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A proposed Important Plant Area as a tool for conserving threatened plants and habitats in the Redberry Lake Biosphere Region, Saskatchewan

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Abstract

We applied the Important Plant Area (IPA) framework to identify a high conservation value site containing threatened plants and habitats in the Redberry Lake Biosphere Region (RLBR), Saskatchewan. The proposed IPA, named Redberry Lake Flats, lies in the buffer zone of the RLBR and overlaps with the Redberry Lake Migratory Bird Sanctuary and Important Bird Area, highlighting the strong ecological connectivity of the terrestrial and aquatic landscapes. From 2010 to 2025, we conducted intensive field studies in the 115.6-ha site, documenting 190 vascular plant species in 52 families and 128 genera. This floristic richness is concentrated within a mosaic of saline shorelines, marshes, calcareous marl fens, wet meadows, grasslands, and aspen woodlands mixed with shrublands. We discovered 12 vascular plant species of conservation concern at the subnational (provincial), national, and global levels. Primary threats to rare plants and habitats in the study area include hydrological alteration, intensive grazing and trampling, and successional overgrowth. The exceptional floristic richness of the site, the co-occurrence of multiple threatened plants, and distinct marl–fen habitats satisfy four of IPA's qualification criteria. Hence, we recommend IPA designation for the Redberry Lake Flats site, targetting hydrology-aware management and continuous monitoring to maintain high plant diversity and habitat integrity.

Key words: Important Plant Area; Redberry Lake Biosphere Region; rare plants; endangered habitat; threats; *in situ* protection, Canada

Introduction

In recent decades, loss of biodiversity has accelerated to unprecedented levels, with global assessments warning that 25% of animal and plant species are threatened with extinction (Ceballos *et al.* 2015). Plants, which underpin ecosystems and human well-being, are particularly imperilled: an estimated one in five plant species is threatened with extinction because of habitat loss, direct exploitation, invasive alien species, and other human pressures (Hooper *et al.* 2012; Brummitt *et al.* 2015). In response, conservation strategies have increasingly emphasized site-based protection of critical habitats and species. The Kunming–Montreal Global Biodiversity Framework now reflects this approach through Target 3, widely known as the "30 × 30" target, which aims to conserve at least 30% of terrestrial, inland water, coastal, and marine areas by 2030 using ecologically representative and well-connected protected and conserved areas (CBD 2022). Identifying such priority sites for flora is essential to stem biodiversity decline at the landscape scale while complementing broader initiatives with focussed, evidence-based local action.

The Important Plant Areas (IPA) program was developed as a systematic framework to identify and conserve the world's most significant sites of wild plant diversity. The IPA approach was modelled after the successful Important Bird Areas (IBA) program but tailored to botanical criteria (Anderson 2002; Plantlife International 2010). First conceived in Europe in the early 2000s by Plantlife International (United Kingdom), in collaboration with the Planta Europa network, the IPA framework has been widely adopted in biodiversity conservation planning. Recently, the criteria qualifying a site for IPA nomination were revised to improve this approach to

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plant conservation (Derbyshire *et al.* 2017). Around the world, IPAs often complement existing protected-area networks by highlighting plant-specific conservation priorities. At present, there are 2947 IPAs in 48 countries, reflecting broad international uptake of the approach (Plantlife International n.d.).

Some subnational jurisdictions in the United States (i.e., states) and Canada (i.e., provinces or territories) have recently adopted the IPA framework (Kor *et al.* 2025). Amid this expansion, Saskatchewan has begun implementing it to support plant conservation (Vinge-Mazer and Neufeld 2019). The program, called Vern Harms Important Plant Areas of Saskatchewan, aims to guide land-use planning decisions, direct development away from sensitive botanical areas, and support monitoring and stewardship that benefit rare plants and threatened ecosystems (NPSS n.d.). Based on global IPA standards, the Native Plant Society of Saskatchewan (NPSS) developed a set of eight criteria for nominating sites in the province. A candidate site may be nominated as an IPA if it meets one of those criteria. Currently, 12 IPAs exist in Saskatchewan in the Prairie, Boreal Plain, and Boreal Shield ecozones (NPSS n.d.).

