KILLDEER BADLANDS —
A Prairie Natural Area

by MARILEE D. CRANNA*

The Killdeer Badlands are located in Saskatchewan, 8 miles west of the West Poplar border crossing and 18 miles southwest of the historic Wood Mountain Northwest Mounted Police Post (Fig. 1). They form a unique focal point for an extensive area of relatively unmodified short-grass prairie and are recommended by the Conservation Terrestrial Section of the International Biological Programme (IBP-CT) for preservation as a Natural Area. The badlands region was once considered for inclusion within the boundaries proposed for a much larger grassland national park between Val Marie and Killdeer, Saskatchewan.

As far as is known, no intensive biological work has been conducted specifically within the badlands. Studies of a reconnaissance nature have been made of the proposed national park.[2 3 6 8 9 12] The soils have been described and an extensive study of the Wood Mountain geology has been completed.[1 7 13 5] Paleontological information has been recorded by L. S. Russell.[10 11] M. Syroteuk, University of Saskatchewan Geography Department, has conducted graduate research studies in the Wood Mountain area.

Numerous features of natural and historical interest are contained within this sizeable short-grass prairie and, in June, 1970 an IBP-CT inventory and description of the landscape, vegetation and human impact was completed. Of the 24 short-grass prairie areas inventoried to 1972, the proposed Wood Mountain-Killdeer Badlands Natural Area has the highest priority. It amply fulfills the requirements for educational and research potentialities.

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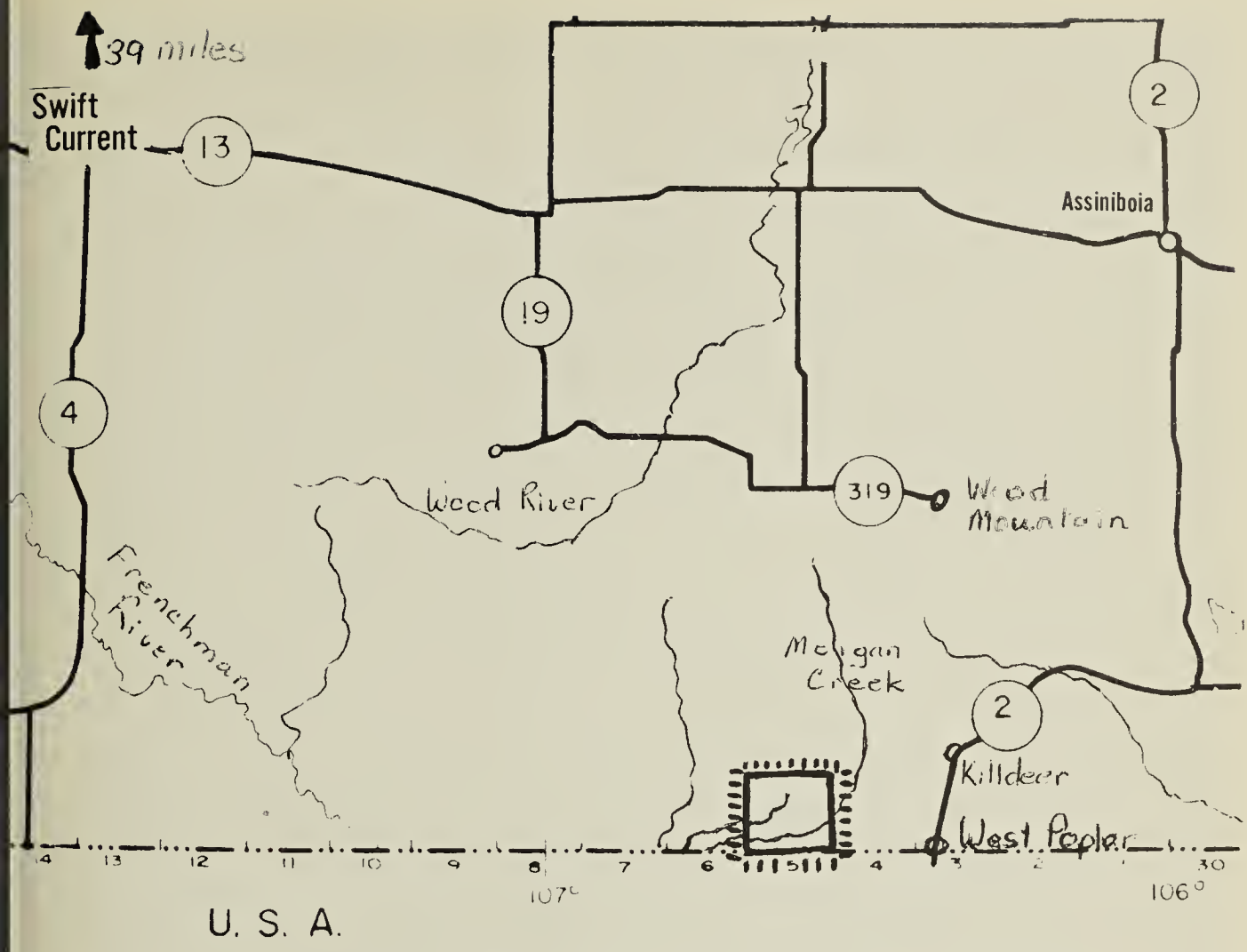
Study Area

