INITIAL SURVEY INSTRUCTIONS for Western Monarch and Milkweed Habitat Suitability Assessment

Table of Contents

Introduction

Survey Name: Milkweed Inventory

This document provides background information on milkweed inventory protocol and how it is applied on the Pacific Northwest Region of the US Fish and Wildlife Service. This document describes how and where to sample on a particular refuge. Field data forms and other support materials for the regional program are described in other documents, as follows:

Support documents have been loaded into a Google Drive:
https://drive.google.com/drive/folders/0B_nGgs3aYCgwWm4zMVpaUXFCWDQ

Refuges: Southeast Idaho National Wildlife Refuge Complex, Mid-Columbia River National Wildlife Refuge Complex, Little Pend Oreille National Wildlife Refuge, Willamette Valley National Wildlife Refuge Complex

Mid-Columbia NWRC	Cold Springs NWR
Mid-Columbia NWRC	Columbia NWR
Mid-Columbia NWRC	Conboy Lake NWR
Mid-Columbia NWRC	Hanford Reach NM
Mid-Columbia NWRC	McKay Creek NWR
Mid-Columbia NWRC	McNary NWR
Mid-Columbia NWRC	Toppenish NWR
Mid-Columbia NWRC	Umatilla NWR
Willamette Valley NWRC	Ankeny NWR
Willamette Valley NWRC	Baskett Slough NWR
Willamette Valley NWRC	William L. Finley NWR
Southeast Idaho NWRC	Bear Lake NWR
Southeast Idaho NWRC	Camas NWR
Southeast Idaho NWRC	Grays Lake NWR
Southeast Idaho NWRC	Minidoka NWR
Southeast Idaho NWRC	Oxford WPA
Inland NW	Little Pend Orielle

Primary Refuge Contact: See refuge-specific details document

Background

A large-scale monitoring program is needed for milkweed species to provide a baseline data on milkweed distribution across western North America and to document potential breeding sites for monarch butterfly. This data will help identify priority areas for conservation actions that benefit monarchs. R1 Refuges are documenting milkweed occurrence data in order to address data deficiencies and collect additional data to support the Region 1 initiated Western Monarch and Milkweed Habitat Suitability Assessment (Models). In addition this inventory will help to identify areas with high potential for restoration or enhancement. Conducting surveys and documenting the occurrence of milkweed host plants are essential for developing and validating the Model.

Survey Objective

1) Improve knowledge of milkweed distribution and potential habitat for Western Monarch in Region 1.
    - Develop a region-wide model (for a variety of milkweed species)
    - Conduct random surveys to improve and test the predictive capability of model, to that end, plots with no milkweed are as important as sites with milkweed (absence).
2) Map additional milkweed patches to inform refuge habitat management.

Survey Design

The sampling frame is a 5km grid spanning National Wildlife Refuges in the Pacific Region. The generalized random-tessellation stratified (GRTS) survey design algorithm was used to generate a spatially balanced and randomized ordering of the samples within the grid. These samples are used to identify 50x50-m grid cells to be surveyed. The samples were sorted by random order identified in the GRTS draw.

Sample Selection

Table 1. Target number of survey Transects on National Wildlife Refuges in the Pacific Region during the Milkweed Inventory. Target is based on 10% of the upland habitat on the refuge. These targets may be revised based on access to tracts not acquired.

Complex	Refuge	Block	Plots Total	Plots Wet	Plots Dry	Transects for complete sampling
SEID	Camas	CMS_B_00	7310	1698	5612	56
		CMS_B_01	3069	508	2561	26
		CMS_B_10	4222	0	4222	42
		CMS_B_11	2721	156	2565	26
		CMS_B_21	308	0	308	3
		TOTAL				153
SEID	Grays Lake	GYL_B_00	5091	3283	1808	18
		GYL_B_01	9153	4719	4434	44
		GYL_B_02	1252	13	1239	12
		GYL_B_10	5521	3480	2041	20
		GYL_B_11	9796	7995	1801	18
		GYL_B_12	2354	843	1511	15
		GYL_B_20	2344	493	1851	19
		GYL_B_21	9794	7788	2006	20
		GYL_B_22	2127	1092	1035	10
		GYL_B_30	4126	320	3806	38
		GYL_B_31	2652	481	2171	22
		TOTAL				237
SEID	Minidoka	MND_B_02	1238	2	1236	12
		MND_B_03	3043	7	3036	30
		MND_B_04	2217	54	2163	22
		MND_B_05	1839	24	1815	18
		MND_B_10	3585	80	3505	35
		MND_B_11	4301	20	4281	43
		MND_B_12	3685	66	3619	36
		MND_B_13	0		0	0
		MND_B_14	0		0	0
		MND_B_15	0		0	0
		MND_B_16	644	65	579	6
		MND_B_20	1241	4	1237	12
		MND_B_21	1976	14	1962	20
		MND_B_22	1181	20	1161	12
		TOTAL				246
SEID	Oxford Slough	OXS_B_00	2833	1002	1831	18
		TOTAL				18

WV	Ankeny	ANK_B_10	4591	512	4079	41
		ANK_B_11	143	0	143	1
		TOTAL				42

WV	Basket Slough	BKS_B_00	4060	636	3424	34
		BKS_B_10	182	8	174	2
		TOTAL				36

WV	WM Finley	WMF_B_00	6873	336	6537	65
		WMF_B_01	855	1	854	9
		WMF_B_10	1190	7	1183	12
		WMF_B_11	111	0	111	1
		WMF_B_12	802	1	801	8
		TOTAL				95

