Biodiversity in Agriculture

Agriculture and Agri-Food Canada's Action Plan

Implementing the Canadian Biodiversity Strategy

Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

Canada

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Action Plan

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Executive Summary

Biological diversity, or biodiversity, is the wide range of characteristics found among living organisms and their ecological settings. This diversity is described in the *Convention on Biological Diversity* at the genetic, species, and ecosystem levels. The conservation and protection of biodiversity is a key activity in sustaining the earth's resources and productivity for the future.

Agriculture and Agri-Food Canada (AAFC) has long recognized the need to conserve biodiversity and has initiated and worked with other federal departments, provinces, and producers on a number of programs important to the conservation and protection of biodiversity. AAFC's *Action Plan* for biodiversity has been developed subsequent to the *Canadian Biodiversity Strategy*, a national commitment through the *Convention on Biological Diversity* . This document focusses on matters within the mandate of AAFC.* The intent of this *Action Plan* is to define the Department's strategy to work with our partners on issues related to biological diversity from an agricultural perspective. Two accompanying documents, *Biodiversity Initiatives-Agriculture and Agri-Food Canada* and *Biodiversity Initiatives-Canadian Agricultural Producers* provide an overview of the broad range of biodiversity conservation initiatives in which the Department and the agricultural and agri-food sector are involved.

Key biodiversity issues in agriculture include:

- habitat conversion and fragmentation,
- agricultural practices,
- wild species at risk,
- diversity of domesticated species,
- exotic species,
- living modified organisms, and
- atmospheric changes.

The key challenges facing AAFC are:

- working with the agri-food sector to maintain sustainable and diverse agro-ecosystems,
- improving our knowledge base and understanding of biodiversity,
- ensuring genetic resources exist for present and future uses in agriculture, and
- integrating biodiversity conservation and sustainable use into operations and decisions.

The *Action Plan* will be guided by the principles of precaution, shared responsibility, competitiveness, integration, and continuous improvement. The activities described are identified under four main goals:

1. **To promote sustainability in agro-ecosystems while respecting natural ecosystems.**
2. **To increase awareness and understanding of biodiversity in agriculture.**
3. **To conserve and facilitate access to genetic resources that are important to agriculture, and share knowledge, expertise, and technologies in a fair and equitable way.**
4. **To integrate biodiversity conservation objectives in departmental policies, programs, strategies, regulations, and operations.**

Many challenges remain ahead in our efforts to conserve and protect biodiversity, while helping to meet the food supply needs of the world. The *Action Plan* is a framework that will allow for the achievement of our mutually shared goals and objectives.

**It should be noted that as of April 1, 1997, the regulatory arm of AAFC, the Food Production and Inspection Branch, has been consolidated with regulatory components of Health Canada and Fisheries and Oceans Canada to form the Canadian Food Inspection Agency (CFIA). From this historical perspective, the CFIA will continue to embrace the initiatives of this* Action Plan *for biodiversity .*

Introduction

Convention on Biological Diversity

Canada is one of over 100 countries that signed the *Convention on Biological Diversity* (the *Convention*) at the United Nations Conference on the Environment and Development (UNCED) in Rio de Janeiro in June 1992. In December 1992, Canada became the first industrialized country to ratify the *Convention*, which subsequently entered into force on 29 December 1993. The *Convention* has three main objectives:

- the conservation of biological diversity,
- the sustainable use of its components, and
- the fair and equitable sharing of the benefits that arise out of the use of genetic resources.

Highlights of the *Convention* are found in Appendix A.

Canadian Biodiversity Strategy

Following Canada's ratification of the *Convention*, federal, provincial, and territorial governments developed the *Canadian Biodiversity Strategy* (the *Strategy*) through broad-based consultations with industry, the scientific community, conservation groups, research institutions, indigenous and local communities, and the public. The *Strategy*, released in November 1995, outlines the measures required:

- to meet the obligations of the *Convention*, and
- to enhance co-ordination of national efforts aimed at the conservation and sustainable use of biological resources.

Highlights of the *Strategy* are found in Appendix B.

Many of the strategic directions contained in the *Canadian Biodiversity Strategy* directly or indirectly address biodiversity issues in agriculture. In summary, the *Strategy* directs federal and provincial governments to:

- maintain the agricultural resource base through research, policy and program reform, and economic incentives;
- conserve biological resources through *ex situ* facilities (e.g., seed and field genebanks);
- develop *in situ* conservation mechanisms for wild relatives of crops, domesticated animals, and microbial organisms; and
- promote sustainable farm practices that are compatible with wildlife.

Action Plan on Biodiversity

This document forms part of a series of federal modules that respond to the *Strategy's* call for reports on current or planned activities. Other modules in the series describe federal biodiversity initiatives relating to forestry, wildlife, aquatic areas, and protected areas. Future modules will deal with some of the issues that cut across individual mandates, such as education and awareness, biodiversity monitoring and assessment, and international co-operation.

A summary document entitled *Implementing the Canadian Biodiversity Strategy — A Federal Response*, is available from Environment Canada's Biodiversity Convention Office. The document describes highlights from each subject-specific module, and provides an overview of federal activity relating to the implementation of the *Strategy*.

This *Action Plan* , developed by Agriculture and Agri-Food Canada (AAFC), sets a framework to guide the Department's implementation of the *Strategy* and to transform its strategic directions into practical actions for the Department. This *Plan*:

- identifies areas where the Department is already fulfilling elements of the *Strategy* , and
- identifies actions the Department will pursue to further contribute to the conservation and sustainable use of biological resources within the Department's scientific and fiscal capabilities.

The *Constitution Act of 1867* identifies agriculture as a shared jurisdiction between federal and provincial governments. Given the shared responsibility and greater attention to environmental issues in support of sustainable agriculture, complementary partnerships with the provinces have become increasingly important.

The *Action Plan* should be viewed as a working plan — one that pursues sectoral and broad-based partnerships and opportunities with other federal departments, provinces, producer organizations, the research community, and local communities. It is not intended to reflect a one-time effort; rather, it is to be reviewed every three years and updated to reflect new developments in biodiversity conservation and sustainable agriculture.

This document is the first step toward the development of a federal response to key agro-biodiversity issues. The second step is to develop a document that describes the work done in collaboration with other federal departments on shared agro-biodiversity issues. Drafts will be circulated for comments to the agri-food sector and all key stakeholders who could play a role in implementing suggested actions.

This *Action Plan* also takes into account other international agreements relevant to agricultural biodiversity, such as the *United Nations Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture*.

How This Document Is Organized

The remainder of this *Action Plan* is divided into the following sections:

- Section One, *Biodiversity Concepts*, discusses the meaning of biodiversity as it relates to the agri-food sector.
- Section Two, *Biodiversity Issues in Agriculture*, provides an overview of biodiversity issues in agriculture.
- Section Three, *Context and Challenges* , provides an overview of AAFC's roles and responsibilities in biodiversity conservation and sustainable use, the current pressures for change, and the key challenges facing the agri-food sector in this context.
- Section Four, *Framework for AAFC Actions*, proposes a framework and the central elements of an AAFC action plan for the conservation of biodiversity and sustainable use of biological resources.
- Section Five, *AAFC Actions* , describes actions that will be undertaken by AAFC in partnership with agriculture and agri-food stakeholders, other federal departments, provincial governments, industry research institutions, non-government organizations, and local communities.
- Appendix A, *Highlights of the Convention on Biological Diversity*, summarizes key components of the Convention.
- Appendix B, *Highlights of the Canadian Biodiversity Strategy*, summarizes key components of the Strategy.
- Appendix C, *Examples of Current AAFC Biodiversity Initiatives*, provides examples of current activities undertaken in support of the Strategy's direction.
- Appendix D, *Glossary of Terms*, provides definitions of key terms used in the document.
- *References* , provides a list of the notes referred to throughout the text.

Section One

Biodiversity Concepts

The *Convention* defines "biological diversity" as "the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems".

In other words, biological diversity (or biodiversity) is the variability of life and its associated processes. Although there are many ways to describe and characterize biodiversity, the *Convention* describes it in terms of three levels:

1. genetic diversity,
2. species diversity, and
3. ecosystem diversity.

Biodiversity is a continuum of genes, species, and ecological interactions.

1.1 Genetic Diversity

Genetic diversity is the genetic variation provided by species. Genetic diversity is a critical component of biodiversity, as it is genetic diversity that provides species with the ability to adapt to new environments and natural or man-made disturbances.

Of importance to the agri-food sector is genetic diversity among:

- domesticated plants and animals and their wild relatives, and
- micro-organisms that are used in agriculture.

Diversity among these organisms and their wild relatives is the source from which genetic material is drawn to develop genetically diverse crops, animals, and micro-organisms. New crop varieties, livestock breeds, and microbial products help keep the agri-food sector competitive and provide it with the ability to adapt to:

- changing environmental and market conditions;
- threats of plant and animal diseases and pests; and
- changing societal and nutritional needs.

Why is biodiversity important to agriculture?

- *Wild species and obsolete crop cultivars and races of livestock provide a source of genetic resources — possessing desired genetic traits — that may be used in crop or livestock breeding programs.*
- *Soil organisms such as arthropods, bacteria, and fungi break down organic matter and minerals, making nutrients available in soil.*
- *Wetlands help protect ground-water reserves, and provide a measure of protection against drought, help control flooding, and provide wildlife habitat.*
- *Many species of insects are pollinators of crop plants; many species of insects, spiders, and mites can be used in biological control as predators of agricultural pests, or as indicators of agro-ecosystem health.*
- *Plants, including agricultural crops, act as a carbon sink, reducing levels of some greenhouse gases and regulating climatic change.*

1.2 Species Diversity

The term "species diversity" is used to describe the variety of species within a geographical area. Commonly studied elements of species diversity are populations of wild flora and fauna — in particular, rare, threatened, and endangered species.

Many of Canada's least-understood groups of organisms have essential functions in the environment, and provide important benefits to agriculture. Soil biota, such as arthropods, bacteria, and fungi break down organic matter and minerals, making nutrients available in soil. Terrestrial arthropods — mainly insects, spiders, and mites — are extremely diverse and beneficial to the environment and agriculture as pollinators of plants, and as regulators of agricultural pests. Since many of these organisms are sensitive to habitat change, climatic variation, and other environmental stresses, they can also be effective bioindicators of environmental conditions.

Why is agricultural biodiversity unique?

- *Unlike most natural resources, agricultural genetic resurces require continuous, active human management.*
- *The interdependence of countries is particularly high with respect to agricultural genetic resources.*

Source: First Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resource for Food and Agriculture.