The area chosen for study, Township 1, Range 5, West of the Third Meridian (49°0′ — 49°15′ N. Lat.; 106°33′ — 106°40′ W. Long.) consists of 36 square miles of leased provincial crown land (Fig. 2). It includes part of the Continental Divide, which separates the waters flowing north to Hudson's Bay and south to the Gulf of Mexico. Local drainage is by southward-flowing Morgan and Rock Creeks. Access to the area is difficult particularly following wet weather, for the terrain is rugged and it is dissected by numerous saline creek beds. No well-travelled roads lead into the area and it is crossed by only a few pasture trails (Fig. 3).

The Wood Mountain climate typifies that of the prairies, being characterized by the extremes of long, cold winters and short, hot summers. Cool nights are the rule regardless of daytime maximum temperatures. The generally dry atmosphere and rapid evaporation make the summer's heat quite tolerable. In the normal year the growing season is estimated to average 170 days and the mean annual total hours of sunshine exceeds 2,200, the highest in Canada.

The average annual precipitation is about 13 inches with snowfall particularly light. The values vary annually with frequent periods of drought. Sometimes the prevailing westerly winds take the form of warming chinooks, but rarely do they last long enough to remove the snow cover completely. Specific temperature and precipitation records have been recorded at West Poplar since October, 1956.

Situated completely within the semi-arid Brown Soil Zone, the area is dominated by brown chernozemic soil



ig. 1. The location of the proposed Wood Mountain-Killdeer Badlands Natural Area in southern Saskatchewan.

n well-drained, non-eroded sites. Ex-ensive regosolic soils, exhibiting poor rofile development characterize the roded and outwash sites. Alluvial soils, ft by flowing water, occupy the valley ats adjacent to the stream banks. Often ese floodplain soils are saline reflec-ng their association with the dark grey arine shales beneath the glacial eposits.

Vegetation, nowhere dense, is typical f the short-grass prairie and reflects its ridity. Many plants are early bloomers take advantage of the more vourable moisture conditions and ooler temperatures of spring. A diver-ty of habitat types are commonly presented, the vegetational associa-ons ranging from poor quality salt-mpregnated grasslands, and dry, eroded ravelly outwash areas to good quality razing lands and moist, sheltered oodlands. Local marsh areas occur in ssociation with the few streams, ponds and springs. Different soil types and the changing moisture regimes due to irregular topography are reflected in the vegetational patterns. Other factors such as prairie fires, grazing and trampling significantly influence the nature of the vegetative cover.

Physiography and Geology

The proposed natural area includes a variety of interesting topographic and geologic features and represents well the Wood Mountain Upland physiographic region. Particularly impressive are the extensive flat to undulating tablelands which reach a maximum altitude of 3,150 feet. Dissecting these are creek valleys and coulees of variable width, depth and steepness. The minimum altitude is 2,625 feet.

The surface features of the countryside result from glaciation and subsequent wet and dry erosional processes. Locally eroded deposits of bouldery

