Appendix 2:

Documentation for GSL Waterbird Survey Analyses

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These notes summarize the approach we took in analyzing the 1997-1999 waterbird survey data during the April 3-5, 2000 meeting in Boise.

Basic Data Tables

Workbook GSLBdNames.xls contains the species, species groups, and codes.

Workbook "Data.xls" contains data used for the analyses. It has the following worksheets, each of which was saved using TruBasic as a separate file with the same name and a "csv" extension for analyses.

Species (just the codes; sorted with groups first, then species by total number recorded)

Areas (Table 1)
1 Area Number (sequential numbers for the transects, 1 to 54)
2 Area code
3 Name
4 Expansion factor (4 for the Bays; 1 otherwise)

Dates
1 Area number (not codes)
2 Year
3 Julian date (Table 2)
4 Assigned Period *
5 Error *
6 Real Period *

* Assigned Period is the period number assigned for the survey, chosen to maximize the number of different periods with a survey. Real Period is the 10-day interval that the survey was actually in. If the survey was run during the intended interval then error is 0 and Real Period = Assigned Period. Otherwise, error is the number of days outside of the interval and Real Period is the period that the survey was run in.

Points (Table 3)
- 1 Area number
- 2 Year
- 3 Point number
- 4 Point type (1=Random; 2=Drainage)

Counts
- 1 Area number (not codes)
- 2 Year
- 3 Julian date
- 4 Point number (0=not a point count)
- 5 Species code
- 6 Number recorded

Notes:

1. In 1999, during periods 3,4, and 5, results reported for Area 5A actually covered 5A and 5B. We handled this by adding rows in the Dates file for these 3 periods. Thus the Dates file contains records saying area 5B was run but Counts does not include any records from area 5B during these periods. Tallies of the number of surveys, from Dates, and of the number of birds from Counts are correct, but comparisons of 5A vs. 5B must exclude periods 3-5 in 1999.

2. Program Change.dat modifies the Dates file. It changes area codes to area numbers, extracts year from date, changes mm/dd to Julian date, and adds "period." Period is the nominal period-the period the survey date actually falls in. Alternate period is our suggested designation for cases in which no survey occurs within a period but surveys occur in the surrounding periods, one of them within a few days of the period lacking a survey. "Error in alt. period" is the number of days by which the survey is outside the alternate period. The Alternate Periods are added manually in Excel. Error in alt. period is added by program AddPer.2. Program Change.cts modifies the Counts files. It changes area codes to area numbers, extracts year from date, and changes mm/dd to Julian date.
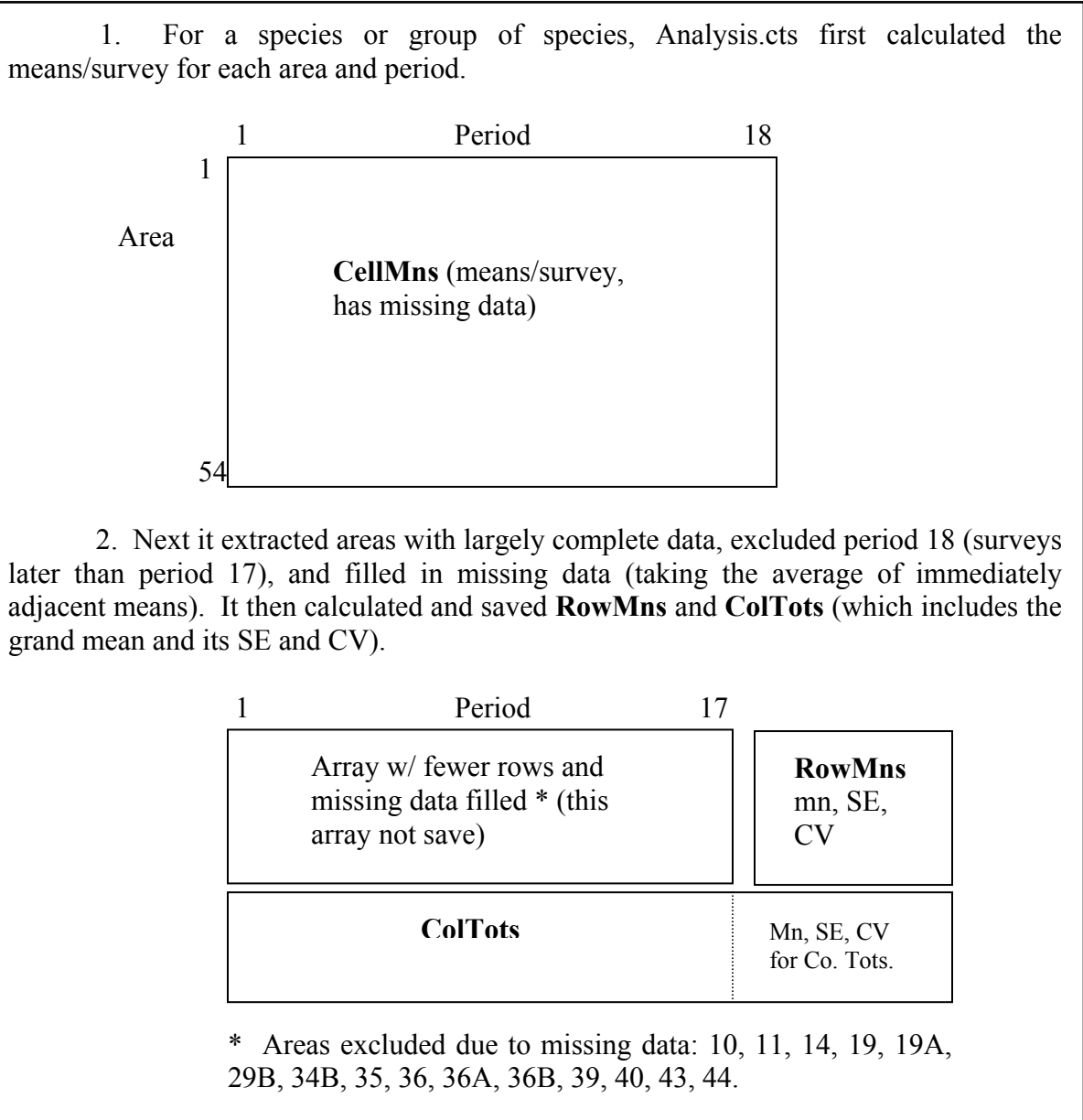
Calculation of Means per Survey

