Supplementary Data Sheet S1. Idaho and Washington data collection sheet observation codes and definitions, 2016–2017.

Idaho/Washington Milkweed & Monarch Observation Codes and Definitions

WEATHER DATA

Temp: record in ° F

Wind speed: use Beaufort scale

Wind Speed Codes		
Beaufort	**MPH**	**Indicators**
0	<1	smoke rises vertically
1	1 to 3	wind direction shown by smoke drift
2	4 to 7	wind felt on face; leaves rustle
3	8 to 12	leaves, twigs in constant motion
4	13 to 18	dust, leaves, and loose paper lifted; small tree branches move
5	19 to 24	small trees in leaf begin to sway

% Cloud cover: Measured in tenths of the sky; choose one: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

Precipitation: Choose one: None, Trace, Light, Moderate, Heavy

Appropriate weather: Temperature ≥70° F, wind ≤ 10-15 mph, distinct shadows cast by sunlight (Y/N)

MILKWEED DATA

Milkweed species: Use abbreviation

Code	**Scientific name**	**Common name**
ASAS	*Asclepias asperula*	Antelope horns
ASCR	*Asclepias cryptoceras*	Pallid milkweed
ASFA	*Asclepias fascicularis*	Narrow-leafed milkweed
ASIN	*Asclepias incarnata*	Swamp milkweed
ASSP	*Asclepias speciosa*	Showy milkweed
ASSU	*Asclepias subverticillata*	Poison milkweed

Milkweed patch structure: The spatial arrangement of the milkweed plants within the landscape. Choose one:

Code	**Milkweed structure**	**Definition**
L	Linear	Close to loosely-spaced grouping of plants, much longer than wide, whose spatial extent cannot be readily delineated by a single GPS point or patch size; plants may be continuously or discontinuously distributed; occur along road margins, fence lines, or other discreet habitat edges that limit population expansion in 1 or more directions. Coordinates should be approximately mid-line when feasible.
N	Nonlinear	Single plants or closely-spaced groups which can be readily delineated by a single GPS point and/or discernable patch size. Also includes patches distributed somewhat continuously throughout a habitat or field within sight distance from each other.

Patch: A discrete grouping of milkweed plants; separated from other milkweed patches by ≥25–50 m (82–164 ft), or dense, tall shrubs and/or trees, buildings, roads, etc.

Patch size: Patch size of milkweed delineated by GPS coordinates, rangefinder, or optical estimate, reported in square meters (length x width).

Plant count: Complete count or estimated number of plants (or stems) in the patch designated by the GPS Coordinates. For large, continuous patches, sub-sampling of a smaller, representative patch is appropriate for estimating the plant count. Plant count includes all milkweed stems, including unbranched and multi-branched plants.

Plant count method: This field is to enter how you derived your plant count and percentages for the stages of phenology – vegetative, flowering, pods. Choose one:

Code	Plant count method	Definition
CP/SC	Complete plant/stem count	all visible unbranched and multi-branched plants were counted within the area designated as the site
OE	Optical Estimation	count and percentages estimated
SM	Standardized Methodology	counts and percentages derived from accepted and documented subsampling methods
OM	Other Methods	

Percent vegetative plants: Percent of plants without buds, flowers, or pods
Choose one: 0%, 10%, 25%, 50%, 75%, 100%

Percent flowering plants: Percent of plants with buds and/or open flowers
Choose one: 0%, 10%, 25%, 50%, 75%, 100%

Percent plants with pods: Percent of plants with pods (includes young to mature pods)
Choose one: 0%, 10%, 25%, 50%, 75%, 100%

All three responses should add to 100%

Average height of plants: Average height of plants in the patch in inches

Larvae herbivory: Plants show evidence of herbivory from caterpillars
Choose one: Yes, No, or Not Checked

Habitat type: General habitat type that the milkweed occurs in. Multi-select if appropriate (separate by

Code	Habitat type	Habitat description
CC	Cultivated Crops	Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.
DF	Deciduous Forest	Areas dominated by trees generally >5 meters tall, and >20% of total vegetation cover. More than 75% of tree species shed foliage simultaneously in response to seasonal change.

commas in field data sheet); for Cultivate Crops, identify type of crop (e.g., corn, potatoes):

EF	Evergreen Forest	Areas dominated by trees generally >5 meters tall, and >20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.
EHW	Emergent Herbaceous Wetlands	Areas where perennial herbaceous vegetation accounts >80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
G	Garden	Garden
G/H	Grassland/ Herbaceous	Areas dominated by graminoid or herbaceous vegetation, generally >80% of total vegetation. Area not subject to intensive management such as tilling, but can be utilized for grazing.
MF	Mixed Forest	Areas dominated by trees generally >5 meters tall, and >20% of total vegetation cover. Neither deciduous nor evergreen species are >75% of total tree cover.
P-OS	Park-Open Space	Areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for <20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
P/H	Pasture/Hay	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for >20% of total vegetation.
S/S	Shrub/Scrub	Areas dominated by shrubs; <5 meters tall with shrub canopy typically >20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
WW	Woody Wetlands	Areas where forest or shrubland vegetation accounts for >20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
D-HI	Developed-High Intensity	Highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.
D-MI	Developed-Medium Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.
D-LI	Developed-Low Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. Areas most commonly include single-family housing units.
ID	Irrigation ditch	Area associated with irrigation canal including access roads.