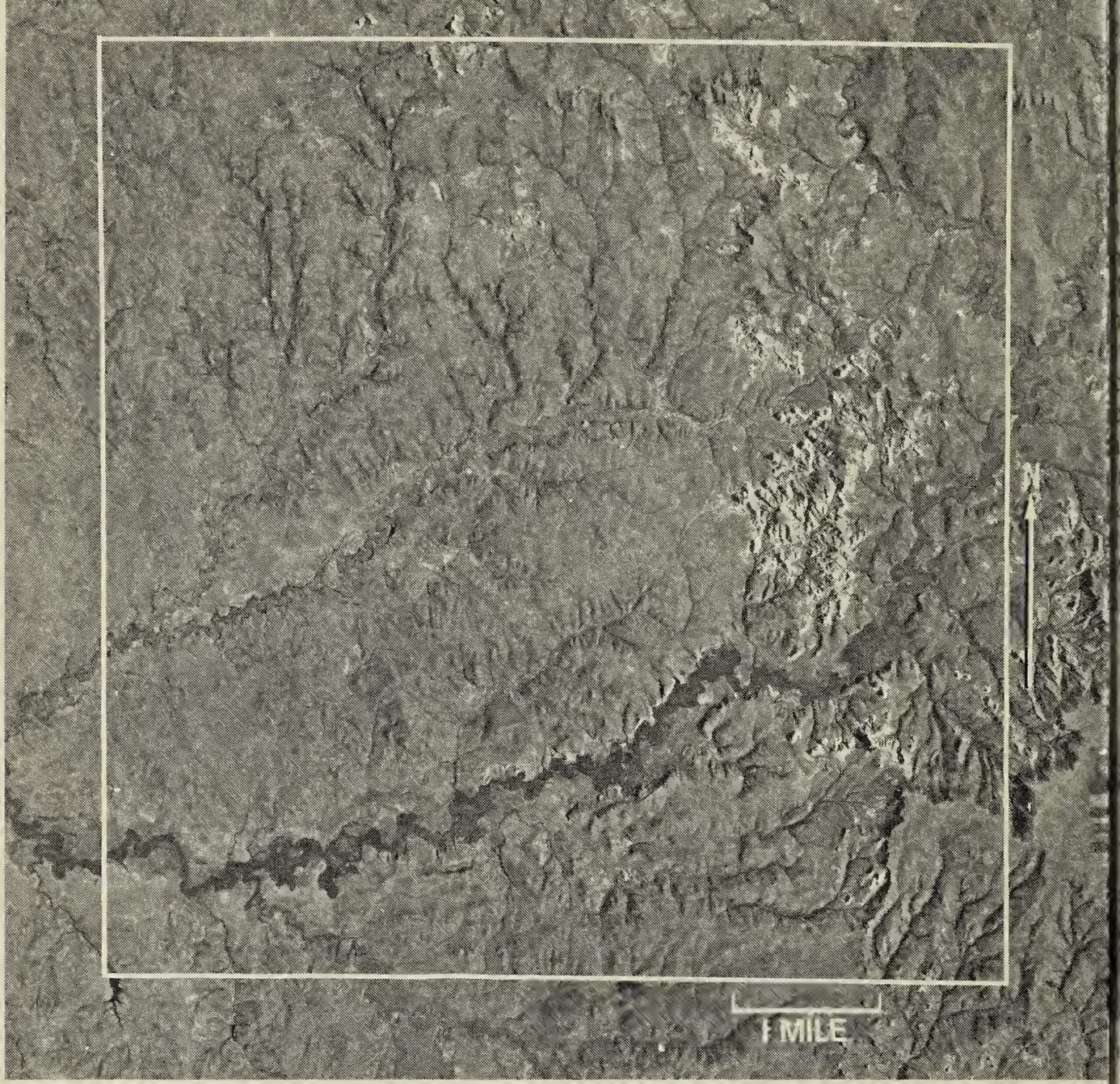


Fig. 2. Aerial view of the study area showing the general physiography. Morgan and Ro Creeks dissect the landscape. The bounded area is TWP 1 Range 5 West of 3rd Meridia (Air photo A21760, Dept. of Energy, Mines and Resources, Ottawa.)

glacial till form a thin veneer over the uplands, the mantle being so shallow that from aerial views, much of the preglacial topography is evident. An abundance of well-rounded quartzite gravels mixed with Precambrian rock fragments characterize the glacial deposits. Glacial erratics of smooth, often striated rocks and boulders dot the landscape. Where the last glacier stagnated, local areas of hummocky or knob and kettle terrain are represented.

Since the glacier disappeared from the region about 20,000 years ago, late glacial and postglacial wind and wat erosion has removed some surfac deposits and has carved the underlyin sedimentary strata into unusual form Strikingly-sculptured badland featuring extensive bedrock exposur are located where the Morgan Cre Valley widens in Sections 11, 12, 1 14, 23 and 24 of Township 1, Range (Fig. 4). These are best viewed fro atop the plateau in Sections 12 and 1 Adjacent to the badlands, on the nort facing slope of the valley in Section 1 is an unusual feature, a "sinking hil

ig. 5). Other topographic forms found thin the valley systems are slump atures, stream meanders, floodplains d alluvial fans.

