Deschutes Basin Habitat Conservation Plan: Habitat Suitability Analysis

Monitoring Conducted in Compliance with
ESA Section 10 Incidental Take Permit TE-89773D-0 and
Deschutes Basin Habitat Conservation Plan


Imagery from UAV flight September 21, 2022

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Background

Implementation of the Deschutes Basin Habitat Conservation Plan necessitates Permittees to provide qualified biologists to fulfill the required measures in cooperation and agreement with USFWS. An analysis of Oregon spotted frog (*Rana pretiosa*) habitat suitability along Crescent Creek and the Little Deschutes River (HCP 7.2.5) and on the upper Deschutes below Wickiup Dam (HCP 7.2.2.1) is required in year 1 (2021) and every 5 years thereafter for the term of the DBHCP. This task was completed in 2022 since it was not completed in 2021 due to smoke conditions, limited legal access and the lack of a final study plan from USFWS.

In 2022, the Casey Tract, a 35-ha area along the Little Deschutes River, was selected for monitoring by USFWS to meet the Permittee's requirements for conducting habitat suitability analyses. The monitoring and analysis requested on the Casey Tract required significantly more biologist hours and resources than could be accomplished within the scope of HCP 7.2.5 and would not fulfill the upper Deschutes habitat suitability analysis requirement. Consequently, it was mutually agreed upon by the Permittees and USFWS that completing the analysis on the Casey Tract would fulfill both HCP 7.2.2.1 and HCP 7.2.5. The biologist hours for those requirements were combined to meet the total 160-hour commitment.

The goal of this assessment was to map and delineate vegetation community types, breaks, and relative elevations of off-channel breeding habitats. Additionally, this study identified locations and total area of reed canary grass within high-use breeding areas. This effort included three major components:

(1) UAV remote sensing to capture high-resolution imagery
(2) Vegetation surveys to map community types and breaks within selected habitats
(3) Photogrammetric processing and analysis

Methods

Site Description

The Casey Tract is a BLM parcel along the Little Deschutes River that contains hydrologically connected wetlands and oxbows occupied by the Oregon spotted frog (OSF). Surveys were conducted from September 19 - 22, 2022 at five oxbow complexes in the Casey Tract (Figure 1). Four of the oxbows are known to support OSF breeding: Casey West, Casey Y, Casey North, and Casey Northwest. Casey New, was added to the analysis because adult OSF were observed in August 2022.

The oxbow sites contain ephemeral wetlands and ponds that are activated during spring and summer precipitation events and when flows from the Little Deschutes are high. Moreover, these oxbows are, to an unknown extent, affected by upstream water operations. The oxbows appear driest during the fall and winter months, which coincides with low flows in the Little Deschutes (Figure 2).

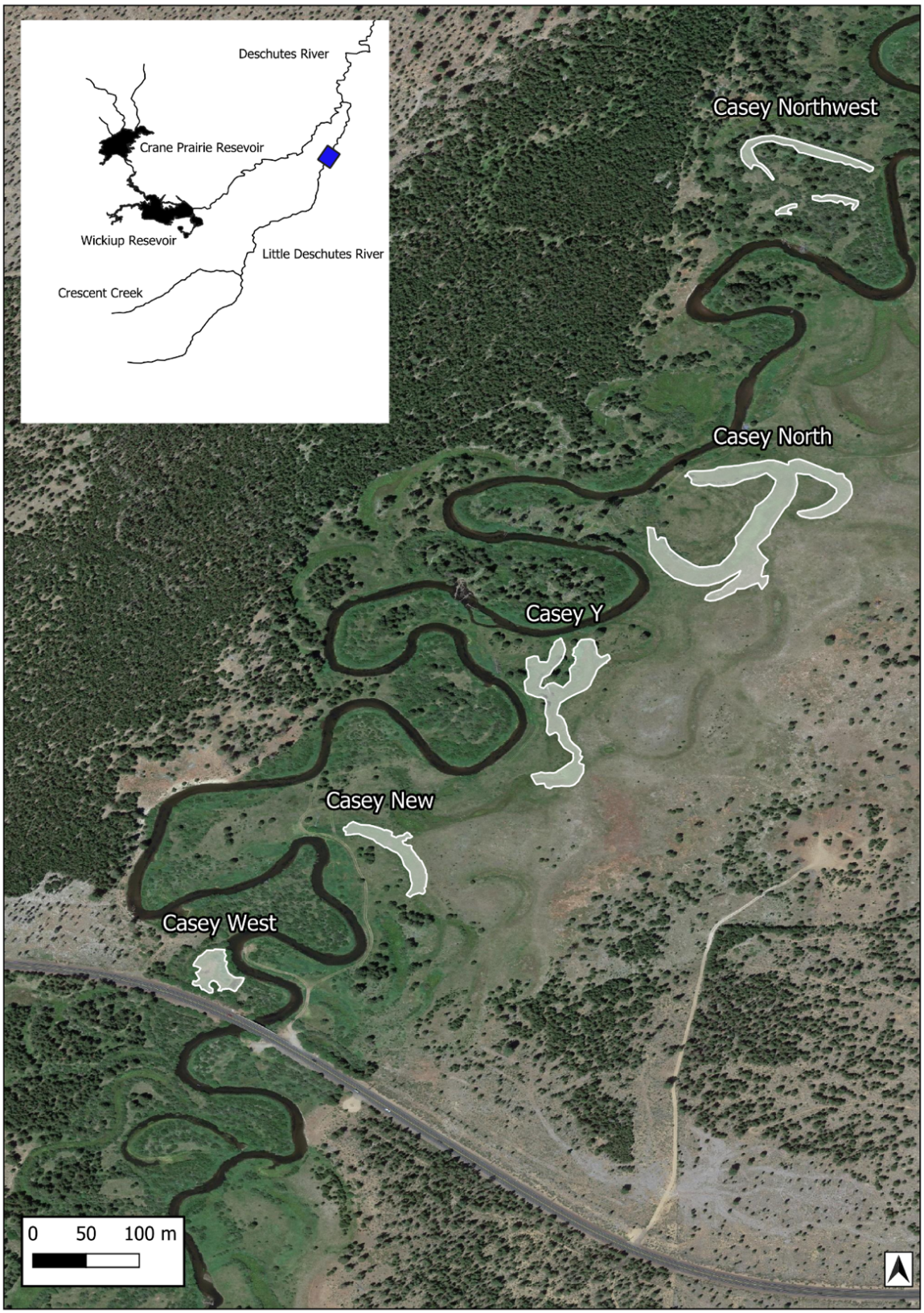

Figure 1. Map of the Casey Tract oxbow survey sites (source: Google Satellite; July 2022). Blue diamond (inset map) denotes the Casey Tract location within the Upper Deschutes River Basin.

