David A. Gauthier
Ed B. Wiken

Reporting on Macro-Ecosystems: The Great Plains of North America

Introduction

Reporting and indicators concerning protected areas and other topics are intended to serve decision-makers. They commonly do so by providing both a context for the 'study area' and a comprehensive platform of basic ecological information. As decision-making increasingly takes place at all levels (e.g., including ranchers, academics, government officials, corporate organizations, resource developers, and environmental groups), the context-setting and information need to be robust to cover varied social, economic, and environmental considerations that stakeholders may have.

The process of state of the environment reporting and indicators has a fairly strong record at national levels and, in cases, at provincial levels. However, at the continental scale that is most suitable for the Great Plains, little exists (Wiken et al. 1997). Within the existing reports, some have had success in applying an ecosystem approach, but this is a recent innovation and an activity to which many organizations are unaccustomed. Attempting to do this for a macro-ecosystem such as the Great Plains is unprecedented even for a seemingly simple indicator such as protected areas.

State of the environment reporting and the use of ecological indicators are rather recent innovations put in place to document, track, and explain changes. The products ideally set a basis for sustainable resource use and living. While this type of venture would be most helpful in guiding actions and policies concerning the use and conservation of pristine areas, many of the world's macro-ecosystems have already been subject to a host of changes induced by human activity. The prairie ecozone of Canada and its natural extension—the Great Plains of North America—exemplify this situation very well.

The North American Great Plains Ecosystem Setting

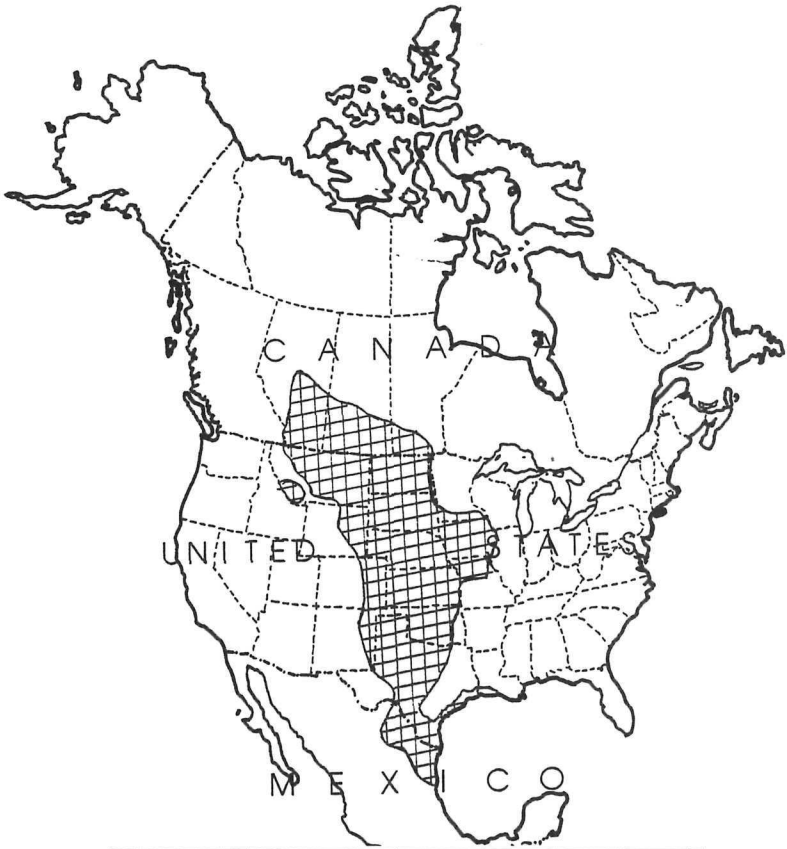
Initiatives like sustainable resource use, ecosystem management, and ecosystem integrity call for an

approach that goes beyond the confines of jurisdictions, whether they are country, state, or provincial borders (Gauthier 1992; Gauthier et al. 1995; Wiken and Gauthier 1997). The Great Plains is one of the best examples of a macro- and continental ecosystem, one that is shared amongst three countries, three provinces, and twenty-one states. Historically, the Great Plains' wealth of resources and productive landscapes has been the seed of its demise in respect to current-day conservation interests. As a result, much of the landscape has been altered, many native ecosystems and species have been lost, and little of what was natural remains.