MIDCO	Toppenish	TPN_B_00	156	0	156	2
		TPN_B_001	1804	556	1248	12
		TPN_B_002	530	86	444	4
		TPN_B_011	200	39	161	2
		TPN_B_012	91	0	91	1
		TPN_B_10	0	0	0	0
		TOTAL				21

MIDCO	Umatilla	UMT_B_00	3360	1729	1631	16
		UMT_B_01	5764	3016	2748	27
		UMT_B_02	2586	2486	100	1
		UMT_B_03	725	36	689	7
		UMT_B_11	947	200	747	7
		UMT_B_12	4437	3883	554	6
		UMT_B_13	7196	3896	3300	33
		UMT_B_14	5246	381	4865	49
		UMT_B_15	1459	51	1408	14
		UMT_B_23	712	353	359	4
		UMT_B_24	3235	1331	1904	19
		UMT_B_25	2054	95	1959	20
		TOTAL				203

MIDCO	Hanford	SAD_B_13	4501		4501	45
		SAD_B_14	7137		7137	71
		SAD_B_15	5568		5568	56
		SAD_B_20	1571		1571	16
		SAD_B_21	5141		5141	51
		SAD_B_22	6381		6381	64
		SAD_B_23	10199		10199	102
		SAD_B_24	9963		9963	100
		SAD_B_25	2393		2393	24
		SAD_B_30	6211		6211	62
		SAD_B_31	10208		10208	102
		SAD_B_32	10208		10208	102
		SAD_B_33	8947		8947	89
		SAD_B_34	2378		2378	24
		SAD_B_40	6463		6463	65
		SAD_B_41	10208		10208	102
		SAD_B_42	5451		5451	55
		SAD_B_43	694		694	7
		SAD_B_48	1526		1526	15
		SAD_B_50	6307		6307	63
		SAD_B_51	7430		7430	74
		SAD_B_57	4897		4897	49
		SAD_B_58	1074		1074	11
		SAD_B_66	4992		4992	50
		SAD_B_67	5861		5861	59
		SAD_B_70	4259		4259	43
		SAD_B_71	6576		6576	66
		SAD_B_72	5798		5798	58
		SAD_B_73	2113		2113	21
		SAD_B_75	842		842	8
		SAD_B_76	8326		8326	83
		SAD_B_77	5983		5983	60
		SAD_B_81	5182		5182	52
		SAD_B_82	9877		9877	99
		SAD_B_83	9616		9616	96
		SAD_B_84	1728		1728	17
		SAD_B_85	5370		5370	54
		SAD_B_86	10208		10208	102
		SAD_B_87	3919		3919	39
		SAD_B_92	2207		2207	22
		SAD_B_93	9493		9493	95
		SAD_B_94	9394		9394	94

		SAD_B_95	10113	19	10094	101
		SAD_B_96	9985	56	9929	99
		SAD_B_97	1659		1659	17
		SAD_B_103	1037		1037	10
		SAD_B_104	6825		6825	68
		SAD_B_105	8051		8051	81
		SAD_B_106	3158		3158	32
		TOTAL				2874

MIDCO	Cold Springs	CSP_B_00	5072	3039	2033	20
		CSP_B_01	195	50	145	1
		TOTAL				22

MIDCO	Columbia - Main	CMB_B_08	6618	2	6616	66
		CMB_B_09	551	0	551	6
		CMB_B_18	6728	95	6633	66
		CMB_B_19	5282	38	5244	52
		CMB_B_29	2921	9	2912	29
		CMB_B_39	2672	46	2626	26
		CMB_B_49	533	0	533	5
		CMB_B_110	1488	0	1488	15
		CMB_B_210	8485	58	8427	84
		CMB_B_211	3017	103	2914	29
		CMB_B_310	5371	254	5117	51
		CMB_B_410	278	0	278	3
		TOTAL				433

MIDCO	McKay Creek	MKC_B_00	2441	1261	1180	12
		MKC_B_10	681	262	419	4
		TOTAL				16

MIDCO	Conboy Lake	CNL_B_00	3287	1458	1829	18
		CNL_B_01	702	206	496	5
		CNL_B_10	2369	1083	1286	13
		CNL_B_11	3891	1304	2587	26
		CNL_B_12	427	106	321	3
		CNL_B_22	45	35	10	0
		TOTAL				65

INW	LPO	LPO_B_03	1093	215	878	9
		LPO_B_60	338		338	1
		LPO_B_61	117		117	1
		LPO_B_62	878		878	9
		LPO_B_63	442		442	4
		LPO_B_64	0		0	0
		LPO_B_70	7111		7111	71
		LPO_B_71	8846		8846	88
		LPO_B_72	8648		8648	86
		LPO_B_73	7927		7927	79
		LPO_B_74	986		986	10
		LPO_B_80	438		438	4
		LPO_B_81	3117		3117	31
		LPO_B_82	7103		7103	71
		LPO_B_83	7872		7872	79
		LPO_B_84	3048		3048	30
		LPO_B_85	0		0	0
		LPO_B_92	0		0	0
		LPO_B_93	3124		3124	31
		LPO_B_94	1856		1856	19
		LPO_B_95	0		0	0
		LPO_B_103	0		0	0
		LPO_B_104	0		0	0
		LPO_B_105	0		0	0
		TOTAL				625

Survey Methods

Definitions: Appendix A illustrates these definitions.