1.3 Ecosystem Diversity

An ecosystem is usually defined as individuals, populations, species, and their environment, and the interactions among its living and non-living parts. Terms such as "forest", "grassland", and "wetland" are commonly used to denote different types of ecosystems. More specifically, the term "habitat" is used to denote the biological and physical environment of a particular species.

A terrestrial ecosystem classification and mapping effort has recently been completed for Canada. The classification system includes three hierarchical levels: ecozones, ecoregions, and ecodistricts. In addition, a sub-regional unit for "agro-ecological resource areas" was developed for certain areas in Canada.[1]

"Agro-ecosystem" is an ecosystem under agricultural management: an open, dynamic system connected to other ecosystems through the transfer of energy and materials.[2]

Typically, agro-ecosystems involve the cultivation of annual crops or the maintenance of livestock populations, and cause major changes to the natural ecosystems they displace. However, agro-ecosystems continue to interact dynamically with, and obtain benefits from, surrounding natural ecosystems. For example, they are characterized by interspecies relationships, nutrient cycling, and biodiversity similar to the types that characterize the natural ecosystem. Natural ecosystems can provide benefits to agriculture, for example:

- preserving wetland and riparian buffers on farms provides valuable wildlife habitat, and helps to protect groundwater resources while providing a measure of protection against drought; and
- farm shelterbelts and woodland habitats attract beneficial insects or predators that feed on agricultural pests, and conserve soil moisture by preventing wind and water erosion.

In addition, crop diversity enables producers to use new crops in rotation, aiding pest management strategies and ensuring more balanced soil nutrient distribution. Biodiversity can also be a source of weeds, pests, and other problems for producers, but these can sometimes be resolved by making simple changes to common practices.

Section Two

Key Biodiversity Issues in Agriculture

This section identifies some of the key biodiversity issues facing Canadian agriculture, and describes certain actions that have been undertaken by the agri-food sector to address them. These issues include:

- agricultural practices,
- habitat conversion and fragmentation,
- wild species at risk,
- diversity of domesticated species,
- exotic species,
- living modified organisms, and
- atmospheric changes.

2.1 Agricultural Practices

Food production involves agricultural practices such as:

- tillage,
- land drainage,
- grazing, and
- use of fertilizers and pesticides.

When applied properly, the impact of such practices on wild flora and fauna is minimized. As knowledge improves about potential effects on wild flora and fauna, new agricultural practices are progressively developed and applied from a perspective of long-term farm stewardship.

Tillage

Tillage affects soil processes such as aeration and compaction, and can render soil susceptible to wind and water erosion, which can affect the level of organic matter and nitrogen. These, in turn, can affect soil biodiversity. Over the last several years, the agri-food sector has increased the practice of conservation tillage, including reduced tillage, zero-tillage, and minimum-tillage (see Figure 1). New crops are planted directly into unploughed soil without additional tillage. As a result, the physical disturbance of soil is reduced, leaving crop residues from previous years unploughed.

The benefits of conservation tillage include less erosion, better water filtration, reduced runoff, improved soil and water quality, and improved cover for wildlife.

While conservation tillage may require an increase in the application of herbicides to control weeds, the practice is generally recognized as providing overall biodiversity benefits.

Tillage equipment and the timing of planting and harvesting can also affect nesting birds and small mammals. In the Prairies, where the principal breeding habitat for many waterfowl species is found, producers are adopting alternative practices to reduce detrimental effects on waterfowl nesting. These practices include rotational grazing, delayed haying, altered cropping practices, and conservation tillage.

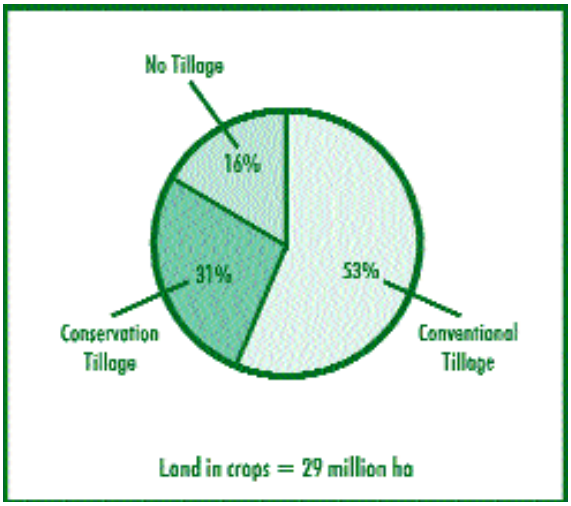

Figure 1: Tillage methods in Canada, 1996 Census.

Land Drainage

Seasonal drainage of excess water from agricultural land may increase water contamination by agricultural chemicals and wastes, with adverse effects on aquatic ecosystems. Programs to model and predict the risk of water contamination and to assess the effects of agricultural run-off on fresh water organisms are helping to mitigate these impacts.

Drainage of wetlands destroys the habitat of a number of species of arthropods, reptiles, amphibians, birds, mammals, and fish. Producers are beginning to recognize the need to conserve wetland resources and are involved in a number of programs to reduce the impact of agriculture on wetlands. For example, under the Interior Wetlands Program in British Columbia, producers are:

- implementing planned grazing systems;
- installing alternative livestock watering systems;
- fencing off livestock from riparian zones; and
- abandoning or relocating certain hayfields to increase wildlife use and increase recreational and wildlife viewing opportunities.

The wetlands and salt-water estuaries of the Grand Codroy Estuary in Newfoundland provide internationally significant waterfowl and migratory bird habitats. Most of the area is privately owned by agricultural producers, whose interest and commitment to conservation stewardship is demonstrated by their voluntary participation in Good Stewardship Agreements. Under these Agreements, producers pledge to manage their individual operations in a way that maintains or enhances the ecological integrity of the area. For example, producers agree to refrain from burning crop stubble, thereby conserving waterfowl nesting habitat.

Grazing

Prairie rangelands provide some of the most extensive and well-managed tracts of native prairie in Canada. Many wildlife species benefit from properly managed rangelands. However, intense grazing pressure can have negative effects on some wild flora and fauna, including waterfowl. Alternative range and forage management practices such as rotational grazing and delayed grazing in the Prairies, and buffer zones around pastures in Ontario, are being used to minimize some of grazing's negative effects on wild birds and mammals.

Fertilizers and Pesticides

Fertilizers and pesticides are used to optimize yields and minimize the risk of crop failure from diseases and pests. However, excessive or improper use can:

- contaminate water, soil, and air;
- affect non-target organisms; and
- enter the food chain.

Concerns over water resources contamination have led greenhouse growers in many provinces, including British Columbia and Ontario, to re-circulate water containing fertilizer through closed loop hydroponic systems that reduce or eliminate the waste water from greenhouse operations. Growers who use re-circulating water systems have reduced fertilizer use by 50%. [3]

High concentrations of phosporous and nitrogen can lead to eutrophication and deoxygenation of surface waters, resulting in degradation of aquatic habitats. Contamination of water resources by agricultural nutrients is primarily a concern in regions where there is intensive irrigation or high rainfall coupled with coarse, highly permeable soils and high water tables.

New pest control products are generally more selective, less persistent, and less toxic to non-target organisms. However, some pesticides are known to adversely affect biodiversity (e.g., some insecticides, such as carbofuran, are known to adversely affect certain bird populations, including songbirds and the endangered Burrowing Owl). Certain bird species, such as the herring gull, have been found to accumulate pesticide residues, which in turn affect certain biological processes such as breeding success and growth. Insecticides can also have a significant effect on agriculturally beneficial soil fauna and insects (e.g., pollinators).

Pesticide use is generally on the decline. For example, current labelling requirements originally proposed by atrazine manufacturers are designed to lower rates, provide buffer zones, and eliminate fall applications and industrial uses. These changes, combined with the efforts of producers, have reduced atrazine use in Ontario by 66 percent since 1983. Since the mid 1970s, producers have adapted to the removal of more than 2000 pesticides, like DDT, chlordane, and toxaphene that have been found to be persistent, bioaccumulative, and toxic to the environment or humans. Producers are also actively participating in plans to prevent nonpoint sources of pollution under regional ecosystem initiatives such as Great Lakes 2000, the Fraser River Action Plan, and St. Lawrence Vision 2000.

Integrated pest management (IPM) approaches, which include careful monitoring of crops and pests, are designed to reduce reliance on chemical pesticides and encourage more natural approaches to pest control. IPM is the focus of AAFC's research activities related to pest management issues.

2.2 Habitat Conversion and Fragmentation

The loss and fragmentation of habitat in agro-ecosystems are major factors in the loss and decline of critical habitat for many of North America's wildlife flora and fauna, including endangered and threatened species. For example, 85 percent of the decline in Canada's original wetland area has been attributed to drainage for agriculture.[4] Wooded areas have also been adversely affected by agriculture.

A significant proportion of good agricultural land, which also has the potential to support a high level of biodiversity, tends to be in areas of residential and industrial concentration. In such cases, both crop land and wildlife habitat are subject to similar land use pressures (e.g., urban encroachment).

However, the protection of natural habitats is not a sufficient guarantee that biodiversity important to agriculture will be preserved. Research is needed to better understand the association between land use patterns and biodiversity conservation.

In the Prairies, the cultivation of marginal agricultural land (Canada Land Inventory Classes 4 to 6) remains a concern. Despite the removal of about 0.5 million hectares (ha) of marginal lands from annual crop production through the Permanent Cover Program, about 4.7 million ha of marginal lands continue to be cultivated annually on the Prairies.[5] It is estimated that only about 1 percent of original tallgrass prairie, 24 percent of mixed-grass prairie, and 5 percent of Fescue prairie remain.[6]

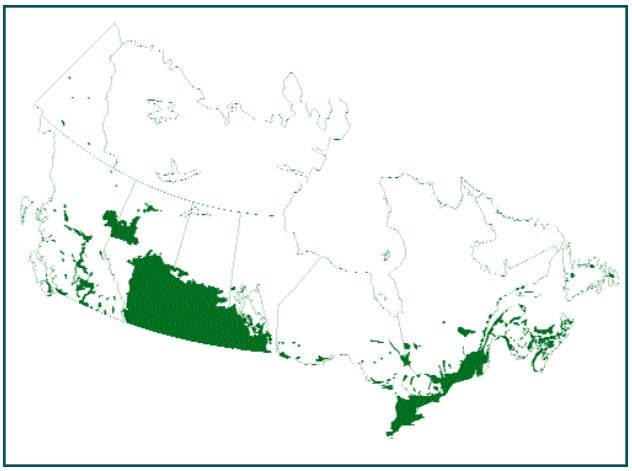

Figure 2: Agricultural land in production.