The Great Plains ecological region (NAEWG 1997; Wiken and Gauthier 1998) is found in the central part of the continent and extends over the widest latitudinal range of any single North American ecological region. It is a relatively continuous and roughly triangular area covering about 3 million sq km (Figure 1). The North American prairies extend north to south about 1,500 km from Alberta, Saskatchewan, and Manitoba in Canada through the Great Plains of the USA to southern Texas and adjacent Mexico, and east to west approximately 600 km from western Indiana to the foothills of the Rockies and into northeastern Mexico. The majority of the Great Plains, approximately 80%, is found within the USA, with 16% in Canada and 4% in Mexico. This large ecological region is generally distinguished by the following characteristics: relatively little topographic relief, grasslands and a paucity of forests, and a climate ranging from subhumid to semi-arid.

The Great Plains is currently a culturally molded ecosystem. The first European settlers began moving westward into the northern and central Great Plains from the eastern forest regions. At first, settlers considered the prairies to be infertile, so they stayed where trees persisted. But the settlers soon realized that the prairie soil was one of the most productive in the world. Today, the prairie grasslands are among the largest farming and ranching areas of the Earth. Agriculture is the most important economic activity as well as the dominant land use and the main stressor for this ecological region. Crop types vary from north to south with differences in growing seasons and temperatures. While agricultural activities dominate the rural landscape, population is centered in urban areas and rural depopulation is a continuing trend in Canada and the USA. Overall, approximately 34 million people live within this ecological region, with some 32 million occupying the portion occurring within the USA.

The character of the Great Plains ecosystem is unlike many other North America ecosystems. For example, in stark contrast to the Great



Area of the Great Plains ecological region		
Canada	45,730,810.	ha
United States	228,748,630.	ha
Mexico	10,553,283.	ha
Total for North America	285,032,723.	ha

Figure 1. The Great Plains of North America.

Plains, the tundra ecosystem contains less than 30,000 people living in an area of 2.8million sq km and falling under only four main jurisdictions. The influence and impact of human activities and land uses in that region are, by contrast, minute. The Great Plains has some of the most extensive networks of roads. These types of factors ultimately affect the conditions of the ecosystems and the biases of decision-making. For example, in the Arctic managers may be able to adopt a stronger "prevent and anticipate" management focus, whereas those in the Great Plains may have to "restore and repair."

The Protected Area Situation

Within the Great Plains macro-ecosystem there are five major ecological regions (Figure 2). Figure 2

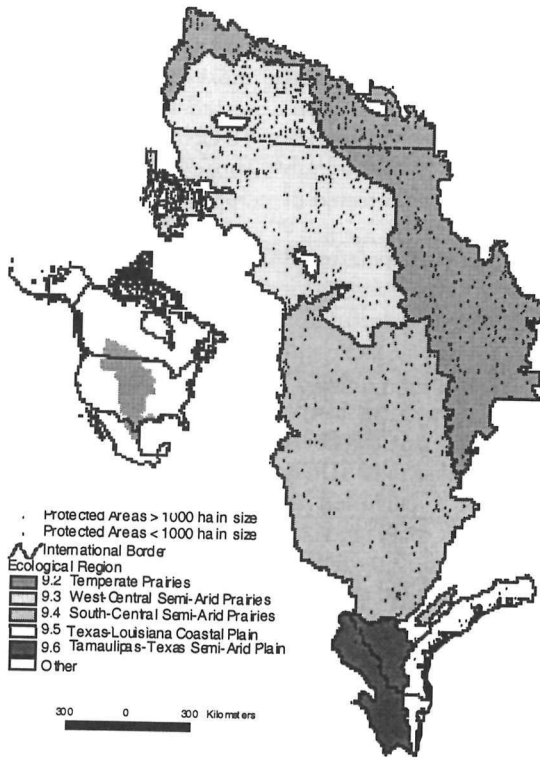


Figure 2. Ecological regions and protected areas of the Great Plains

also shows the distribution of protected areas according to those that are greater than 1,000 ha in size and those that are less. In the remainder of this paper, unless noted otherwise the term "protected areas" refers only to those areas greater than 1,000 ha.

