CHAPTER 2

Species Selection and Grazing Management Guidelines

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PASTURES COMMONLY ARE CULTIVATED FIELDS planted to introduced grasses and legumes. The objectives or goals of pasture plantings may include:

• Livestock grazing or hay
• Forage to improve animal nutrition
• Forage to improve animal health
• A more balanced forage supply
• Forage for low-production periods
• Forage for winter use
• Forage for earlier or later season of use
• Food/habitat for wildlife
• Reduced soil erosion and sedimentation
• Improved soil quality
• Improved water quality

All of these goals are achievable when the pasture plant community is healthy. Healthy pasture plants capture energy from the sun and facilitate water and nutrient cycling.

This chapter discusses factors that will help you choose appropriate grass and legume species for your pasture. It includes descriptions of common pasture species, including areas of adaptation, growth characteristics, use, and grazing management recommendations.

Key Points

• Select pasture forage species that are adapted to your site conditions, livestock needs, and management style.
• Manage grazing to maintain pasture and livestock health based on the optimum season of use and appropriate grazing/stubble heights for your forage species.
Species selection

Select plant species on the basis of site conditions and what the species can contribute to your objectives. Keep in mind the following:

- Recognize that each site is unique and that conditions change with the seasons and over time.
- Select species that will accommodate your grazing goals and type(s) of grazing animals.
- Plant forages that will best match your management style.
- Choose species with regrowth characteristics that will meet your objectives.
- After selecting species, choose varieties that will provide good yield, quality, and disease resistance.
- Be sure that the planned seeding is within your economic capabilities and that you can complete the planting with available manpower and equipment.

Remember, species that are not adapted to the site or to its intended use will fail even if all other requirements are met.

We recommend that you review your local soil survey, which describes your farm’s soils and their characteristics. Soil surveys are prepared by the USDA Natural Resources Conservation Service. Most are available online (http://soils.usda.gov/survey/), although some are available only in hard copy from local USDA-NRCS offices.

Soil surveys include maps, photos, descriptions, and tables. The tables contain detailed information about soil uses such as crops, pasture, rangeland, recreation, and engineering. They also include information about depth to rock or restrictive layers, soil texture, permeability, water-holding capacity, soil chemical characteristics, soil salinity, soil reaction (pH), and erosion. Climate information includes the average frost-free period and annual precipitation.

Use these site characteristics to help select adapted grasses and legumes. Before choosing a species or mixture of species, consult the species descriptions in this or other pasture guides. See table 2.1 for more information.

Dryland pasture

Generally, only perennial species should be planted on non-irrigated sites. Perennial plants provide a dependable source of nutritious forage and do not require annual seedbed preparation and seeding.

The risk of seedling failure increases as annual precipitation declines. For example, an area that receives 16 inches of annual rainfall has a greater chance of seedling establishment than an area that receives less than 12 inches of annual precipitation.

Consider adding adapted forbs and legumes to the planting. They add diversity, increase forage yield, and contribute to improved soil and forage quality. Legumes also fix nitrogen (N).

Some legumes, such as alfalfa and clovers, may cause grazing animals to bloat (see chapter 12). Others, such as sainfoin, birdsfoot trefoil, and cicer milkvetch, do not cause bloat. Small burnet is a non-bloat, non-leguminous forb.

Siberian wheatgrass, crested wheatgrass, Russian wildrye, forage kochia, and sweetclover are best adapted to areas receiving less than 12 inches of annual precipitation. These species are more widely used for grazing rather than haying. Altai wildrye, intermediate and pubescent wheatgrass, and alfalfa perform best in areas receiving 12 inches or more annual precipitation, where they produce more than crested wheatgrass.

In regions exceeding 15 to 18 inches of annual precipitation, meadow brome, smooth brome, tall fescue, orchardgrass, small burnet, alfalfa, sainfoin, cicer milkvetch, and birdsfoot trefoil provide increased forage production and quality. On wet soils, consider creeping foxtail, timothy, tall fescue, cicer milkvetch, birdsfoot trefoil, and clover species.

On wet, saline sites where the water table is within 3 feet of the soil surface, consider tall wheatgrass, ‘NewHy’ hybrid wheatgrass, Altai wildrye, tall fescue, western wheatgrass, or strawberry clover. On dry, saline sites with less than 16 inches of annual precipitation, consider Russian wildrye, tall wheatgrass, or western wheatgrass. On both wet saline and dry saline sites, consider including slender wheatgrass in the seed mixture as a cover crop species at no more than 1 pound per acre. Slender wheatgrass is saline-tolerant and easy to establish, but will not persist in the stand for more than 2 or 3 years.
### Table 2.1. Growth stage for grazing or harvesting forage, stubble height, optimum season of use, and regrowth ability.

