

2 BIODIVERSITY PRINCIPLES

MANAGING FOR BIODIVERSITY

EIGHT AGRICULTURAL BIODIVERSITY PRINCIPLES

Managing for agricultural biodiversity is about conserving the variety and number of all living things, including both native and domestic species, and the relationships and interactions among them. The principles on the following pages reflect the key relationships and interactions that need to be considered when managing for biodiversity on farms and ranches.

- 1 Go Native**
Native areas (wetlands, aquatic areas, riparian areas, forest woodlands, and grasslands) provide the most important contribution to biodiversity.
- 2 Semi-natural is Valuable**
Semi-natural areas such as shelterbelts, hedgerows, fencerows, buffers, road margins, pastures, and haylands also contribute to the conservation of biodiversity.
- 3 Location, Location, Location**
The location, pattern, and seasonal availability of habitat influences the type and amount of biodiversity present.
- 4 You Gotta Have Connections**
Connection between native and semi-natural areas on your land, and neighbouring landscapes, is important to biodiversity.
- 5 Achieving New Heights**
Structural diversity – the variation in physical structure of both native vegetation and crops – on your land provides an important contribution to biodiversity.
- 6 Healthy Ecosystem Wanted**
The health of the soil and water influences the type and amount of biodiversity present.
- 7 Nature Loves Variety**
The number and mix of species present, including crops and livestock, influences the type and amount of biodiversity present.
- 8 Watch Out for Aliens**
Invasive alien species are generally detrimental to the conservation of biodiversity.

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PRINCIPLE 1

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PRINCIPLE 2

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PRINCIPLE 5

Achieving New Heights

Structural diversity – the variation in physical structure of both native vegetation and crops – on your land provides an important contribution to biodiversity.



PRINCIPLE 6

Healthy Ecosystem Wanted

The health of the soil and water influences the type and amount of biodiversity present.

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Watch Out for Aliens

Invasive alien species are generally detrimental to the conservation of biodiversity.