The objective of our study was to provide information on threatened vascular plants and their habitats at the proposed Redberry Lake Flats IPA. The information is intended to support evidence-based designation of this site as an IPA within the Redberry Lake Biosphere Region (RLBR) to enhance its conservation management.

Study Area

In 2000, the RLBR was designated as a UNESCO biosphere reserve to conserve biodiversity, support sustainable development, and advance research, monitoring, education, and training initiatives (RLBR n.d.). The only biosphere reserve in Saskatchewan, it is organized into three interrelated zones typical of biosphere reserve structure worldwide: a core area, a buffer zone, and a transition area. After expansion of the biosphere reserve in 2019 (RLBR n.d.), it became a biosphere region, and the name of the organization was changed accordingly. Currently, the RLBR covers about 700 000 ha; its core area consists of the saline Redberry Lake (52.70°N, 107.17°W; 515 m above sea level) and several islands, while the surrounding Hafford Plain and Whitewood Hills upland form the buffer zone (Figure 1). The outer transition area includes agricultural and residential land uses within the biosphere region.

The RLBR is located on the boundary of the Prairie and Boreal Plain ecozones, which include the Aspen Parkland ecoregion and the Boreal Transition ecoregion, respectively (Acton *et al.* 1998). The study site, named Redberry Lake Flats (hereafter referred to as the Flats site), is in the Hafford Plain ecodistrict (landscape area) that belongs to the Aspen Parkland ecoregion. The Flats site is located on the southwest shore of Redberry Lake (section 1) and extends south along Marshy Creek (section 2; Figures 1, 2a,b). The Flats site encompasses ~115.6 ha of Agricultural Crown Lands, divided into two parcels (section 1 is 59.5 ha and section 2 is 56.1 ha). Of this total, 46.7 ha (40%) are protected at the federal level in the Redberry Lake Migratory Bird Sanctuary (Government of Canada 2024), which is also designated as an Important Bird Area (IBA Canada n.d.), and at the provincial level in the Whooping Crane Migration Corridor under the *Wildlife Habitat Protection Act* (WHPA 1992). The remaining 68.9 ha are unprotected Agricultural Crown Lands (HABISask 2026).

Botanical and ecological research within the RLBR has expanded over the past decade, resulting in several floristic studies (e.g., Kricsfalusy 2021a,b, 2023a,b, 2026a,b; Kricsfalusy and Kindrachuk 2023), which include some observations from the Flats site.

Methods

Between 2010 and 2025, we conducted field surveys as part of a long-term floristic inventory of the RLBR, with focus on threatened vascular plants, as defined with IPA standards (Derbyshire *et al.* 2017). This current article presents data on threatened plants and their habitats collected in the proposed IPA (sections 1 and 2), including two new threatened plant species in section 1, which were not reported previously (Kricsfalusy 2021a,b, 2023a). The results of the studies conducted in section 2 during the 2023–2025 field seasons are presented here for the first time.

We identified all the plant species encountered in the field, and we took representative photographs for documentation (photographic vouchers are available). For taxa that proved difficult to confirm in the field (e.g., certain subspecies or varieties), we collected specimens and later verified them against standard floras and by comparison with reference material in the W.P. Fraser Herbarium (SASK) at the University of Saskatchewan. Vouchers are preserved as herbarium specimens but not deposited in SASK. Geospatial coordinates for each observation were recorded using handheld Global Positioning System units (Garmin Oregon 650t, New Taipei City, Taiwan) with ~2 m accuracy.