<table>
<thead>
<tr>
<th>Minimum plant height before and after haying or grazing (inch)</th>
<th>Before</th>
<th>Stubble</th>
<th>Optimum season of use&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Regrowth ability</th>
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<td><strong>GRASSES</strong></td>
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<td>Meadow</td>
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<td>Sp/Su/F</td>
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<td>Smooth</td>
<td>8</td>
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<td>Sp/Su/W</td>
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<td>Cereals, grains</td>
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<td>4</td>
<td>F/W/Sp</td>
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<td>Creeping foxtail</td>
<td>6</td>
<td>4</td>
<td>Sp/Su/F</td>
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<td>Festulolium</td>
<td>8 to 10</td>
<td>3</td>
<td>Sp/F</td>
<td>Good</td>
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<td>Kentucky bluegrass</td>
<td>5</td>
<td>2</td>
<td>Sp/F</td>
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<td>Orchardgrass</td>
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<td>Sp/Su/F</td>
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<td>Perennial ryegrass</td>
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<td>Sp/Su</td>
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<td>Reed canarygrass</td>
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<td>Tall fescue</td>
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<td>Timothy</td>
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<td>Crested</td>
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<td>Sp/F</td>
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<td>Basin</td>
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<td>Russian</td>
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<td><strong>LEGUMES AND OTHER FORBS</strong></td>
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<td>Birdsfoot trefoil</td>
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<td>Cicer milkvetch</td>
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<td>Sainfoin</td>
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<td>Good</td>
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<tr>
<td>Sweetclover</td>
<td>8</td>
<td>6</td>
<td>Su</td>
<td>Excellent</td>
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</table>

<sup>a</sup> Sp = spring; Su = summer; F = fall; W = winter
Pasture and Grazing Management in the Northwest

**PRECIPITATION OVER 18 INCHES AND IRRIGATED PASTURE**

The easiest type of pasture to manage consists of a single grass with or without a legume. A single species is easier to seed and establish and more uniformly palatable than multiple-species seedings. It also requires a lower level of management. This type of planting is often suitable for a specific class of animal on a site with uniform soil, landscape, and moisture conditions. It has the advantage of allowing you to match your soil, climate, and grazing resources to your management, resources, and goals.

In this scenario, you likely know the type of grazing animal. Understanding soil and climatic limitations can be more difficult, but is essential to long-term success. After identifying all of your resources and environmental conditions, you can choose a forage species and seed at the appropriate depth, time, and rate. Daily and seasonal management decisions (such as Management-intensive Grazing) then become keys to long-term success.

For irrigated seedings, simple mixes including a grass (such as orchardgrass or meadow brome) and a legume (such as alfalfa, sainfoin, or cicer milkvetch) are recommended. Simple grass-legume mixes require less total seed than a complex mixture. They produce as much forage as complex mixtures and are easier to manage and graze uniformly.

A simple grass-legume mix is also easier to establish in alternate rows, which is recommended when possible (Figure 2.1). Seeding the grass and legume in alternating rows allows both species to establish in their own rows with minimal competition between the grass and legume. Partitioning a drill box into alternating rows of grass and legume seed is one way to accomplish alternate-row seeding. Another method is to use a grass or grain box for the grass and an alfalfa or fluffy box for the legume. Route the seed flow accordingly in an alternate-row fashion.

On irrigated sites, annual species, such as cereal grains and ryegrass, may be a viable alternative, depending on your objectives and forage needs. They require preparing a new seedbed and planting each year, however.

In mountainous or rolling areas, or in fields with multiple soil types or moisture conditions, mixes of multiple grasses or grass-legume-forb mixes may be desirable. On these sites, pastures with multiple plant species often perform better than a monoculture. Under these conditions, plant diversity confers several advantages:

- Legumes increase forage quality and add valuable N to the soil. (They may, however, limit weed-control options.)
- Diversity increases resistance to pests.
- A mixed seeding can ensure that one or more of the species will establish and survive under various environmental conditions.

Complex mixtures may include grasses such as intermediate wheatgrass, meadow brome, and orchardgrass. In many situations, the addition of a forb such as small burnet will add diversity to the planting. Legumes that fix N, both bloat-type species (for example, alfalfa and clovers) and non-bloat species (for example, sainfoin, birdsfoot trefoil, and cicer milkvetch) increase soil N and forage quality.

As the number of species in a mixture increases, pasture management must become more complex in order to maintain the composition and health of the stand. With mixtures of two or more species, relative palatability is of major importance. If species differ in palatability, the more palatable species will decline due to excessive grazing. The result may be a single-species stand invaded by aggressive annual and perennial weeds. For example, tall fescue is high-yielding and very competitive, but it is less palatable than many other irrigated forage species. In a mixed seeding, it will dominate the stand after several years.

Management-intensive Grazing can overcome the tendency of animals to overgraze the more palatable species. Ultimately, a pasture diverse in species composition is desirable, but in the long term species composition depends more on grazing management than on what is seeded.
See chapter 4 for more information on seeding methods, rates, and mixtures.

See chapters 13–15 for grazing management recommendations.