Through the Adopt-a-Pothole Program, producers in Manitoba are leasing small parcels of wetland and associated upland habitats to the Delta Waterfowl Foundation. The goal of this program is to facilitate the enhancement and conservation of the lands for wildlife habitat. In certain cases, the Foundation enhances the wildlife production capability of the land by installing nesting structures or by working with producers to seed upland nesting cover. For example, in the Minnedosa area, over 324 hectares (ha) of wetland and 1,214 ha of upland wildlife habitat have been protected and enhanced by approximately 70 producers.

Contrary to general perceptions, Canada's agricultural land base is limited. Only 11 percent of Canada's land is capable of supporting agriculture; less than 5 percent is capable of producing crops. Most of the land in Canada that is suited to agriculture is already in production (see Figure 2). Although the overall quantity of farm land has remained relatively constant over the last several years, there is evidence that agricultural practices have intensified and, as a result, wildlife habitats continue to be affected in some agricultural areas.[7]

This means that there is often less wildlife habitat on farmlands. However, agricultural intensification has also had a very positive effect on wildlife habitat by permitting areas with marginal soils to be removed from production.

Recognition of the benefits to be gained from maintaining and enhancing wildlife habitat is growing within the agri-food sector. As a result, the sector has made substantial contributions to habitat protection and restoration.

Examples of producer involvement include:

- planting shelterbelts and multi-row plantings to prevent water and wind erosion and provide habitat for wild flora and fauna;
- restoring habitats by seeding native grasses and shrubs along riparian areas;
- setting lands aside to provide for wildlife habitat;
- converting cultivated land on fragile soils to permanent cover; and
- installing nesting structures for waterfowl and other birds.

AAFC's Shelterbelt Centre Program provides technical planning assistance and involves the production and distribution of tree seedlings for farmstead, field, wildlife, and agro-forestry plantings throughout the Prairie provinces. About 10 percent of the seedlings are provided for projects related to land reclamation and for organizations such as 4-H clubs.

Shelterbelts are reducing soil erosion and introducing biological, compositional, structural, and functional diversity in the agro-system. Over 1,300 kilometres of field shelterbelts are planted annually in the Prairies. The Program also promotes and aids in the sustainable use of biological resources on agricultural lands.

2.3 Wild Species at Risk

The protection of threatened and endangered species is a priority issue both within Canada and internationally. Ten species have already been declared extinct, and eleven others are no longer found in the wild in Canada. To date, 276 species of wildlife have been listed "at risk" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Only a few vascular plants have been assigned status by COSEWIC. Most invertebrates, micro-organisms, and lower plants have not been evaluated to determine their status. Many of these species are important agents in the regulation of ecological processes that contribute to sustainable agriculture.

The greatest threats to these species result from:

- habitat conversion and fragmentation,
- toxic contaminants,
- atmospheric pollution,
- introduced species, and
- climate change.

Some of the endangered species that have the potential, or are known and assumed to be affected by agricultural development, are listed below.

Plants

Gattinger's Agalinis
Skinner's Agalinis
Prickly Pear Cactus (East population)
White Prairie Gentian
Small White Lady's Slipper
Furbish's Lousewort
Pink Milkwort
Mountain Avens (East population)
Loggerhead Shrike
Slender Mouse-ear-cress
Heart-Leaved Plantain
Small Whorled Pogonia
Cucumber Tree

Fish

Salish Sucker

Reptiles

Blue Racer

Birds

Burrowing Owl
Mountain Plover (East population)

Source: Wildlife Habitat Canada, 1995. Saving Species; Building Habitat into Endangered Species Conservation in Canada.[8]

Agriculture, forestry, and industrial and urban development have contributed to the decline of some species. Endangered species that have the potential to be affected by agricultural development, or are known or assumed to be affected, are listed above.

Agricultural producers are involved with endangered species conservation on a daily basis. For example:

- Producers in Alberta and Saskatchewan are assisting in the conservation of Burrowing Owls through the Operation Grassland Community Program and Operation Burrowing Owl. Landowners maintain Burrowing Owl habitat, restrict the use of pesticides around nesting sites, and contribute to an annual owl census. Approximately 250 producers are voluntarily conserving 21,000 hectares of Burrowing Owl habitat.
- Under the Swift Fox Re-introduction Program, ranchers in southern Alberta and Saskatchewan are contributing to the re-introduction of the Swift Fox by permitting the release of foxes onto their rangelands. Producers further contribute to the success of the program by providing sighting information. Approximately 700 foxes have been released since 1983.
- Producers in south-central Saskatchewan are helping to provide elevated nesting sites for Ferruginous Hawk populations through their participation in the Ferruginous Hawk Nesting Platform Project with SaskPower and Nature Saskatchewan.
- Farmers on Île aux Grues in the St. Lawrence River are leaving certain parcels of land intact to help re-establish the Yellow Rail, a vulnerable bird species in Quebec.

Threatened and endangered species are also being protected on AAFC's Community Pastures. For example, AAFC is playing an important role in the Swift Fox release program and the management of a Black Tailed Prairie Dog Colony in Saskatchewan. AAFC's Shelterbelt Centre in Indian Head, Saskatchewan, is also actively involved in the creation of nesting sites for Ferruginous Hawks in Community Pastures. To date, 42 nest sites have been established using Plains Cottonwood in 13 Pastures. The Shelterbelt Centre also provides seedlings for multiple-row tree plantings to improve habitat for the threatened Loggerhead Shrike.

2.4 Diversity of Domesticated Species

Domesticated species represent a small fraction of the world's biota but provide over 90 percent of the world's food supply. On a global scale, the total number of cultivated varieties of crops or breeds of livestock is not fully known. However, there is concern that the genetic variation of crops and breeds of livestock is declining.

A broad genetic base for agricultural species is required to produce new varieties of crops, domesticated animals, and micro-organisms to ensure the competitiveness of Canadian agriculture. However, selective breeding for increased productivity and uniformity has narrowed the genetic base of animals, plants, and micro-organisms used in agriculture. The genetic base has also been narrowed by the effects of human activities and changing environmental conditions upon the wild relatives of agricultural crops and animals that are sources of desired genetic traits.

Although field crop production has been dominated by relatively few crops (e.g., potato, corn, wheat, barley, canola), in recent years farmers have turned increasingly to specialty and non-traditional crop production and alternative livestock production as a means of diversifying their farm operations and improving their incomes. Between 1991 and 1996, specialty crops increased by 88 percent, from 837,000 ha[9] to 1,577,000 ha.[10]

To ensure that genetic resources are available over the long term, federal and provincial governments, industry, research institutions, and non-governmental organizations conserve genetic resources in the form of:

- plant and animal domesticates,
- plant and animal material bred for Canadian conditions,
- wild relatives of crop plants and domesticated animals, and
- adapted micro-organisms.

For example, AAFC operates genebanks for potatoes, cereals, oilseeds, forages, fruits, and hardy ornamentals. These genebanks function in partnership with public and private sector organizations. AAFC also maintains agricultural microbial collections of mainly plant and animal diseases. These collections provide the basis on which diseases that could affect or devastate domestic and wild plants and animals are diagnosed. These same collections allow the monitoring of genetic changes in pathogens that enable disease resistance to be bred into domestic species. The basis of crop production in Canada is the continual production of disease-resistant varieties in response to changes in pathogens or the introduction of new pathogens.

The other broad use of existing microbial collections in Canada is the development of fungi and bacteria that promote plant growth. Some of these organisms help to control root diseases, which in turn increases yield and reduces the need for chemical fungicides. Others, such as the Philom Bios product PB50, increase the availability of soil nutrients to crop plants.

These microbial collections assist in the development of an understanding of microbial biodiversity in agricultural systems and enable sustainable crop and animal production patterns to be devised. Efforts have also been made towards the development of a plan for farm animal genetic resources conservation in Canada.

No country can expect to conserve all of the genetic diversity that it would ever need. Since Canada often draws on the resources of other countries to meet our own changing agricultural conditions, the federal government supports bilateral and multilateral initiatives aimed at the conservation of, and access to, global genetic material. A number of international initiatives are underway, including the recent adoption of a *Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture* and the negotiation of an International Undertaking under the United Nations Food and Agriculture Organization, and the ongoing scientific and technical work of the International Plant Genetic Resources Institute.

Crops that are becoming more apparent on Canadian farms include:

daikon radishes
mustards
dry field peas and beans
canary seed
safflower and triticale
peanuts
lathyrus
caraway
bok choy
fenugreek
escarole
sunflowers
lentils
buckwheat
essential oil crops
Jerusalem artichoke
coriander

alternative crops such as those used for pharmaceuticals (e.g., evening primrose, borage, digitalis)

Agricultural producers are part of a network of individuals who grow and exchange endangered and heirloom species of food crops in an attempt to maintain genetic diversity. Numerous varieties of flowers, fruits, herbs, vegetables, trees, shrubs, and grains are being preserved through Seeds of Diversity Canada. Of these food crops, over 1,100 distinct varieties are grown and exchanged by approximately 100 individuals across Canada. Seeds of Diversity Canada began in 1984 as the Heritage Seed Program of the Canadian Organic Growers.

Rare Breeds Canada is a national non-profit organization that actively involves agricultural producers in the conservation of rare, minority, and endangered livestock breeds. Through its Satellite Breeding Network, groups of animals are sent to member farms to establish small breeding populations. Thirty-four farms are currently involved in the network, housing approximately 120 of the organization's 700 head of livestock. Participants are typically retired or hobby farmers, who generally retain a portion of the breeding stock to begin their own herd or flock. Livestock breeds involved in the program include Jacob sheep, Canadienne cattle, Canadian horses, donkeys, and various flocks of heritage poultry, geese, and turkeys.

2.5 Exotic Species

The significant threat that harmful exotic species can pose to biodiversity, the economy, and recreational activities is increasingly being recognized internationally and domestically. An example is the Leafy Spurge, which is native to Europe and portions of Asia, and is now established in the southern prairie provinces and southwest Ontario. It poses a significant agricultural threat since the plant contains chemicals that are poisonous to cattle and it invades native rangelands.

Not all exotic species are harmful pests; some exotic species are beneficial resources such as agricultural crop species, breeds of livestock, the alfalfa leafcutter bee, and biocontrol agents. Leafy spurge, for example, is presently being controlled by several exotic insects specifically introduced for this purpose.

2.6 Living Modified Organisms

Technological applications in biology (biotechnology) are transforming agricultural research. Many applications have concentrated on the transfer of agronomically valuable traits such as disease resistance and pest resistance. One particular focus is on improving the natural pest resistance of crops such as corn, soybeans, and potatoes, which would reduce the need for agricultural pesticide use. Crop plants with tolerance to novel, more environmentally benign herbicides, are also being developed. Other examples include microbial products that are developed to improve the nitrogen fixation process of certain growing plants (legumes), and the development of more effective animal vaccines.