Conservation ranks are from the Saskatchewan Conservation Data Centre (SKCDC n.d.), cross-referenced with the NatureServe database (NatureServe n.d.). In addition to our field observations, we consulted the Hunting, Angling and Biodiversity Information of Saskatchewan database (HABISask 2026)

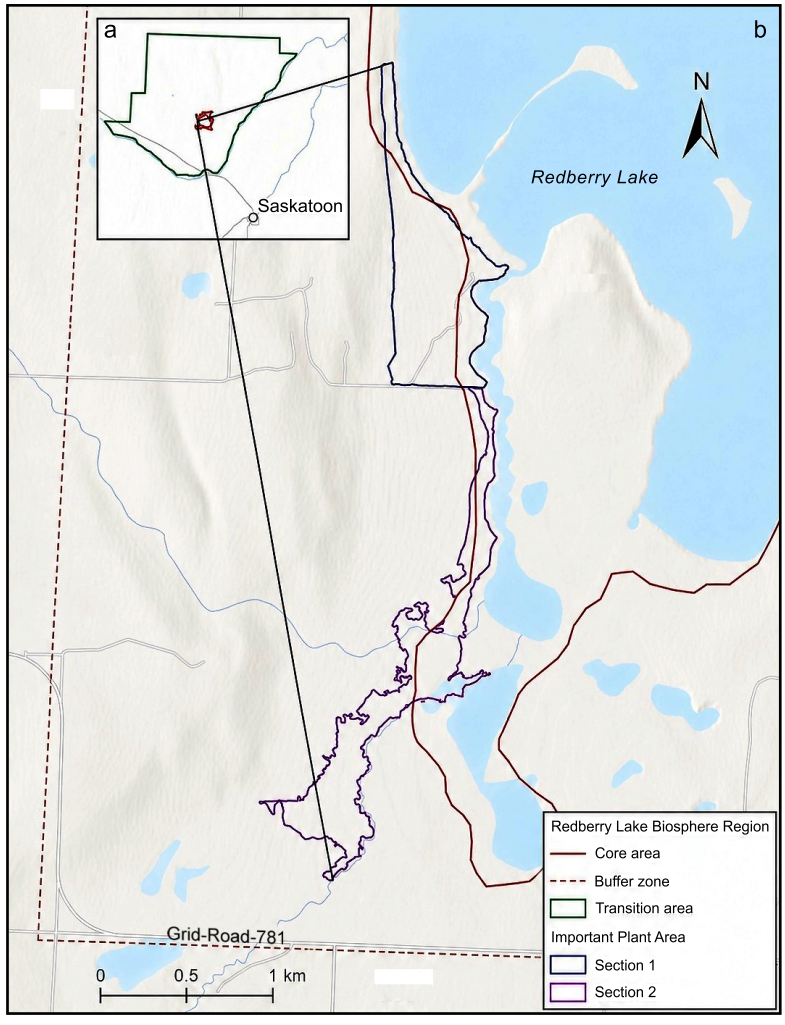

FIGURE 1. Map of the proposed Redberry Lake Flats Important Plant Area (IPA) within the Redberry Lake Biosphere Region (RLBR), Saskatchewan, Canada. a. Location of the RLBR in Saskatchewan in reference to Saskatoon; b. Position of the study area in the RLBR with the extent of the proposed IPA within the buffer zone of the RLBR. Zoning of the RLBR: a core area dedicated to conservation, a buffer zone allowing for limited human activity, and a transition area where sustainable resource use is actively encouraged.

for any existing records of threatened vascular plants in the study area and to obtain information on land tenure and environmental attributes. All spatial data were analyzed, and a map was prepared using ArcGIS Pro version 3.3.0 (ESRI, Redlands, California, USA). Integrating different data sets allowed a more comprehensive understanding of the Flats site natural settings and its conservation values.

Classification of the ecological systems of Saskatchewan follows Acton *et al.* (1998). Vegetation types were delineated using the principles of Ecological Land Classification (Lee *et al.* 1998; Statistics Canada 2018), adapted by V.V.K. for Saskatchewan. During field studies and data review, we documented evidence of several threats (disturbances) at the site, including cropland encroachment, intensive grazing and trampling, occurrence of invasive alien species, nutrient runoff from adjacent croplands, hydrological alteration (e.g., drainage or changes to groundwater flow), and recreational disturbance.

