagebrush along the shoreline and high fluctuations in the water level may result in few wading birds. Birder Steve Summers of Cedar City reports moderate numbers of shorebirds at Minersville reservoir in August and September. Means/record (>10) are KILL – 24, AMAV – 20, WILL – 10, WESA – 31, LESA – 12, BASA – 11, and RHPH – 10. These numbers may be biased, as counts were not standardized and there are no data regarding visits when no individuals of a species were seen. Regardless, these data suggest moderate use of Minersville Reservoir by shorebirds. The rest of the stratum is unsuitable for shorebirds.

Land Ownership: Minersville Reservoir is managed by the Utah Division of Parks and Recreation. The rest of the stratum is a mix of public and private land.

Classification: Minersville Reservoir is Type 2 habitat. The remainder of stratum is Type 3.

Survey Method: Occasional ground surveys of Minersville Reservoir to confirm low numbers of shorebirds.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Local Contact: For Minersville Reservoir, Norm Forbush, Park Manager, 801-586-4497.

Pilot Studies Needed: None.

Stratum 9.113. Southwest Utah – Sevier and Escalante Deserts

Figure 54. Stratum 9.113, Southwest Utah - Sevier and Escalante Deserts



Description: The eastern border of this stratum is Highway 30, the southern border is Highway 56 and the northern border is Highway 6 to Clear Lake. The entire stratum is dry desert and is unsuitable for shorebirds, although Sevier Dry Lake could become suitable in very wet years.

Land Ownership: This stratum consists of public and private lands.

Classification: Entire stratum is Type 3 habitat.

Survey Method: None needed unless casual observation suggests a change in shorebird use.

Measurement Error and Measurement Bias: None.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 9.114. Southwest Utah – Parowan Valley



Description: This stratum is located between highway 130 and 21 and I-15. Most of stratum is unsuitable for shorebirds. Little Salt Lake is a playa lake that may have some water in spring,

but is dry the rest of the year. Shorebirds on migration can be found in small numbers at variable locations throughout the stratum, such as the Parowan sewage ponds. The number of shorebirds, however, is too low to warrant surveys.

Land Ownership: This stratum consists of public and private lands.

Classification: This stratum is Type 3 habitat.

Survey Method: None needed unless casual observation indicates a change in shorebird use.

Measurement Error and Measurement Bias: None.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 9.115. Southwest Utah – Cedar City



Description: This stratum is located between Cedar City, highway 56 and the Harmony Mountains. Because the lake often fills in spring, but is usually dry the remainder of the year, shorebird use at Quichapa Lake is variable. When Quichapa Lake is wet, it has moderate shorebird use. Birder Steve Summers of Cedar City reports the following means/record (>10) in

April and May at Quichapa Lake: AMAV - 378, BNST - 600, LESA - 33, MAGO - 26, RNPH - 250, WESA - 22, WILL - 15, and WIPH - 14. In August and September, he reports means/record (>10) of AMAV - 31, BNST - 376, LESA - 18, LBDO - 11, RNPH - 200, and WESA - 20. These numbers may be biased, as counts were not standardized and there are no data regarding visits when no shorebirds were seen. These data, however, suggest moderate use of Quichapa Lake by shorebirds. The remainder of the stratum has little shorebird use.

Land Ownership: This stratum consists of public and private lands.

Classification: Quichapa Lake is Type 2 habitat and the rest of the stratum is Type 3.

Survey Method: Occasional ground surveys of Quichapa Lake in spring and fall to confirm low numbers of focal species. Surveys need to be conducted during wet years.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Stratum 9.116. Southwest Utah – Southwestern



Description: This stratum lies between Highway 56, I-15 and the Utah borders. Most of this stratum is high elevation and does not support shorebirds. Enterprise Reservoir is >6000' and is ice free late in the spring, although it does have good potential shoreline habitat. *Birding Utah* guide reports WILL, SPSA, and WESA in this area. Casual observations, however, suggest low numbers of shorebirds. Gunlock Reservoir is a lower than Enterprise, but does not have much shoreline habitat when the reservoir is full.