If you plan to cut forage for hay or use a less intensive grazing system, it is better to plant a simple mixture of one grass species and a single legume. If you do plant more than one grass species, select species similar in palatability.

**Pasture species—grasses**

**BLUEGRASS, KENTUCKY (POA PRATENSIS)**

Kentucky bluegrass is a long-lived, introduced, shallow-rooted, sod-forming perennial grass.

**Adaptation and use**—Even with 18 inches of annual precipitation, Kentucky bluegrass does not provide much forage. Irrigation or additional rainfall is required for good forage production. In the Intermountain West, Kentucky bluegrass is not recommended for pasture planting, except for use as high-quality horse pasture. However, under irrigated conditions it commonly comes in on its own if the pasture is overgrazed.

Existing Kentucky bluegrass pastures can provide highly palatable forage and fair to good yield if managed through irrigation, a good fertility program, and periodic ripping or chiseling of the root zone. Kentucky bluegrass generally is not harvested for hay because of its short stature and very fine stems and leaves, which can be difficult to cure properly for hay.

**Grazing management**—Grazing can begin in spring when grass is 5 inches tall. Remove livestock when stubble height is approximately 2 inches. Regrowth ability is excellent. Livestock can be rotated back onto Kentucky bluegrass pastures when regrowth is approximately 6 inches tall.

**BROME, MEADOW (BROMUS BIEBERSTEINII [SYN. B. RIPARIUS])**

Meadow brome is a long-lived, introduced, deep-rooted perennial grass with short (4- to 6-inch) rhizomes.

**Adaptation and use**—Meadow brome is an excellent choice in areas that are prone to frost in early to late spring. It is one of the earliest sources of spring forage available. This species is palatable to all classes of livestock and wildlife. It is productive and compatible in mixtures with legumes such as alfalfa, sainfoin, cicer milkvetch, and birdsfoot trefoil.

Growth begins in early spring, and productivity is very high during the cool season. This species is also capable of strong summer growth when fully irrigated. Meadow brome initiates regrowth more quickly than smooth brome, even during high summer temperatures.

**Grazing management**—Meadow brome reaches full productivity in 2 to 3 years. Because it establishes roots slowly, livestock can easily uproot young plants. New plantings should not be grazed until late summer or early fall under irrigated conditions. Under dryland conditions, do not graze until the second year. Harvesting for hay during the establishment period is recommended.

On established stands, begin spring grazing when the forage is 8 inches tall. Remove livestock when stubble is 4 inches tall. Meadow brome recovers quickly from grazing if soil moisture is available, as it initiates regrowth from existing tillers and not from the crown. A 21- to 28-day recovery period is recommended.

Four to 6 inches of fall regrowth will build food reserves to provide for early growth the following spring.

**BROME, SMOOTH (BROMUS INERMIS)**

Smooth brome is a long-lived, introduced, aggressive, sod-forming grass.

**Adaptation and use**—Smooth brome is best adapted to moist, well-drained soils where annual precipitation is at least 14 inches or the pasture is irrigated. It is very shade-tolerant.

Seedlings are often weak, but established plants spread via rhizomes to provide full stands. Smooth brome is a very aggressive grass that generally does not allow invasion by other species. It often invades adjacent pastures and areas along ditches, canals, drains, and streams. It can be a serious weed in these areas.

Smooth brome is high in crude protein, low in crude fiber, and highly palatable. It is compatible in mixtures with legume species such as alfalfa, sainfoin, cicer milkvetch, and birdsfoot trefoil.

Vegetative growth begins in early spring, and most growth occurs during the cool spring period. Smooth brome is slow to regrow, even under fully irrigated conditions, because new tillers must develop before initiating above-ground growth.

**Grazing management**—New stands do not tolerate heavy grazing and may die out if utilized heavily when young.
Stockpiling for fall, winter, and early spring grazing should begin between the first of June and the beginning of July. Grazing should not occur until smooth brome has reached 8 inches tall. Remove livestock when stubble is 4 inches tall. Regrowth is initiated from the crown and rhizomes, and recovery is slow. A rest period of 35 to 42 days is recommended between grazing periods.

**CANARYGRASS, REED (PHALARIS ARUNDINECEA)**

Reed canarygrass is a long-lived, introduced, widely adapted, coarse, vigorous, productive, sod-forming grass.

Adaptation and use—Reed canarygrass is frost-tolerant and suited to wet soils with a pH of 4.9 to 8.2. Initial stands are often poor because of poor germination and weak seedlings. Once established, reed canarygrass can withstand continuous water inundation for 70 days in cool weather. Reed canarygrass invades wet areas along ditches, canals, drains, and streams and is a serious weed in these areas.

This species produces high forage yields on moist, fertile soils that are high in N and organic matter. When fertility is limiting, it becomes sod-bound. Mature stands are unpalatable, requiring careful grazing and haying management for quality forage production. Reed canarygrass contains alkaloids that repel herbivores. The lack of palatability and poor animal performance often seen with this species may result from the presence of these alkaloids. Newer varieties contain lower levels of alkaloids.