Block: one 5-km by 5-km grid cell. In GIS, a grid composed of 5km cells was laid over each refuge. The 5k Blocks are used to distribute sampling effort around a refuge.
Plot: one 50-meter by 50-meter grid cell. In GIS, a grid composed of 50-m cells was laid over each refuge. Start Plots were randomly chosen for sampling. The chosen Plot becomes the start Plot - the first Plot in the Transect. Field data are entered at the Plot level.
Transect: 10 adjacent Plots.
Panel: 10 – 15 Transects per Block (or less if the survey targets for the Block are less).

Systematic surveys are conducted using the milkweed geodatabase developed by R1 I&M Program. This survey can be implemented in conjunction with monarch surveys or separately. Surveys are conducted utilizing a GPS-based 50m x 50m grid overlay of the Refuge (each grid cell is a Plot). Suitable refuge habitats, generally non-forested areas, are walked in a Transect pattern with predetermined start points. As each grid cell (Plot) is encountered, the required attributes* of milkweed is entered into the geodatabase.

Choosing Survey Plots: Appendix A illustrates the process described below.

Order of sampling Blocks.
In order to distribute surveys around the refuge, the survey Plots are stratified by Blocks. The order in which Blocks are visited is flexible. The goal for each refuge is to visit every Block. Therefore the Blocks can be visited in a systematic or opportunistic way, using best judgment. Begin by surveying the first Block, conduct 10 to 15 Transects, also referred to as a Panel, (or less if the survey targets for the Block are less) before moving to the

second Block. Continue working through all Blocks, sampling 10 to 15 Transects (may vary) before moving to the next Block.

After completing one Panel of Transects in each Block, return to the first Block and repeat the process. Transect targets by Block are provided in Table 1. Ultimately the number of Transects completed will depend on travel logistics, how many Transects can be sampled during a single day and how many survey sites are identified in the targets table (Table 1).

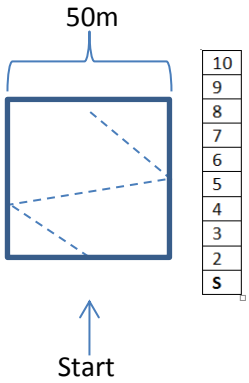
Order of sampling Transects within Blocks: Start Plots are identified by a unique ID and given a random ordered number for sampling, identified through the GRTS draw. These serve as the start of a Transect and have been coded with the Plot order. In addition the samples have been coded with a Panel value. Work through the samples following the Plot order. Use best judgment in how you work across a Block. It may make sense to deviate from the exact order of the Plots, knowing that you will complete the targets for the given Block (10 Transects per Block, may vary), and end up being able to adhere to the essence of the sample design (lowest Plot orders are done first when possible).

Sort Plots on Plot order to identify the first 10 to 15 start Plots. Note the Survey Sites layer has coded Panels, each panel has 15 (may vary) samples to select from. (See Appendix B, How to Prepare Files for Survey Activity) Plots may fall on rivers, wetlands, or marshes, which are clearly not milkweed habitat. Those Plots can be rejected and the next Plot on the ordered list used as a replacement. A GIS exercise may be helpful to reject Plots before heading out to the field. It may be useful to select and code all sample sites that fall into unsuitable habitats ahead of time. One way to do that is to use the panel column and a set value such as 99.

Sampling targets: targets for 10% sampling of upland have also been stratified by Block. See Table 1.

Navigating to Survey Plot: See Appendix C. Region 1 Milkweed and Monarch Monitoring Geodatabase User Guide for detailed instructions on using the geodatabase and ArcPad field forms.

Open ArcPad on the Mobile Device/ GPS unit; use your Survey Sites layer to navigate to a sample site. The sample site will be located in the center point of the first Plot to survey (in the Transect). Turn on the 50 m grid layer (Plot) and adjust your position so that you are located roughly at the center point of edge of start Plot. We recommend studying start Plots to devise survey game plan and appropriate order of survey Plots prior to entering the field. Discuss best routes and accessibility with knowledgeable refuge staff (biologist, technicians, fire crew managers, maintenance workers, etc.) and reference other available resources (refuge atlases, road maps, topographic maps, land cover maps, and more).



Surveying within 50m x 50m Plots: When you have reached the center point of the edge of the start Plot, assess the 50m start Plot in front of you: can you spot milkweed; are there any physical barriers such as dense brush or open water; is there an obvious way to traverse the Plot?

Let the landscape dictate how you traverse the Plot, work back and forth in a zig-zag pattern if possible, using the Mobile Device/ GPS unit to help navigate and stay within the Plot boundaries. When you feel confident that you've covered the area, enter milkweed data (presence or absence) into Geodatabase (see document: *Geodatabase User Guide* for detailed instructions). Be wary that milkweed may be growing under thick vegetation or tree cover (especially Russian Olive- *Elaeagnus angustifolia L.*); just because it isn't easily visible

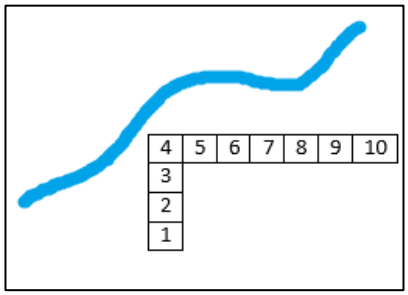
doesn't mean it isn't there. Also keep an eye out for last year's dead stalks with dried up pods, if you find these there is likely to be milkweed close by.