We followed the threats assessment approach (IUCN–CMP Unified Classification of Direct Threats, v. 3.2, International Union for Conservation of Nature, Gland, Switzerland) adopted for the IPA nomination process in Saskatchewan (NPSS n.d.). For each species, we assessed the scope (the proportion affected),

Figure 2. The Redberry Lake Flats, Saskatchewan, Canada. a. Section 1 located on the southwest shore of Redberry Lake. b. Section 2 located along Marshy Creek. Photos: S.S. Enan.

severity (the projected overall decline caused by the threat acting within the scope), and timing (ongoing or future) of each applicable level 2 threat category (see NPSS n.d. nomination form for IPAs). We then categorized the overall threat level from the accumulated level 2 threats in the threats calculators as low, moderate, or high, based on their likely effects on rare plant species and sensitive habitats. The definitions used in the NPSS nomination form for IPAs are:

- Low: a significant likelihood of impacts, activities or events that will result in a small though significant (5–20%) reduction in population numbers or habitat
- Moderate: a significant likelihood of impacts, activities, or events that will result in a significant (20–60%) reduction in population numbers or habitat
- High: a significant likelihood of impacts, activities, or events that will result in a severe (>60%) reduction in population numbers or habitat.

Results

Floristic diversity

Field surveys identified 190 vascular plant species representing 52 families and 128 genera in the Flats site (Table S1). This high level of floristic diversity includes 24.8% of the flora of the RLBR in only 0.02% of its total area. Species richness is strongly

concentrated within a few families (Table 1): Asteraceae (33 species), Poaceae (23), and Cyperaceae (21), which together account for 40.5% of the recorded species. Additional families with high species richness include Rosaceae (11 species), Fabaceae (nine), Salicaceae (nine), Orchidaceae (six), Juncaceae (six), Ranunculaceae (five), and Amaranthaceae (four). Seven families contain three species each, five families contain two species, and 30 families contain one species.

We observed a comparable pattern at the genus level (Table 1). The most diverse genera are sedge (*Carex* L.; 13 species), willow (*Salix* L.; seven), and rush (*Juncus* L.; six). Aster (*Symphyotrichum* Nees; four species) and six genera with three species each (wormwood [*Artemisia* L.], goldenrod [*Solidago* L.], birch [*Betula* L.], bulrush [*Schoenoplectus* (Recheinbach) Palla], bluegrass [*Poa* L.], and rose [*Rosa* L.]) also contribute notably to the flora. These 10 genera contain 48 species, corresponding to 25.3% of all vascular plants in the study area. The remaining taxa are distributed among 96 genera represented by a single species and 22 genera represented by two species, accounting for the remaining 142 species across the site.

Overall, the flora of the Flats site includes graminoids and forbs typical of wetlands and grasslands in the Aspen Parkland ecoregion, interspersed with scattered woodland stands and shrub patches. Saline lowlands along Redberry Lake support sedge-dominated marshes and wet meadows, while small groundwater-fed calcareous fens along Marshy Creek further enhance overall species richness.

Threatened plants

We found 12 vascular plants of conservation concern at the Flats site (Table 2, Figure 3), representing a substantial concentration of at-risk species within a relatively small area. They span seven families and 10 genera, with the highest richness observed in Orchidaceae and Cyperaceae, each contributing three species (25% of the total), followed by Amaranthaceae with two species (16.7%). The remaining four families (Asteraceae, Gentianaceae, Ophioglossaceae, Ruppiaceae) each contain a single species. In terms of species richness per genus, bugseed (*Corispermum* L.) and sedge have two species each (16.7%), while the other eight genera each include a single species.