There are 603 protected areas in the Great Plains. Table 1 shows that, in total, they occupy just under 6% of the Great Plains. Ninety-nine percent of the area protected occurs within only three of the five ecological regions. The majority (72%) of the area protected occurs in the west-central semi-arid prairie. The Texas - Louisiana coastal plain and the Tamaulipas–Texas semi-arid plain contain less than 1% of the area protected in the Great Plains.

The six-category international IUCN system for classifying protected natural areas is useful for comparisons across ecological and jurisdictional boundaries (Table 1) (IUCN 1994). Sixty percent of the area classed as protected in the Great Plains has been coded as to its IUCN status. Of that, 80% is coded as IUCN Category VI, managed resource protected area. Only 5% of the area protected in the Great Plains that has been coded as to its IUCN status falls into IUCN classes I to III (strict nature reserve/wilderness, national park, or natural monument), often considered to be managed for the highest degree of protection.

It is also useful to examine these data by country (Table 2). Canada contains 16% of the Great Plains in two ecological regions, the temperate prairies and the west-central semi-arid plains. Those two compose the prairie ecozone of Canada, which occupies 5% of the country's total land area. Twenty-six percent of the protected areas in the Great Plains occur in Canada.

Eighty percent of the Great Plains are found in the USA, and they occupy approximately 29% of the country's continental land area. Almost 75% of the Great Plains' protected areas are in the USA. When all IUCN categories are considered, those areas provide protection for approximately 7% of the Great Plains within the USA.

Five percent of Mexico's land area is prairie, representing 4% of the total area of the Great Plains of North America. While there are protected areas within the Mexican Great Plains, they are few and relatively small (less than 1,000 ha).

Table 3 provides a summary of protected area information for Canada and the USA according to ecological regions. While the USA and Canada are relatively similar in the proportionate representation of protected areas in the temperate prairies, the USA has substantially more proportionate representation in the west-central semi-arid plains.

Table 4 examines the distribution

Table 1. Number and extent of protected areas (>1,000 ha) for the ecological regions of the Great Plains, by IUCN category

	Temperate Prairies	West-Central Semi-Arid Prairies	South-Central Semi-Arid Prairies	Texas-Louisiana Coastal Plain	Tamaulipas-Texas Semi-Arid Plain	TOTAL
IUCN Cat. I						
Number	2	8	1	1	0	12
Area (ha)	6,253	46,492	5,526	50	0	58,321
% area	0.008	0.05	0.006	0.0005	0	0.02
IUCN Cat. II						
Number	8	10	1	0	0	19
Area (ha)	162,963	252,964	1,056	0	0	416,983
% area	0.21	0.29	0.001	0	0	0.14
IUCN Cat. III						
Number	4	6	4	0	0	14
Area (ha)	7,014	15,154	3,188	0	0	25,356
% area	0.009	0.02	0.003	0	0	0.008
IUCN Cat. IV						
Number	46	47	13	9	0	115
Area (ha)	307,459	647,741	76,484	118,124	0	1,149,808
% area	0.39	0.7	0.08	1.23	0	0.40
IUCN Cat. V						
Number	22	6	18	3	1	50
Area (ha)	128,529	29,445	49,924	36,233	7,563	251,694
% area	0.16	0.03	0.05	0.56	0.05	0.09
IUCN Cat. VI						
Number	31	78	3	0	0	112
Area (ha)	620,223	7,238,411	636,596	0	0	8,495,230
% area	0.80	7.9	0.65	0	0	2.93
Unclassified						
Number	107	97	71	8	1	284
Area (ha)	752,484	3,929,975	1,872,338	19,273	1,620	6,575,690
% area	0.97	4.6	1.93	0.29	0.01	2.27
TOTAL						
Number	220	252	111	21	2	606*
Area (ha)	1,984,925	12,160,182	2,645,112	173,680	9,183	16,973,082
% area protected, each ecological region	2.6	13.3	2.7	2.7	0.07	
% area protected, entire Great Plains	0.7	4.2	0.9	0.06	0.003	5.9

* Because of overlap of protected areas across ecological region boundaries, some are recorded as occurring in more than one region, yielding a total number higher than the actual count of 603.