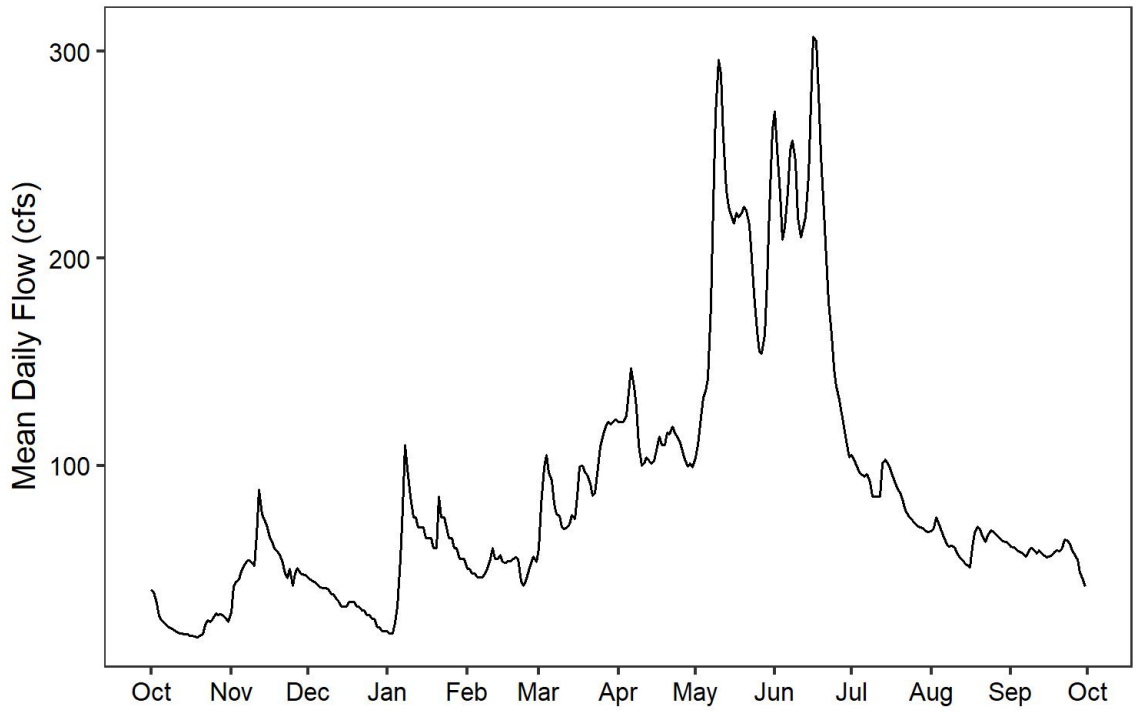

Figure 2. Mean daily flows on the Little Deschutes near La Pine. Provisional data from OWRD Gage 14063000.

UAV Remote Sensing

High resolution imagery of each site was recorded using a DJI Phantom 4 Pro V2 and a standard RGB sensor. All flights were completed on September 19 under partly cloudy skies and variable light conditions. Flight plans were developed using DJI Ground Station Pro software and used the following parameters:

- 80% and 70% front and side overlap, respectively
- 100 ft in elevation at 10 mph
- Nadir
- 0.8 cm/pixel

Vegetation Surveys

Ground truthing was required to classify and delineate distinctive vegetation communities within the five oxbow habitats. Distinctive plant associations within each oxbow site were identified by systematically walking through the site and recording ocular estimates of cover for individual plant species using modified Daubenmire categories (USDA FS 2008). Wetland plant associations were determined based on the keys provided in Riparian and Wetland Vegetation of Central and Eastern Oregon (Crowe et al. 2004). Plant associations were further subdivided in some instances, based on topography and apparent soil moisture; presence of mosaics of plant associations; and other distinct changes in plant community structure discernable in the field.

These distinctions were typically related to the relative proportion of obligate wetland, facultative wetland, and facultative species.

Once the species composition and distinctive plant associations were visually identified within a site, polygons were delineated by recording numerous points along the outermost edge of the break between distinct plant associations. Those points were recorded in EPSG:3857 WGS 84 Pseudo Mercator coordinate system with an EOS Arrow 100 GNSS receiver, capable of sub-meter accuracy, and ESRI's Field Maps application. Plant associations that were visually apparent from UAV remote sensing were delineated during image analysis post-processing. Additionally, invasive reed canarygrass within the survey area was marked in the field and quantified during image analysis post-processing.

Ground Control

Survey control for UAV flights was established using real-time kinematic (RTK) corrections from the Oregon Real-time GNSS Network. At each site, five ground control points (rebar and cap) were placed outside the inundation zones to facilitate future data collection in the project area. Positions were measured with a Trimble R8 Model 2 GNSS receiver mounted on a 2-meter GPS rover rod and measured directly above each ground control point. All measurements are referenced to the North American Datum of 1983 (2011) [NAD83(2011)], State Plane Coordinate System Oregon South (3602), and all points are on North American Vertical Datum of 1988 (NAVD88) GEOID12B.

Photogrammetric Processing

UAV imagery was processed using Agisoft Metashape to create high-resolution orthomosaics and digital elevation models (DEM) of each site. Because there was a large discrepancy between photo elevations (absolute altitude) and ground control elevations (~65 m), we used a relative altitude correction to align photos with ground control points (Agisoft, LLC metashape-scripts 2021). Once photo elevations were corrected, image processing followed Metashape's standard workflow procedure:

1. Photo alignment
2. Tie point optimization (removed 10% of tie points with greatest error for reconstruction uncertainty, projection accuracy and reprojection error)
3. Ground control integration
4. Dense point cloud generation DEM and orthomosaic construction (EPSG:3857 WGS 84 Pseudo Mercator coordinate system)

Analysis

Site orthomosaics and DEMs were paired with high resolution geospatial data in QGIS to map and quantify wetland plant associations, reed canarygrass, and relative elevations. Geospatial data and imagery were integrated in EPSG:3857 WGS 84 Pseudo Mercator coordinate system. Total area and average elevation for each community type was calculated using QGIS field calculator and zonal statistics tool.

Results

Vegetation Surveys

At the five oxbow sites, we identified five predominant plant associations and one aquatic plant association. Plant Associations varied with elevation (Table 1) and apparent soil moisture. Sedges were by far the dominant cover in the oxbow habitats and were characterized by three main plant associations: *Carex utriculata* (CAUT), *Carex vesicaria* (CAVE), and a mix of sedge species (MIXED SEDGE). The CAUT plant association was typically found in the lowest elevation portions of the oxbows where emergent vegetation was present, with the exception of open water ponds, and is dominated by *C. utriculata* (beaked sedge), an obligate wetland species. Other plant species common in this habitat include *C. vesicaria* (inflated sedge), and *Persicaria amphibia* (water smartweed). One sub-type of the association (CAUT-POND) was mapped in areas that supported shallow ponded surface water and aquatic species such as *Sparganium emersum* (European burr-reed), *Potamogeton natans* (broad-leaved pondweed), and *Nuphar polysepala* (yellow pond lily).

The CAVE plant association is dominated by *C. vesicaria* with varying percentages of *C. utriculata*, *Persicaria amphibia*, and *Juncus balticus* (Baltic rush). At the Casey West site, *C. vesicaria* and *P. amphibia* were co-dominant, resulting in a CAVE – PEAM sub-type plant association. Generally, the CAVE plant association was typically found at slightly higher elevation than CAUT associations. At several sites, portions of the oxbow habitat was dominated by a mix of *C. utriculata* and *C. vesicaria* or unidentifiable sedges (MIXED-SEDGE), often in complex mosaics. The vegetation in these polygons was distinguishable from adjacent CAUT and/or CAVE plant associations and was typically found at intermediate elevations between CAUT associations and CAVE associations.

TRANSITION plant associations occurred at elevations greater than CAUT, CAVE, and MIXED SEDGE associations and consisted of a mix of facultative wetland and facultative species. TRANSITION polygons were narrow bands along the margin of the oxbows, creating a break between the wetland and upland plant species. Three sub-types were identified: sedge to grass dominated, grass to shrub dominated, and reed canarygrass to willow dominated.

The PHAR plant association was used to map patches or linear bands of *Phalaris arundinacea* (reed canarygrass). PHAR typically occurred along the margins of oxbows at elevations above the CAUT, CAVE, and MIXED SEDGE associations. PHAR was generally located within the TRANSITION and SHRUB-GRASS plant associations. The total area mapped for each plant association and their average elevations for each of the five oxbow complexes, along with sub-types and less common plant associations are summarized in Hitchcock and Cronquist (2018). An inventory of all species present across the five oxbow habitats is summarized in Table 2.