PRINCIPLE 3

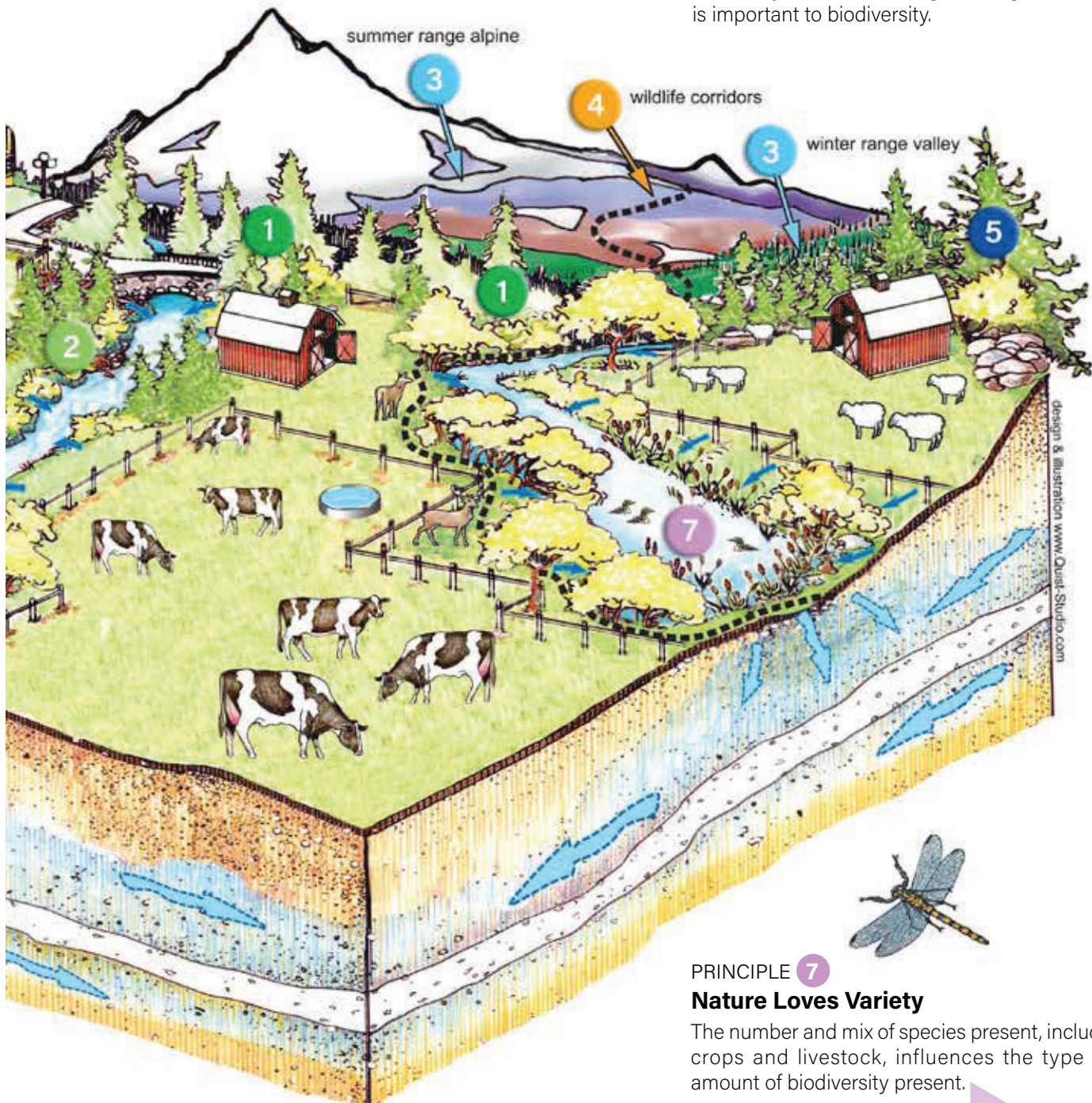
Location, Location, Location

The location, pattern, and seasonal availability of habitat influences the type and amount of biodiversity present.

PRINCIPLE 4

You Gotta Have Connections

Connection between native and semi-natural areas on your land, and neighbouring landscapes, is important to biodiversity.



PRINCIPLE 7

Nature Loves Variety

The number and mix of species present, including crops and livestock, influences the type and amount of biodiversity present.

The loss of diversity puts the world's food and fiber supply at risk

90% of all plants and animals used for food were domesticated and/or cross bred originally from **wild stocks**

50% of the world's food consumed is from just **3** plant crops

96% of commercial vegetable varieties available in 1903 are **now extinct**

BIODIVERSITY PRINCIPLE 1: GO NATIVE

Native areas (wetlands, aquatic areas, riparian areas, forests/woodlands, and grasslands) provide the most important contribution to biodiversity on your land.

Native plants and animals have evolved over time in response to the physical and biological conditions of the areas in which they occur. As a result, they are uniquely adapted to local conditions. For example, native grasslands can be more drought resistant than tame pastures, and in low-input agriculture systems, locally adapted grasses often produce higher yields and are more resistant to pests than varieties that have been bred for high performance under optimal conditions. Native areas are also home to many unique plant and animal species which depend on these areas for food, shelter, reproduction, rest stops during migration, and refuge from predators.

Many producers have native areas on their farms or ranches and are often faced with the challenge of determining how much of their land to put into production and how much to leave as native land. In general, large areas of native habitat support more and/or different species than smaller areas. Once native areas are converted to the production of tame species or other land uses, it can be very difficult, time consuming, and costly to restore them to their native state.

What Can You Do?

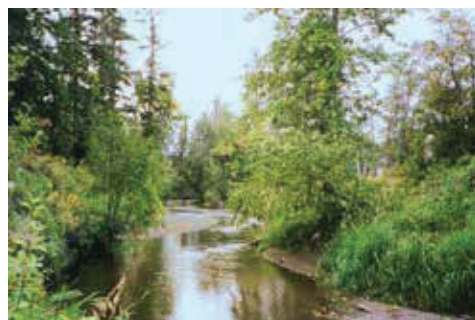
- ▶ Maintain native areas, including riparian areas, wetlands and aquatic areas, forests, woodlands, and grasslands.
- ▶ Where possible, restore riparian areas, wetlands, forests, woodlands, and grasslands to their natural state by planting or encouraging the establishment of native species.
- ▶ Manage all native areas so that sensitive and rare plant and animal species continue to live there.
- ▶ Where possible, expand native areas.

DID YOU KNOW?

Grasslands cover less than 1% of BC's land base, but they provide habitat for more than 30% of the province's threatened or endangered species.

Grasslands Conservation Council of BC.
2009. Grassland Portfolio: Thompson Basin
Ecosection.