Grazing management—In spring, early and frequent grazing (with rotations as often as 2 weeks) helps prevent or reduce stem and panicle production. Grazing should occur when reed canarygrass has reached 8 inches tall. Remove livestock when stubble is 4 inches tall. The recommended rest period is approximately 14 to 21 days. Forage quality can be maintained by not allowing growth over 12 inches tall.

**FESCUE, TALL (SCHEDONORUS PHOENIX [SYN. FESTUCA ARUNDINACEA])**

Tall fescue is a long-lived, introduced, deep-rooted, high-yielding, cool-season bunchgrass.

Adaptation and use—Tall fescue is suited to irrigation, sub-irrigation, moderately wet conditions, and dryland areas where effective annual precipitation exceeds 18 inches. It performs very well in acidic soils, as well as in soils that are moist, saline, and alkaline (pH 4.7 to 9.5). It is not well adapted to sandy soils with prolonged dry periods.

The leaves' thick cuticle helps tall fescue stay green into early winter. Thus, it can be stockpiled for winter use.

Tall fescue is recommended as a monoculture seeding or as part of an alternate-row planting. It is very competitive and tends to out-compete other species in a mixture. It has lower palatability than most pasture grasses, so other species often are overgrazed and eventually eliminated from the pasture.

Avoid turf-type tall fescues for grazing use. Fungal endophyte problems can develop in livestock grazing on tall fescue when the endophyte is in the seed, the only time the plant can become infected. Infected tall fescue plants produce alkaloids that cause fescue foot, bovine fat disorder, and fescue toxicosis disorders (see chapter 12). Toxin concentration is greatest in the inflorescence, moderate in stems and leaf sheaths, and lowest in leaf blades. You can reduce or eliminate this problem by using endophyte-free seed or new varieties with endophytes that don't produce toxins.

Grazing management—Growth begins in early spring, and grazing should begin after plants are at least 6 inches tall. Maintain stubble height at 4 inches. Regrowth is good in cool spring and fall weather, but only fair during summer heat. The recommended rest period between grazing cycles is approximately 21 to 28 days. Frequent spring grazing cycles when plants are in the vegetative stage will help reduce alkaloid concentrations in animal diets if the endophyte is present.

**FESTULOLUM (FESTULOLUM BRAUNII)**

Festuloliums are derived from a cross between either an Italian or perennial ryegrass and meadow fescue. Meadow fescue traits provide persistence, ease of establishment and management, and good disease resistance. The high palatability and forage qualities of ryegrass are combined with seasonal productivity of meadow fescue. Although first developed in the 1950s, most festuloliums are relatively new varieties, and little forage research data or experience is available.

Adaptation and use—Festuloliums are suited to fertile soils with irrigation, including sub-irrigation, and to humid areas where effective annual precipitation exceeds 18 inches. Persistence may be short term.

Grazing management—Growth begins in early spring, and grazing should begin after plants are 8 to 10 inches tall. Maintain stubble height at 3 to 4 inches.
Regrowth is good in cool spring and fall weather and better than that of perennial ryegrass during summer heat. The recommended rest period between grazing cycles is approximately 21 to 28 days.

**FOXTAIL, CREEPING (ALOPECURUS ARUNDINACEUS)**

Creeping foxtail is a long-lived, introduced, cool-season, deep-rooted, dense, sod-forming grass. Creeping foxtail is similar in appearance to timothy, but seed heads generally are black and hairy.

**Adaptation and use**—Creeping foxtail is very well adapted to wet, acidic, poorly drained sites. It has slight to moderate saline/alkaline tolerance, but produces abundant excellent-quality forage on wet, fertile sites. It is suited to irrigation, sub-irrigation, moderately wet to very wet conditions, and to dryland areas where effective annual precipitation exceeds 18 inches. On wet sites, it is usually superior to other adapted grasses such as reed canarygrass and timothy. It is very cold-tolerant and can persist in areas where the frost-free period averages less than 30 days.

Creeping foxtail invades wet areas along ditches, canals, drains, and streams and can be a serious weed in these areas.

Creeping foxtail is productive and compatible in mixtures with legume species such as cicer milkvetch and birdsfoot trefoil.

Seed is very light and difficult to drill without the use of cracked corn, rice hulls, or other carriers. Creeping foxtail has low seedling vigor, but once established it spreads readily by rhizomes.

Productivity is very high during the cool season. This species is also capable of strong summer growth when fully irrigated, and leaves remain green until after hard frosts in the fall.

**Grazing management**—Growth begins early in the spring. Spring grazing should begin after the forage is 6 inches tall. Remove livestock when stubble is 4 inches tall. Creeping foxtail recovers quickly from grazing if soil moisture is available, and regrowth ability is excellent. A 21- to 28-day recovery period is recommended.