All rare plants are ranked as threatened (Table 2) at the subnational (provincial) level (S1–S3: Critically Imperilled through Vulnerable) by the SKCDC (n.d.); none has been formally assessed by the Committee on the Status of Endangered Wildlife in Canada (SARA Public Registry 2026). Among them, Dwarf Clubrush (*Trichophorum pumilum* (Vahl) Schinz & Thellung) is ranked Critically Imperilled (S1) in Saskatchewan. Some species hold global and/or national conservation status, including Alkali Marsh Aster (*Almutaster pauciflorus* (Nuttall) Á. Löve & D. Löve) and Prairie Moonwort (*Botrychium campestre* W.H. Wagner & Farrar var. *campestre*). Their occurrence contributes to the site's conservation priority. Globally uncommon Loesel's Twayblade (*Liparis loeselii* (L.) Richard), classified as Near Threatened by IUCN (2026), further emphasizes the importance of the site to orchid conservation.

Threatened habitats

Habitat diversity reflects the ecological heterogeneity of the Flats site (Figure 4). We identified several habitats, including a few vegetation communities that harbour rare plants. Wetlands, particularly calcareous fens and seepage fens, support the greatest number of threatened species (Alkali Marsh Aster, Northern Elegant Sedge [*Carex concinna* R. Brown], Bristle-leaved Sedge [*Carex eburnea* Boott], Large Yellow Lady's-slipper [*Cypripedium parviflorum* var. *pubescens*

TABLE 1. List of the largest families and genera of flora in the Redberry Lake Flats, Saskatchewan, Canada.

Family	No. species	No. genera
Asteraceae	33	23
Poaceae	23	18
Cyperaceae	21	6
Rosaceae	11	8
Fabaceae	9	7
Salicaceae	9	2
Juncaceae	6	1
Orchidaceae	6	6
Ranunculaceae	5	4
Amaranthaceae	4	3
Total	127	78

Family	Genus	Common name	No. species
Cyperaceae	*Carex*	Sedge	13
Salicaceae	*Salix*	Willow	7
Juncaceae	*Juncus*	Rush	6
Asteraceae	*Symphyotrichum*	Aster	4
Asteraceae	*Artemisia*	Wormwood	3
Asteraceae	*Solidago*	Goldenrod	3
Betulaceae	*Betula*	Birch	3
Cyperaceae	*Schoenoplectus*	Bulrush	3
Poaceae	*Poa*	Bluegrass	3
Rosaceae	*Rosa*	Rose	3
Total			48

TABLE 2. List of threatened vascular plants in the Redberry Lake Flats, Saskatchewan, Canada.

	Scientific name	Common name	Conservation rank*			Herbarium/ photo
			G	N	S	
1.	*Almutaster pauciflorus* (Nuttall) Á. Löve & D. Löve	Alkali Marsh Aster	G4	N3	S3	+/+
2.	*Botrychium campestre* W.H. Wagner & Farrar var. *campestre*	Prairie Moonwort	G3	N3	S3	–/+
3.	*Carex concinna* R. Brown	Northern Elegant Sedge	G5	N5	S3	+/–
4.	*Carex eburnea* Boott	Bristle-leaved Sedge	G5	N5	S3	+/+
5.	*Corallorhiza striata* Lindley var. *striata*	Striped Coralroot	T5	N5	S3	+/+
6.	*Corispermum americanum* (Nuttall) Nuttall var. *americanum*	American Bugseed	T5	N4	S3	+/+
7.	*Corispermum pallasii* Steven	Pallas' Bugseed	G4	NU	S2	+/+
8.	*Cypripedium parviflorum* var. *pubescens* (Willdenow) O.W. Knight	Large Yellow Lady's-slipper	T5	N5	S2	+/+
9.	*Gentianopsis virgata* subsp. *macounii* (Holm) Pringle	Macoun's Fringed-gentian	G5	N4	S3	+/+
10.	*Liparis loeselii* (L.) Richard	Loesel's Twayblade	G5	N4	S3	+/+
11.	*Ruppia cirrhosa* (Petagna) Grande	Spiral Ditchgrass	G5	N5	S3	+/–
12.	*Trichophorum pumilum* (Vahl) Schinz & Thellung	Dwarf Clubrush	G5	N4	S1	+/+