Evolution of landforms often relates the preglacial bedrock formations. e Bearpaw and Eastend Formations, d locally the Whitemud and French- an Formations of Cretaceous age, and Tertiary-aged Ravenscrag and Wood ountain Formations are exposed in proposed natural area, and exten- ely so in the badlands. The Raven- rag Formation is the capping stratum, sting directly upon the Eastend For- ation or upon the Whitemud and enchman Formations, where these ve not eroded away. At elevations ove 3,150 feet the youngest Wood ountain quartzite sands, gravels and bbles cap the highlands.

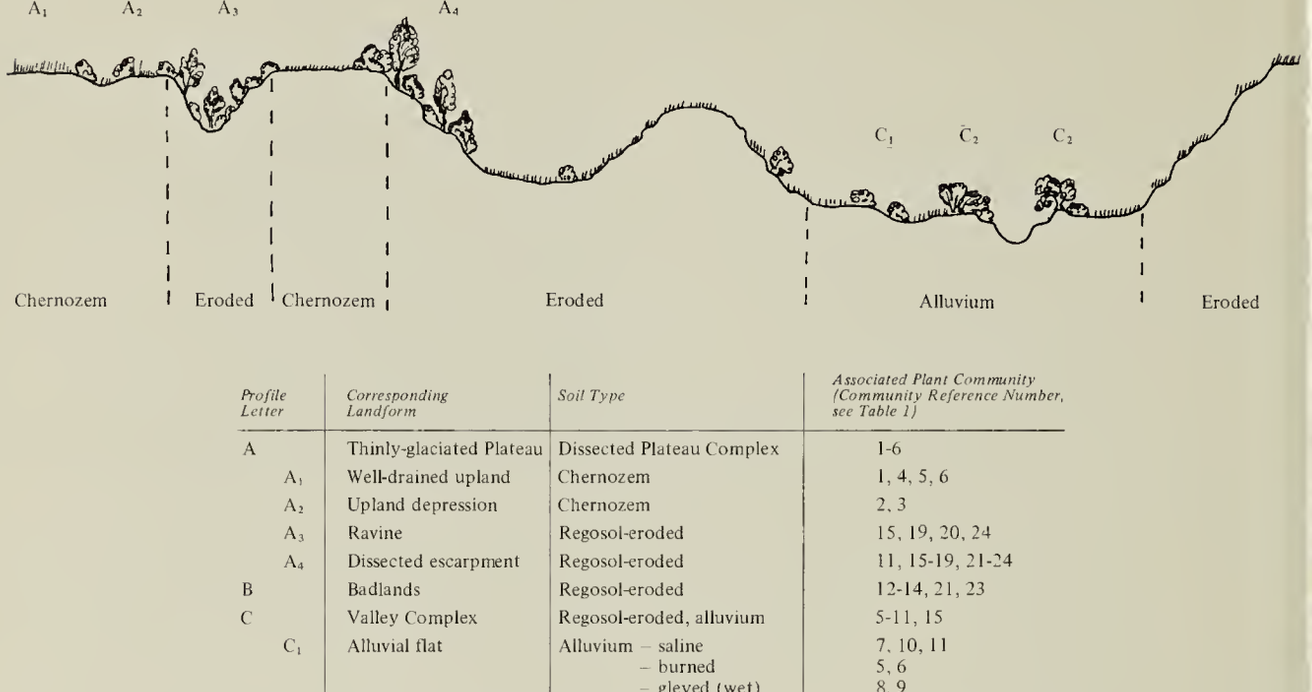
g. 3. A view from the typical grassed uplands south of the badlands, looking north toward the teepee buttes. Only a few pasture trails provide access to the area.

Origin of the conical 'teepee buttes' of e badlands began with the running of rface water into vertical cracks in the nmarine Ravenscrag Formation and e wearing of these into ever-widening sures and gullies. Eventually the alter- te weak and more resistant bedrock ata stand out in relief displaying in- esting layer-cake erosional forms ig. 3). Formation bedding is further nphasized by variations in strata loration. This is well illustrated thin the Ravenscrag Formation where nite coals and carbonaceous shale ds ignite due to lightning. Oxidation the iron compounds through burning uses the change to salmon-orange and ick-red hues.

Fig. 4. The Killdeer Badlands, 8 miles west of Killdeer, showing the influence of erosion on the different strata. The degree of vegetation cover varies with slope aspect and steepness, soil type and moisture conditions.