How to Select 10 Survey Plots to form a Transect: To complete one survey Transect, you need to survey 10 adjacent Plots; the preferred method is that you complete the 10 Plots in a straight line from south to north; this maintains the random approach to the survey. But use best judgment, it may be necessary to traverse the Transect north to south or make unexpected turns. Read guidance below on how to choose an alternate Transect configuration if you encounter barriers on the landscape, a refuge boundary, previously surveyed cells, or a physical barrier (wetland edge, cliff, very dense vegetation, waters edge).

After surveying 10 Plots (one Transect) move on to your next start Plot and survey another Transect (10 Plots).

Transect: Traverse 10 Plots in one straight line (may vary). The preferred direction is south to north. Find your start Plot, survey this Plot. After the start Plot is surveyed, continue on to next adjacent Plot north of your start Plot. Survey the remaining Plots in this direction that make up the 10 total Plots in the Transect.

Rules for Encountering Barriers in the Field: If you encounter a barrier in the field that prevents you from continuing to survey in your current direction, then choose the next Plot that is 90 degrees to the right (east) and finish the remaining Transect Plots in this direction. If while finishing your survey in the new direction you encounter another barrier, follow the same procedure, turn 90 degrees to the right (south) and finish the remaining Plots in this direction (see image for clarification).



Recording Data in the Field: Use the Geodatabase on the Mobile Device/ GPS unit to enter data collected while surveying. See Appendix C., Region 1 Milkweed and Monarch Monitoring Geodatabase User Guide, for detailed instructions on what data to record. If it is not possible to use the GPS unit to record data use the hard-copy data collection sheet and then transfer attributes to the geodatabase back in the office.

If hard-copy data sheets were used to collect field data, you must enter data into geodatabase. Scan and send hard-copy data sheets to R1 I&M at the end of the season along with the geodatabase.

Monarch Survey as part of Milkweed Survey: Record any monarchs seen incidentally during milkweed surveys in the Geodatabase (see Appendix C. Region 1 Milkweed and Monarch Monitoring Geodatabase User Guide for more details on what fields to record). A more extensive monarch survey methodology can be used while conducting a milkweed survey and instructions can be found in the Monarch ISI.

Sample Forms:

See Appendix B.

FWS hardcopy data sheet milkweed 28Mar2016.docx
FWS hardcopy data sheet monarchs 28Mar2016.docx
FWS Milkweed and Monarch Observation Codes and Definition Sheet_31Mar2016.pdf

Data layer and Map Preparation Guidance:

See Appendix C. Milkweed Data Layer and Map Preparation Guidance

Mobile Device/ GPS unit Instructions:

See Appendix D. Region 1 Milkweed and Monarch Monitoring Geodatabase User Guide

MMG Geodatabase:

ArcGIS geodatabase grid cells overlapping refuge boundaries in Oregon, Washington, and Idaho. Milkweed sampling points are identified.
ArcPad layer file and ArcGIS layer files

Supplies for milkweed mapping:

1. Mobile Device or other suitable GPS unit that accommodates the Geodatabase and or provides accurate coordinates.
2. Plant Field Guide or other appropriate references for identifying plant genera and/or species
3. Field data sheets and data dictionary
4. Maps
5. Counter

Personnel: Personnel should be able to navigate to waypoints using a GPS unit, identify milkweed species, and use a digital form for data entry. Personnel should be physically capable of traversing rough terrain for extended multi-hour timeframes.

Data Management and Analysis

Data Entry File Format

Refuge data collected using the Milkweed and Monarch Geodatabase are uploaded into the Refuge's GIS system.

Data Storage and Archive Location

ServCat will be used to control access to the data. The data that is suitable for publication will be marked Public visible so as to be consumed by Data.gov. Data.gov will be the primary means of distributing/sharing the data and subsequent reports, models, and other materials related to the ***Western Monarch and Milkweed Habitat Suitability Assessment***, to the public and cooperating agencies and organizations as needed.

Regional Monarch/Pollinator Coordinator and Regional Refuge Biologist are responsible for the management and analyses of the data. The project is supported by the I&M Data Manager who is responsible for metadata, archiving and distribution.

Procedures for processing and verifying data (QAQC)

Field Station responsibilities

Data collected on mobile devices/GPS units will be checked back in following procedures described in the User Guide no later than seven days from when it was checked out. The geodatabase will be backed up to another location weekly during periods of survey activity. Back-up routine ought to be developed early on in the project.

Upon data check-in, spot checking should occur shortly thereafter. Best to do this while the memory is fresh! Definitely perform spot checking prior to starting any new check-in procedures.

At the end of the field season the refuge will post a final geodatabase to Google Drive. The BRB/I&M staffs will use the file to compile a Region 1 comprehensive geodatabase.

BRB/I&M responsibilities

The BRB/I&M staffs will compile a Region 1 comprehensive geodatabase.

The Geodatabase records are uploaded monthly into the Western Monarch and Milkweed Occurrence Database, an Access database, for inclusion into the Western Monarch and Milkweed Habitat Suitability Assessment (Model). Data analyses are run through the Model to develop appropriate map outputs to inform habitat projects. The Access database is developed for long-term storage of data, uploaded to

See *USFWS_R1_DataProcessing_Milkweed (to be developed)* for details on file processing, data management, and database issues.

Methods/Software used in Data Analysis

ArcGIS Geodatabase format (10.3.3)
ArcPad .axf (10.2)

Metadata Content and Format

No use constraints. Sharing by agreement that requests citation. See database data dictionary. XML Workspace available for schema.