**ORCHARDGRASS (DACTYLIS GLOMERATA)**

Orchardgrass is a long-lived, deep-rooted, high-yielding, introduced bunchgrass.

**Adaptation and use**—Orchardgrass does best on soils with few limitations and good drainage. Avoid shallow and sandy soils. At 18 inches of annual precipitation, orchardgrass does not provide much forage. Irrigation or additional rainfall is required for good forage production. Orchardgrass is shade-tolerant. It is more vulnerable to diseases than many pasture grasses.

Orchardgrass is less winter-hardy than meadow brome, smooth brome, timothy, or creeping foxtail. It is not well adapted to areas with cold, dry winters. Production is also lower in areas that commonly experience mid-to late-spring frost. Other species may be a better selection under these conditions.

Orchardgrass is highly palatable to livestock and wildlife, especially in the early part of the growing season. It is widely preferred by all classes of livestock and wildlife. It is used for hay, pasture, or silage. It is compatible in alfalfa, sainfoin, and clover mixes. It is also used in erosion-control mixes, primarily for its forage value.

Varieties are early-, mid-, and late-season in maturity. Late-season varieties are preferred in mixtures with alfalfa.

**Grazing management**—Do not graze new plantings until late summer or fall of the first growing season. Harvesting for hay during the establishment period is recommended.

On established pastures, orchardgrass initiates growth early in the spring, with long, folded leaves arising mostly from the plant base. For optimum forage quality and regrowth, harvest orchardgrass while still in the boot stage. Grazing should begin when growth reaches approximately 8 inches. Remove livestock when plants have at least 4 inches of stubble height remaining. Regrowth is good when plants are properly grazed. A 28- to 35-day recovery period is recommended.

Orchardgrass does not tolerate close or continuous grazing, because energy is stored mainly in the lower stems and leaf parts. Close grazing in the fall is associated with winter kill. Winter grazing should be limited to 60 percent of annual growth.

**RYEGRASS, PERENNIAL (LOLIOUM PERENNE)**

Perennial ryegrass is an introduced, short-lived, rapidly establishing, vigorous bunchgrass.

**Adaptation and use**—Perennial ryegrass is adapted to a wide variety of soil conditions. For high yields, it requires as much as 30 to 50 inches of precipitation or irrigation and large nutrient inputs. This species does best where winters are mild. Perennial ryegrass prefers acidic to mildly basic soils (pH of 5.0 to 8.0).
Perennial ryegrass is moderately productive and produces high-quality forage. Because it is strongly preferred by grazing animals, it is not recommended in mixtures with other grasses. It also may retard the establishment of other perennials if seeded too heavily in a mixture.

In cooler regions of the Intermountain West, treat this species as an annual. It will provide good forage for grazing within 60 to 90 days following planting, but probably will not maintain a full stand the following year.

Perennial ryegrass often contains a fungal endophyte that is linked to the occurrence of ryegrass staggers (see chapter 12). There have been reports of ryegrass staggers in Oregon and California. You can reduce or eliminate this problem by using endophyte-free seed, although production may be lower.

Because of the need for high fertilizer application rates, split applications are recommended.

**Grazing management**—Grazing can begin when vegetation is 8 to 10 inches tall. Leave a 3-inch stubble height. Perennial ryegrass has good recovery after grazing. A 21- to 28-day recovery period between grazing cycles is recommended. Perennial ryegrass tends to go dormant when summer temperatures exceed 80°F.

**TIMOTHY (PHLEUM PRATENSIS)**
Timothy is a short-lived, shallow-rooted, introduced, perennial bunchgrass.

**Adaptation and use**—Timothy is adapted to cool, humid areas and to high elevations. It is adapted to irrigated areas and areas with effective annual precipitation of at least 18 inches. It produces moderate to high yields on wet, fertile soils. It is compatible in mixes with legumes.

Timothy establishes quickly and volunteers readily on preferred sites. It invades wet areas along ditches, canals, drains, and streams and can be a serious weed in these areas.

Timothy is preferred by cattle and horses, and timothy hay is a premium feed for horses. This species is very palatable in late spring and early summer, but only moderately palatable in late summer and fall (after seedhead development). It is late-maturing.

Timothy can also be used for ground cover and erosion control on cut or burned-over forest land.

**Grazing management**—In spring, the crowns form swollen, bulb-like internodes that store energy. Close grazing and trampling during moist conditions can damage these internodes and severely reduce stands.

Begin grazing during the vegetative stage, after grass has reached at least 6 inches in height. A 4-inch stubble height should remain following grazing. Timothy should be hayed before seedheads have emerged from the boot. It regrows slowly following grazing or haying. A 28- to 35-day recovery period between grazing cycles is recommended.

**WHEATGRASS, CRESTED**
Crested wheatgrass growth begins early in the spring. Following heading, protein levels drop rapidly, and forage becomes coarse and less desirable. Growth may begin again in fall if moisture is available.