IUCN Category I = strict nature reserve / wilderness area
IUCN Category II = national park
IUCN Category III = natural monument
IUCN Category IV = habitat/species management area
IUCN Category V = protected landscape/seascape
IUCN Category VI = managed resource protected area

Table 2. Number and extent of protected areas (>1,000 ha) in the Great Plains, by ecological region and country

Country	Total area (sq km)	Area (sq km) of prairie (%)	Percentage of Great Plains in each country	Number of protected areas (% of total)	Area (sq km) of protected areas (% of prairie protected)
Canada	9,970,610	457,308 (5%)	16%	159 (26%)	15,874 (3.5%)
Continental USA	7,825,161	2,287,486 (29%)	80%	444 (74%)	153,856 (6.7%)
Mexico	1,958,201	105,532 (5%)	4%	0 (0%)	0 (0%)
TOTAL	19,753,972	2,850,327 (14%)	100%	603 (100%)	169,730 (5.9%)

Table 3. Number and extent of protected areas (>1,000 ha) in the Great Plains of Canada and the USA, by ecological region and country

Ecological Region	Canada				USA			
	% of ecological region in Canada	# of PAs	Area (sq km) of PAs	% of ecological region protected	% of ecological region in USA	# of PAs	Area (sq km) of PAs	% of ecological region protected
Temperate Prairies	29	69	6,332	2.8	71	151	13,517	2.4
West-Central Semi-Arid Prairies	27	90	9,542	1.5	73	162	112,059	17.7
South-Central Semi-Arid Prairies	0	0	0	0	100	111	26,451	2.7
Texas-Louisiana Coastal Plain	0	0	0	0	82	21	1,736	2.2
Tamaulipas-Texas Semi-Arid Plain	0	0	0	0	37	2	91	0.2
TOTAL	16	159	15,874	2.1	80	447*	153,856	6.7

* Because of overlap of protected areas across ecological region boundaries, some are recorded as occurring in more than one region, yielding a total number higher than the actual count of 444.

of protected areas solely according to country and administrative jurisdiction (state or province). Three Canadian provinces, eighteen U.S. states, and three Mexican states contain portions of the Great Plains. When federal management agencies are included, these figures reflect the multiplicity and inherent complexity of attempting to achieve coordinated ecosystem management over such a large macro-ecosystem.

Most of Canada's Great Plains is found in Saskatchewan. It also has the greatest number of large protected areas and the largest percentage (5%) of prairie protected in Canada (Gauthier and Patino 1998;

Table 4. Number and extent of protected areas (>1,000 ha) in the Great Plains, by province and state