Reporting

The data that is suitable for distribution will be marked Public visible so as to be consumed by Data.gov. Data.gov will be the primary means of distributing/sharing the data and subsequent reports, models, and other materials related to the ***Western Monarch and Milkweed Habitat Suitability Assessment***, to the public and cooperating agencies and organizations as needed.

Insert ServCat and Data.gov links

Appendices & Maps

Appendix A. Choosing Sample Site Locations

The following terms are used in this project.
Block: one 5-km by 5-km grid cell. In GIS, a grid composed of 5km cells was laid over each refuge. The 5k Blocks are used to distribute sampling effort around a refuge.
Plot: one 50-meter by 50-meter grid cell. In GIS, a grid composed of 50-m cells was laid over each refuge. Start Plots were randomly chosen for sampling. The chosen Plot becomes the start Plot - the first Plot in the Transect. Field data are entered at the Plot level.
Transect: 10 adjacent Plots.
Panel: 10 – 15 Transects per Block (or less if the survey targets for the Block are less

Feature class name Grid_5km_GCS : this is the 5-km by 5-km grid

- Purpose of this grid is to cluster sampling around the refuge, to ensure all parts of each refuge get sampled.
- Each Block has a unique ID, consisting of the refuge literal, the letter B, and a 2 or 3 digit number. (ie, CMS_B_00).
- For example, see Figure 2. The first Block to sample is the southwest corner of the refuge (Block 1). Block 2 has no Plots and will be skipped.

Sampling is conducted in 50-m by 50-m Plots; 10 adjacent Plots make up a Transect. Plots are chosen through the GRTS draw and they become the start Plot for a Transect.

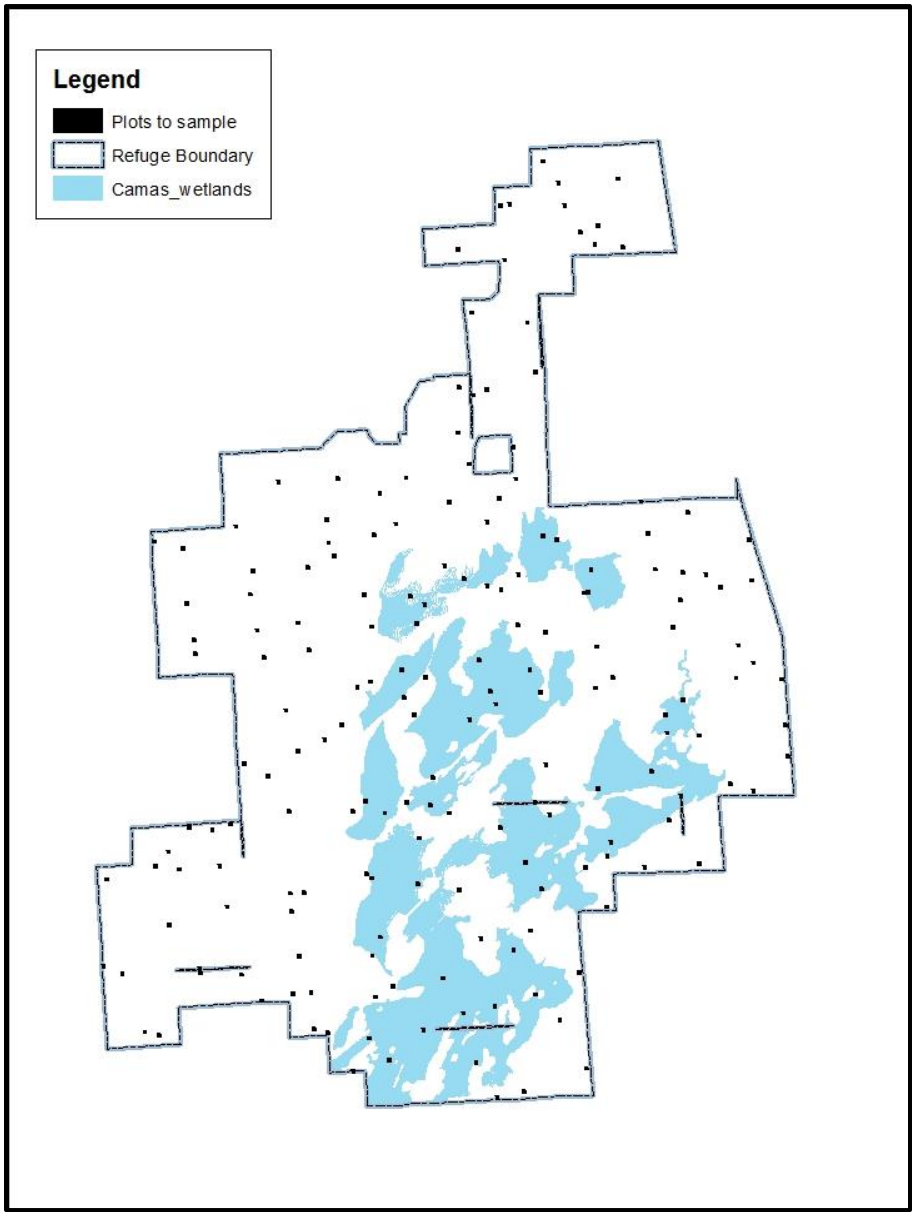
Feature class name SurveySites: this is the sample array that will be used to identify the 50-meter by 50-meter Plots that are the Transect start locations.