[http://www.bcgrasslands.org/
thompsonportfolio.htm](http://www.bcgrasslands.org/thompsonportfolio.htm)



Aquatic and Riparian Habitat

BIODIVERSITY PRINCIPLE 2: SEMI-NATURAL IS VALUABLE

Semi-natural areas (e.g., shelterbelts, hedgerows, fencerows, pastures and haylands, buffers, road margins) also contribute to the conservation of biodiversity.

In general, the least altered areas of your farm and ranch have the highest potential for conserving biodiversity. However, other areas that contain non-native perennial vegetation or a mix of native and non-native plants can also be important to biodiversity. Uncropped areas can become naturalized and contribute to ecosystem functioning, especially where there is little available native habitat. For example, plantings of hybrid poplar trees in field margins or around farmsteads, and old tame pastures that have grown wild can provide food and shelter for native wildlife. They can also contribute to the ecosystem services that agriculture depends on by providing habitat for pollinating insects and species that help control pests.

Infrequently tilled cropland can also support large, diverse assemblages of soil organisms, which contribute to site productivity by cycling nutrients and maintaining soil structure and moisture. In addition, when legumes are part of the plant mix in a tame pasture, external nutrient inputs can be reduced, which saves money and reduces the risk of contamination. A mix of plants also increases a pasture's ability to meet livestock nutritional needs, and its ability to withstand diseases or pests.

Tame pastures can also be included in grazing rotations so that overall biodiversity benefits. They can provide an alternative forage source when native pastures are particularly sensitive or when they need to be rested to allow native plants to complete their reproductive cycles.

DID YOU KNOW?

Ten percent of the soil-dwelling organisms found on a farm in southern England occurred only in the grassy margins surrounding cultivated fields.

Grassy Field Margins Enhance Soil Biodiversity. 2009.



Semi-natural Landscape

What Can You Do?

- ▶ Maintain or establish semi-natural shelterbelts, hedgerows, fencerows, pastures and haylands, buffers, and road margins.
- ▶ Where possible, restore areas by planting native species.
- ▶ Wherever possible, use native and locally adapted plant species that thrive under local conditions.
- ▶ Manage semi-natural areas so that sensitive and rare plant and animal species continue to live there.

BIODIVERSITY PRINCIPLE 3: LOCATION, LOCATION, LOCATION

The location, pattern, and seasonal availability of habitat influences the type and amount of biodiversity present.

Location of Habitat

Location affects the physical and biological characteristics of a habitat, which in turn determines which species it can support. A single animal may need different types of habitat in different locations for finding food, water, shelter, and mates.

Some habitats support more species than others because of their location. For instance, riparian habitats, which are located next to water, generally support more species than habitats in dry areas. Valley bottoms tend to support more and different types of species than alpine areas, which can provide habitat for very specialized and often rare species. Habitats near urban areas generally support fewer species than agricultural lands or habitats in more remote, undeveloped areas.

In BC, agricultural regions have some of the highest levels of species richness in the province (see page 28). While areas of high species richness are important, farms and ranches located in areas of lower species richness can also play an important role in managing for biodiversity.



Big Bend, Vancouver

Patterns of Habitat

Pattern refers to the arrangement of habitats across the landscape. These patterns may occur at a fine scale, such as a cluster of small wetlands, or at a broad landscape scale, such as connected areas of forest that extend well beyond the farm.

Historically, native grassland, forest, wetland, and riparian habitats in BC covered large areas and were interconnected. However, urban and agricultural development, plus a variety of other factors have altered this natural pattern by reducing, fragmenting, and isolating many habitat types. This has changed the amount of available habitat for some native species and has affected their ability to move safely between areas. Taking action on the farm to protect and restore historical patterns of habitats can enhance biodiversity at both the farm and landscape scales. This will also help rebuild ecosystem functions.



Black Bear den
SALMON RIVER ROUNDTABLE

Seasonal Availability of Habitat

A particular habitat's importance to a species can vary throughout the year due to seasonal changes in the availability of food, water, and shelter. As a result, many species move between habitats at different times of the year to take advantage of locally abundant resources. For example, in autumn, salmon migrate from the ocean to rivers and streams to spawn. Because they congregate in these areas, they can become an abundant food source for other animals. As a result, bears, eagles, gulls, and other animals often move into these areas in the fall to feed.



Grizzly Bear (blue-listed)
TONY STEVENS PHOTO

Some habitats, such as small ponds used by amphibians for breeding, can disappear at certain times of the year and then reappear as the season changes. Retaining these types of seasonally available habitats is extremely important for maintaining biodiversity.