Country	State or Province	Area (sq km) containing portions of the Great Plains	Area (sq km) of prairie (% of Great Plains portion)	% of Great Plains Ecological Region in State or Province	# of PAs	Area (sq km) of PAs (%)
Canada	Alberta	660,457	152,295 (23)	5.3	19	1,150 (0.8)
	Manitoba	649,937	70,075 (10.8)	2.5	29	2,455 (3.5)
	Saskatchewan	649,187	234,938 (36.2)	8.2	111	12,269 (5.2)
USA	Arkansas	137,540	28 (0.02)	0.001	0	0
	Colorado	270,865	114,318 (42.2)	4	26	9,326 (8.2)
	Idaho	215,739	84 (0.04)	0.003	1	71 (86)
	Illinois	146,385	56 (0.04)	0.002	1	1 (2.4)
	Iowa	145,048	136,172 (93.9)	4.8	49	379 (0.3)
	Kansas	211,873	211,869 (100)	7.4	32	2,521 (1.2)
	Louisiana	121,909	16,330 (13.4)	0.6	7	361 (2.2)
	Minnesota	218,357	80,386 (36.8)	2.8	27	2,544 (3.2)
	Missouri	180,443	88,724 (49.2)	3.1	6	137 (0.2)
	Montana	380,100	280,260 (73.7)	9.8	91	43,514 (15.5)
	Nebraska	199,844	199,844 (100)	7	16	4,280 (2.1)
	New Mexico	315,155	67,390 (21.4)	2.4	14	1,662 (2.5)
	North Dakota	182,056	182,056 (100)	6.4	70	19,846 (10.9)
	Oklahoma	180,895	158,677 (87.7)	5.6	13	8,617 (5.4)
	South Dakota	198,282	193,432 (97.6)	6.8	40	47,558 (24.6)
	Texas	687,711	481,706 (70)	16.9	46	5,392 (1.1)
	Wisconsin	146,323	854 (0.6)	0.03	2	25 (3)
	Wyoming	252,996	75,295 (29.8)	2.6	12	7,620 (10.1)
Mexico	Coahuila	150,747	25,818 (17.1)	0.9	0	0
	Neuvo Leon	65,227	33,592 (51.5)	1.2	0	0
	Tamaulipas	78,178	46,127 (59)	1.6	0	0
TOTAL		6,445,256	2,850,327 (44.2)	.100	612*	169,730 (6)

* Because of overlap of protected areas across ecological region boundaries, some are recorded as occurring in more than one region, yielding a total number higher than the actual count of 603.

Gauthier et al. 1998, Patino and Gauthier 1997). Within the USA, those Great Plains states whose land area is at least 70% prairie (North Dakota, Nebraska, Kansas, Iowa, Montana, South Dakota, Texas, and Oklahoma) vary widely in the percentage of that prairie which is protected (ranging from less than 1% for Iowa to 25% for South Dakota).

Examining protected area data according to both ecosystems and administrative jurisdictions provides a useful means by which to evaluate those areas according to different perspectives and requirements (Wiken and Lawton 1995; Wiken et al. 1996). Across the Great Plains, the diversity of land forms, soils, hydrologic regimes, climate, vegetation, and wildlife species and communities—as shaped by human activities—has resulted in numerous ecosystems that require a multitude of management approaches to insure their protection. Jurisdictions can benefit in their coordination efforts by combining standardized ecosystem and protected area classification schemes.

The grasslands have been and remain productive areas for many resource sectors, such as agricultural, gas and oil, and mining. While these ecosystems have been widely supportive of human endeavours, that support has come at the cost of the systems' original assets. This analysis has provided an initial look at the presence and absence of conservation areas across the continent's core, once dominated by native grasslands. It is a general indication of where the assets remain. The pattern of protected areas shows a generally wide dispersal northwards from the Rio Grande. Success in establishing protected areas is lowest in Mexico and highest in the USA. In terms of designating additional protected areas, most of the larger, and therefore likely more viable, properties (those greater than 1,000 ha) are in the USA. The percentage of Great Plains protected within North America (5.9%) is relatively low, and is, by many worldwide standards, insufficient.

In North America, the "Old West" and the Great Plains are often thought of as synonymous terms. The Old West signified an era with hardy and colourful characters, a dynamic environment, and spectacular and vibrant landscapes. That era only survives as a legacy recorded in history books. The legacy of the natural grasslands is disappearing into history as well. The remnant and often-isolated spots of the former grasslands are now typically contained within protected areas. These areas scattered across the plains are the few remaining pages that have not yet been relegated to the natural history books. They are like a fleet of Noah's Arks moored in a sea of agricultural lands. Existing protected areas within the Great Plains appear as island vestiges of the past. Unlike

other areas such as the tundra, protected areas in the Great Plains are not entities within a larger landscape of wilderness. Their isolated, island pattern mediates against their likely effectiveness as clusters for migrating species. It also weighs heavily against their ability to, on their own, maintain their ecological integrity over the long term due to their small size and the surrounding land uses. It is becoming very clear that cooperative partnerships and reporting endeavours among individuals, organizations, and agencies throughout the Great Plains are essential to insure that conservation objectives are met.