*NatureServe conservation ranks (SKCDC n.d.): G = global, N = national, S = subnational (provincial), T = trinomial (infraspecific taxon, i.e., subspecies or variety, its status follows the species' global rank), U = unrankable because of lack of information or conflicting status, 1 = Critically Imperilled (at very high risk of extirpation because of very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors), 2 = Imperilled (at high risk of extirpation because of restricted range, few populations or occurrences, steep declines, severe threats, or other factors), 3 = Vulnerable (at moderate risk of extirpation because of a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors), 4 = Apparently Secure (at a fairly low risk of extirpation because of an extensive range and/or many populations or occurrences, but with possible cause for some concern because of local recent declines, threats, or other factors), 5 = Secure (at very low or no risk of extirpation because of a very extensive range, abundant populations or occurrences, with little to no concern from declines or threats).

(Willdenow) O.W. Knight], Macoun's Fringed-gentian [*Gentianopsis virgata* subsp. *macounii* (Holm) J.S. Pringle], Loesel's Twayblade, and Dwarf Clubrush), while woodland microsites embedded in the wetland–meadow transition area harbour such species as Prairie Moonwort, Large Yellow Lady's Slipper, and Striped Coralroot (*Corallorhiza striata* Lindley var. *striata*). The detailed description of this woodland community is in Kricsfalusy (2021b). In contrast, sandy shoreline and saline habitats along the site margins host xerophytic species, including the rare plants American Bugseed and Pallas' Bugseed (*Corispermum pallasii* Steven). The presence of Spiral Ditchgrass (*Ruppia cirrhosa* (Petagna) Grande) in open water highlights the importance of shallow hydrologic features for rare aquatic species. Grasslands were severely altered before the RLBR was created, and now they are represented by semi-natural meadows, where only one rare species (Large Yellow Lady's-slipper) was recorded.

Floristic diversity of the calcareous fens at the Flats site (section 2), which qualifies as Prairie Fen type under IPA criterion "restricted vegetation community" (NPSS n.d.), is presented in Table S2. These fens are open habitats that contain the greatest diversity of vegetation communities (54 species) and an abundance of threatened plants (five species). A few seepage fens scattered across woodlands at the Flats site (section 1) are very small (about 5 m^2 each) but support some rare sedges (Northern Elegant and Bristle-leaved sedges). Although Canadian National Vegetation Classification (CNVC n.d.) has not been completed for the Prairie ecozone, we tried to classify Prairie Fen vegetation type. Based on the U.S. National Vegetation Classification (USNVC n.d.), a comparable vegetation community would be Northern Plains Rich Fen (CEGL002268. *Carex* spp.*–Triglochin maritima–Eleocharis quinqueflora* Marl Fen). This community type has status G1 (Critically Imperilled) at the global level, which is currently under review (USNVC n.d.). As shown in Table S2, the studied calcareous fens at the Flat's site have different variants of the vegetation community: graminoid, sedge-mixed forb, and shrub dominated (Figures 4d–f). All three fen variants include small pools of open water with or without marl deposits.

Threats to rare species and habitats

Several threats jeopardize the integrity of the Flats

FIGURE 3. Some threatened plant species of the Redberry Lake Flats, Saskatchewan, Canada. a. Alkali Marsh Aster (*Almutaster pauciflorus*). b. Prairie Moonwort (*Botrychium campestre* var. *campestre*). c. Macoun's Fringed-gentian (*Gentianopsis virgata* subsp. *macounii*). d. Pallas' Bugseed (*Corispermum pallasii*). e. Large Yellow Lady's-slipper (*Cypripedium parviflorum* var. *pubescens*). f. Striped Coralroot (*Corallorhiza striata* var. *striata*). g. Loesel's Twayblade (*Liparis loeselii*). h. Dwarf Clubrush (*Trichophorum pumilum*). i. Bristle-leaved Sedge (*Carex eburnea*). Photos: V. Kricsfalusy.