Most of the analyses were done with program Analysis.cts (Figure 1). It uses a "species list" which includes all of the groups identified by Don Paul and all single species for which more than 10 individuals were recorded 1997-1999 (about 85 species). It first reads the Dates file into an array. It then prepares a data table for each species (and species group) either in a specified year or for all years. For a given species, it reads each record in Counts and determines whether the year and species should be included in the analysis. If so, it records the number counted. The program, thus, gets the number of counts, and the number of birds counted for every transect and period. It then calculates means per transect-period and optionally stores this data in a file, CellMns.

For analyses of restricted areas, the program eliminates rows and/or periods that are not to be included and then calculates row means, SEs, and CVs and column totals. It

also calculates the mean of the column totals and the SE and CV of this mean. These results are stored in the file RowMns and ColTots.

Figure 1. Arrays used in program Analysis.cts to calculated means/survey for each area-period (CellMns) area for all periods (RowMns) and for selected areas (those with largely complete data) within each period (ColTots). Grand means, SEs, and CVs are contained within the array ColTots.

1. For a species or group of species, Analysis.cts first calculated the means/survey for each area and period.

2. Next it extracted areas with largely complete data, excluded period 18 (surveys later than period 17), and filled in missing data (taking the average of immediately adjacent means). It then calculated and saved **RowMns** and **ColTots** (which includes the grand mean and its SE and CV).

* Areas excluded due to missing data: 10, 11, 14, 19, 19A, 29B, 34B, 35, 36, 36A, 36B, 39, 40, 43, 44.

Points Analysis

These analyses were carried out with program Analysis.pts. Analysis.pts stores Dates and Points and then uses these to build the array NPts(p,[R,D]) which has the number of random and drainage points surveyed in each period. The program then reads through counts. When it finds a point count it looks in Points to see if the record is useful for this analysis and, if it is, gets the period from Dates. The program prints out the means/survey for random and drainage points and the differences. These are regarded as a random (systematic) sample from which the grand mean, and its SE and CV, are calculated.

The Points spreadsheet was constructed from Manning's list of point types for each year with the following modifications. We excluded pt. 2 at Area 5a (I-80, North-N) because, according to the list, results from pt. 1 and pt. 2 were to be added and treated as a single point. By excluding pt. 2, we kept the sample size for this area correct. 1999 was assumed to be like 1998 except that we excluded W. Layton point 1 (it was done a few times early but then not again) and E Promontory-N because the types were not clear (according to Manning).

In constructing NPts, the program reads thru Dates and looks for a match in Points. When no match is found, it does not add anything to Points. Thus, excluding these records from Points results in them being excluded from the sample sizes even though they occur in Dates. Similarly, in reading thru Counts, when a point record is found we look for it in Points. If it isn't found, then no birds are added so the record is excluded. The one needed change is that records for point 2 at Area 5a DO need to be included. This was handled by changing the point number to 1.

Analyses to Address the Questions Don Paul Posed

Paul and Manning prepared a list of questions to be addressed. Our work on each is summarized below.