- Each sample site is coded with the 50m Grid_ID, which is spatially corresponds to the site, and is unique for each sample site and consisting of the refuge literal, the letter T, and a 2 or 3 digit number.
- The sites were stratified by the 5-km Block then assigned a spatially-balanced Plot order for sampling using GRTS.
- *Stratum* Column contains the stratum name, which corresponds to the 5-k Block id.
- The *Sample* column contains the draw order, identified during the GRTS process.
- *Plot order* column shows the order for surveying, within a strata. Twice as many points were drawn during GRTS process as needed, so there should be plenty of replacements.

Feature class name Grid_50m_GCS: this is the 50-meter by 50-meter grid, the grid contains the features that make up the Plot boundaries.

Camas Refuge is used to illustrate the GIS feature classes and the selection process. We calculated how many Transects should be conducted for complete sampling in each 5-k Block, based on the upland acres, the proportion of area within the Block that is refuge land, and a target of 10% of refuge land surveyed (excluding wetlands).

Figure 1. Plots for complete sampling on Camas NWR. Plots are spatially balanced across the refuge and selected Plots are the start Plot in a 10 Plot Transect.

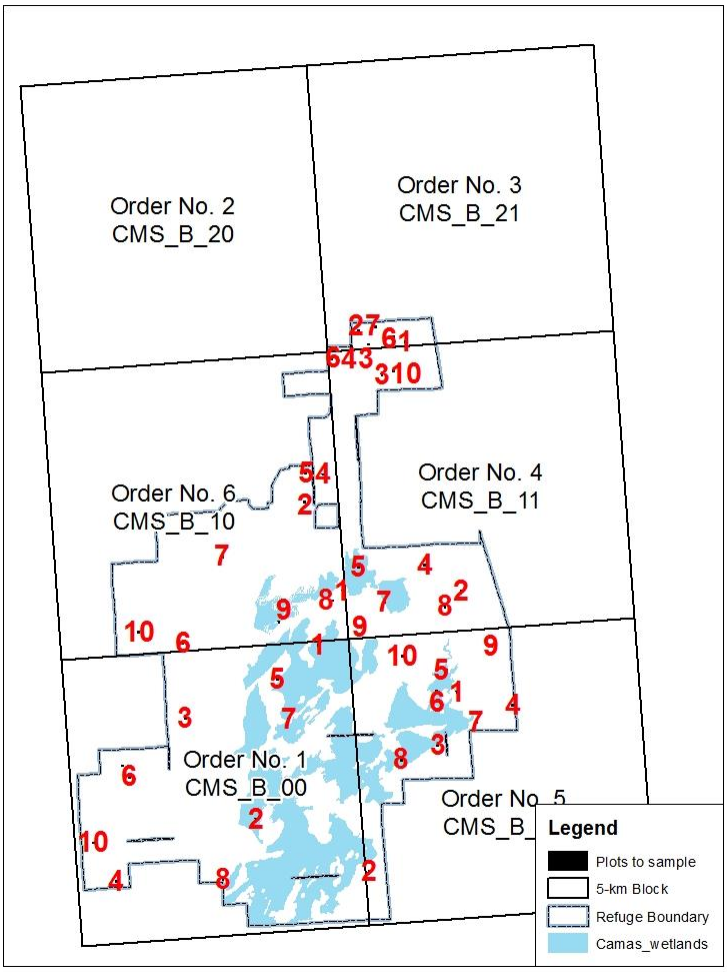


Based on size of the refuge, surveying 153 Transects would provide complete sampling for Camas Refuge. The Plots shown (Figure 1) are spatially distributed and ordered, as identified in a GRTS draw. Notice that some of the Plots fall in ponds, distributed and ordered, as identified in a GRTS draw. Plots can be rejected. With GRTS, replacement Plots are drawn at the same time so there are plenty of replacement Plots (not shown on this map).

Complete sampling might not be achievable on many refuges, but we still want samples distributed across the refuge. The 5-km by 5-km block will help achieve that.

Figure 2. 5-km Blocks on Camas Refuge.

The number of survey Plots are stratified by Block (Figure 2), to distribute surveys across the refuge. Blocks are identified by a unique ID (CMS_B_xx).