Figure 4. Main habitat types within the Redberry Lake Flats, Saskatchewan, Canada. a. Natural thicket and poplar woodland. b. Natural grassland. c. Natural saline meadow. d. Graminoid marl fen. e. Sedge mixed forb fen. f. Shrubby marl fen. g. Shallow marsh and deep marsh. h. Saline marsh. Photos: V. Kricsfalusy.

site (Table S3). In the decades before the designation of the RLBR, a large part of its current buffer zone was subject to severe transformations as prairie was converted to farming. As a result, the floristic structure and composition of natural vegetation have undergone significant changes, favouring the proliferation of invasive alien species. Invasive species such as Smooth Brome (*Bromus inermis* Leysser), Kentucky Bluegrass (*Poa pratensis* L. subsp. *pratensis*), and Canada Thistle (*Cirsium arvense* (L.) Scopoli) represent a high risk for native plants in these semi-natural meadow communities. Smooth

Brome has detrimental effects on the growth, survival, and extinction rates of native grass species (Palit and DeKeyser 2022). Thus, agricultural activities at the boundary of this area present a moderate risk of further proliferation of invasive alien species into remnant natural grasslands and wetlands.

Woody encroachment through unmanaged succession is a severe threat, reducing sunlit microsites needed by rare species. Intensive grazing and trampling pose a high risk to sensitive fen vegetation. Hydrological changes, such as groundwater drawdown or lake-level fluctuations, may also pose a high risk, because wetland and fen specialists depend on stable water regimes. Drainage has occurred in the vicinity of the fens and is likely the most serious threat, as changes to the site's hydrology could have a large impact on the plant community there. Nutrient runoff from adjacent farmland is a moderate risk, with the potential to alter plant community composition.

Discussion

For conserving biodiversity and nominating a site as an IPA, the first step is to document the flora and habitat patterns of a particular area. Various factors, such as regional climate, topography, soils, and threats (disturbances), contribute to species composition and habitat characteristics at different scales. According to the Vern Harms Important Plant Areas Program, a site in Saskatchewan may be nominated as an IPA if it meets one of eight criteria (NPSS n.d.). Our findings meet four of those criteria, particularly in terms of floristic richness, presence of rare plant species and restricted vegetation communities, and threats to the Flats site.

Floristic surveys conducted at the site have identified 190 vascular plant species from 52 families and 128 genera. This high level of floristic diversity includes 10.6% of the 1789 species of vascular plants of Saskatchewan (SKCDC n.d.). Given that the Flats site encompasses a rich diversity of vegetation types representing over 10% of the provincial flora, it meets criterion 5 for designation as an IPA (NPSS n.d.).

Our field studies revealed 12 threatened plant species at the Flats site. A few of these plants are ranked at the global (G3, one taxon) and national levels (N3, two taxa), and all species are ranked at the subnational (provincial) level (S1, one taxon; S2, two taxa; S3, nine taxa). This simultaneously meets both criterion 1 (site contains at least one plant species of global concern) and criterion 2 (site contains an assemblage of at least three plant species of concern that are provincially ranked by the SKCDC as S1 or S2; NPSS n.d.).

During our field surveys, we observed high-quality habitats across the Flats site. The unusual assemblage of different types of wetlands, woodlands, grasslands, shoreline dunes, and aquatic ecosites co-occurring within a compact 115.6-ha area underscores the great habitat diversity and the functional connectivity of microhabitats at the site. Several groundwater-fed marl fens, particularly along Marshy Creek, harbour rich plant communities on calcareous soils, representing the restricted vegetation community type Prairie Fen, strongly supporting the site designation as an IPA under criterion 6 (NPSS n.d.). According to Thorpe (2014), fens are only occasionally found in the Prairie ecozone. Marl fens are a special class of calcareous fens. At the Flats site, we observed them on the toe slopes of rolling terrain where mineral-rich groundwater seeps out of the hillside or other places where the groundwater is close to the surface.