Table 1. Oxbow vegetation characteristics for Casey Tract survey sites.

Site	Plant Associations	Avg. Elevation (m)	Minimum Elevation (m)	Total Area $(m)^2$	Standing Water (Y/N)	PHAR $(m)^2$	General Description
Casey West	CAUT	1,273.85	1,273.47	95.19	N	0	*Carex utriculata* dominated, with saturated soils
	CAUT - POND	1,273.63	1,273.40	56.95	Y	0	*Carex utriculata* dominated, with ponded water and aquatic plant species
	MIXED SEDGE	1,274.07	1,273.40	868.20	N	0	*Carex vesicaria* dominated, with 5-25 percent cover *Carex utriculata* observed; appears wetter than typical CAVE habitat
	CAVE	1,273.80	1,273.41	196.52	N	0	*Carex vesicaria* dominated
	CAVE - PEAM	1,273.99	1,273.80	19.98	N	0	*Carex vesicaria* dominated, with 25-50 percent cover of *Persicaria amphibia* observed
	TRANSITION - PHAR–SALIX	1,274.43	1,273.66	56.95	N	NA	*Phalaris arundinacea* dominated transitioning to Salix dominated; distinctly higher elevation band than sedge habitat
	POND	1,273.75	1,273.48	127.86	Y	0	Perennial pond with aquatic plant species and some emergent sedges in shallow areas; steep sides
Casey New	CAUT	1,273.83	1,273.42	64.48	N	0	*Carex utriculata* dominated, with saturated soils
	CAVE	1,273.88	1,273.42	865.74	N	4.14	*Carex vesicaria* dominated (>50 percent cover observed) with FACW and FAC species
	TRANSITION – SEDGE/GRASS	1,273.99	1,273.64	514.06	N	17.79	*Carex vesicaria* dominated (>25 percent cover observed) with increased cover of FACW and FAC species
	TRANSITION – GRASS/SHRUB	1,274.22	1,273.73	448.77	N	16.45	Dominated by FAC and FACW species of grasses, forbs, shrubs; sedges not present
	PHAR	1,274.28	1,273.84	156.28	N	NA	*Phalaris arundinacea* dominated patches (>25 percent cover observed)
Casey Y	CAUT	1,273.65	1,273.15	36.29	N	0	*Carex utriculata* dominated

Site	Plant Associations	Avg. Elevation (m)	Minimum Elevation (m)	Total Area $(m)^2$	Standing Water (Y/N)	PHAR $(m)^2$	General Description
	CAUT - POND	1,273.46	1,272.82	330.38	Y	0	*Carex utriculata* dominated, with ponded water and aquatic plant species
	CAVE	1,273.74	1,273.04	2,366.17	N	10.72	*Carex vesicaria* dominated with small component of OBL and FACW species
	TRANSITION – SEDGE/GRASS	1,274.04	1,273.18	941.14	N	75.97	*Carex vesicaria* dominated (>25 percent cover observed) with OBL, FACW and FAC species
	TRANSITION – GRASS/SHRUB	1,274.45	1,273.08	1,359.64	N	89.07	Dominated by FAC species of grass, with smaller component of OBL, FACW grasses, forbs, rushes, shrubs
	PHAR	1,274.20	1,273.54	246.95	N	NA	*Phalaris arundinacea* dominated patches (>25 percent cover observed)
Casey North	CAUT	1,273.29	1,272.86	207.08	N	0	*Carex utriculata* dominated depression; moist but not saturated soil
	MIXED SEDGE	1,273.48	1,272.84	5,216.15	N	1.62	Mosaic of habitats with co-dominant *Carex utriculata* and *Carex vesicaria* in proportions varying with topography; soils moist to almost dry
	TRANSITION – SEDGE/GRASS	1,273.74	1,273.01	2,120.79	N	12.22	*Carex vesicaria* dominated (>50 percent cover observed) narrow band that transitions to drier species of grasses and forbs
	TRANSITION – GRASS/SHRUB	1,274.18	1,273.26	2,487.78	N	12.93	*Deschampsia cespitosa* dominated narrow band that transitions to drier species
	PHAR	1,273.85	1,273.29	36.07	N	NA	
Casey Northwest	CAUT	1,273.21	1,272.65	275.66	N	0	*Carex utriculata* dominated depressions; moist but not saturated soil
	MIXED SEDGE	1,273.44	1,273.15	1,710.75	N	0	*Carex utriculata* dominated habitat with substantial subdominant to co-dominant *Carex vesicaria.*

Table 2. Plant species list observed in Casey Tract oxbow sites surveyed September 2022.

Scientific Name	**NWI wetland status**	**Common Name**
Achillea millefolium	FACU	Common yarrow
Agrostis exarata	FACW	spiked bentgrass
Agrostis sp.	-	bentgrass
Agrostis stolonifera	FAC	spreading bentgrass
Artemisia ludoviciana	FACU	white sagebrush
Carex sp.	-	sedge
Carex utriculata	OBL	beaked sedge
Carex vesicaria	OBL	inflated sedge
Castilleja miniata	FACW	scarlet paintbrush
Cicuta douglasii	OBL	western water hemlock
Deschampsia cespitosa	FACW	tufted hairgrass
Elodea sp.	OBL	waterweed
Elymus glaucus	FACU	blue wildrye
Epilobium ciliatum	FACW	fringed willowherb
Equisetum hyemale	FACW	tall scouring rush
Festuca idahoensis	FACU	Idaho fescue
Fragaria virginiana	FACU	Virginia strawberry
Galium trifidum	FACW	three-petal bedstraw
Gentianopsis simplex (Gentiana simplex)	FACW	one-flowered fringed gentian
Geum macrophyllum	FAC	large-leaf avens
Hordeum brachyantherum	FACW	meadow barley
Iris missouriensis	FACW	Rocky Mt. iris
Juncus balticus	FACW	Baltic rush
Mentha canadensis (M. arvensis)	FACW	field mint
Nuphar polysepala	OBL	spatterdock
Persicaria amphibia	OBL	water smartweed
Phalaris arundinacea	FACW	reed canarygrass
Phleum pratense	FAC	timothy
Pinus contorta	FAC	lodgepole pine
Poa palustris	FAC	fowl blue grass
Poa pratensis	FAC	Kentucky blue grass
Potamogeton natans	OBL	floating-leaved pondweed
Potentilla anserina ssp anserina	OBL	silverweed
Ranunculus sp.	-	buttercup
Rosa woodsii	FACU	Woods' rose
Rumex occidentalis	FACW	western dock
Salix spp.	FACW	willow
Sceptridium multifidum	FAC	leathery grapefern
Sidalcea oregona	FACW	Oregon checkerbloom
Solidago sp.	-	goldenrod
Sparganium emersum	OBL	simple-stemmed burreed
Spiraea douglasii ssp menziesii	FACW	Douglas spiraea
Symphyotrichum spathulatum	FAC	western mountain aster

Photogrammetry

Elevations of the delineated plant associations were averaged from the UAV imagery-derived DEM (Figure 3). Because the sedge plant associations were extremely dense, generally precluding any bare ground, the elevations are higher than ground level. As a result, elevations of plant associations in the oxbow habitat should be considered relative. However, the elevations of large shrubs and grasses, including large patches of PHAR, were corrected by classifying adjacent ground point elevations and interpolating between them. This type of DEM, known as a digital terrain model, creates a surface without tall vegetation, thereby providing better estimates of ground elevations. These relative values can be confirmed or corrected using LiDAR or other land survey techniques.