With new biotechnological techniques, scientists are able to use more precise methods for breeding better livestock and crop varieties, and for improving foods, feeds, fertilizers, soil supplements, veterinary vaccines, and pest control agents. New methods have also been developed to store genetic material. In addition, modern molecular diagnostics have allowed breeders to identify new samples, screen them for disease, and identify potentially useful genes.

Although biotechnological processes can offer important benefits to food production and the environment, concerns have been expressed about the safety of these new technologies, especially the possibility that genetically modified organisms could have an adverse effect on biodiversity.

Agriculture and Agri-Food Canada and Health Canada regulate agricultural biotechnology products using health and safety standards. In addition, AAFC thoroughly assesses the environmental risks — including risks to biodiversity — related to the release of biotechnology products into the environment. AAFC has developed regulations that clarify the responsibility for environmental assessments of seeds, feeds, fertilizers, and veterinary biologics under the respective agricultural statutes. This process took more than two years and involved extensive multi-stakeholder consultation. Environment Canada co-operated with the process by taking part in setting the standards and information requirements for these assessments.

To date, the major biotechnology focus in agriculture has involved micro-organisms and the major field crop species (e.g., canola, corn, flax, potato, and soybean). These major crop species are not native to Canada. The use of biotechnological techniques on these species raises different questions with respect to biodiversity and possible negative effects on wild relatives as would the use of similar biotechnological techniques on native species. Since it is inevitable that the use of biotechnological techniques will become more widespread, a concerted effort must be made to increase knowledge on the biology and ecology of native species, and on how new genetic traits introduced through biotechnology could change these biologies, ecologies, and subsequently, biodiversity.

2.7 Atmospheric Changes

Human activities are changing the Earth's atmosphere by increasing the concentrations of greenhouse gases (e.g., carbon dioxide, methane) and ozone-depleting substances (e.g., chlorofluorocarbons (CFCs), methyl bromide). Current models predict an increase in global temperature of about 0.3 Celsius degrees per decade if no steps are taken to reduce emissions of these greenhouse gases.[11] If emission controls are put into place, it is estimated that the increase in global temperature would be reduced to 0.1 to 0.2 Celsius degrees per decade[15]. Although it is difficult to predict regional climatic changes, such changes would have an impact on soil and water resources, the types, varieties and distribution of crops grown in Canada, and livestock production. Adaptive innovations in technology and methods in the agri-food sector will be required.

Agriculture production acts as an important carbon sink converting atmospheric carbon dioxide and water into organic matter and oxygen. However, agriculture also involves the release of greenhouse gases. Agriculture accounts for about 6.3 percent of Canada's greenhouse gas emissions, or about 39 million tonnes carbon dioxide equivalent.[12] The primary sources from agriculture are methane generated from ruminant animals and manure, and carbon dioxide from the combustion of fossil fuels used in farming operations.

Efforts are being made to understand the various processes involved in the cycling of greenhouse gases in order to increase the annual conversion of carbon dioxide into organic matter (through photosynthesis) and to reduce the amount lost with agricultural operations. Opportunities in this regard include:

- reducing summer fallow acreage;
- reducing and eliminating tillage used in crop production;
- increasing forage acreage and improving crop yields;
- improving livestock feeding technologies and rumen efficiencies through the use of feed additives;
- improving the efficiency and use of nitrogen fertilizers; and
- reducing fossil fuel usage for farm operations.

Agriculture is also a contributor to ozone depletion. Methyl bromide, a fumigant used in agriculture, is an ozone depleting substance subject to restrictions under the *Montreal Protocol to Control Ozone Depleting Substances.* The agri-food sector has been an active participant in the process to find and adopt alternative approaches to replace this fumigant. Canada is aiming to phase-out this substance by 2001. The sector is adapting quickly to this challenge.

Section Three

Context and Challenges

Agriculture and Agri-Food Canada's mandate is to promote the development, adaptability, and competitiveness of the agri-food sector so that it provides equitable returns to producers and processors, and maximizes its contribution to national economic and environmental objectives.

Agriculture and Agri-Food Canada's vision for Canadian agriculture is that of "*a growing, competitive, market-oriented agriculture and agri-food industry that is profitable and responds to changing food and non-food needs of domestic and international consumers; is less dependent on government support; and contributes to the well-being of all Canadians and quality-of-life in rural communities while achieving farm financial security, environmental sustainability and a safe, high-quality food supply*".[13]

Wise stewardship of natural resources is the foundation on which the future of Canada's agriculture and agri-food production will be built. Agriculture and Agri-Food Canada has had a long history of national initiatives aimed at the conservation and sustainable use of biodiversity.

This section provides an overview of the Department's history with respect to the conservation of biodiversity, the current state of departmental activities in the conservation of biodiversity and sustainable use of biological resources, and the forces that presently influence the direction of the Department — and its key challenges — regarding biodiversity.

3.1 Overview of Past Initiatives

Historically, departmental conservation efforts focussed on agricultural soil and water conservation, and research on the development of livestock breeds and crop varieties that are adapted to Canadian conditions. These efforts were carried out through initiatives such as the establishment of Dominion Experimental Farms in the 1880s, the first soil survey in 1914, and the establishment of the Prairie Farm Rehabilitation Administration (PFRA) and the first Community Pastures in 1935.

In the early 1970s, AAFC established Canada's first national program to preserve crop genetic resources. In the 1980s, Canada accepted responsibility for preserving world base-collections of oat and barley genetic resources. Since that time, Canada has continued to develop bilateral relations with other countries to conserve plant genetic resources.

The 1980s also brought several important international developments related to the sustainable use of biological resources. These included Canada's endorsement of the World Conservation Strategy and the publication of the Brundtland Commission Report, *Our Common Future*. In response to these developments, joint federal-provincial initiatives were introduced, including the Federal-Provincial Soil and Water Accords and the National Soil Conservation Program. These initiatives focussed on soil and water conservation issues, but they also contained elements that raised awareness among producers of the off-farm effects of their practices, including effects on biodiversity.

Agri-Food Policy Review

In 1989, a comprehensive review of Canadian agri-food policy broadened the focus on the environment to include issues related to:

- soil resources,
- water quality,
- water quantity,
- wildlife habitat,
- air and climate,
- energy,
- pollution and waste management, and
- genetic resources.[14]

While the term "biodiversity" was not an explicit issue during the review, several of the review's recommendations directly addressed biodiversity concerns in agriculture.

Following the review, a number of national and joint federal-provincial initiatives were established that reflected this broader focus, including the Sustainable Agriculture component of the Green Plan, the Land Management Assistance Program in Eastern Canada, the National Network for Plant Genetic Resources, and the Permanent Cover Program on the Prairies. The *National Environment Strategy for Agriculture and Agri-Food*, released in the summer of 1995, broadened the list of issues and included biodiversity as a priority for action.[15]

AAFC's sustainable development strategy, *Agriculture in Harmony with Nature*, was released in the spring of 1997. It establishes links with this *Action Plan* within the broader framework of sustainable development.

3.2 Current AAFC Initiatives

At present, AAFC contributes to the conservation and sustainable use of biological resources through activities such as:

- **Research** — by developing and transferring innovative technologies that promote the environmental sustainability of the agri-food sector, including preserving, using, and providing access to genetic resources important to agriculture, and promoting an Integrated Pest Management (IPM) approach.
- **Environmental programming** — by funding initiatives through the adaptation councils established under the Canada Adaptation and Rural Development Fund, and working with local and regional wildlife groups on habitat improvement projects in the Prairies, through PFRA's Shelterbelt Centre and Community Pasture programs.
- **Regulation** — by preventing the introduction and spread of animal and plant pests and diseases, and the introduction of alternative livestock that could have a significant adverse effect on Canadian biota, and by ensuring the safety of products of biotechnology through environmental assessments.
- **Managing Community Pastures** — by managing both wild and domestic biological resources and conserving habitat in the Community Pasture program.
- **Policy integration** — by considering biodiversity objectives in proposed projects, policies, and programs.
- **Information and awareness** — by developing agri-environmental indicators to enhance the information base available on environmental conditions and trends related to primary agriculture, and by providing information on sustainable agriculture practices.

More detailed descriptions of current AAFC activities are provided in Appendix C, and in the accompanying document *Agriculture and Agri-Food Canada: Initiatives Relating to Biodiversity* .

3.3 Key AAFC Challenges

The agri-food sector is currently being re-shaped by significant changes in the global economy, trade agreements, technology, consumer preferences, and fiscal pressures. At the same time, natural processes, including global climate change and transnational environmental concerns, continue to present new challenges to the sector.

As these challenges and pressures increase, and given current fiscal constraints and the rise in cost of research activities, partnerships will become an increasingly important reality for addressing the environmental challenges that face the sector. Partnerships will allow the Department to creatively find ways to maintain environmental progress within fiscal and technical realities, facilitating research and the transfer of environmentally-sound technologies.

The key challenges facing AAFC in responding to the *Canadian Biodiversity Strategy* in the next three years are:

- Working with the agri-food sector to maintain sustainable and diverse agro-ecosystems while preserving natural ecosystems.
- Improving the knowledge base and understanding of biodiversity.
- Ensuring the diversity and accessibility of genetic resources for present and future uses in Canadian agriculture.
- Integrating biodiversity conservation and sustainable use into departmental operations and decisions.

Challenge: Working with the Agri-Food Sector to Maintain Sustainable and Diverse Agro-ecosystems

The *Canadian Biodiversity Strategy* directs federal and provincial governments to:

- maintain, develop or use appropriate social and economic policies, incentives, and programs to promote the conservation and sustainable use of biodiversity and the co-existence of wild flora and fauna and other wild organisms and their habitats in agricultural landscapes (strategic directions 1.40, 1.45, 1.48).
- develop and transfer technology or approaches that: minimize negative impacts of pest control products on biodiversity; reduce impacts on soil, water and air pollution; lead to the identification of productive soil types (strategic direction 1.45).

Program funding has been the primary instrument to facilitate and promote environmental change in the agri-food sector. For example, education and awareness, technology development and transfer, environmental farm planning, and farm demonstration projects have been sponsored through the Sustainable Agriculture Component of the Green Plan. A number of other programs, mentioned earlier, are also providing important benefits to the conservation of biodiversity.

The Department's challenge is to continue to work with the sector to promote the sustainable use of biological resources while preserving natural ecosystems to the maximum extent that is practical. The Department must also encourage the development and transfer of affordable technologies, information, and expertise to better identify and address farm-level biodiversity concerns. The Department will also need to investigate the areas of greatest vulnerability to better target efforts to mitigate agricultural impacts on biodiversity.