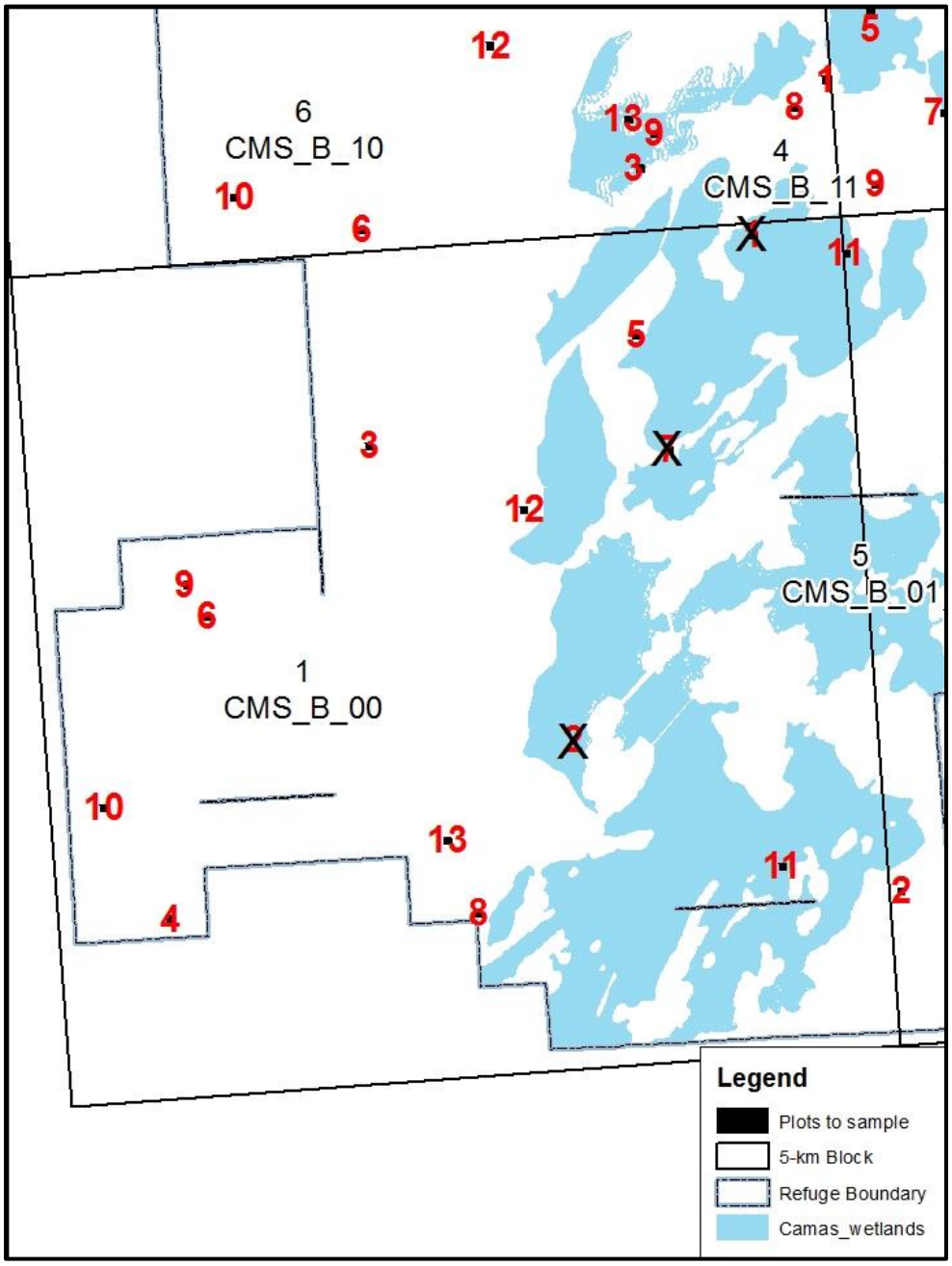


Before heading out to the field, refuge staff can overlay the sample sites on their base files and reject sites that clearly do not occur on surveyable terrain, but we still want samples distributed across the refuge. The 5-km by 5-km grid will maintain the randomization. If in doubt, best to visit the Plot on the ground to make the final determination. Examples for rejection could include 1) Plot falls in a lake or river; 2) Plot falls in an area of the refuge that is inaccessible.

Cycle through the Blocks on a given refuge. The intent of this protocol is to visit every Block on a refuge, then repeat the cycle until the sample targets for each individual Block is met. But the order that the Blocks are visited can be somewhat flexible. Realistically some travel to sites may be dependent on opportunity, and/or other logistics. All Blocks should d be visited before cycling back to repeat Blocks. Survey 10 Transects (a Panel) (or the Block total if less than 10) before moving to next Block.

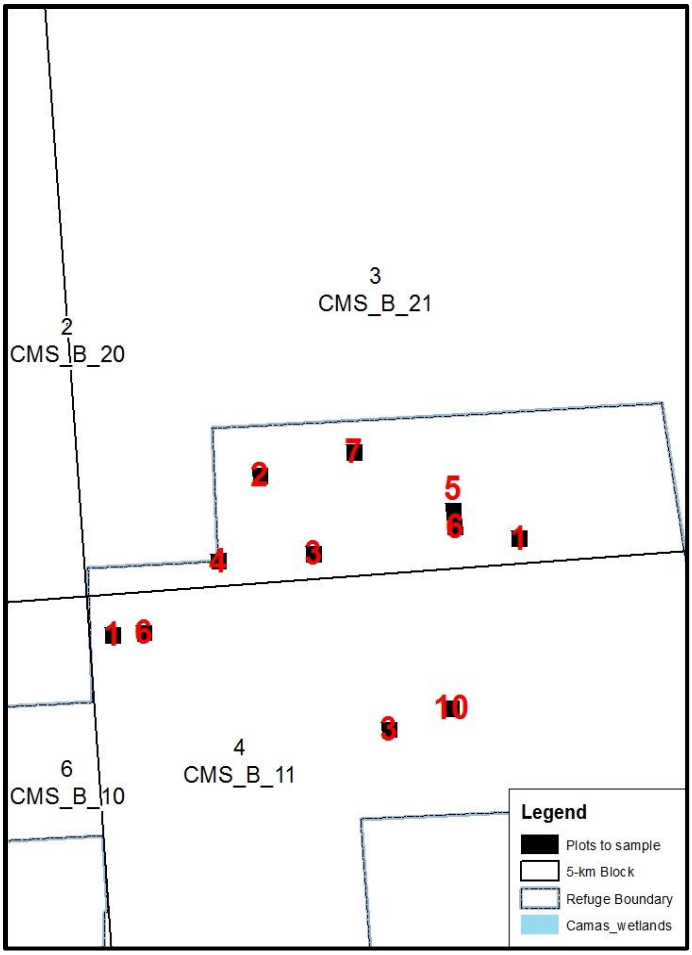
- After 10 Transects (or the Block total if less than 10) are surveyed in Block 1, move to Block 2.
- Block 3 only needs 3 Transects (see Table 1 and Figure 4), so sample the first 3 then move to Block 4.
- Continue surveying in this manner until all Blocks have been surveyed during the round.
- If time permits, return to Block 1 and start a second round.