Common Action and Partnerships

Numerous partnership programs to conserve prairie are in place across the Great Plains. Some are specific to particular resources, such as the North American Waterfowl Management Plan, and the High Plains Partnership for Species at Risk (Walsh 1997), while others are broader, encompassing many resource sectors and stakeholder interests. For example, the Great Plains Partnership (GPP) is an international program made up of "federal, state, and local agencies, tribes, non-governmental organizations and landowners who believe that through cooperation rather than conflict, economic and environmental interests can be compatible."

The Partnership's mission is to catalyze and empower the people of the Great Plains to define and create their own generationally sustainable future. To this end, the Partnership brings together individuals and groups who commit appropriate resources, work to remove institutional barriers, develop the necessary science and data, and enhance local, regional, and world-wide learning from these efforts (GPP 1999a).

Connected to the Great Plains Partnership is the Great Plains International Data Network (GPIDN). Membership in the data network is open to all parties interested in participating in a Great Plains program that facilitates access, exchange, and integration of databases relating to the region.

Members of the GPIDN are interested in exploring ways of cooperating with other agencies and jurisdictions to advance data activities and sustainable development within the Great Plains region. A framework document describes the components of the GPIDN. Over 120 U.S., Canadian, federal, non-governmental, nonprofit, state and local participants are represented on the data network. By working together, exchanging ideas and information, and pooling resources, it is anticipated that the GPIDN can develop mechanisms to facilitate Great Plains data access, exchange and integration. As a result, this will stimulate scientists in the Great Plains region to identify challenges and propose solutions, so that decision-makers and stakeholders can make wise decisions on the management of the region (GPP 1999b).

Regional conservation plans are also being developed. For example, in Canada, prairie conservation action plans have been developed for Saskatchewan (PCAP 1998), Alberta (Prairie Conservation Forum 1997),

and Manitoba (Manitoba Natural Resources 1998). These plans reflect agreements among representatives of numerous resource industry associations, government agencies, and nongovernmental organizations regarding the conservation of the Canadian prairies.

There are no standardized sets of indicators commonly used to report on the success of the wide range of conservation programs throughout the prairies. By their very existence, such conservation programs are an indicator of conservation activity useful for reporting purposes. However, measures of the success of such programs are essential to facilitate planning and policy needs. The criteria used by each conservation program as measures of their productivity and success in achieving their objectives can be useful reporting indicators. Such indicators would vary from measures of communication and education success to the amount of land conserved through land securement projects. The ultimate success of the various cooperative conservation partnerships on the prairies could be compromised by the absence of reporting and indicator items. Increasingly, planners, managers, investors, and the general public are calling for measures that document, track, and explain changes as a basis for sustainable living.

Implementing successful cooperative conservation programs in the prairies requires working with a large number of private owners; lessees; rural and urban municipalities; state, provincial, and federal governments; First Nations and other indigenous governments; and a host of interest groups. Such programs recognize and respect different cultural interests, the reality of substantially altered landscapes, the importance of agri-business and other economic interests, and the seriousness of biodiversity losses. They also recognize the need to extend conservation beyond the boundaries of existing protected areas to the entire working landscape. In these types of cooperative partnerships lie the best hope for the conservation of the Great Plains.

Acknowledgments

Special thanks for their assistance in data preparation and analysis to Rob Beric of Ottawa, Ontario, and to Sarah Gammell and Lorena Patino of the Canadian Plains Research Center in Regina, Saskatchewan. Also, the Canadian Council on Ecological Areas provided access to the Canadian Conservation Areas Database.

References

Gauthier, D. A. (ed.). 1992. *Framework for a Nation-wide System of Ecological Areas in Canada: Part 1—A Strategy.* Canada Council on Ecological Areas Occasional Paper Series no. 12, Ottawa: CCEA.

Gauthier, D. A., and L. Patino. 1998. Saskatchewan's natural heritage: Provincial and federal lands classified by international conservation management categories. Poster map. Regina, Sask.: Canadian Plains Research Center, University of Regina.