In agriculture, the enhancement of wildlife habitat and conservation of biodiversity is not always viewed to be in the best interest of producers. Conserving biodiversity can result in removing land from crop production, and increased crop damage. There can also be costs associated with preserving wildlife and habitat, although crop insurance is available for crop depredation caused by migratory waterfowl. The ultimate goal is to develop and implement creative ways to achieve the sustainable use of the rural landscape.

Challenge: Improving Our Knowledge Base and Understanding of Biodiversity

The *Canadian Biodiversity Strategy* directs federal and provincial governments to:

- improve inventories and effectively manage biological data and information in order to support biodiversity conservation efforts (strategic directions 1.41, 2.4, 2.5, 2.6. 2.9, 2.11, 2.12, 2.13, 2.14).
- promote an understanding of the need to conserve and sustainably use biodiversity (strategic directions 1.46, 3.1, 3.4).

The Department produces systematic treatments, identification guides, and taxonomic catalogues on plants, insects, mites, and fungi, and in developing national information systems on accessioned collections of some of these organisms. In addition, AAFC maintains an inventory of wild plant and animal resources in the Community Pastures system on the Prairies. Other federal departments, provincial agencies, and non-government organizations are also producing information on biodiversity in agro-ecosystems. An essential prerequisite to improving knowledge and understanding of biodiversity is research on genetic and ecological processes that maintain and enhance it. However, large gaps in knowledge about biodiversity in agriculture still remain, and much of the basic inventory has yet to be completed.

Linked to such an inventory is the need for indicators and monitoring programs in order to ensure feedback to decision makers and the agri-food sector regarding the effects of agriculture on biodiversity. The Department is in the process of developing a core set of regionally sensitive, national agri-environmental indicators on soil, water, biodiversity change, agricultural greenhouse gases, farm resource management, and input use efficiency. The biodiversity change indicators will provide information on changes in the availability and fragmentation of selected habitats in agro-ecosystems, and in the composition and structure of biotic communities in relation to representative agricultural land use practices and cropping systems.

In order to develop and validate these indicators, a sound scientific understanding of agri-environmental processes and linkages, and credible, relevant, and scientifically rigorous data are required. Little of this data is currently available, and data collection can be costly. Consequently, there is a need to fully use existing datasets to the greatest extent possible, taking advantage of opportunities to fill data gaps. Significant amounts knowledge may also be obtained through inter-agency collaboration and focussed efforts to collect, standardize, manipulate, and integrate data.

There is a need to develop resources in the field of information technology and information management with regard to data on biodiversity. Appropriate data management is essential for linking the data obtained from inventory development and monitoring to the decision-making process. New information technologies now exist that can provide the Department with cost-effective tools for reaching our clients, transferring technologies, and enhancing our ability to monitor and preserve the quality of our air, water, and soil. AAFC is beginning to use current technologies to manage and disseminate information related to biodiversity. For example, the Department has developed a World Wide Web site to enable easy access to its biological and resource information and is translating existing paper-based products and collection-based information into electronic form. However, little of the vast amount of available information is yet in a form that can be accessed electronically through tools such as the Internet.

Challenge: Ensuring Genetic Resources Exist for Present and Future Uses in Agriculture

The *Canadian Biodiversity Strategy* directs federal and provincial governments to:

- conserve biological resources that are essential to agriculture, including domesticated animals, plants, and microbial germplasm, and their wild relatives, with priority given to genetic material that is most at risk (strategic direction 1.43).
- maintain or develop *in situ* and *ex situ* conservation mechanisms to support the conservation and sustainable use of biological resources essential to agriculture (strategic direction 1.50).
- facilitate access to samples of Canada's genetic resources on mutually agreed terms, and under the understanding that these agreements will differ for each sector using these resources (strategic direction 5.3(b)).

Consumers want choice and an ample and consistent supply of high-quality, nutritious food. Potential changes in future diets will necessitate having a broad genetic base from which to develop products that suit these dietary needs. Since future environmental changes, social changes, and food preferences are difficult to predict, the agri-food sector must combat genetic erosion and genetic vulnerability. This will ensure the broadest possible range of genetic diversity in crop plants, farm animals, and micro-organisms important to agriculture. To the extent that such genetic resources are not maintained on an ongoing basis by farmers or in natural reserves, they must be consciously preserved and managed as part of an *ex situ* genetic resources conservation system, using methods such as genebanks, tissue culture, and cryopreservation. Agriculture and Agri-Food Canada plays an important role in *ex situ* conservation for plant, animal, and microbial genetic resources. In addition, genetic diversity must also be used by integrating it into new crop varieties and races of livestock. This is a long and research-intensive process.

The Plant Gene Resources Network enhances the genetic diversity of Canadian crop plants and wild plants of economic importance by acquiring, evaluating, researching, documenting, and distributing samples of genetic resources for food and agriculture. However, it is not possible to preserve all of the genetic diversity of all of the crops required for future uses. Efforts must be pooled with other countries to manage collections. The Canadian agri-food sector is also challenged to ensure that native plant germplasm of economic importance, such as the wild relatives of crop plants, is adequately conserved *in situ* .

With respect to farm animal genetic resources, grassroots organizations are the mainstay of live animal conservation. Although the Department is in the process of completing a series of baseline inventories on farm animal diversity, much work needs to be done to ensure that farm animal genetic resources continue to be present for future uses. In addition, an action plan for farm animal genetic resources conservation efforts in Canada has been developed by the Canadian Animal Germplasm Technical Experts Board.[16] The Canadian Foundation for the Conservation of Farm Animal Genetic Resources, a non-government organization, has been established to take an active role in farm animal genetic resource conservation. However, the Department must continue to support these grassroots organizations.

Micro-organisms that affect agriculture include a very large and diverse number of species; many of them are not yet cultured or identified. The practical emphasis must be on *in situ* conservation, and on the maintenance of collections that contain groups of micro-organisms of particular importance to agriculture. Current collections of bacterial strains are used for research activities on plant adaptation to abiotic stresses, plant growth, and biological pest studies. These collections are of modest-size and do not include representatives of many genera that provide agriculturally important functions (e.g., nutrient recycling). The content of present collections needs to be assessed in comparison with other microbial collections available through universities, industry, and various government departments.

Since preserving samples of genetic resources is a costly activity, Canada has always favoured pooling efforts with other countries. Most major Canadian crops and domestic animals were introduced from abroad, so Canada often draws upon biological resources present in other countries to meet our agricultural changes. However, many of these traditional sources are rapidly eroding and some commercial crop and animal gene pools have greatly diminished in recent years (e.g., commercial poultry gene pool). Canada must continue to work with the international community to ensure continued access to genetic resources and biological specimens that may be needed for the future of Canadian agriculture.

Challenge: Integrating Biodiversity Conservation and Sustainable Use into Operations and Decisions

The *Canadian Biodiversity Strategy* directs federal and provincial governments to:

- "assess current and proposed major government agricultural policies and programs to ensure that ecological, economic, social and cultural objectives are considered" (strategic direction 1.39).

Environmental assessments are an integral and essential aspect of the AAFC's environmental protection tool kit. The Department conducts environmental assessments of projects under the *Canadian Environmental Assessment Act* (CEAA). It is also applying environmental assessment to strategic levels of planning and decision making (e.g., the formulation of legislation, policies, and programs) and to regulatory activities that may affect biodiversity (e.g., importation of non-traditional animals and releases of agricultural products that are living modified organisms with novel traits).

However, much work still needs to be done to improve environmental assessments as a tool for protecting biodiversity. Improved baseline biodiversity data and analytical tools are required to improve the Department's predictive ability to assess project, policy, and regulatory proposals to ensure that they do not adversely affect biodiversity.

The Department must also ensure that its land management practices continue to be compatible with biodiversity objectives. At present, AAFC's Prairie Farm Rehabilitation Administration manages a large crown land base (approx. 930,000 ha in pastures and 17,000 ha in reservoirs, irrigation projects, and other lands). These lands are used for livestock production and other purposes while being managed for biodiversity through appropriate range management practices. For example, these lands are providing habitat for a number of co-operative projects aimed at the protection and recovery of threatened and endangered species that include the Ferruginous Hawk, Burrowing Owl, Swift Fox, and Black Tailed Prairie Dog.

If the federal government passes the *Canada Endangered Species Protection Act* there could be new requirements for the protection and recovery of vulnerable, threatened, and endangered wild species on federal crown land. Implementation of the new legislation will require the Department to work more closely with other federal departments, provincial governments, producers, and other clients to implement effective resource management practices that complement endangered species needs and livestock grazing operations.

Section Four

Framework for AAFC Actions

This section provides a framework for, and the central elements of, the AAFC *Action Plan* for the conservation of biodiversity and sustainable use of biological resources.

4.1 Principles

A number of environmental, economic, social, and political considerations need to be taken into account in the implementation of the *Action Plan* . Since there may be circumstances where these considerations may be given different priorities, AAFC's *Action Plan* will be guided by the following principles:

- **Precaution** — Where there are threats of serious or irreversible damage to biodiversity, lack of scientific certainty should not be used as a reason for postponing mitigative actions that are cost-effective or justified for other reasons.
- **Shared Responsibility** — Actions to address biodiversity issues in agriculture need to involve other federal departments, provincial governments, intergovernmental organizations, international funding agencies, private sector enterprises, universities and other research institutions, non-government conservation groups, producer associations, producers, and local communities.
- **Competitiveness** — Measures to address biodiversity issues should be sensitive to the competitiveness of the agri-food sector and market forces, the quality-of-life in rural communities, and Canada's ability to provide a high-quality food supply.
- **Integration** — Biodiversity should be considered at the earliest stages of development, and through the entire life cycle of departmental plans, policies, programs, and projects.
- **Continuous Improvement** — This *Action Plan* will evolve as scientific and economic understanding of biodiversity and its relationship with agriculture increases and as technologies are developed. It should provide the starting point to identify opportunities to conserve and sustainably use biodiversity in the agriculture sector.

4.2 Goals

Agriculture and Agri-Food Canada's goals for conserving biodiversity are to:

1. **Promote sustainability in agro-ecosystems while respecting natural ecosystems.**
2. **Increase awareness and understanding of biodiversity in agriculture.**
3. **Conserve and facilitate access to genetic resources that are important to agriculture, and share knowledge, expertise, and technologies in a fair and equitable way.**
4. **Integrate biodiversity conservation and sustainable use objectives in departmental policies, programs, strategies, regulations, and operations.**

Section Five

AAFC Actions

GOAL 1

Promote sustainability in agro-ecosystems while respecting natural ecosystems.