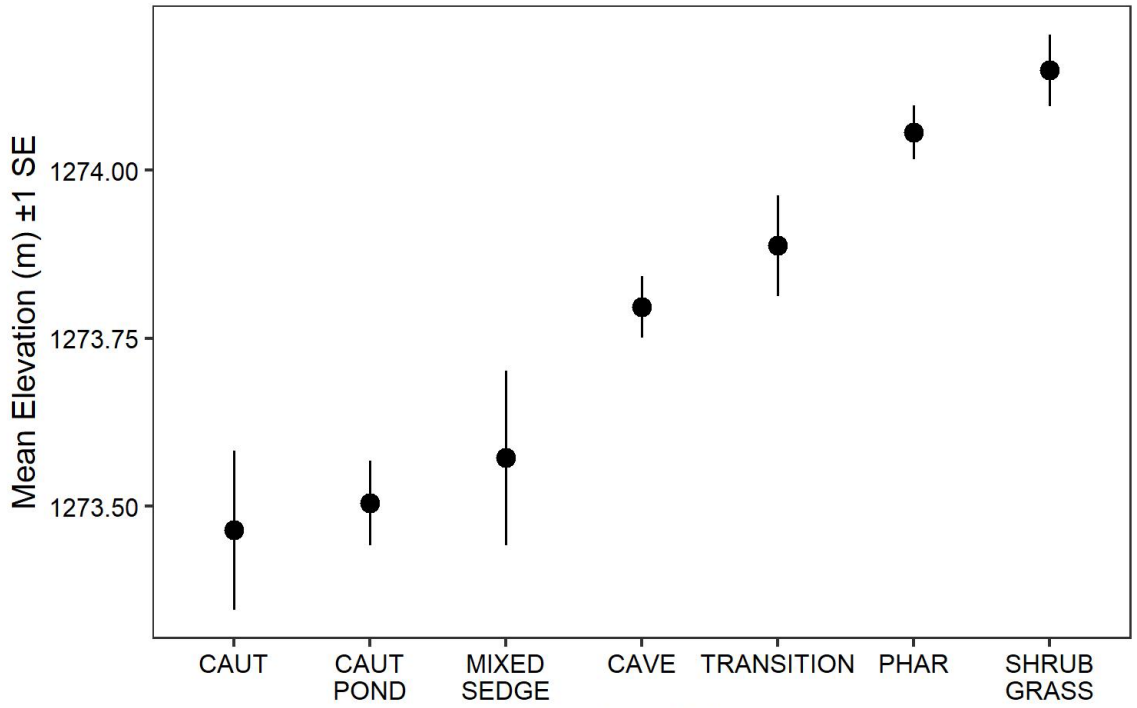

Figure 3. Mean elevations for predominant plant associations observed in oxbows at the Casey Tract.

Casey West

The Casey West site contains a pond and wetland complex that provides adult and juvenile OSF habitat throughout the spring, summer, and fall seasons (Figure 4). During November, this pond became frozen. The ephemeral wetlands throughout this site are dominated by *C. utriculata* and *C. vesicaria*, and other wetland obligate species (Figure 5). Reed canarygrass is abundant but confined to elevations approximately 0.39 - 0.80 meters above sedge-dominated plant associations (Table 1; Figure 5).

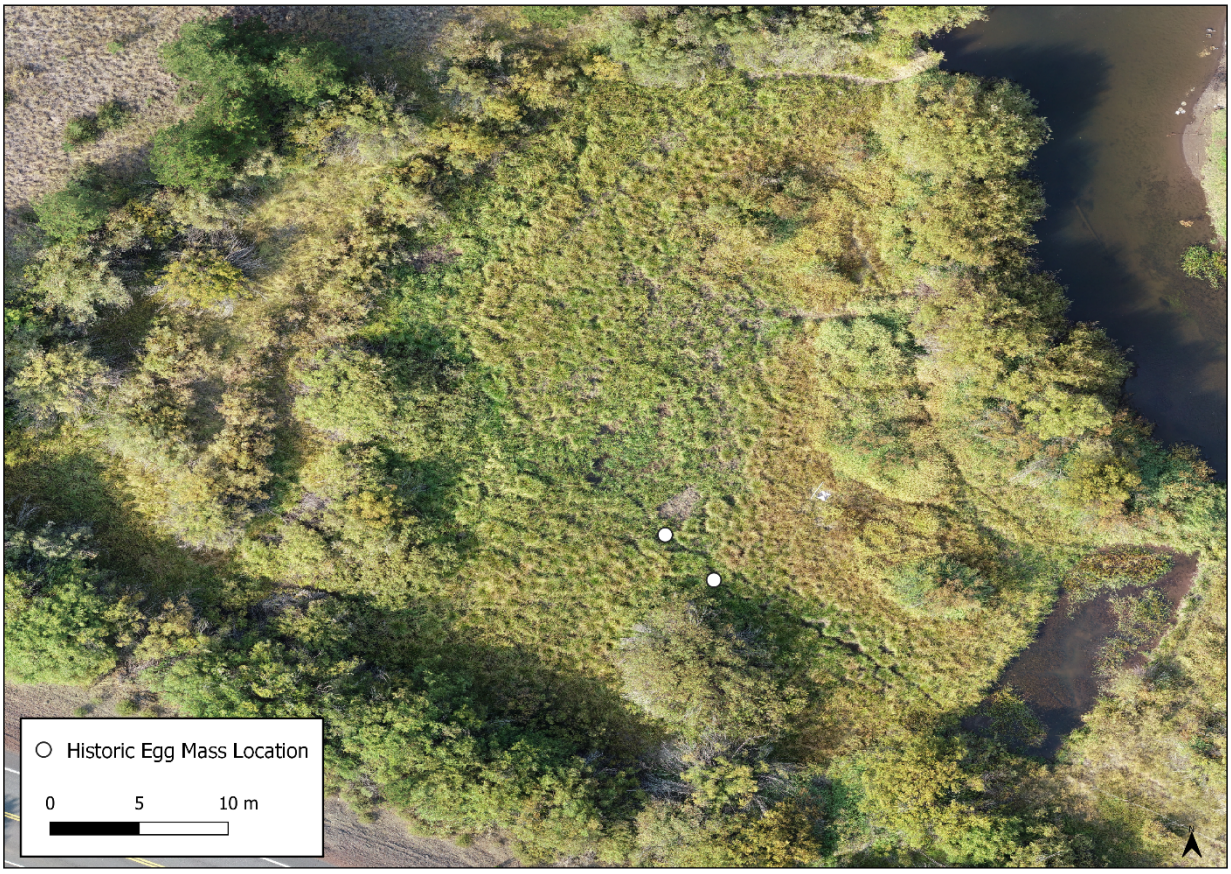

Figure 4. Casey West orthomosaic. Egg mass locations are from 2013 survey data.