Fens are important hotspots of biodiversity, carbon sequestration, and water regulation, but drainage for agriculture has degraded many of them, reducing their multifunctionality (Lamers *et al.* 2015; Ahmad *et al.* 2025). According to Bowles *et al.* (2005), plant species adapted to spring run and marl flat appear to have the greatest vulnerability to local extinction because of their landscape rarity in the North American calcareous prairie fens. Because calcareous fens depend on a constant supply of nutrients, primarily through groundwater that flows through mineral-rich soils, maintenance of the water table is assumed to be a key contributor to this high species diversity (Duval and Waddington 2011). Intensive cattle grazing can impact fens by altering water quality, trampling herbaceous vegetation, increasing bare ground, and leading to colonization by invasive species (Kost and Hyde 2009). However, in some fens, low intensity grazing with domestic herbivores can be an effective tool for maintaining and restoring plant diversity (Rosenthal *et al.* 2012). Some studies have looked at natural succession in calcareous fens, but the process is still not well understood. Vigorous shrub growth in the fens might be a result of acidification of calcareous fens or exposed mineral soil providing a seed bed (Godwin 1974). Overall, we identified hydrological alteration, intensive grazing and trampling, and successional overgrowth as major threats to calcareous fens at the local scale.

Applying spatial analysis, we found that the Flats site lies entirely within the buffer zone of the RLBR and overlaps with the Redberry Lake Migratory Bird Sanctuary (also recognized as an IBA) and Whooping Crane Migration Corridor. These overlapping conservation designations highlight the ecological connectivity of the Flats site and underscore its importance for both plant and bird communities.

As we mentioned earlier, 12 IPAs in Saskatchewan are located in the Prairie, Boreal Plain, and Boreal Shield ecozones (NPSS n.d.). Most of these IPAs

were nominated to protect rare plants in unique grassland, sand dune, riparian, alvar, and badland habitats. Two were recognized to preserve a boreal forest peat bog in the Boreal Transition ecoregion and a prairie marl fen in the Moist-Mixed Grassland ecoregion, respectively. The latter IPA, the Eastern Qu'Appelle Valley Fen, is the only place in Saskatchewan identified for protection of a fen habitat. This site harbours seven plant species ranked at the subnational (provincial) level as Vulnerable (S3). No nationally or globally assessed species were observed at the site during visits in 2017 and 2018 (Vinge-Mazer 2019) and our survey in 2025.

Therefore, we hope that designation of the Flats site as an IPA can fill a gap in provincial conservation programs and legislation and will serve as a crucial baseline for researchers, land managers, and the public who are interested in conserving and sustaining biodiversity of the region.

Conclusion

Our research is the first initiative to identify a proposed IPA in the RLBR, the only biosphere region in Saskatchewan. The study site, named the Redberry Lake Flats, supports a high level of vascular plant species richness and habitat diversity within a compact area, strengthening ecological connectivity with the adjacent Redberry Lake Migratory Bird Sanctuary and IBA. A complex mosaic of habitats, including saline shorelines, marshes, calcareous marl fens, wet meadows, grasslands, and aspen woodlands mixed with shrublands, supports this exceptional plant species' richness. Together, a high level of floristic richness of the Flats site, the occurrence of multiple threatened plant species, and the presence of restricted vegetation community types satisfy four IPA qualification criteria, while the minimum requirement for a site nomination in Saskatchewan is one criterion. Although the Flats site falls within the buffer zone of the RLBR, less than half of its area is legally protected. The remaining area faces pressures from agricultural expansion, invasive alien species, successional overgrowth, intensive grazing and trampling, hydrological alteration, and nutrient inputs, threatening rare plants and their habitats, particularly marl fens.

This lack of concern for fens is compounded by the lack of information on their vegetation, hydrology, and ecology. Continued monitoring and targetted management actions are needed to maintain ecosystem integrity. Designation of the Flats site as an IPA would enhance long-term stewardship and ensure that plant-focussed conservation priorities are integrated into wider land-use planning in the biosphere region.

Author Contributions

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Supplementary Materials:

Table S1. List of vascular plants in the Redberry Lake Flats, Saskatchewan, Canada.

Table S2. Floristic composition of threatened habitats at the Redberry Lake Flats, Saskatchewan, Canada.

Table S3. Threats to rare plants and sensitive habitats at the Redberry Lake Flats, Saskatchewan, Canada.