This goal will promote the adoption of low-cost, innovative solutions to biodiversity challenges and the incorporation of biodiversity considerations in farm-level decision making. To achieve this goal, the Department must step up partnership efforts to develop affordable technologies, information, and expertise to better identify and address farm-level biodiversity concerns. One of the most effective ways the Department can achieve this is through research on technologies —including biotechnologies — that support the sustainable use of biological resources and minimize adverse impacts of agricultural practices on biodiversity. The Department can also promote the incorporation of biodiversity considerations into sustainable farm-level practices through continued support for management tools such as environmental farm plans and best management practices.

Objective 1

Increase biodiversity through new crop development and crop diversification.

Actions

1. **Develop new crop varieties with improved genetic resistance to diseases, pests, and environmental stresses, in partnerships with private breeding companies and universities.**
2. **Conduct research on alternative crops (e.g., field peas, lupins, ginseng, Jerusalem artichoke, horseradish, amaranth, monarda, fenugreek, naked oats, and sunola) in partnerships with provincial governments and the private sector, to increase crop diversity and improve the sustainability of the sector.**
3. **Work in partnership with conservation agencies to develop native grass and legume eco-vars for re-vegetation, reclamation, and grazing.**
4. **Promote development of competitive niche markets for minor crops, heritage varieties, rare animal breeds and sustainable new and diversified agri-food products.**

Objective 2

Minimize the adverse impacts of agricultural practices on biodiversity..

Actions

1. **Encourage the development and transfer of technologies (including biotechnologies) that contribute to the protection and maintenance of biodiversity.**
2. **Develop integrated pest management technologies by combining biological, chemical, and mechanical methods, in partnership with other federal departments, provincial government agencies, universities, and the private sector.**
3. **Encourage the conservation of natural lands within agro-ecosystems.**
4. **Encourage the adoption of appropriate range management principles and practices.**

Objective 3

Promote the incorporation of biodiversity considerations in farm-level decision making.

Actions

1. Continue to support the development of environmental management tools such as environmental farm plans and best management practices.
2. Develop expertise and promote the use of multi-species shelterbelts, multi-row plantings, and riparian buffer strips where appropriate to conserve soil and enhance wildlife habitat to demonstrate the economic and biodiversity value these practices provide.
3. Continue to provide tree and shrub seedlings through the PFRA Shelterbelt Centre tree distribution program for erosion control and biodiversity enhancement.
4. Assess policy and economic instruments for their ability to accomplish economic and biodiversity objectives in an equitable and cost-effective manner.
5. Continue to support and work with multi-stakeholder groups such as the National Agriculture Environment Committee (NAEC), and the Canadian Agriculture Research Council (CARC) to promote the conservation of biodiversity and the sustainable use of biological resources within the farm community.
6. Encourage proactive co-operation between farm organizations and environmental conservation groups to preserve and restore natural habitats.

Objective 4

Minimize risks to biodiversity from exotic and living modified organisms with novel traits.

Actions

1. Continue to assess the impact of agricultural products with novel traits, (under the *Seeds*, *Feeds*, *Fertilizers*, *Plant Protection* and *Health of Animals Acts*) on biodiversity as part of regulatory decision making.
2. Continue to prevent the introduction and spread of alien or domestic animal and plant pests and diseases that threaten cultivated, domesticated, and wild species under the *Plant Protection Act* and the *Health of Animals Act*.

Objective 5

Work with other countries and participate in international fora to promote measures for the conservation of biodiversity and the sustainable use of biological resources.

Actions

1. Play an active role and encourage the participation of the agri-food sector in the preparation of Canadian positions and in negotiations undertaken by the Conference of the Parties (COP) to the *Convention on Biological Diversity* and the United Nations Food and Agriculture Organization of relevance to agricultural biodiversity.
2. Participate in international negotiations with respect to the development of a biosafety protocol regarding the safe transport, handling, and use of living modified organisms that may have an adverse effect on biodiversity.

GOAL 2

Increase awareness and understanding of biodiversity in agriculture.

Governments, industry, research and educational institutions, and non-government organizations all have a role in increasing awareness of biodiversity. There are a number of research and education partnerships already underway. To achieve this goal, the Department must continue to facilitate partnerships to increase awareness and understanding of biodiversity in agriculture. These partnerships will also serve to increase understanding of the positive aspects of adopting sound management practices that are compatible with biodiversity objectives.

Objective 1

Improve the accessibility and use of available scientific and technical information on biodiversity .

Actions

❶ **Develop major systematic treatments, identification guides and taxonomic catalogues, in printed and electronic form, on insects, mites, bio-indicators of soil and water quality, insect biocontrol agents, weeds and aquatic plants, cultivated crops, toxic and allergenic fungi, disease and decay fungi, pathogenic and biocontrol fungi, and mycorrhizal fungi, in partnerships with Environment Canada, the Canadian Forestry Service, the Canadian Museum of Nature, and universities.**

❷ **Initiate the development of geographically referenced electronic databases and inventories of biodiversity in agriculture and explore the feasibility of cross-referencing these with computerized databases related to other natural resources important to agriculture, such as soil, climate, and land cover.**

❸ **Make use of modern information technologies, such as the Internet, to communicate scientific and technical information on biodiversity important to Canadian agriculture.**

❹ **Complete a range condition assessment database, over the next five years, for all Community Pastures to improve range management decisions and understanding of biodiversity in different range condition classes.**

❺ **Participate in international biodiversity information management initiatives such as "Species 2000", Biodiversity Information Network (BIN21), Interagency Taxonomic Information System (ITIS), and OECD Megascience Forum Working Group on Biological Informatics.**

Objective 2

Build partnerships within Canada and other countries to improve research capabilities and understanding of biodiversity in agro-ecosystems.

Actions

❶ **Implement the Memorandum of Understanding Among the Four Natural Resource Departments on Science and Technology for Sustainable Development, which outlines the roles and responsibilities of federal departments with respect to science and technology activities in support of sustainable development.**

❷ Continue to build partnerships with other federal departments, provinces, university researchers, industry research scientists, and other countries on research projects that promote biodiversity conservation.

❸ Continue to support the Canadian Agri-Food Research Council (CARC) and consider its recommendations in relation to biodiversity.

❹ Study the impact of agricultural management technologies on soil biodiversity.

❺ Provide diagnostic tools and identification services for insects, arachnids, fungi, and plants introduced into Canada, to differentiate indigenous from non-indigenous species.

❻ Improve the Department's analytical capability to better predict the impacts of agricultural policy and program proposals on biodiversity.

❼ Develop guidelines for non-trade distorting incentive measures to conserve agrobiodiversity.

Objective 3

Develop indicators that enable the agri-food sector to measure its progress towards the conservation and sustainable use of biodiversity in agro-ecosystems.

Action

❶ Pursue the development of biodiversity indicators for agriculture.

Objective 4

Promote information sharing on agro-biodiversity issues.

Actions

❶ Incorporate the concepts of biodiversity conservation and sustainable resource use into existing information, education, and awareness programs.

❷ Work in partnership with farm organizations, industry, educational institutions, professional associations, and stakeholder groups to develop information materials on biodiversity and agriculture.

GOAL 3

Conserve and facilitate access to genetic resources that are important to agriculture and share knowledge, expertise, and technologies in a fair and equitable way.

This goal will help ensure that the Canadian agri-food sector continues to have access to biological resources that are vital to its long-term competitiveness and sustainability, and will promote the transfer of technologies derived from the use of genetic resources. To achieve this goal, the Department must continue to be a key player in the evaluation and conservation of important genetic resources for food and agriculture in *ex situ* facilities and promote their *in situ* conservation. The key to the success of this goal is creating effective networks with other federal departments, provincial governments, private companies, universities, farm organizations, farmers, non-governmental organizations, and international partners who are involved in *in situ* and *ex situ* conservation. In addition, the Department must continue to share knowledge, expertise, and technologies derived from the use of genetic resources in an equitable manner, particularly with countries who provide genetic resources.

Objective 1

Improve the scientific and technical capacities of ex situ *conservation mechanisms and enhance opportunities for collaboration with other partners.*

Actions

❶ **Build state-of-the-art facilities for the conservation and study of seed crop genetic resources in Saskatoon.**

❷ **Move the heritage fruit collection of the Canadian Clonal Genebank to improved facilities at the Greenhouse and Processing Crops Research Centre in Harrow, Ontario.**

❸ **Continue to maintain and operate the crop-specific genebanks for potatoes, cereals, oilseeds, forages, special crops, and hardy ornamentals.**

❹ **Develop mechanisms for more collaborative partnerships with other federal departments, provincial agencies, and the Canadian Museum of Nature to strengthen national collections such as the Canadian National Mycological Herbarium, the Canadian National Collection of Insects and Arachnids, the Canadian Collection of Fungal Cultures, and the Canadian National Collection of Vascular Plants (herbarium).**

❺ **Develop a national system for the conservation of valuable farm animal genetic resources and encourage its implementation through public and private organizations (e.g., Rare Breeds Canada, Canadian Foundation for the Conservation of Farm Animal Genetic Resources).**

❻ **Continue to sample native woody plant populations in the Prairies and establish a nursery for *ex situ* conservation of native plant material such as plains cottonwood.**

❼ **Implement activities as appropriate for Canada from the *Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture* endorsed at Leipzig, June 1996.**

Objective 2

Enhance efforts to identify and evaluate genetic diversity that can improve agricultural productivity and sustainability.

Actions

❶ **Study the nature and extent of genetic diversity and selected agronomic traits in samples of plant genetic resources preserved in departmental collections.**

❷ **Identify and prioritize indigenous wild plant species of value to the agri-food sector and develop partnerships to ensure their conservation.**

Objective 3

Facilitate the use of, and access to, departmental samples of genetic resources.

Actions

❶ **Develop or update catalogues and inventories of collections preserved by Agriculture and Agri-Food Canada (e.g., develop a catalogue of the Canadian Collection of Fungal Cultures, update the electronic plant genetic resources database management system, develop a database inventory of current microbial collections, update the inventories of Canadian poultry and cattle germplasm, and update a directory of all Canadian culture collections).**

❷ **Develop mechanisms to facilitate access to samples of genetic resources and biological specimens preserved by Agriculture and Agri-Food Canada, including animal and microbial genetic resources, and herbarium and insect specimens.**

❸ **Provide access to the genetic resources present *in situ* on Community Pastures, including valuable native plant materials subject to the operational needs of the pasture system and the potential environmental impacts of access and collection.**

Objective 4

Collaborate with other countries by developing and sharing knowledge, expertise, and technologies derived from the use of genetic resources in a fair and equitable way.