Land Ownership: Gunlock Reservoir is managed by the Utah Division of Parks and Recreation. Enterprise Reservoir is managed by the Dixie National Forest. The rest of the stratum is a mix of private and public lands.

Classification: The stratum is all Type 3 habitat.

Survey Method: None needed unless casual observation indicates a shift in shorebird use.

Measurement Error and Measurement Bias: Minimal.

Selection Bias: None.

Pilot Studies Needed: None.

Appendix A: The Great Salt Lake Waterbird Survey

The distribution and abundance of shorebirds in the Great Salt Lake area (Figure 58) is well known as a result of an extensive waterbird survey carried out during 1997-2001. Surveys were conducted on more than 50 plots (Figure 59 and Table 22) once every 10 days from early April to late September.






Figure 59. Survey sites in the Great Salt Lake Waterbird Survey (see Table 22 for names and descriptions).

Table 22. Description of survey sites in the Great Salt Lake Waterbird Survey.

			Mean Number of Shorebirds per
WBS-ID	Name	Description	Survey
1	Timpie Springs WMA	State managed wetland	363
2	Stansbury Island North	Private Shoreline	91
3A	Stansbury South- N	Shoreline	8731
3B	Stansbury South- S	Shoreline	2210
5A	I-80 North- N	Shoreline	857
5B	I-80 North- S	Wetland-flooded area	284
6	Saltair	Shoreline	1301
7	Associated Duck Club	Private duck club	1035
8A	Kennecott- Goggin	Shoreline	1771
8B	Kennecott- Lee Creek	Shoreline	4460
8C	Kennecott- ISSR	Privately managed wetland	1582
9A	Audubon Lakeside- S	Shoreline	541
9B	Audubon North	Shoreline	1351
9C	Audubon Interior	Privately managed wetland	Insufficient Data

WBS-ID	Name	Description	Mean Number of Shorebirds per
10	Crystal Lakeside	Marsh	6665
11	Earmington Bay Lakeside	Shoreline	6973
12	Farmington Bay WMA	State managed wetland	7969
12	West Farmington	Shoreline	/36
1/	Antelone Island East	Island shoreline	1050
15	Antolopo Island Wost	Island shoreline	297
10	Antelope Island Coupoway	Pood to jolond	307
170	Most Kovoville, Interior	Noroh	00
17A 47D	West Kaysville Chara	Charalina	4/0/
17B	West Kaysville- Shore	Shoreline	4220
18	West Layton	Shoreline	1422
19A	Beach	Shoreline	1608
19B	Howard Slough WMA- Dike	Diked shoreline	4013
19C	Howard Slough WMA- Pond	State managed wetland	1466
20	Ogden Bay WMA	State managed wetland	8691
21	Ogden Bay Lakeside	Marsh	23136
22	Ogden Bay North	Shoreline	1696
23	Rainbow	Private duck club	389
24	South Harold Crane WMA	State managed wetland	5609
25	Harold Crane WMA	State managed wetland	6254
27	South Bear River	Federal managed wetland	36256
28	Willard Spur	Federal managed wetland	4744
29A	Bear River Refuge	Federal managed wetland	51157
29B	Bear River Refuge Road	Federal managed wetland	452
30	Bear River Club	Private duck club	649
32	Public Shooting Grounds WMA	State managed wetland	772
33	Salt Creek WMA	State managed wetland	1609
34A	East Promontory- N	Shoreline	258
34B	East Promontory- S	Shoreline	245
35	Locomotive Springs WMA	State managed wetland	294
36A	Salt Wells Flat WHA- Shore	Federal shoreline	59
36B	Salt Wells Flat WHA	Federal managed wetland	290
37	Bear River Bay	Open water	5995
38	Orden Bay	Open water	12937
30	Earmington Bay	Open water	2830
40	Magaarp	Two lakeside pende	2030
40 11	Now State Duck Club	Privato duok olub	42000
41 42	East Farmington Bay	Agricultural, urban, and industrial lands	17
43	Deardens Knoll	US Air Force/BLM public land	8402
44	Jordan River	Private agricultural land	Insufficient Data

The Great Salt Lake Waterbird Survey provides an excellent basis for deciding which area should be covered in the permanent shorebird survey. Means numbers recorded per survey during July and August were calculated for all of the survey areas together (Table 23) and for each of the survey areas. Maps depicting the area-specific means were then prepared for all shorebirds for which the mean number recorded per sample survey (all areas) exceeded 50 (Figure 60) and the maps were scrutinized to identify concentration areas.