What Can You Do?

- ▶ Be aware of how habitats located on your property contribute to biodiversity.
- ▶ Consider the historical pattern of habitat when determining opportunities to protect and restore habitat on your farm.
- ▶ Protect and restore seasonally available habitat that is important to maintaining biodiversity.
- ▶ Plan the location of farm developments and cropping to account for biodiversity.



Bald Eagle
DAVE FRASER PHOTO



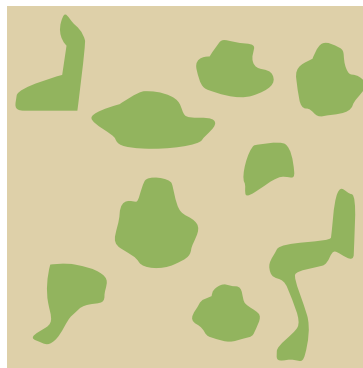
Salmon are an abundant food source for many animals
M. NAGA PHOTO

BIODIVERSITY PRINCIPLE 4: YOU GOTTA HAVE CONNECTIONS

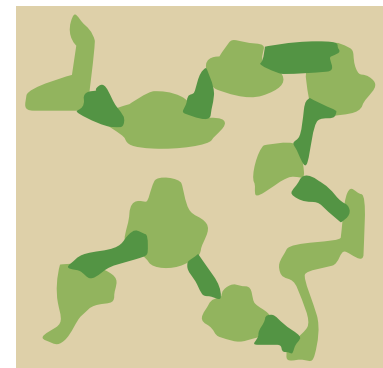
Connecting native and semi-natural areas on your land and with neighbouring landscapes is important to biodiversity.



Intact Habitat Patch



Scattered Habitat Patches



Connected Habitat Patches

Connecting individual patches of native and semi-natural land can improve habitat quality for plants and animals. A single, large block of grassland or forest generally supports more species than a similar area of small, isolated habitat patches. However, the value of those isolated patches can be greatly improved if they are connected by habitat corridors.

Uncultivated areas that connect patches of terrestrial habitat can be used as travel corridors by animals during migration, when searching for food and mates, and when young are dispersing. They also provide routes for pollen and seeds to spread. The most effective terrestrial corridors:

- ▶ are vegetated year round,
- ▶ do not present barriers to wildlife movement,
- ▶ are generally left undisturbed during times when wildlife use them,
- ▶ contain a diversity of plants of different heights and types, and
- ▶ are an appropriate width to provide shelter and escape routes from predators.



Connected forested habitat

Aquatic habitats that have become isolated by dams or other structures that impede water flow can be reconnected by:

- ▶ improving or constructing side-channels,
- ▶ deepening or lengthening groundwater-fed channels,
- ▶ removing pipes and culverts or installing a bridge, or
- ▶ restoring natural water flow in the channel.

Connecting native and semi-natural areas over landscapes much larger than an individual farm or ranch is especially important if the survival needs of certain native species are to be met. For example, wild ungulates, such as deer and elk, often migrate to different elevations during different seasons to find food, raise their young, and escape harsh weather conditions. This is particularly true in the large river valleys where much of BC's agricultural land is located. These valleys are among the most disrupted landscapes in Canada. As a result, connecting every piece of native habitat in these areas is critically important to native biodiversity.



Connected riparian habitat

MIKE WALLIS PHOTO

What Can You Do?

- ▶ Leave uncultivated land between habitat patches so natural infilling occurs.
- ▶ Join habitat patches by leaving or creating shelterbelts or hedgerows between them.
- ▶ Connect habitat patches by planting native vegetation between them.
- ▶ Work with your neighbours to join habitat patches across the landscape.

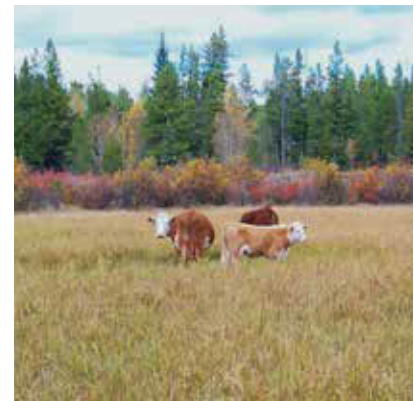
BIODIVERSITY PRINCIPLE 5: ACHIEVING NEW HEIGHTS

Structural diversity—the variation in physical structure of both native vegetation and crops—on your land provides an important contribution to biodiversity.