The sinking hill consists of a 200-foot section from the center of a low hill that has broken away sharply from the rest of the hill and has allegedly settled nearly a foot a year since the early 1930's (Fig. 5). The Eastend sandstone and siltstone strata form the upper part of the sinking segment. Large concretions are embedded in the fine yellowish sandstone and siltstone walls. It is suggested that lateral stream erosion below the Bearpaw-Eastend contact may be the cause of the sinking process. Apparently Morgan Creek undercuts the stream bank west of the sinking hill, causing erosion of the Bearpaw shales. With progressive erosion, the block of ground adjacent to the creek shifts northwest

Fig. 5. A view of the sinking hill, looking northeast toward Morgan Creek, shows one of the near-vertical sandstone and siltstone walls and the down-dropped block. Rattlesnakes frequent the site.



Profile Letter	*Corresponding Landform*	*Soil Type*	*Associated Plant Community (Community Reference Number, see Table 1)*
A	Thinly-glaciated Plateau	Dissected Plateau Complex	1-6
A_1	Well-drained upland	Chernozem	1, 4, 5, 6
A_2	Upland depression	Chernozem	2, 3
A_3	Ravine	Regosol-eroded	15, 19, 20, 24
A_4	Dissected escarpment	Regosol-eroded	11, 15-19, 21-24
B	Badlands	Regosol-eroded	12-14, 21, 23
C	Valley Complex	Regosol-eroded, alluvium	5-11, 15
C_1	Alluvial flat	Alluvium – saline	7, 10, 11
		– burned	5, 6
		– gleyed (wet)	8, 9
C_2	Creek bank	Alluvium	15, 20

Fig. 6. A diagrammatic representation of the relationship between landscape, soils and vegetation in the study area.

laterally, removing the support for the overlying Eastend strata. Settling of these upper beds into the resulting chasm creates the sinking effect. An alternate explanation of the sinking process is that of the dissolution of underlying salt deposits to form a cavern into which the overlying beds settle.[8]

Associated with the bedrock formations are many features of paleontological interest. Fossilized bone fragments of fish, turtles, rodents, primitive deer-like forms, camels and three-toed horses have been found in the Wood Mountain gravels. One specific location, west of Morgan Creek in the southeast quarter of Section 2 of Township 2, Range 5, West of the Third Meridian has been reported. In the Frenchman Formation of the badlands, bones of the three-horned dinosaur (*Triceratops*), and fragments of turtles and crocodiles have been discovered. The underlying Eastend Formation contains plesiosaurian bone fragments.

Landscape — Vegetation Relationships

The plant communities dominating this landscape fall readily into four habitat groups: grasslands of neglible salinity (Figs. 3 and 7), grasslands of th alluvial flats — saline or wet (Figs. and 9), barren, eroded and gravelly ou wash areas (Fig. 4) and woodlands moist protected draws, depression ravines and creek banks (Fig. 10). detailed portrayal of the relationsh between vegetation communities an landscape is presented in Fig. 6 an Table 1.

Various grasses representatives of th Short-Grass Prairie Region domina the plant community spectrun Associated with the better grazing area are spear grass (*Stipa comata*), blu grama grass (*Bouteloua gracilis*), Jun grass (*Koeleria cristata*) and sedge (*Carex filifolia, Carex eleocharis*). Found in less abundance are whea grasses (*Agropyron* spp.) and bluegrasse (*Poa* spp.). Drier sites of gravell uplands and southern exposures, an heavily grazed areas are characterize by an increased abundance of pastu sage (*Artemisia fridida*), moss phlo (*Phlox hoodii*), little club-mos (*Selaginella densa*), prickly pear cactu (*Opuntia polyacantha*) and pincushio cactus (*Mammillaria vivipara*). Patche of snowberry (*Symphoricarpos occider*

le 1. The dominant plant communities and corresponding community reference numbers (see Fig. 6) for the Wood Mountain-Killdeer Badlands Natural Area.