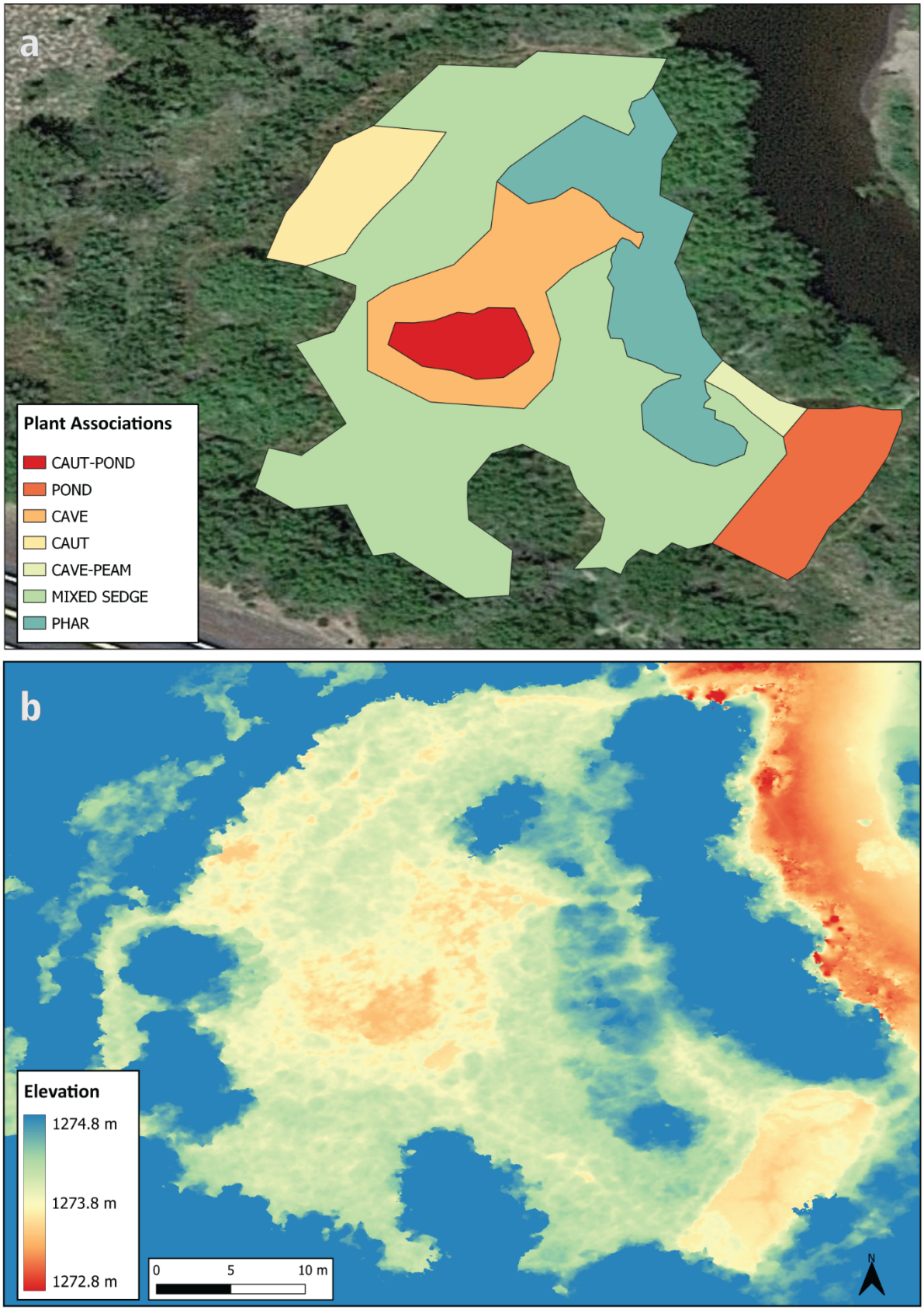

Figure 5. Casey West (a) Plants Association map and (b) Digital Elevation Model.

Casey New

Casey New (Figure 6) was established as part of this 2022 study because adult OSF were observed in the oxbow during an August 2022 site visit, when surface water was present. This small oxbow is dominated by sedges and has large patches of reed canarygrass overlapping the TRANSITION plant association (Figure 7). On average, reed canarygrass was 0.45 – 0.40 meters above the sedge plant associations (Table 1), though small patches overlapped with the CAVE polygon (Figure 7).

Figure 6. Casey New orthomosaic.

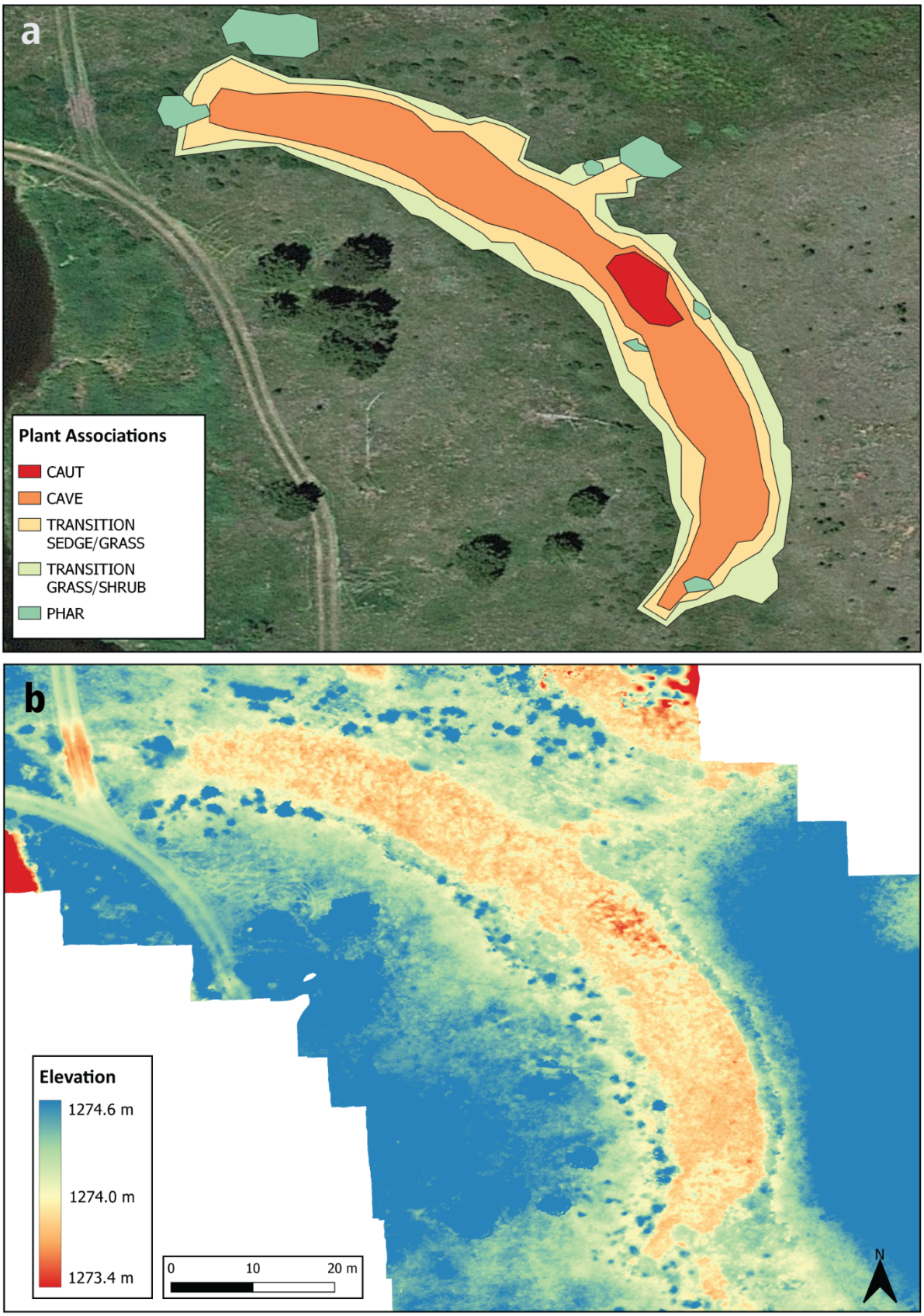

Figure 7. Casey New (a) Plant Association map and (b) Digital Elevation Model.

Casey Y

Casey Y (Figure 8) contained two CAUT polygons with standing water and were occupied by adult OSF during the September 2022 survey. Small patches of reed canarygrass are present in the CAVE plant association but larger patches were associated with the TRANSITION plant associations (Figure 9). The TRANSITION plant associations were > 0.55 meters higher on average than the sedges (Figure 9).

Figure 8. Casey Y orthomosaic.