Maintaining a mix of vegetation layers, such as forbs, grasses, shrubs, and trees provides a diversity of habitats for birds, animals, and beneficial insects. Structural diversity is obvious where there is a mix of uncultivated areas, such as hedgerows, woodlands, and riparian areas. It is less obvious in native pastures, but it can be achieved by maintaining different heights of grasses, forbs, and woody vegetation, which can provide cover and breeding sites for native species.

What Can You Do?

- ▶ Establish and/or maintain a mix of forbs, grasses, shrubs, and trees on your land.
- ▶ Establish and/or maintain a mix of plant heights and age classes.



Grasses, shrubs, and trees provide structural diversity

BC MINISTRY OF FORESTS AND RANGE

BIODIVERSITY PRINCIPLE 6: HEALTHY ECOSYSTEMS WANTED

The health of native and semi-natural areas, all other farmland, and soil and water influences the type and amount of biodiversity present.

Healthy Ecosystems

Healthy ecosystems are the foundation of biodiversity. When ecosystems are healthy, they function effectively and efficiently in terms of building soils, storing and filtering water, storing and cycling nutrients, and regulating climate and the impacts of disturbances such as droughts and floods. All life forms in an ecosystem, and farms depend on one or more of these functions. For example, if a landscape does not provide sufficient water or appropriate soil quality to support the trees in which warblers nest, the birds are unlikely to occur in the area. As a result, they cannot help control local insect populations. The easiest way to conserve biodiversity is to create conditions in which the greatest variety of life can thrive – that is, create healthy landscapes.

In general, healthy ecosystems occur where there is:

- ▶ a diversity of plant and animal species;
- ▶ representatives of all land types and native plant communities that occur in the area;
- ▶ large areas of native vegetation;
- ▶ few areas of bare soil;
- ▶ minimal erosion;
- ▶ corridors and large areas of perennial cover;
- ▶ few weeds;
- ▶ productive plant communities;
- ▶ appropriate types and levels of disturbance, such as fire, flooding, and drought, which maintain natural landscape processes; and
- ▶ functioning riparian areas adjacent to waterbodies.

The intensity and timing of farming and ranching activities can have significant impacts on the health of ecosystems. Generally, when intensive agriculture is practiced and when the timing of activities does not take biodiversity into consideration, negative impacts on ecosystem health can be anticipated.

Healthy Soils

Soils store water, provide a substrate for plants, and support a variety of organisms. In fact, soil is a world teeming with life—plant roots, viruses, bacteria, fungi, algae, protozoa, mites, nematodes, worms, ants and other insects and their larvae (grubs), and larger animals. The number of living organisms below ground is often far greater than above ground. Soil organisms break down organic matter and release nutrients back into the soil, which plants then use. These and other natural processes help stabilize soils and improve soil structure, tilth, and productivity.



Healthy wetland ecosystem



Healthy woodland ecosystem

JARED HOBBS PHOTO



Soil profile

Soils can be particularly sensitive to the timing of equipment operations, forest harvesting, livestock grazing, and controlled burning. If these activities occur when soil moisture content is high, soil compaction can occur. This can lead to decreased soil aeration and moisture capacity, which affects the natural community of soil organisms and site productivity. It can also increase the risk of erosion. Generally, in both cultivated and grazed systems, maintaining a relatively stable upper soil layer, including thatch/residue, is critical to maintaining diverse and functioning soil communities. It also contributes to improved crop yields.

Clean Water

Clean water is free of excess nutrients, sediments, and other pollutants. It is needed to maintain viable populations of all life forms from the smallest organisms to fish, birds, large mammals, and human populations. Clean water is also critical for agricultural irrigation and for maintaining healthy soils, crops, and livestock.

What Can You Do?

- ▶ Minimize soil disturbances by appropriately managing tillage, grazing, and the development of roads, trails, and landings. Avoid grazing and harvesting when the ground is saturated (especially in riparian areas) or at times that may be stressful to tree seedlings and shrubs.
- ▶ Plant cover and relay crops to avoid soil erosion.
- ▶ Use production inputs appropriately to avoid disrupting soil biota and the natural functioning of soil and aquatic ecosystems. Use biological and physical methods to control pests, wherever possible.
- ▶ Manage your farm or ranch as a part of a functioning watershed or landscape by maintaining key ecological functions such as pollination, soil building, water filtration and storage, nutrient storing and cycling, erosion control, and organic matter decomposition.