mmunity erence nber	Plant Community	Community Reference Number	Plant Community
1	*Stipa comata, Bouteloua gracilis – Koeleria criststa, Carex* sp.	14	*Sarcobatus vermiculatus – Chrysothamnus nauseosus – Artemisia* spp.
2	*Poa* sp. *Agropyron* sp. – *K. cristata*	15	*Symphoricarpos occidentalis – Rosa* sp., *Elaeagnus commutata, (Salix* sp., *Potentilla fruticosa, Shepherdia canadensis, Ribes oxyacanthoides)*
3	*Poa* sp. – *K. cristata – Carex* sp.	16	*Populus tremuloides – Shepherdia argentea – Amelanchier alnifolia/Rosa* sp.
4	*B. gracilis – Plantago purshii*	17	*Fraxinus pennsylvanica* var. *lanceolata/A. alnifolia – Prunus virginiana* var. *melanocarpa – Cornus stolonifera*
5	*Agropyron smithii – Polygonum aviculare – Carex* sp.	18	*S. argentea – F. pennsylvanica* var. *lanceolata/ Juniperus communis*
6	*Artemisla frigida, Phlox hoodii – Selaginella densa*	19	*P. virginiana* var. *melanocarpa – A. alnifolia, Rosa* sp. – *R. oxyacanthoides, S. occidentalis*
7	*Distichlis stricta – Puccinellia nuttalliana*	20	*Salix* spp., *Shepherdia argentea*
8	*Eleocharis* spp. – *Carex* – spp. – *Juncus balticus*	21	*Juniperus horizontalis, J. communis – E. commutata, S. canadensis, P. fruticosa, Arctostaphylos uva-ursi*
9	*Scirpus americanus – Carex praegracilis – Juncus balticus*	22	*Crataegus* sp.
10	*Hordeum jubatum*	23	*Artemisia* spp. *R. oxyacanthoides, S. occidentalis, Rhus trilobata, Rosa* sp.
11	*Atriplex nuttallii*	24	*Prunus pennsylvanica – P. virginiana* var. *melanocarpa, Crataegus* sp., *A. alnifolia*
12	*Astragalus triphyllus – Hymenoxys richardsonii – (Haplopappus* sp., *Carex filifolia, Gutierrezia diversifolia,*		
13	*Eriogonum multiceps – (G. diversifolia, Eriogonum flavum, Lesquerella alpina, Haplopappus* sp.)		

s) and rose (*Rosa* sp.) occupy the ssland depressions (Fig. 7).

Characterizing the alluvial flats are rsely-growing salt-tolerant grasses d herbs. Most notable are alkali grass *istichlis stricta*) and salt-meadow ss (*Puccinellia nuttalliana*), but also resented are foxtail barley (*Hordeum atum*) and salt sage (*Atriplex nuttii*). Sedges (*Carex* spp.), bulrushes *irpus* spp.), spike rushes (*Eleocharis* .) and wire rush (*Juncus balticus*) are ciated with the freshwater creeks, ds and springs (Fig. 9). Wolf-willow *aeagnus commutata)*, buffalo-berry *epherdia argentea)*, willows (*Salix* .), snowberry and rose are occionally found in alluvial locales.

Vegetation cover in the badlands and er eroded and outwash areas is quite nt, many of the steeper slopes being re (Fig. 4). Creeping juniper *niperus horizontalis*), ground juniper *niperus communis*) and bearberry *rctostaphylos uva-ursi*) form mats r some of the clay slopes. Cushion lk vetch (*Astragalus triphyllus*), lorado rubber plant (*Hymenoxis hardsonii*), umbrella plant *riogonum flavum* and *Eriogonum multiceps)*, broomweed (*Gutierrezia diversifolia*), spatulate bladderpod (*Lesquerella alpina* var. *spathulata*) and spiny ironplant (*Happlopapus* sp.) are commonly represented. Greasewood (*Sarcobatus vermiculatus*), rabbit-brush (*Chrysothamnus nauseosus*), skunk-bush (*Rhus trilobata)* and various sage species (*Artemisia* spp.) are widespread.

A number of woody perennials are confined to the moist and sheltered coulees, draws and depressions (Fig. 10). Tree species include trembling aspen (*Populus tremuloides)* and green ash (*Fraxinus pennsylvanica* var. *lanceolata*). The shrub-tree association is further characterized by buffalo-berry (*Shepherdia* spp.), saskatoon (*Amelanchier alnifolia*), chokecherry (*Prunus virginiana* var. *melanocarpa*), gooseberry (*Ribes oxyacanthoides)*, dogwood (*Cornus stolonifera*), shrubby cinquefoil (*Potentilla fruticosa*), hawthorn (*Crataegus* sp.), wolf-willow, snowberry and rose.

Fauna

Barring species which are known to be already extinct in Canada, the Wood Mountain physiographic region con-

Fig. 7. The greatest development of the dominant grassland habitat occurs on the undulating uplands. Moist draws and depressions are characterized by snowberry, rose and scattered sagebrush.

tains a complete sample of prairie fauna. Many species are or could be regular residents of the proposed Killdeer Badlands Natural Area.