**Standard-type crested wheatgrass** (*Agropyron desertorum*) is adapted to a wide range of sites and to precipitation zones as low as 9 to 10 inches. This species is more drought-tolerant than Fairway-type crested wheatgrass. Above 6,500 feet elevation, expect lower plant vigor and reduced stands.

**Fairway-type crested wheatgrass** (*Agropyron cristatum*) is similar to standard crested wheatgrass but shorter statured and earlier maturing. It also has finer stems and leaves. It establishes on similar sites (10 to 18 inches annual precipitation), but is better adapted to higher elevations. It does not survive as well as standard crested wheatgrass under prolonged drought conditions.

**Hybrid crested wheatgrass** (*Agropyron cristatum x A. desertorum*) is a hybrid cross between standard-type and induced tetraploid Fairway-type crested wheatgrass. Seedlings are very vigorous during germination and early establishment. It is adapted to a wide range of sites and to annual precipitation zones as low as 9 to 10 inches. This species is more drought-tolerant than Fairway-type crested wheatgrasses.

**Grazing management**—Begin grazing after plants have reached the 6-inch growth stage. To maintain long-term plant health, leave 3 inches of stubble at the end of the grazing period or going into winter. In spring, a 28- to 35-day recovery period between grazing periods is recommended. Crested wheatgrass has poor regrowth ability in early to late summer, primarily because it goes dormant following heading and in hot weather.
Fall grazing is possible in some years following fall rains. Late-fall and winter grazing requires protein supplements. To avoid grass tetany, ensure that adequate stubble remains following fall grazing or supplement livestock with magnesium and calcium during spring grazing. Grazing stubble with spring green-up reduces the risk of tetany.

**WHEATGRASS, INTERMEDIATE AND PUBESCENT (THINOPYRUM INTERMEDIUM)**

Intermediate wheatgrass is a mildly rhizomatous, sod-forming, late-maturing, long-lived, introduced grass. Pubescent and intermediate wheatgrass are very similar, but pubescent wheatgrass has pubescence (fine hairs) on the leaves and seedheads.

**Adaptation and use**—Intermediate and pubescent wheatgrass are recommended for upland, medium- to fine-textured soils. Intermediate wheatgrass is best adapted to areas with 13 to 18 inches of annual rainfall, while pubescent wheatgrass is suitable for areas with 11 to 18 inches of annual rainfall. Both are somewhat saline-tolerant (electrical conductivity of 6 to 12 mmhos/cm). Neither is shade-tolerant.

This species is excellent for situations where only one to three irrigation applications are possible. It readily responds to irrigation and fertilization with increased forage production, but can withstand extended drought periods without irrigation.

Intermediate and pubescent wheatgrass are suited for use as hay and pasture, alone or with alfalfa or other legumes. Both are useful for soil stabilization and erosion control on disturbed sites.

This species begins growth early in the spring and remains green and palatable into the summer, producing large amounts of nutritious forage. Forage quality and growth are reduced during mid- to late summer.

**Grazing management**—On established stands, begin spring grazing after grass has reached a height of 8 inches. Regrowth following grazing is good if soil moisture is available. Nitrogen application significantly increases forage production and regrowth following clipping or grazing under irrigated conditions. On irrigated pasture with high moisture conditions, allow a 21- to 28-day recovery period in the spring. A longer recovery period may be needed in late spring, early summer, and fall. Leave a 4-inch stubble height after each grazing period and going into winter. Heavier grazing will result in reduction and eventual loss of the stand.

**WHEATGRASS, SIBERIAN (AGROPYRON FRAGILE)**

Siberian wheatgrass is a long-lived, drought-tolerant, vigorous, winter-hardy, introduced bunchgrass.

**Adaptation and use**—Siberian wheatgrass is well adapted to medium loam to light, sandy, droughty soils.

Siberian wheatgrass has finer leaves than crested wheatgrass and retains its greenness and palatability later into the summer. It yields less than crested wheatgrass during normal rainfall years, but generally produces higher yields than crested wheatgrass during periods of extended drought. It is adapted to sites with as little as 7 to 16 inches of annual precipitation.

Siberian wheatgrass is palatable to all classes of livestock. It is a preferred feed in spring and again in fall if soil moisture is available and regrowth occurs. Following heading, protein levels drop rapidly. Forage becomes coarse and less desirable in early to mid-summer. Late-fall and winter grazing requires protein supplements.

**Grazing management**—Growth begins early in the spring. Begin grazing after plants have reached the 6-inch growth stage. To maintain long-term plant health, leave 3 inches of stubble at the end of the grazing period. In spring, a 28- to 35-day recovery period between grazing cycles is recommended. Siberian wheatgrass has poor regrowth ability in summer, primarily because it goes dormant following heading during the heat of the summer.

Growth resumes with fall moisture, and fall grazing is possible in years when sufficient regrowth occurs.