Gauthier, D., L. Patino, and L. Langford. 1998. Mapping conservation lands in Saskatchewan. Pp. 724-741 in *Linking Protected Areas with Working Landscapes Conserving Biodiversity: Proceedings of the Third International Conference on Science and Management of Protected Areas, 12-16 May 1997.* N.W.P. Munro and J.H.M. Willison, eds. Wolfville, N.S: Science and Management of Protected Areas Association.

Gauthier, D., K. Kavanagh, T. Beechey, and E. Wiken (eds.). 1995. *Framework for Developing a Nation-Wide System of Ecological Areas: Part 2—Ecoregion Gap Analysis.* Canadian Council on Ecological Areas Occasional Paper No. 13. Hull, Québec: CCEA.

GPP [Great Plains Partnership]. 1999a. Web site: http://www.greatplains.org/gpp/index.htm.

———. 1999b. Web site: http://www.greatplains.org/gpidn/index.htm.

IUCN. 1994. *Guidelines for Protected Area Management Categories.* Gland, Switzerland, and Cambridge, U.K.: IUCN–The World Conservation Union and World Conservation Monitoring Centre.

Manitoba Natural Resources. 1998. *Manitoba's Prairie Conservation Action Plan, 1996-2001.* Winnipeg: Manitoba Natural Resources.

NAEWG [North American Ecosystem Working Group]. 1997. *Ecological Regions of North America: Towards a Common Perspective.* Montréal, Québec: Commission for Environmental Cooperation.

Patino, L., and D. A. Gauthier. 1997. Protected areas in the prairie ecozone of Saskatchewan: concepts, indicators and gap analysis. Pp. 328-342 in *Proceedings of Caring for the Home Place: Protected Areas and Landscape Ecology Conference, 29 September–2 October 1996.* Regina, Sask.: University Extension Press and the Canadian Plains Research Center.

PCAP Committee. 1998. *Saskatchewan Prairie Conservation Action Plan.* Regina, Sask.: Canadian Plains Research Center.

Prairie Conservation Forum. 1997. Alberta Prairie Conservation Action Plan. Lethbridge, Alta.: Prairie Conservation Forum.

Walsh, N. E. 1997. Creating a high plains partnership. *Endangered Species Bulletin* 23(4), 8-9.

Wiken, E. B., and D. Gauthier. 1997. Conservation and ecology in North America. In *Proceedings of Caring for the Home Place: Protected Areas and Landscape Ecology Conference, 29 September–2 October 1996.* Regina, Sask.: University Extension Press and the Canadian Plains Research Center.

———. 1998. Ecological regions of North America. Pp. 114-129 in *Linking Protected Areas with Working Landscapes Conserving Biodiversity: Proceedings of the Third International Conference on Science and Management of Protected Areas, 12-16 May 1997.* N.W.P. Munro and J.H.M. Willison, eds. Wolfville, N.S: Science and Management of Protected Areas Association.

Wiken, E. B., D. Gauthier, I. Marshall, K. Lawton, and H. Hirvonen. 1996. *A Perspective on Canada's Ecosystems: An Overview of the Terrestrial and Marine Ecozones.* Canadian Council on Ecological Areas Occasional Paper no. 14. Ottawa: CCEA.

Wiken, E. B., I. Kirkham, and D. Gauthier. 1997. From provinces to continents: Networking state of the environment reports. Paper presented at the South African Research and Documentation Centre Workshop on SOE. SARDC-IMERSA, Harare, Zimbabwe.

Wiken, E. B., and K. Lawton. 1995. North American protected areas: An ecological approach to reporting and analysis. *The George Wright Forum* 12(1), 25-33.

David A. Gauthier, Executive Director, Canadian Plains Research Center, University of Regina, Regina, Saskatchewan S4S 0A2 Canada; gauthier@cas.uregina.ca

Ed B. Wiken, Canadian Council on Ecological Areas, 2067 Fairbanks Avenue Ottawa, Ontario K1H 5Y9 Canada; ecologic@istar.ca