Located along the Frenchman Valley riverflats to the west are the only black-tailed prairie dog colonies in Canada. When not persecuted, this species has the ability to colonize new areas. To eliminate prairie dogs would be to eliminate numerous species which depend directly or indirectly upon them for their existence. These include the burrowing owl, ferruginous hawk, golden eagle and rattlesnake still found in the area, the kit fox, now considered rare or absent, and the black-footed ferret, extinct in Canada, but still found in the United States.

Re-establishment of near-extinct or vanishing populations is considered feasible. Reintroduction of the kit fox and ferret depends entirely upon a healthy prairie dog population. In view of the historical association of the area with bison herds, their reintroduction and management has been recommended as a desireable undertaking.[9] The plains wolf and plains grizzly, once predators of the bison are now extinct.

A few mammalian species of interest to sportsmen are native to the proposed natural area. Mule deer are common, but recent figures released by the Department of Natural Resources (DNR) indicate this area to have one of the lowest densities of any survey zone in southern Saskatchewan. Pronghorn a telope surveys show their populati densities to be slightly lower than oth nearby areas and of minor importan compared to the Maple Creek-Cra Lake area. According to the DNR "A telope population trend survey" f 1972, the provincial antelo population shows a downward tre and a density well below the long-ter average. Protection of a nucle population would prevent this speci from becoming locally endangered an serve as a source of supply for surrou ding areas. Other mammals represent are the white-tailed jack rabbit, Nu talls's cottontail, Richardson's grou squirrel, coyote, red fox, skunk, po cupine, bobcat and badger.

Several rare or endangered avia species are regular breeders within t proposed park area. The Prairie Falco Golden Eagle and Ferruginous Haw threatened by widespread pesticide us habitat destruction and other pe secution, nest in or near the Killde Badlands as do the Turkey Vultur Burrowing Owl, and Long-bill Curlew. The Sage Grouse, largest North American grouse and well-know for its strutting and booming displa during spring courtship is a permane resident. Due to the destruction of i natural prairie habitat, few substanti populations remain.

A number of species, unique to t semi-arid grassland environment a

Fig. 8. A view from the sinking hill, northe across the Morgan Creek Valley shows posed valley slopes and a meanderi creek. Moist meadows, saline patches a wooded creek banks are associated with t alluvial flats.

ach the northern edge of their range
hin this area.[4] Chief among these are
Poor-will, Sage Thrasher, Brewer's
rrow and Rock Wren. The discovery
Violet-green Swallows nesting in the
tes along the Frenchman River in
65 makes this area the only known
ation in Canada east of the Rockies
ere the species breeds. The discovery
Mountain Plovers immediately west
the proposed park raises the
sibility that they may yet be found
eding within the area.

The area's fauna is further diversified
five snake species: the plains garter,
stern hognose, bull snake, yellow-
lied racer and rattlesnake. Also oc-
ring in the vicinity are snapping tur-
s. The horned toad is known to be
nd within the proposed national
k boundaries, but is generally restric-
to the southwestern Saskatchewan
d Alberta vicinity, adjacent to the In-
national Bounday.

nservation Problems And nagement Suggestions

he proposed Killdeer Badlands
tural Area contains a representative
nple of the diverse short-grass prairie
sical conditions and a near complete
ge of the native prairie life forms still
sting in Canada. An area of great
ural beauty, its openness and ex-
lent vantage points allow one to wit-
s a scene similar to that experienced
the first explorers and settlers.

. 9. Local saline areas and small marshes
haracterize the temporary ponds, creeks
nd springs. Blooming rose bushes and
oisture-loving grasses, sedges and rushes
urround this upland pond.

Fig. 10. Moist wooded north-facing slopes and sheltered draws are dominated by green ash with a varying understory of chokecherry, saskatoon, wolf-willow, buffalo-berry and dogwood. Fringing the grasslands are wolf-willow, snowberry and rose.

Features of geological, paleontological, biological, archeological and historical significance contribute to its suitability for interpretation of natural history in a prairie setting. Since it is also of sufficient size to sustain a good sample of the prairie environment, the area has high education and research potential. To fulfill its potential for present and future generations, it must be properly protected and managed.