To avoid grass tetany, ensure that adequate stubble remains following fall grazing or supplement livestock with magnesium and calcium during spring grazing. Grazing stubble with spring green-up reduces the risk of tetany.

**WHEATGRASS, TALL (THINOPYRUM PONTICUM)**

Tall wheatgrass is a long-lived, tall, coarse, vigorous, late-maturing, winter-hardy, introduced bunchgrass.

**Adaptation and use**—Tall wheatgrass is adapted to a wide range of soils and climates. It is recommended for 14-inch or higher annual rainfall zones or sites with high water tables. Once established, tall wheatgrass tolerates saline, alkali, and high water table conditions better than most grasses. It is adapted to saline areas such as
greasewood and saltgrass sites where the water table is from a few inches to several feet below the surface.

Tall wheatgrass is useful for erosion control and as a wind barrier to control soil erosion and drifting snow. It provides nesting cover and food for upland game birds.

This species is the latest maturing of the wheatgrasses. Palatability is acceptable early in the growing season, but mature plants become very unpalatable. Late-standing material becomes good winter forage for livestock when used with supplemental protein sources.

**Grazing management**—Grazing should not begin until grass is at least 10 inches tall. Stubble height should never be less than 6 inches between grazing periods and at the end of the grazing season. Regrowth is slow, and rest periods should be at least 35 days.

**WHEATGRASS, WESTERN (PASCOPYRUM SMITHII)**

Western wheatgrass is a long-lived, late-maturing, widely distributed, winter-hardy, strongly rhizomatous, native grass with coarse, blue-green leaves.

**Adaptation and use**—Western wheatgrass is adapted to lowlands prone to early-season flooding. It is particularly productive in clayey to silty swales and waterways and has moderate to high salt tolerance. It is best adapted to 12- to 14-inch and higher rainfall zones in the Intermountain West. It is a productive native hay producer during above-normal precipitation years and under irrigation.

When used as pasture, this species is an excellent source of spring and early-summer forage, with crude protein content of 16 to 18 percent. However, forage quality declines rapidly as plants mature. Western wheatgrass provides good winter grazing if protein supplements are provided. Protein content of cured western wheatgrass is usually a little higher (4 to 5 percent) than that of other wheatgrasses.

Western wheatgrass is typified by poor germination and low seedling vigor. Plantings usually result in scattered stands that spread in 3 to 5 years to dominate the site.

Once established, western wheatgrass becomes very persistent and provides excellent soil-binding and erosion-control characteristics.

**Grazing management**—Western wheatgrass begins growth later than most wheatgrasses. Grazing should not begin until grass is at least 4 inches tall. Stubble height should not be less than 3 inches between grazing periods and at the end of the grazing season. Regrowth is slow, and rest periods should be at least 35 days.

**WILDRYE, ALTAI (LEYMUS ANGUSTUS)**

Altai wildrye is a long-lived, deep-rooted, winter-hardy, drought-resistant, cool-season, introduced grass with short rhizomes.

**Adaptation and use**—Altai wildrye is adapted to moderately deep to deep loam to clay loam soils with 14 inches or more of annual rainfall. Roots can grow and use moisture to a depth of 15 feet. This species can withstand saline conditions almost as well as tall wheatgrass and is almost as productive on saline sites.

Seedlings develop slowly, and good seedbed preparation and weed control are essential.

Altai wildrye begins growth in mid-spring and grows into late fall. Basal leaves are somewhat coarse, but are very palatable during late summer and early fall. Altai wildrye provides excellent winter forage. Coarse, erect, stiff stems reach 2 to 4 feet in height and tolerate snow loads. Protein levels of 8 percent are common in standing winter feed. This species can also be swathed into windrows, cured and utilized as winter feed (see chapter 14).

**Grazing management**—Grazing can begin when grass is 8 inches tall. Remove livestock when stubble is 6 inches. This species has fair to good regrowth characteristics if soil moisture is available. Grazing cycles with approximately 35 days or more rest are recommended.

**WILDRYE, BASIN (LEYMUS CINEREUS)**

Basin wildrye is a slightly spreading, robust, tall, coarse, long-lived, native bunchgrass.

**Adaptation and use**—Basin wildrye is especially suited to deep, fine-textured clayey to loamy soils that receive 10 to 16 inches of annual precipitation. It is well adapted to moderately saline or alkaline lowlands, floodplains, and areas with high water-holding capacity.

Basin wildrye is useful for calving pasture and for wildlife forage and cover. Once established, this is a very high-yielding species. Basin wildrye is highly
palatable in the spring, but palatability declines rapidly with maturity. The old, coarse growth is readily utilized by late-fall or winter grazing, as long as protein supplements are provided.

**Grazing management**—Poor seedling vigor usually results in sparse stands. Do not graze new seedings until seedheads are evident or until at least the end of the second growing season.