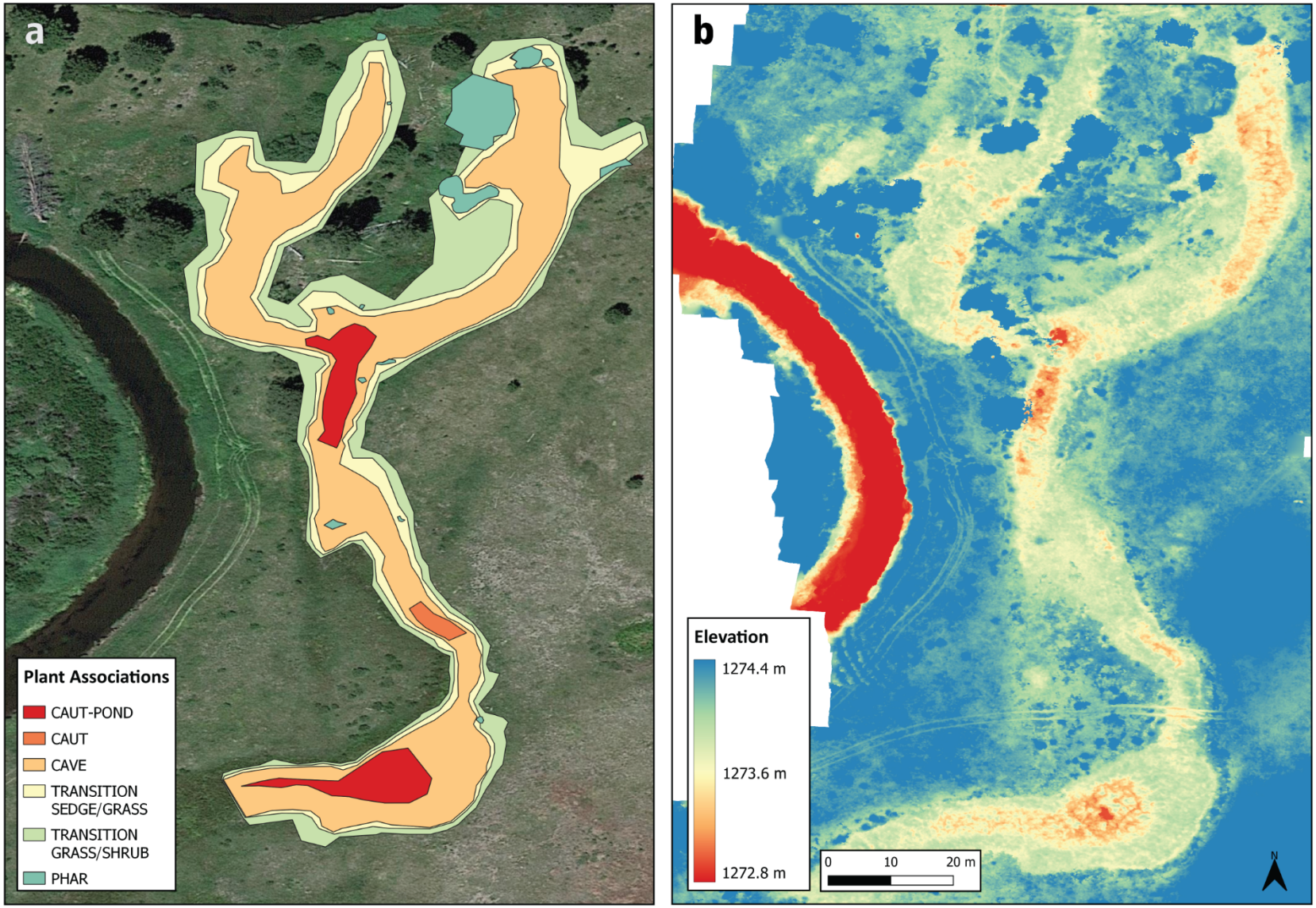

Figure 9. Casey Y (a) Plant Association map and (b) Digital Elevation Model.

Casey North

Casey North has sections that contain a relatively well-established riparian area with willow species creating a steep break between the oxbow and upland habitats (Figure 10, Figure 11). Reed canarygrass occurred only in very small patches, in the TRANSITION plant associations (Figure 11).

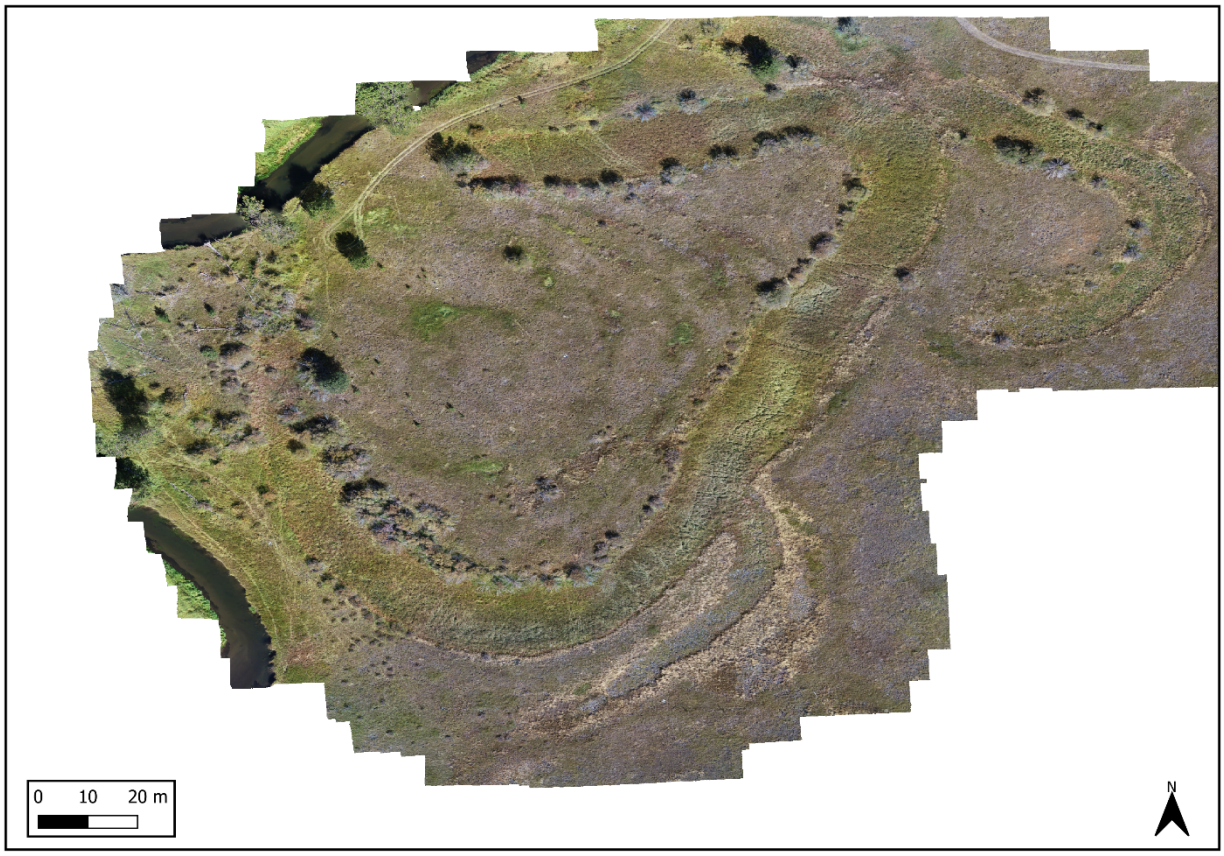

Figure 10. Casey North orthomosaic.