Soil organisms



Clean water

TONY BROWN PHOTO

DID YOU KNOW

Beef cattle need 22–75 litres of clean water per head per day.

R.T. France and R.B. Haywood-Farmer. 1998. *Livestock Behaviour and Management*. Pages 92–107 in C.W. Campbell and A.H. Bawtree, eds. *Rangeland Handbook for B.C.* British Columbia Cattleman's Association, Kamloops, BC.

BIODIVERSITY PRINCIPLE 7: NATURE LOVES VARIETY

The number and mix of species present, including crops and livestock, influences the type and amount of biodiversity present.

Biodiversity not only includes the mix of species but also the genetic variety within species. Genetic variety has allowed for the selection of traits that are very important to agricultural production and products. It also contributes the adaptability of a species.

Biodiversity is a little like money in the bank. Higher levels of biodiversity are associated with proper landscape functioning, which generally leads to higher productivity and year-to-year stability in production. Higher levels of biodiversity can also provide more ecosystem services, such as pollination, soil fertility, water quality, pest control, and disease resistance.

Biodiversity on agricultural land includes all crops and livestock. Maintaining diverse varieties of livestock as well as annual and perennial crops helps ensure that agriculture remains sustainable under changing climatic, social, and economic conditions.



Crop variety

What Can You Do?

- ▶ Maintain a variety of plant species of different ages and heights in the native and semi-natural areas on your farm or ranch.
- ▶ Grow a variety of crops.
- ▶ Consider using agroforestry practices on your farm or ranch.
- ▶ Consider raising different varieties of livestock.
- ▶ Where possible and with great care, disturbance techniques (e.g., fire, grazing, flooding) that mimic natural disturbances may be used to rejuvenate soil and vegetation.

BIODIVERSITY PRINCIPLE 8: WATCH OUT FOR ALIENS

Invasive alien species are generally detrimental to the conservation of biodiversity.

Next to habitat loss, invasive alien species pose one of the greatest threats to biodiversity in BC and many other parts of the world. Invasive species include plants, animals, insects, and micro-organisms that are not native to a region but were introduced either accidentally or intentionally. They often out-compete native species for available resources and can reproduce prolifically. Because they usually arrive unaccompanied by their natural predators or competitors, they can be difficult to control. Left unchecked, many invasive species can transform ecosystems. Examples of invasive alien species in BC include Canada thistle, purple loosestrife, Japanese knotweed, quackgrass, yellow bush lupine, knapweed, yellow perch, the European Starling, and the American bullfrog.

Agricultural areas frequently provide opportunities for invasive species to establish. Alien weed species often invade disturbed sites, which occur during crop management or with heavy grazing. Once established, these species can be hard to control and can have profound impacts on production. Regional responses to invasive alien species are common in many agricultural areas. Controlling and eradicating invasive species is frequently a large challenge involving concerted effort among many people.

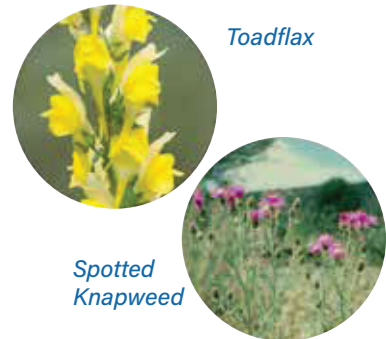
When managing for biodiversity, it is important to remember that not all species are considered equal. For example, the introduction of invasive fish species into local waterbodies can have severe impacts on native fish species such as trout and salmon. Also, starlings thrive in disturbed and fragmented landscapes, but they often out-compete native birds for nest sites. Management practices that support increased starling populations will not contribute to the general health of the overall landscape.

What Can You Do?

- ▶ Identify, control, and where possible and appropriate, eradicate invasive species. This can include maintaining healthy perennial cover and diverse native vegetation, minimizing the edge between disturbed areas (e.g., cultivated fields, roads and trails) and native habitats, or using domestic grazing animals to control weeds.
- ▶ Do not allow invasive fish species to gain access to waterbodies.
- ▶ Get assistance in developing management practices that foster desirable species and discourage undesirable ones.



*Field with
Oxeye Daisies and
Orange Hawkweed*



Toadflax

*Spotted
Knapweed*



W.S. PRICE PHOTO

*American Bullfrog –
invasive alien species*