Actions

❶ **Develop economic valuation methodologies to assess the benefits derived from the use of genetic resources for food and agriculture.**

❷ **Continue to transfer knowledge, expertise, and technologies derived from the use of genetic resources to other countries, on mutually agreed terms.**

❸ **Participate in international forums, such as the Conference of Parties to the *Convention on Biological Diversity* and the Food and Agriculture Organization (FAO) Commission on Genetic Resources for Food and Agriculture, to ensure the best possible terms of co-operation among countries to conserve, exchange, and use genetic resources important for food and agriculture.**

❹ **Participate in international networks such as the crop genetic resources networks promoted by the International Plant Genetic Resources Institute.**

GOAL 4

Integrate the principles of biodiversity conservation into departmental policies, programs, strategies, regulations, and operations.

This goal will ensure that biodiversity is truly integrated throughout departmental policies and operations. The key to the success of this goal is making departmental managers responsible for considering biodiversity during the development phase of their plans, projects, programs, or policies. This does not mean that AAFC is charting a new course, but rather building on the work that has already been undertaken within the Department. For example, biodiversity is already considered to be a part of the environmental assessments carried out within the Department. In addition, biodiversity is already a key consideration in the management of Community Pastures. However, certain changes will be required in current project planning and policy development practices and procedures, to ensure that biodiversity is a key component of departmental decision making.

Objective 1

Include the principles of biodiversity conservation and sustainable use in agricultural policies and programs.

Actions

❶ **Identify opportunities to integrate biodiversity conservation and sustainable use of biological resources into agricultural policies and programs in the early phase of their development, or when they are undergoing review.**

❷ **Support the adoption of programs that do not favour any particular commodity and that do not encourage intensive monoculture.**

❸ **Examine a variety of instruments (including voluntary approaches, education and awareness measures, non-trade distorting economic instruments such as green marketing, regulation, research, and technology transfer) that can serve as incentives for biodiversity conservation and the sustainable use of biological resources.**

❹ **Promote Canada's image in the market place of having a green and environmentally sound agricultural setting, in order to provide incentives for continuing those practices that contribute the most to achieving a green agri-food system and to conserving agrobiodiversity.**

❺ **Review the progress made in implementing this *Action Plan*.**

Objective 2

Consider the conservation of biodiversity and sustainable use of biological resources in the Department's assessment processes.

Actions

❶ **Improve current environmental assessment (EA) guidelines and methodologies undertaken under the *Canadian Environmental Assessment Act* to provide better guidance to departmental EA practitioners on how to assess projects for their potential implications on biodiversity.**

❷ Improve the consideration of biodiversity in environmental assessments of agricultural policy and program initiatives.

❸ Consider vulnerable, threatened, and endangered species and rare, unique, or fragile ecosystems in the environmental assessments of projects, policies, and programs.

Objective 3

Adopt and implement appropriate measures to safeguard biodiversity in Community Pastures.

Actions

❶ Continue to develop and adopt innovative techniques and range management practices that facilitate the conservation of ecosystems in collaboration with partners and pasture patrons.

❷ Protect species at risk, and their habitats, in collaboration with partners and pasture patrons.

❸ Undertake, with clients, partners, and other stakeholders, re-vegetation projects using native vegetation species, particularly in areas that have been affected by development.

❹ Continue to implement policies, with respect to the protection of wetlands on federal lands managed by AAFC.

Appendix A

Highlights of the Convention on Biological Diversity

The global *Convention on Biological Diversity* was adopted in May 1992, in Nairobi. Over 100 nations signed the *Convention* at the UN Conference on Environment and Development in Rio de Janeiro in June 1992. The *Convention* entered into force in December 1993.

The *Convention* has three goals:

1. the conservation of biological diversity;
2. the sustainable use of its components; and
3. the fair and equitable sharing of the benefits that arise out of the use of genetic resources.

The articles of the *Convention on Biological Diversity* reach beyond the conservation of biodiversity and the sustainable use of biological resources, encompassing such issues as:

- access to genetic resources;
- sharing benefits from the use of genetic material; and
- access to technology, including biotechnology.

The *Convention* is a landmark for several reasons. It is the first time that biodiversity has been comprehensively addressed, and the first time that genetic diversity has been included in a binding global treaty.

The *Convention* is a framework agreement. It leaves individual Parties responsible for determining how most of its provisions are to be implemented. The *Convention*'s provisions are usually expressed as overall goals and policies, rather than precise obligations or specific targets. The *Convention* places decision making at the national level; unlike other treaties related to the conservation of biological diversity, there are no lists, annexes of accepted sites, or species to be protected. However, the *Convention* allows for the possibility that the Conference of the Parties to the *Convention* can further negotiate annexes and protocols.

The major issues of the *Convention* include:

- national sovereignty,
- conservation and sustainable use,
- access,
- funding, and
- implementation.

National Sovereignty

The *Convention* recognizes that countries have sovereign rights over biological resources, while also recognizing the conservation of biological diversity as a "common concern". The term "common concern" implies a common responsibility to the issues and their importance to the international community. This concept is referred to in the preamble and twice in the main text. Article 3 of the *Convention* states that nations have the sovereign right to manage their own resources pursuant to their own environmental policies. Article 15 on access to genetic resources also notes the sovereign rights of States over their natural resources as a basis for the authority to determine access to genetic resources. However, these notions are balanced by Articles that make clear that States are responsible for conserving their biodiversity and for using the biological resources in a sustainable manner. These are emphasized in Article 6 (General Measures for conservation and Sustainable Use), Article 8 (*In situ* Conservation), and Article 10 (Sustainable Use of Components of Biological Diversity).

Conservation and Sustainable Use

The *Convention* creates obligations to develop national strategies and plans to integrate the conservation of biological diversity and the sustainable use of its components into sectoral or cross-sectoral plans, programs, and policies (Articles 6 and 10). There are also obligations to identify components of biodiversity and priorities for action. The identification and monitoring of activities that may have significant adverse effects on conservation and use are also required (Article 7).

In a general way, emphasis is placed on *in situ* conservation with obligations that call for measures such as the establishment of a system of protected areas, to the rehabilitation of degraded ecosystems and recovery of threatened species, to the protection of natural habitats and the maintenance of viable population of species in natural areas (Article 8). *Ex situ* conservation measures are also called to complement the *in situ* measures (Article 9).

Obligations regarding the sustainable use of biological resources, including agriculture, are addressed in Article 10 and in a number of other Articles. The *Convention* requires measures for research and training (Article 12), for public education and awareness (Article 13), for the use of techniques such as impact assessment (Article 14), and for contingency measures to respond to emergency situations (Article 14). The role of indigenous and local communities in the conservation of biodiversity and sustainable use of its components is also recognized as is the need to encourage equitable sharing of benefits derived from the use of their knowledge and innovations (Articles 8 and 10).

Access

The *Convention* includes obligations and measures on two types of access:

1. access to genetic resources; and
2. access to relevant technology, including biotechnology and information.

Article 15 recognizes that the authority to determine access to genetic resources rests with national governments and is subject to national legislation. This view provides Parties with the opportunity to negotiate mutually agreed terms for fair and equitable sharing of benefits required by Article 15.

The *Convention* also includes the basic obligation to provide or facilitate access to, and transfer of, technology (including biotechnology) (Article 16). The provisions on technology transfer and on access to benefits of biotechnology are limited by the scope of genetic resources included in Article 15 of the *Convention*, which does not extend to genetic resources placed in gene banks and other *ex situ* facilities before the entry into force of the *Convention*.

Funding

The *Convention* commits Parties to provide financial support and incentives for the national measures needed to implement the *Convention*. It also contains provisions for developed countries to provide new and additional financial resources to developing countries (Article 20). The financial mechanism to provide funds to developing countries is set out in Article 21. The Global Environment Facility (GEF) is the institutional structure that operates the financial mechanism on an interim basis.

Implementation

Implementation is largely at the national level. At the international level, the Conference of the Parties, its Subsidiary Body on Scientific Technical and Technological Advice, and the Secretariat have key roles to play. These bodies rely on other international governmental and non-governmental organizations that are working on biodiversity issues such as UNEP, FAO, UNESCO, and the World Conservation Union (IUCN).

Appendix B

Highlights of the Canadian Biodiversity Strategy

One of the key obligations for parties that have ratified the *Convention* is to prepare a national biodiversity strategy. The *Canadian Biodiversity Strategy* has been developed as a guide to the implementation of the *Convention on Biological Diversity in Canada.* The strategic directions contained in the *Strategy* are relevant from a national perspective, and emphasize the importance of intergovernmental co-operation to create the policy, management, and research conditions necessary to advance ecological management.

Key Elements of the Strategy

The vision of the *Canadian Biodiversity Strategy* is that of a society that lives and develops as a part of nature, values the diversity of life, takes no more than can be replenished, and leaves to future generations a nurturing and dynamic world, rich in its biodiversity. The goals of the *Strategy* are to:

- conserve biodiversity and use biological resources in a sustainable manner.
- improve our understanding of ecosystems and increase our resource management capabilities.
- promote an understanding of the need to conserve biodiversity and use biological resources in a sustainable manner.
- maintain or develop incentives and legislation that support the conservation of biodiversity and the sustainable use of biological resources.
- work with other countries to conserve biodiversity, use biological resources in a sustainable manner, and equitably share the benefits that arise from the use of genetic resources.

Proposed mechanisms for implementing the *Canadian Biodiversity Strategy* include:

- filing jurisdictional reports on implementation policies, activities, and plans;
- co-ordinating the implementation of national and international elements of the *Strategy* ;
- ensuring that mechanisms are in place to permit and encourage non-government participation in the implementation of the *Strategy* ; and
- reporting on the status of biodiversity.

Key Directions for Agriculture

Many of the Strategic directions contained in the *Strategy* are relevant to AAFC. However, the key activities for agriculture are to:

1.39 Assess current and proposed major government agricultural policies and programs to ensure that ecological, economic, social, and cultural objectives are considered.

1.40 Maintain, adjust, or develop economic incentives that promote the conservation of biodiversity and sustainable use of biological resources on agricultural lands.

1.41 Inventory and evaluate genes, populations, species, and ecosystems to ensure the conservation of natural control systems and the identification of species for use as biocontrol agents.

1.42 Develop and use agricultural pest-control products and integrated pest management approaches to minimize negative impacts on non-target ecosystems and those species approaching or already at risk.

1.43 Conserve biological resources that are essential to agriculture, including domesticated animals, plants and microbal germplasm, and their wild relatives, with priority given to genetic material that is most at risk.

1.44 Develop and implement programs that promote and facilitate the co-existence of wild flora and fauna, and other wild organisms and their habitats in agricultural landscapes.

1.45 Through research, training, and technology transfer, facilitate the further adoption of environmentally sustainable farm practices, including those that:

- reduce soil erosion, surface and ground water contamination, and air pollution; and
- lead to the identification of productive soil types in relation to specific crop requirements.