Habitat association: Habitat parameters that describe the milkweed stand location. Multi-select if appropriate (separate by commas in field data sheet):

Code	Habitat association	Definition
EH	Edge Habitat	Milkweed plants occur within a 5 meter transition zone between 2 habitat types
FH	Floodplain Habitat	Milkweed plants occur along shorelines of a waterbody or within the natural floodplain of a river or stream
FR	Fence Row	Milkweed occurs predominantly along a fenceline, usually in a linear fashion, and excluded from expansion by management actions or other features
GP	Garden-Park	
R	Roadside	Milkweed plants occur within a roadside right-of-way, usually in a linear fashion, and excluded from expansion by impervious surfaces or other features
PUC	Public Utility Corridors	Any rights-of-way or facilities managed by a utility company; e.g., under transmission lines, pipelines
IC	Irrigation Canals	Open artificial water conveyance systems generally associated with agricultural
IAF	Irrigated Agriculture Fields	Fields or crops irrigated for agricultural purposes, usually with sprinkler systems or watered through crop rows
NA	None of the Above	Milkweed plants do not occur in any of the above scenarios

Management actions: Known land management or other actions that occur on the site that may affect (positively or negatively) milkweed plants. Multi-select if appropriate (separate by commas in data collection sheet):

Code	Management actions	Definitions
G	Grazing	Livestock grazing occurs at least once every 3 years
IM	Intense Mowing	Mowing occurs annually or more frequently
LM	Light Mowing	Mowing occurs, but with at least 1 year of rest between each mowing
H	Haying	Haying occurs at least once every 3 years
IH	Intense Haying	Haying occurs annually or more frequently
PB	Prescribed Burning	Prescribed burning occurs at least once every 3 years
FHA	Frequent Herbicide Applications	Herbicide applications occur annually or more frequently; may or may not target milkweed
IHA	Infrequent Herbicide Applications	Herbicide applications occur every 2 years or less; may or may not target milkweed
IA	Insecticide Applications	Insecticide applications occur at once every 3 years or more frequently
TH	Timber Harvest	Milkweed plants occur in a designated timber harvest area
BC	Brush Clearing	Understory vegetation is cleared at least once every 3 years for fire suppression or other reasons
RG	Road Grading	Roads and/or road ditches are graded at least once every 3 years
SW	Supplemental Watering	Milkweed plants receive supplemental water directly as part of landscape or nursery operations
IW	Indirect Watering	Milkweed plants receive supplemental water from agricultural runoff, sprinkler systems, roadside ditches, agricultural ponds
IDM	Irrigation Ditch Maintenance	Ditch maintenance occurs once every 3 years or less
UNK	Unknown	Land management actions are unknown or undiscernible

Threats: Known or potential issues that may threaten the persistence of a milkweed population. Surveyors are encouraged to identify threats that may not be listed below (e.g., military training, wildfire, etc.). Multi-select if appropriate:

Code	Threats	Definitions
M	Mowing	Repeated seasonal mowing or mowing during monarch breeding season
H	Haying	Repeated seasonal haying or haying during the monarch breeding season
HA	Herbicide Application	Application directly on milkweed or close proximity (<50')
IA	Insecticide Application	Application directly on milkweed or in close proximity (<50')
G	Grazing	Excessive grazing that causes trampling of plants
FR	Flooding Regimes	Natural floodplain function lost due to dams or other management actions
VE	Vegetation Encroachment	Lack of fire and other natural disturbance regimes that promote vegetation succession
IS	Invasive Species	Presence of invasive grass or shrub species that suppress milkweed growth
RD	Recreational Disturbance	Site subject to off-road vehicle use, foot traffic that can impact plant growth
IDM	Irrigation Ditch Maintenance	Removal/eradication of milkweed plants within irrigation ditch profiles.
D	Development	Removal/eradication of milkweed plants from residential/business land development.

Milkweed adjacent: Note whether milkweed is contiguous to adjacent grid cells. Choose Y or N for each adjacent cell. Where milkweed is present in an adjacent cell, include milkweed structure code (e.g., S, C, L).

Survey notes: Describe survey, site access, document photos, or any other pertinent observations. Note locations of any federally listed plant and animal species observed during the survey.

MONARCH DATA

Female monarch count: Number of adult female monarchs observed at the site

Male monarch count: Number of male monarchs observed at the site

Total monarch count: Total number of adult monarchs observed

Behavior notes: Observed behavior of adult monarchs at site (multi-select if appropriate, separate by commas)

Code	Behavior notes	Definition
FM	Flying (Migrant)	Subjective - monarch flying out of or over the site in a relatively straight direction and altitude that indicates migratory behavior
FF	Flying (Foraging)	Subjective - monarch flying near ground-level, flight path non-directional
L/P	Loafing/Perched	Monarch perched on a non-flowering plant or other object during daytime
NR	Night Roosting	Monarch perched in a tree, shrub, or other sheltered site just prior to sunset
N	Nectaring	Monarch actively nectaring from a flower
M	Mating	Male and female monarchs clasped together
EL	Egg Laying	Female monarch actively laying eggs
E	Eclosing	Butterfly is emerging from pupal case
O	Other	None of the above behavior
NO	None Observed	None observed

Egg count: Number of monarch eggs observed

Larvae count: Number of monarch larvae observed; quantify instar stage (1^{st} – 5^{th})

Pupae count: Number of monarch pupae observed

Pupae substrate: Plant species pupae were attached to (by scientific name or take sample)

Nectar species used: Enter the genus and/or species of nectar plants monarchs are using. If unknown, photograph the plant/flower and identify later.

Other pollinators observed: Enter genus and/or species of other pollinator species observed during survey. Consult pollinator I.D. sheet and take photographs for positive identifications.

Monarchs adjacent: Note whether adult monarchs are observed in adjacent cells. For instance, if an adult monarch is observed in the cell NW of the surveyed cell, enter Y-NW and provide count and behavior code(s). If none are observed in adjacent cells, enter N.