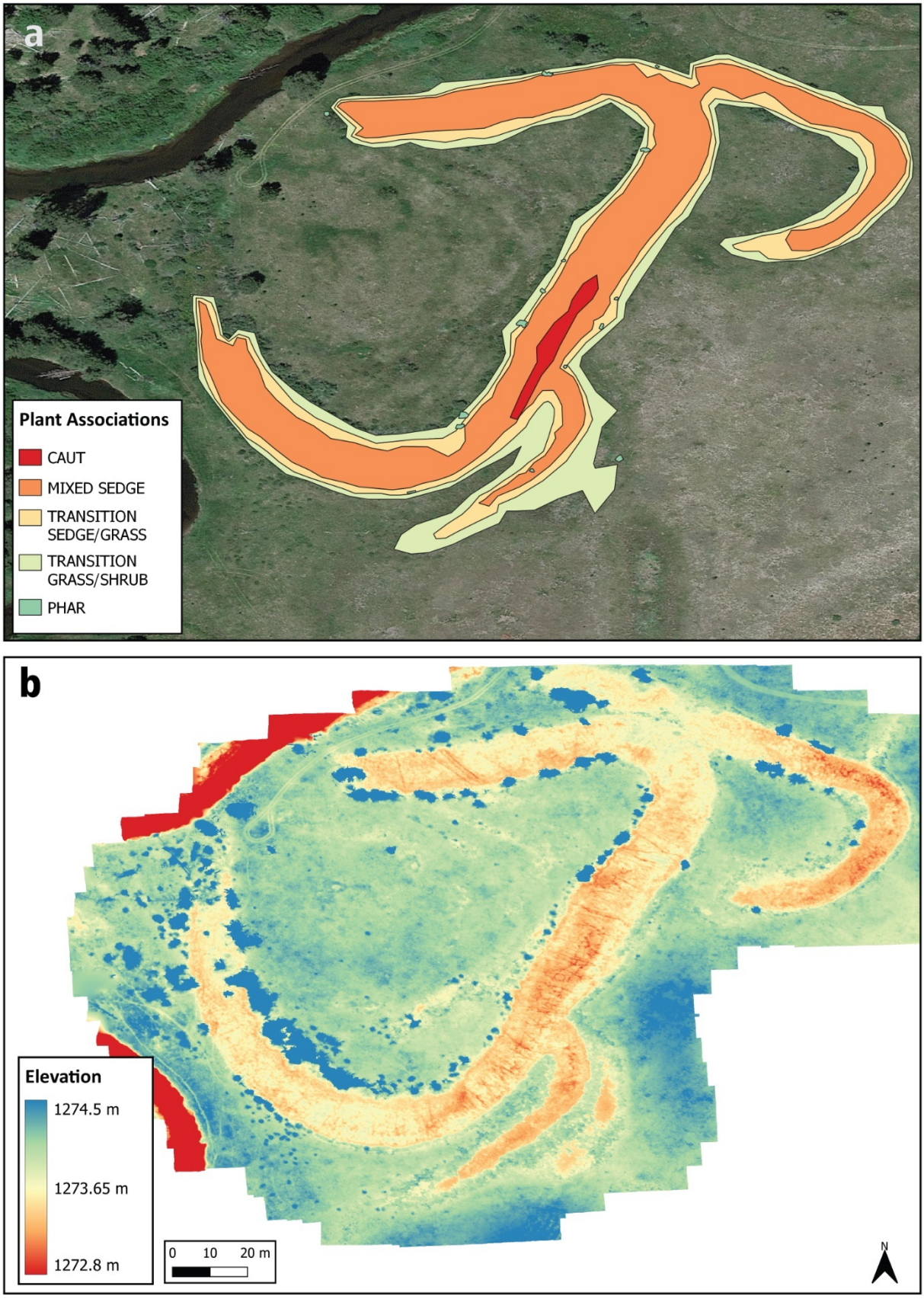

Figure 11. Casey North (a) Plant Association map and (b) Digital Elevation Model.

Casey Northwest

Casey Northwest has a distinctive riparian area surrounding the oxbow habitat that is primarily composed of willow species (Figure 12). The sedge habitat in the oxbow complex lies in a depression below the willows, often creating steep-sided channels (Figure 13). Reed canarygrass was virtually absent within the oxbow, although a few small, sparse patches were observed in upland habitats between the mapped oxbow habitats and along the riverbank. There was no standing water observed at this site during surveying in September, however, much of the soil was moist.

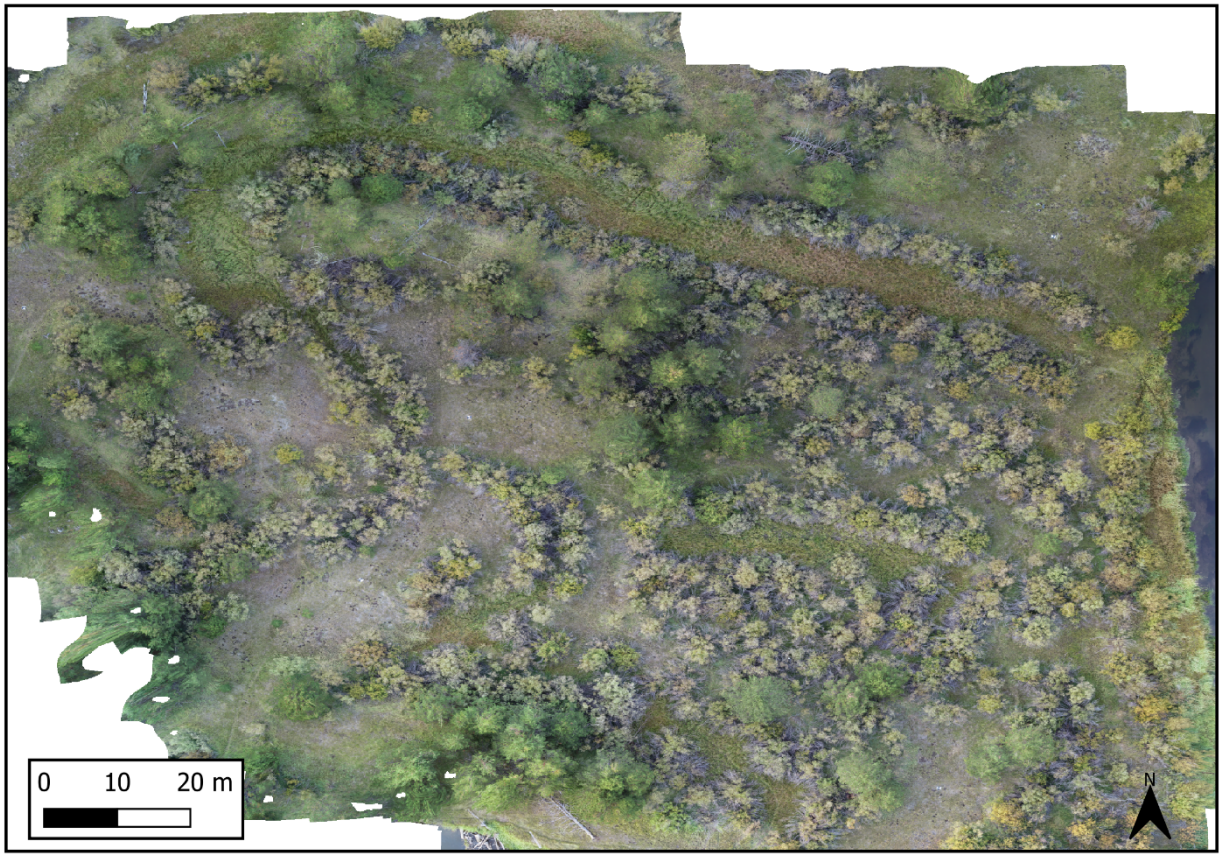

Figure 12. Casey Northwest orthomosaic.