1.46 Encourage agricultural producers to develop farm management plans that support the conservation of biodiversity and the sustainable use of biological resources.

1.47 Facilitate the sharing of experiences and expertise among farmers to promote management practices that favour the conservation of biodiversity and the sustainable use of biological resources.

1.48 Maintain or develop policies or programs that conserve biodiversity by supporting the sustainable use of native grasslands.

1.49 Identify and conserve areas that support native species and communities or could contribute to systems of protected areas, especially in intensively developed areas in accordance to the directions provided in the section on protected areas of the *Strategy* .

1.50 Maintain or develop *in situ* and *ex situ* conservation mechanisms to support the conservation and sustainable use of biological resources essential to agriculture by:

- determining and acting upon regional,provincial, territorial, national and international priorities for the conservation and sustainable use of biological resources, research and training, and the establishment of facilities; and
- continuing to support existing federal, provincial, territorial, regional, and international *ex situ* institutions.

Appendix C

Examples of Current AAFC Biodiversity Initiatives

Strategic Direction 1.39 Assessment of policies and programs

Initiatives include:

- environmental assessments of projects under the *Canadian Environmental Assessment Act (CEAA)*.
- environmental reviews of products regulated under the *Seeds*, *Feeds*, *Fertilizer* , *Health of Animals*, and *Plant Protection Acts*.
- environmental assessments of departmental policy and program proposals.
- periodic assessments of income support programs (GRIP, NISA, and Crop Insurance) under the *Farm Income Protection Act* .
- development of procedural manuals to guide departmental staff on environmental assessment procedures.
- development of a modelling system integrating economic and environmental variables to assist with assessment of environmental impacts from policy initiatives.

Strategic Direction 1.40 Development of economic incentives

Initiatives include:

- examination of economic instruments, including cross compliance, to selected agro-environmental problems, including habitat conservation.
- support for environmental initiatives through the provincial adaptation councils (under the Canadian Adaptation and Rural Development Fund).
- support for the conservation of marginal farmlands under the Permanent Cover Program.

Strategic Direction 1.41 Inventory and evaluation of biological resources

Initiatives include:

- development of mycological databases.
- development of identification tools for fungus, vascular plants, insects, and mites.
- upgrading the Canadian Plant Genetic Resources Information System.
- development of a national information system on invasive alien pests, and rare and threatened germplasm.
- development of a national information system on insects and arachnids.
- survey of Canadian owners of farm animal genetic resources.
- inventory of soil resources.
- inventory of known fungal, viral, bacterial and nematode parasites on Canadian plants.
- inventory of approved Canadian and foreign plant varieties.
- biodiversity inventory in Community Pastures.
- support for the Ecological Monitoring and Assessment Network (EMAN).
- monitoring of land management, soil conservation, and soil and water quality on Community Pastures.

Strategic Direction 1.42 Integrated pest management approaches

Initiatives include:

- research on integrated pest management approaches.
- research into biocontrol strategies.
- research and development of new crop varieties with genetic pest resistance.
- research on management of pests and inputs through soil and water conservation practices.
- evaluation and use of alternative pest management tools for the shelterbelt centre, pasture systems, and irrigation projects.
- implementation of domestic and international commitments to reduce the use of harmful toxic substances.

Strategic Directions 1.43 and 1.50 Conservation of biological resources

Initiatives include:

- contribution to the Canadian National Collection of Insects and Arachnids (CNCIA).
- contribution to the Canadian Collection of Fungal Cultures and the Canadian National Mycological Herbarium.
- upgrades to the Seed Genebank and Clonal Genebank within the Plant Genetic Resources Network.
- collections of bacteria and viruses.
- support for the conservation of farm animal genetic resources and traditional and heritage crops.

Strategic Direction 1.44 Programs for wildlife and wildlife habitat

Initiatives include:

- management of wild and domestic biological resources in Community Pasture and Reservoir Programs.
- re-vegetation with oil and gas companies in Community Pastures.
- implementation of Green Plan projects on grazing strategies for riparian sites.
- habitat improvement projects with local and regional wildlife groups.
- support for sustainable development studies in Prairie Canada.
- support for Ducks Unlimited Canada wetland projects.
- management of a Black Tailed Prairie Dog colony in a Community Pasture in Saskatchewan.
- restoration of habitat for threatened and endangered species by the Shelterbelt Centre (e.g., nesting sites for Ferruginous Hawks in Community Pastures, and tree plantings for Loggerhead Shrike).
- provision of habitat for the re-introduction of the Swift Fox.

Strategic Direction 1.45 Research, training, and technology transfer

Initiatives include:

- biosystematics research program.
- research and development on new crop varieties.
- research on fungal organisms as bio-indicators.
- research on new crops and new varieties for rotation, intercropping, replacement, and niche markets.

- research on using micro-organisms to improve production.
- research on inputs to benefit agricultural production and soil micro-organisms.
- research on wildlife and agriculture.
- research in support of reducing greenhouse gases and atmospheric acidity from agricultural sources.
- research on the effects of ozone related to agriculture.
- research on genetic diversity in native woody plant populations.

Strategic Direction 1.46 Farm management plans

Initiatives include:

- assistance for farm management plans through funding.

Strategic Direction 1.47 Sharing information

Initiatives include:

- technical assistance for field shelterbelt planting by the Shelterbelt Centre.
- development of agri-environmental indicators (including biodiversity change indicator, farm resource management indicator, soil degradation risk indicator, input use efficiency indicator, greenhouse gas balance indicator, indicator of risk of water contamination).
- development of communication vehicles over the Internet.
- national and international workshops and courses on biodiversity-related subjects.

Strategic Direction 1.48 Policies and programs for native grasslands

Initiatives include:

- conservation of native vegetation in Community Pastures.
- re-establishment of woody plants and native grasses in the Prairies with Ducks Unlimited.
- Tall Grass Prairie restoration projects in selected Manitoba Community Pastures.

Strategic Direction 1.49 Identification and conservation of protected areas

Initiatives include:

- contribution to the development of the national ecological framework for Canada.
- collaboration in the Representative Areas Network Strategy for Saskatchewan.

Appendix D

Glossary of Terms

Agro-ecosytems: An ecosystem under agricultural management; an open dynamic system connected to other ecosystems through the transfer of energy and materials.

Biocontrol agent: A biological enemy used to control a pest species.

Bioindicator: An organism that indicates the presence or absence of any particular factor, such as heavy metals, or the state of the quality of the environment.

Biological diversity: The variability among living organisms for all sources including terrestrial, marine, and aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems.

Biological resources: Biological resources include genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity.

Biotechnology: The application of science and engineering to the direct and indirect use of living organisms, or parts or products of living organisms, in their natural or modified forms.

Country of origin of genetic resources: The country that possesses genetic resources *in situ* .

Country providing genetic resources: The country supplying genetic resources collected from *in situ* sources, including populations of both wild and domesticated species, or taken from *ex situ* sources, which may or may not have originated in that country.

Domesticated or cultivated species: Species in which the evolutionary process has been influenced to meet the needs of humans.

Ecosystem: A dynamic complex of plant, animal, and micro-organism communities, and their non-living environment, interacting as a functional unit.

Ecosystem diversity: The variety and frequency of different ecosystems.

Endangered species: An official designation assigned by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The designation is assigned to any indigenous species, subspecies, or geographically separate population of fauna or flora that is threatened with imminent extinction or extirpation throughout all or a significant portion of its Canadian range.

Ex situ **:** Offsite, out of its natural or original habitat; associated with collections of plants and animals in storage facilities, botanical gardens, or zoos.

Ex situ **conservation:** The conservation of components of biological diversity outside their natural habitats.

Exotic species: An organism that exists in a free state in an area in which it is not native; also refers to animals that are held in captivity or in free-ranging populations that are not native to Canada.

Genetic diversity: The frequency and diversity of different genes or genomes. Genetic diversity is often represented by the phrase “the diversity within species”. It includes the variation both within a population and between populations.

Genetic material: Any material of plant, animal, microbial, or other origin containing functional units of heredity.

Genetic resources: Genetic material of actual or potential value.

Grassland: Any land on which the dominant plants are grasses or on which grasses originally dominated.

Habitat: The place or type of site where an organism or population naturally occurs. Species may require different habitats for different uses throughout their lifecycle.

In situ **:** In place, on site; term is used to refer to organisms located in their natural or original habitat.

In situ **conditions:** Conditions where genetic resources exist within ecosystems and natural habitats and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.

In situ **conservation:** The conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings. In the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.

Integrated Pest Management: A decision-making process that uses all necessary techniques to suppress pests effectively, economically, and in an environmentally sound manner.

Living Modified Organisms (LMOs): Organisms that have been deliberately modified to exhibit one or more traits, and that are novel to the species in Canada, not excluding a modified form of an organism that is exotic to Canada.

Modelling: The use of mathematical and computer-based simulations as a tool to enhance understanding of complex systems and as a planning technique for purposes such as predicting the impacts of policy or programs on environmental components.

Natural area: An area of land in which organisms and ecological processes are undisturbed by humans.

Novel trait: A characteristic in a modified organism that has been created or introduced through a specific genetic change and that makes the organism different from the unmodified organism.

Permanent cover: Perennial plant communities, either seeded or native, that are not harvested and ploughed under at the end of a growing season, thereby providing a permanent cover on the soil surface.

Pesticide: A substance (organic, natural, or synthetic chemical) used to directly or indirectly control, destroy, attract, or repel a pest or mitigate or prevent its injurious, noxious, or troublesome effects. Classes of pesticides include herbicides, insecticides, algicides, and fungicides.

Protected areas: Geographically defined area designated or regulated and managed to achieve specific conservation objectives.

Rangeland: Land that produces native forage used for animal consumption, and lands that are re-vegetated naturally or artificially to provide a forage cover that is managed like native vegetation; generally considered as land that is not cultivated.

Riparian: Refers to land bordering aquatic habitat, and generally implies a particular type of habitat often characterized by an overstory of trees or other large woody plants with a complex understory of other woody or herbaceous species.

Species diversity: Number, genetic distance, and relative abundance of species.

Sustainable use: The exploitation of biological resources in a manner and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

Threatened species: An official designation assigned by the Committee on the Status of Endangered Wildlife in Canada. The term describes any indigenous species, subspecies, or geographically separate population of fauna or flora that is likely to become "endangered" in Canada if the factors affecting its vulnerability are not reversed.

Tillage: Operations such as ploughing, harrowing, and disking that are used in cultivating the soil to make conditions suitable for the growth of crop plants.

Wild relatives: Non-domesticated plant or animal species that are taxonomically related to domesticated crop or livestock species, and that might serve as potential sources of genes for the breeding of new varieties or races.

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