III.2. Bird Use Days

We used ColTots grand mean and its SE to calculate bird use days for each group (using 170 days in the study period). Eighty percent CIs are the estimated bird use days +/- 1.28 * SE.

We did all years; estimates for 1999 only and for other species can be added using the ColTots worksheet.

III.3. Grand total bird numbers by period

We summed the ColTots across species (using only the species groups) to get number present in each period.

III.4. All lake suite totals by period

We used the entries from ColTots for 1997-1999 and 1999 only.

III.5&6. Shoreline activity and habitat analysis by area groups

Manning's additional notes indicated that for these two tasks we should prepare a table with species (avocets/stilts, gulls, SNPL, peeps) as rows and periods as columns and that the cell entries should be means/survey for each of the areas. We did not do Howard Slough because there was too much missing data from this area. We did do the other five areas, and we did 1999 and 1997-1999 for each one. The output was called TaskIII.6. We obtained the reduced arrays using program Analysis.1 and modifying the Shrink subroutine so that it only extracted which ever rows from CellMns that we wanted. We also nullified the statements to print row means.

We did not yet address the question "What habitat is there?"

III.7. Comparison of bird numbers and species richness at random and drainage point samples.

Analysis.pts was used to calculate the means/survey for random and drainage points and the difference. Manning is analyzing these results.

III.8. How well do point samples predict bird numbers and species in the associated survey area?

Manning has the means per random point and transect. She will address this issue by converting both to densities. Subsequent analysis can be carried out in the same was as to address question 7 above.

Table 1. Areas

Number	Code	Name	ExpFact
1	1	TIMPIE SPRINGS WMA	1
2	2	STANSBURY ISLAND NO.	1
3	3A	STANSBURY SOUTH- N	1
4	3B	STANSBURY SOUTH- S	1
5	5A	I 80 NORTH- N	1
6	5B	I-80 NORTH- S	1
7	6	SALTAIR	1
8	7	ASSOCIATED DUCK CLUB	1
9	8A	KENNECOTT- GOGGIN	1
10	8B	KENNECOTT- LEE CREEK	1
11	8C	KENNECOTT- ISSR	1
12	9A	AUDUBON LAKESIDE- S	1
13	9B	AUDUBON NORTH	1

Number	Code	Name	ExpFact
14	10	CRYSTAL LAKESIDE	1
15	11	FARM BAY LAKESIDE	1
16	12	FARMINGTON BAY WMA	1
17	13	WEST FARMINGTON	1
18	14	ANTELOPE ISLAND EAST	1
19	15	ANTELOPE ISLAND WEST	1
20	16	ANT ISLAND CAUSEWAY	1
21	17A	WEST KAYSVILLE	1
22	17B	WEST KAYSVILLE	1
23	18	WEST LAYTON	1
24	19	H SLOUGH WMA- D & P	1
25	19A	H SLOUGH WMA- BEACH	1
26	19B	H SLOUGH WMA- DIKE	1
27	19C	H SLOUGH WMA- POND	1
28	20	OGDEN BAY WMA	1
29	21	OGDEN BAY LAKESIDE	1
30	22	OGDEN BAY NORTH	1
31	23	RAINBOW	1
32	24	SOUTH H CRANE WMA	1
33	25	HAROLD CRANE WMA	1
34	27	SOUTH BEAR RIVER	1
35	28	WILLARD SPUR	1
36	29A	BEAR RIVER REFUGE	1
37	29B	BEAR RIVER REFUGE RD	1
38	30	BEAR RIVER CLUB	1
39	32	PUB SHOOT GRNDS WMA	1
40	33	SALT CREEK WMA	1
41	34A	EAST PROMONTORY- N	1
42	34B	EAST PROMONTORY- S	1
43	35	LOCOMOTIVE SPGS WMA	1
44	36	SALT WELLS FLAT WHA	1
45	36A	SALT WELLS- SHORE	1
46	36B	SALT WELLS FLAT WHA	1
47	37	BEAR RIVER BAY	4
48	38	OGDEN BAY	4
49	39	FARMINGTON BAY	4
50	40	MAGCORP	1
51	41	NEW STATE DUCK CLUB	1
52	42	EAST FARMINGTON BAY	1
53	43	DEARDENS KNOLL	1
54	44	JORDAN RIVER	1