Figure 3. Block CMS_B_00 is the first Block.



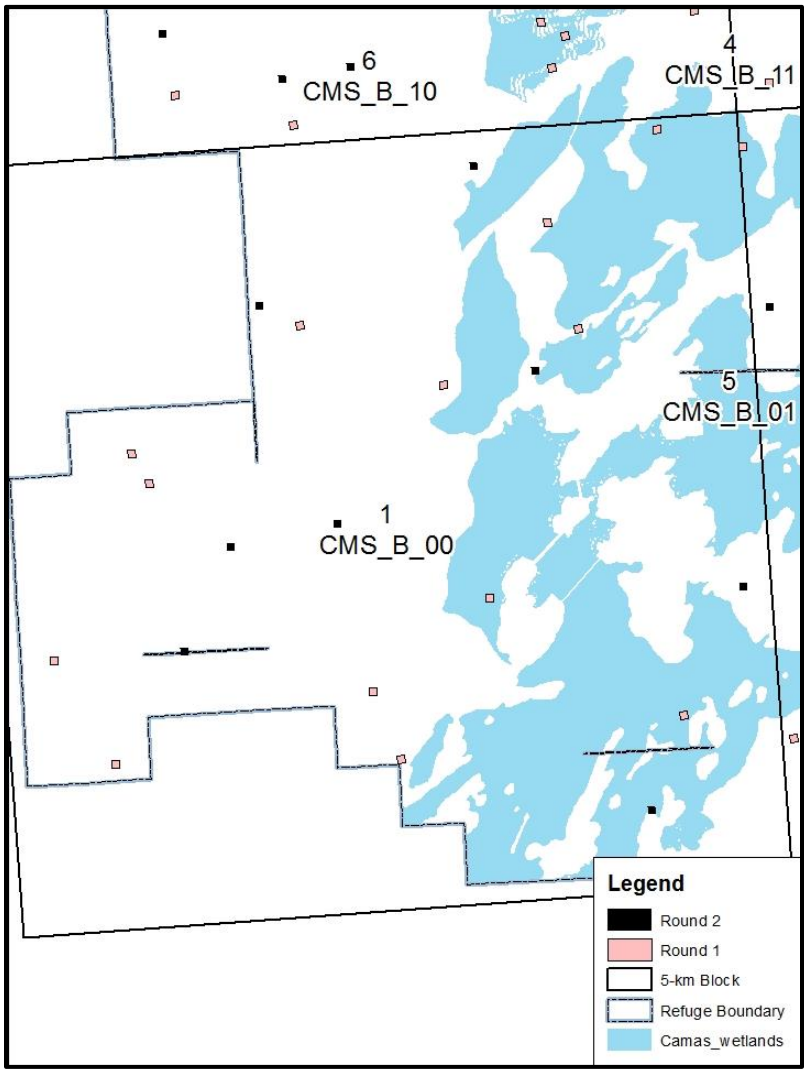
- Plots 1, 2, and maybe 5 are rejected because they fall in a pond (Figure 3). The next Plots on the ordered list within Block 1 are chosen as replacements.

Figure 4. Block CMS_B_21 is the 3rd Block. Only a small portion of the refuge lies in Block 3, so only 3 Transects are needed.



- Survey 3 Transects in Block 3
- Seven Plots were mapped, because extra samples were drawn. Sample the first 3, if you can.
- Move through Blocks 4, 5, and 6 using the same process. Replace Plots if they are unsuitable for sampling
- After all Blocks have been surveyed once, return to Block 1 and re-start with next round (Figure 5) of new Transects. Revisit the ordered list of Plots to determine the next 10 Transects to survey.

Figure 5. Round 2 of surveys starts back in Block CMS_B_00, first Block in random order. Ten additional Transects are surveyed, starting right after the last Plot surveyed on the randomized list.



- Sample the next 10 Transect starts in Block 1.
- Again, reject Plots and replace with the next one on the list, if necessary.
- Block 3 was completed the first round (the total sample target has been met), so move to Block 4 and sample the next 10 Transects.

Appendix B. Field Forms

Appendix B Field Forms.zip

- FWS hardcopy data sheet milkweed 28Mar2016.docx
- FWS hardcopy data sheet monarchs 28Mar2016.docx
- FWS Milkweed and Monarch Observation Codes and Definition Sheet_31Mar2016.pdf

Appendix C. Data Layer and Map Preparation Guidance

Appendix C Milkweed Data Layer and Map Preparation Guidance.pdf

Appendix D. Region 1 Milkweed and Monarch Monitoring Geodatabase User Guide

Mobile device/ GPS unit instructions found in the Region 1 Milkweed and Monarch Monitoring Geodatabase User Guide.
Appendix D Region 1 Milkweed and Monarch Monitoring Geodatabase User Guide.pdf

Appendix E. MMG Geodatabase

ArcGIS geodatabase grid cells overlapping refuge boundaries in Oregon, Washington, and Idaho. Milkweed sampling points are identified.
ArcPad layer file and ArcGIS layer files