In the past, much attention has been given to arguments supporting the need for a clearly defined protected area system into which the preservation of a natural area network could be rationalized. Such natural areas will have to be justified in relation to broad land-use planning, considering such needs as space for living, recreation, environmental conservation and economic development. Now it appears that this concept has finally caught on and that increasing pressures are being applied to the authorities for better natural resource protection. Since 1969, the IBP-CT has encouraged the provincial government to provide leadership in its planning by establishing some model Natural Areas, representing different types of terrain. The object is to protect, first, on a trial basis and, later, if successful, on a permanent basis, native areas representing dominant ecosystems and unique habitats for the purposes of aesthetics, science, research and education. The Killdeer Badlands area was rated highly in the original IBP-CT recommendations.

Management of natural areas poses another problem, one of extreme importance. Since the areas will vary in size, composition and vulnerability, each should have a general management plan. Management criteria are needed to protect the features of particular value. Prior to the formulation of the plans, each area proposed for protection should be identified as to its purpose and objectives and these should be reflected in the final boundary proposals. If an area is large enough, zoning is an acceptable management procedure to rationalize conflicting needs. Ideally a portion of the landscape should be left upon which to observe successional trends in the absence of manipulative management.

Management plans for the Killdeer Badlands area will be influenced largely by the fragility of and the extent of visibility within this open environment. Construction activities often cause extensive soil erosion, a significant factor particularly in the semi-arid grasslands where high winds and slow vegetation growth are typical. For this reason, decisions relating to the number of physical improvements to be allowed within or near the area are important. This pertains primarily to roads, trails, turn-offs, look-outs, parking lots, campsites and fences. An attempt to harmonize these features with the landscape, taking advantage of topographic changes and changes in alignment and view has been suggested. Treatments to minimize dust, and sodding of bare areas such as ditch-cuts, are possible solutions to the erosion problems.

Special attention must be given to the amount and nature of publicity given to natural areas, for an overabundance of people can severely modify them, limiting their values for research and education purposes. The location and number of facilities should be dictated by the recommended carrying capacity for each area. Development of part of an area for interpretive purposes, explaining its sensitivity, reasons for preservation and restricted recreational use would be advantageous.

For the proposed Killdeer Badlands Natural Area, an interpretive progr unique in Canada could be formulat

Policies must also be adopted reg ding fire, disease and insect infestati control, species introductions, obs vational or manipulative experimen and educational use, hunting or oth control of wildlife populatio agricultural practices of reseedi spraying, mowing, grazing, clearing a drainage changes, mineral and oil ploration and extraction and tra mode and limitations.

Summary

On the basis of field studies conduct by IBP-CT, the Killdeer Badlands ha been given a high priority in recomme dations to the Government of Sask chewan for model Natural Ar establishment. This paper provides preliminary description of the ecolo of the area with specific references to ceptional features of interest. Using it an example, some of the problems whi could arise in protecting Natural Are are identified and possible manageme practices for the future suggested. opportunity to experience natur history in the prairie setting exists n in southwestern Saskatchewan. If futu generations are to receive simil benefits, it is our responsibility provide proper protection a management of a prairie landsca representative. Would not the propos Killdeer Badlands Natural Area fulf the requirements well?

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INTERPRETIVE PROGRAM

Saskatchewan Department of Natural Resources

by ROBERT J. LONG*

As the administrator of Saskatchewan's renewable resources, the epartment of Natural Resources has ng had an interest in environmental ucation. Provincial Parks have been anned with this in mind, Hunter fety programs have attempted to improve the behaviour of sportsmen, and onservation Information Service blications have attempted to keep sidents informed on resource developents. The Museum of Natural History Regina is a division of D.N.R. whose tire function is to disseminate information on Saskatchewan's natural and storical heritage.

In recent years, the dramatic upswing interest in education out-of-doors has rced the department to step up its ograms. One of the most significant velopments has been the expansion d consolidation of the Interpretive ogram, which had previously existed a series of independent trails and hibit centers in our Provincial Parks. his project has been assigned to the Interpretive Services Section of the Museum of Natural History.

The Interpretive Program is still a long way from being 100% operational, but progress is being made. Existing facilities are being upgraded, and new services are developed each year. We are now working on an over-all "master plan" which will provide guide-lines for future development. Ultimately we will see a far-reaching program that deals not only with nature-study topics, but also subjects within the realm of human history and resources management. Provincial Parks will continue to be the centers of development, but facilities will also be developed on D.N.R. lands where conditions and local interest warrant.

The Interpretive Program is intended to provide facilities and information that will encourage residents and visitors to look at and understand their surroundings within the parks, and after they leave.

There are four elements to the proposed program, including Nature Trails, Nature Center Exhibits, Naturalist Programs, and Publications. Each of these is an essential part of a

askatchewan Museum of Natural History, gina, Saskatchewan.