Most areas had a substantial number of shorebirds. The average number of shorebirds per survey, during July and August, exceed 200 for all but seven of the 55 survey areas and the average was 1000 or more in 33 of the areas. The eastern shore and associated wetlands were particularly important for the most abundant species but the south and southwest shores were also important for some species. For example, western sandpipers and willets were found along the entire shore, snowy plovers were particularly abundant on the south shore, and both yellowlegs were frequently found away from the lake in the smaller, more isolated wetlands. It thus seems necessary to cover the entire area surveyed in the Great Salt Lake Waterbird Survey.

Table 23. Mean number of shorebirds recorded per survey in July and August during 1997-2001 on the Great Salt Lake Waterbird Survey.

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AMAV	WIPH	BNST	WESA	LBDO	MAGO	PEEP	PHAL	SNPL	
109,301	79,847	33,353	15,923	12,722	11,702	4,274	4,115	762	
LESA	WILL	BASA	KILL	UNYE	RNPH	GRYE	LEYE	BBPL	
522	372	367	266	235	234	211	190	54	
LBCU	SAND	SPSA	SEPL	SESA	REKN	WHIM	COSN		
41	36	27	20	4	3	1	1		

American avocet **Black-necked Stilt** Mn Birds/Survey Mn Birds/Survey 0 - 10 11 - 100 101 - 1,000 1,001 - 10,000 100 0 - 10 11 - 100 101 - 1,000 1,001 - 10,000 >10,000 10,000 \bigcirc Wilson's Phalarope Long-billed Dowitcher C Mn Birds/Survey 0 - 10 11 - 100 101 - 1,000 1,001 - 10,000 >10,000 Birds/Surve 0 - 10 11 - 100 101 - 500 501 - 1,000 >1,000 0 0 \bigcirc **Marbled Godwit** Western Sandpiper Mn Birds/Survey Mn birds/Survey 0 - 10 11 - 100 101 - 500 501 - 1,000 >1,000 0 - 10 11 - 100 101 - 500 501 - 1,000 0 \bigcirc 0 >1,000 **PEEP (mainly WESAs?) Snowy Plover** 0 Mn birds/Sur 0 1 - 10 11 - 50 51 - 100 200 >100 Mn Birds/Survey Birds/Survey 0 - 10 11 - 100 101 - 500 501 - 1,000 >1,000 C \bigcirc

Figure 60. Mean number of shorebirds recorded during July and August 1997-2001 on the Great Salt Lake Waterbird Survey.

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Figure 60 (cont'd). Mean number of shorebirds recorded during July and August 1997-2001 on the Great Salt Lake Waterbird Survey.





Appendix B: Timing of Surveys

Results from the surveys were analyzed to determine when shorebirds are present in greatest numbers. We excluded data from 1997 because surveys that year did not begin until early July and we also excluded 8 areas with uneven coverage. The results (Figure 61) showed that Wilson's phalaropes occur in large numbers in July and August; American avocets, black-necked stilts, and long-billed dowitchers occur in large numbers during August and September; and that relatively small numbers of black-bellied plovers and marbled godwits occur during spring. Several other species were recorded but not in significant numbers to affect the decision about when surveys should be conducted.

The trend data suggest that the survey should be held in July and August. The specific dates can be chosen after other work is completed but for the analysis of which areas should have highest priority, this report uses the Great Salt Lake Waterbird Survey periods 10-15 which correspond approximately to 1 July-31 August. This analysis should suffice for surveys anytime during the late summer and fall. If a decision is made to conduct spring surveys too, then a new analysis might be appropriate to decide which areas to survey because few avocets, stilts, phalaropes, and dowitchers are present in the spring and species that are present then (e.g., plovers, sanderlings) may well occur primarily in other areas.



Figure 61. Mean number of shorebirds recorded per survey during the Great Salt Lake Waterbird Survey, 1998-2001.