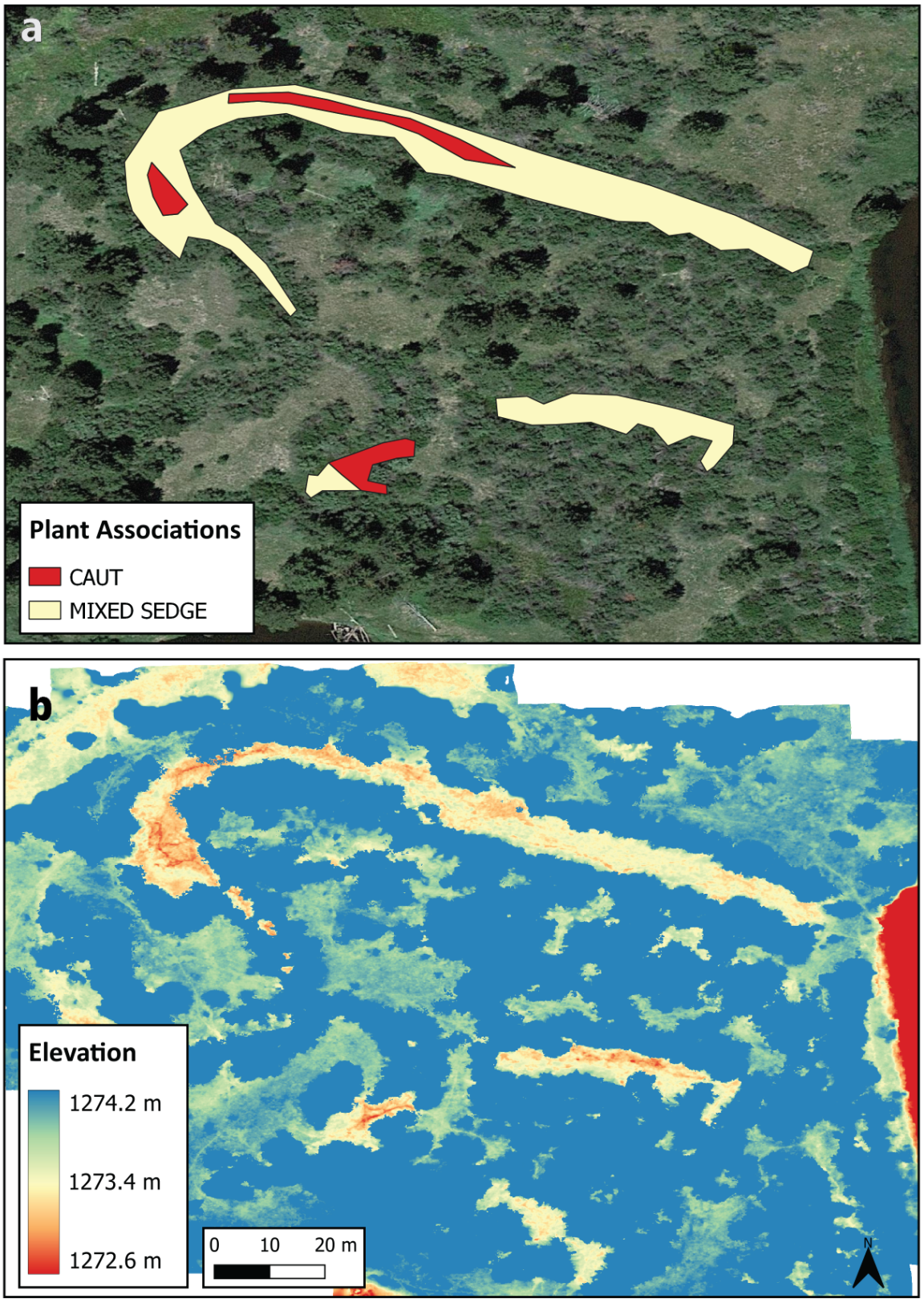

Figure 13. Casey Northwest (a) Plant Association map and (b) Digital Elevation Model.

Discussion

Oxbow habitats on the Little Deschutes River are influenced by unregulated flows, which have strong seasonal variation driven by surface runoff (DBBC 2020). These seasonal flows likely correspond with the observed variability in the vegetation composition and duration of surface water present in oxbows. This is evident by the activation of oxbow habitat in the Casey Tract during the spring and summer period followed by diminishing wetlands and ponds during fall and winter months. The oxbow habitat at the Casey Tract was dominated by obligate wetland sedges (*C. utriculata* and *C. vesicaria*), which occurred within distinct elevation gradients. These dominant species along with the presence of both saturated soil and standing water in late September suggests there is stable hydrologic connectivity with the Little Deschutes River and that the oxbow habitats are activated, to some extent, throughout all seasons.

The breaks between sedge habitats CAVE and CAUT had elevational differences but also differences in apparent soil moisture characteristics. The CAVE plant association was found at slightly higher elevations and the soils became drier in late summer. The lower elevation CAUT plant associations often co-occurred with, or were proximal to, saturated soils and standing water. In some locations (e.g., Casey West and Casey Y), the CAUT polygons included deep, standing water that appeared to be present year-round.

Oregon Spotted frogs have differing hydrological needs and habitat requirements throughout their life stages (Watson et al. 2000) and throughout seasons (Watson et al. 2003). Sedge dominated plant communities are associated with OSF breeding habitat (Watson et al. 2003), which is consistent with observations of egg masses in the Casey Tract oxbows over the past decade (DBBC 2020). The characteristics and proximity of these different sedge habitats likely provide habitat for juvenile and adults throughout the year. Further, they provide breeding and rearing habitat in the spring and early summer months, coinciding with high flows in the Little Deschutes River. Indeed, adult Oregon spotted frogs were observed during the field surveys at Casey West and Casey Y, where standing water was present. These areas of standing water represented the lowest elevational points in the oxbows and both were observed to support *C. utriculata* and other wetland obligate species as the dominant vegetation.

Connectivity between life stage specific microhabitats may be an important consideration for restoration in the Casey Tract. For example, some oxbow habitats have abundant breeding habitat but lack deeper standing water during drier months. From this study, is unclear if the lack of surface water is a result of slightly higher ground elevations or other hydrologic features that were not measured. Future analyses using this data in conjunction with LiDAR or land surveys could provide detailed information on the precise ground elevations associated with standing water. Moreover, an assessment of soil moisture relative to river stage would provide valuable information on the hydrologic relationship between the flows in the Little Deschutes River and the adjacent oxbow habitats.

Although the sedge habitat was dominant at the Casey Tract, patches of reed canarygrass were observed in all but one oxbow. Adult OSF will avoid reed canarygrass (Watson et al. 2003) and it is considered a threat to their habitat (USFWS 2020). When present in the oxbows, reed canary

grass was not abundant relative to sedges, however it was extremely abundant above the TRANSITION vegetation breaks, adjacent to the riverbank, and along dirt roads within the Casey Tract parcel. Further, reed canarygrass is known to occur on the Little Deschutes River upstream of the Casey Tract, supplying a persistent source and pathway for dispersal, and making eradication futile. However, reed canarygrass was generally confined to elevations above the sedge plant associations. Therefore, it may be feasible to locally manage small patches of reed canarygrass in the oxbow habitat.

The photogrammetric, elevational, and vegetation data collected for this assessment can be used to establish a functional relationship between surface water and habitat area. These observations can also serve as baseline data for time-series analysis of habitat change over the term of the DBHCP. The processed imagery and analysis were provided to USFWS as part of the 2022 annual report prepared by the Permittees in compliance with habitat suitability measures HCP 7.2.2.1 and HCP 7.2.5.

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