Table 2. Julian Dates

Mth	Day	JDay	Mth	Day	JDay	Mth	Day	JDay	Mth	Day	JDay	Mth	Day	JDay	Mth	Day	JDay
Jan	1	1	Mar	1	60	May	1	121	Jul	1	182	Sep	1	244	Nov	1	305
	2	2		2	61		2	122		2	183		2	245		2	306
	3	3		3	62		3	123		3	184		3	246		3	307
	4	4		4	63		4	124		4	185		4	247		4	308
	5	5		5	64		5	125		5	186		5	248		5	309
	6	6		6	65		6	126		6	187		6	249		6	310
	7	7		7	66		7	127		7	188		7	250		7	311
	8	8		8	67		8	128		8	189		8	251		8	312
	9	9		9	68		9	129		9	190		9	252		9	313
	10	10		10	69		10	130		10	191		10	253		10	314
	11	11		11	70		11	131		11	192		11	254		11	315
	12	12		12	71		12	132		12	193		12	255		12	316
	13	13		13	72		13	133		13	194		13	256		13	317
	14	14		14	73		14	134		14	195		14	257		14	318
	15	15		15	74		15	135		15	196		15	258		15	319
	16	16		16	75		16	136		16	197		16	259		16	320
	17	17		17	76		17	137		17	198		17	260		17	321
	18	18		18	77		18	138		18	199		18	261		18	322
	19	19		19	78		19	139		19	200		19	262		19	323
	20	20		20	79		20	140		20	201		20	263		20	324
	21	21		21	80		21	141		21	202		21	264		21	325
	22	22		22	81		22	142		22	203		22	265		22	326
	23	23		23	82		23	143		23	204		23	266		23	327
	24	24		24	83		24	144		24	205		24	267		24	328
	25	25		25	84		25	145		25	206		25	268		25	329
	26	26		26	85		26	146		26	207		26	269		26	330
	27	27		27	86		27	147		27	208		27	270		27	331
	28	28		28	87		28	148		28	209		28	271		28	332
	29	29		29	88		29	149		29	210		29	272		29	333
	30	30		30	89		30	150		30	211		30	273		30	334
	31	31		31	90		31	151		31	212						
Feb	1	32	Apr	1	91	Jun	1	152	Aug	1	213	Oct	1	274	Dec	1	335
	2	33		2	92		2	153		2	214		2	275		2	336
	3	34		3	93		3	154		3	215		3	276		3	337
	4	35		4	94		4	155		4	216		4	277		4	338
	5	36		5	95		5	156		5	217		5	278		5	339
	6	37		6	96		6	157		6	218		6	279		6	340
	7	38		7	97		7	158		7	219		7	280		7	341
	8	39		8	98		8	159		8	220		8	281		8	342
	9	40		9	99		9	160		9	221		9	282		9	343
	10	41		10	100		10	161		10	222		10	283		10	344
	11	42		11	101		11	162		11	223		11	284		11	345
	12	43		12	102		12	163		12	224		12	285		12	346
	13	44		13	103		13	164		13	225		13	286		13	347
	14	45		14	104		14	165		14	226		14	287		14	348
	15	46		15	105		15	166		15	227		15	288		15	349
	16	47		16	106		16	167		16	228		16	289		16	350
	17	48		17	107		17	168		17	229		17	290		17	351
	18	49		18	108		18	169		18	230		18	291		18	352
	19	50		19	109		19	170		19	231		19	292		19	353
	20	51		20	110		20	171		20	232		20	293		20	354
	21	52		21	111		21	172		21	233		21	294		21	355
	22	53		22	112		22	173		22	234		22	295		22	356
	23	54		23	113		23	174		23	235		23	296		23	357
	24	55		24	114		24	175		24	236		24	297		24	358
	25	56		25	115		25	176		25	237		25	298		25	359
	26	57		26	116		26	177		26	238		26	299		26	360
	27	58		27	117		27	178		27	239		27	300		27	361
	28	59		28	118		28	179		28	240		28	301		28	362
				29	119		29	180		29	241		29	302		29	363
				30	120		30	181		30	242		30	303		30	364
										31	243		31	304		31	365

Table 3. Points at random and drainage locations surveyed in 1997-99.

Area			1997		1998		1999	
No.	Code	Name	R	D	R	D	R	D
3	3a	Stansbury South-N	1		1		1	
4	3b	Stansbury South-S	1		1		1	
5	5a	I-80 North-N	1,2*		1,2*		1,2*	
7	6	Saltair	1,3	2	1,3	2	1,3	2
9	8a	Kennecott-Goggin	2	1	2	1	2	1
10	8b	Kennecott-Lee Creek	1		1		1	
12	9a	Audubon Lakeside-S	1		1		1	
13	9b	Audubon North	1		1		1	
15	11	Farm Bay Lakeside	2	1,3	1,2,3		1,2,3	
17	13	West Farmington	1	2,3	1	2,3	1	2,3
19	15	Antelope Island West	1,2		1,2		1,2	
22	17b	West Kaysville	1,2,3	4				
23	18	West Layton	2	1,3	2	1,3	2	3
25	19a	Howard Slough Beach	2	1	1,2		1,2	
45	34a	East Promontory-N	2	1,3	2	1,3		
		Total	19	12	19	8	18	5

* Results from points 1 and 2 added and treated as a single point.