On established stands, allow basin wildrye to reach at least 10 to 12 inches of growth before grazing. Take great care to avoid close grazing or clipping, which may result in high levels of plant loss in a single season. During active growth, do not graze below a 10-inch stubble height to avoid removing the growing point. Regrowth ability following grazing is poor, and multiple grazing cycles are not recommended. Maintain at least a 6-inch stubble height going into the winter.

**WILDRYE, RUSSIAN** (*PSATHYROSTACHYS JUNCEA*)

Russian wildrye is a long-lived, saline-, drought-, and cold-tolerant introduced bunchgrass.

**Adaptation and use**—Plant in areas that receive at least 8 inches of annual precipitation.

Russian wildrye can withstand saline conditions almost as well as tall wheatgrass. It is useful on soils too alkaline for crested wheatgrass and too dry for tall wheatgrass. Once established, Russian wildrye competes very effectively against undesirable plants.

This species produces abundant basal leaves that remain green and palatable throughout summer and fall as long as soil moisture is available. Russian wildrye is palatable to all classes of livestock. It cures better on the stump than most cool-season grasses and makes excellent fall and winter feed. In late-summer, fall, and winter, it is more palatable than crested wheatgrass. Russian wildrye is not suited for hay production due to the predominance of basal leaves, which make it difficult to harvest.

Russian wildrye is very sensitive to deep seed placement. Plant at 0.25 to 0.5 inch depth. Wide row spacing (at least 18 inches) results in the highest potential production.

**Grazing management**—Russian wildrye grows rapidly in the spring. It can be grazed when plant growth reaches 8 inches. At least 3 inches of stubble should remain following grazing. Manage stands carefully to avoid overutilization, as stands can be damaged by heavy spring use. In spring, a 28- to 35-day recovery period between grazing cycles is recommended. Recovery periods during summer should be more than 35 days. Russian wildrye regrows quickly if soil moisture becomes available, and it responds very well to supplemental irrigation.

**Pasture species—legumes and other forbs**

**ALFALFA** (*MEDICAGO SATIVA*)

Alfalfa is a very productive, palatable, perennial, introduced legume (plants that fix N). Many varieties are available, each with specific characteristics and purposes.

**Adaptation and use**—Alfalfa is adapted to well-drained sites. It does poorly at higher elevations and on sites with a high water table. It is suitable for irrigated sites or on dryland sites with effective annual precipitation of at least 12 inches. Varieties differ in their fall dormancy rating. Fall dormancy is correlated with winter hardiness in older varieties. Newer varieties that have a winter survival rating of less than 3 are suitable for areas with hard winters.

Alfalfa is suited for use as hay, pasture, or haylage. It is compatible with most dryland and irrigated forage grasses. Bloat can be a problem when grazing alfalfa. To reduce bloat problems, limit alfalfa to 25 percent of a mixed stand and seed at 1 pound per acre.

The taproot of alfalfa is vulnerable to pocket gopher damage. Creeping varieties are less susceptible to damage. Creeping types are also more tolerant of grazing than are crown-type varieties.

Plant alfalfa in midspring after the risk of a killing frost has passed or in summer at least 6 weeks before a killing frost. Seed requires inoculation with N-fixing bacteria before planting. See chapter 4 for the proper inoculum.

**Grazing management**—Grazing can begin after alfalfa reaches a height of 6 inches. Following grazing or haying, alfalfa starts to regrow quickly but replenishes its food reserves slowly. Frequent defoliation at short intervals depletes reserves and reduces survival. A rest period of 28 to 35 days is recommended. Terminate grazing 3 to 4 weeks before the first killing frost to allow buildup of food reserves for winter survival.
BURNET, SMALL (SANGUISORBA MINOR)
Small burnet is a perennial, semi-evergreen, introduced forb that grows up to 2.5 feet tall. It is non-leguminous (does not fix N) and deep rooted.

Adaptation and use—Small burnet is best adapted to well-drained soils. It can be grown on low-fertility, droughty soils, as well as on moderately wet, acid soils. It establishes easily on good soils, but will not persist with less than 14 inches of annual precipitation or in areas that are shaded, poorly drained, or have a high water table.

Small burnet provides moderate amounts of forage. It is very palatable to livestock and wildlife. Upland game and songbirds utilize its seed.

Grazing management—Defer grazing until the second growing season to allow plants to become established. In established stands, growth is most vigorous in spring and fall. Allow plants to reach a height of 12 inches before grazing. Recovery following grazing is good. Rest periods should be about 35 days. Stubble height at the end of the grazing period or season should be 6 inches.

CLOVER, ALSIKE (TRIFOLIUM HYBRIDUM)
Aliske clover is a short-lived (3 to 5 years), perennial legume.

Adaptation and use—Aliske clover is adapted to flooded or poorly drained, acid soils. It makes good hay from wet bottomlands and tolerates moderately saline to alkaline conditions with high water tables. It produces best under irrigation or on dryland where the effective annual precipitation is at least 18 inches. This species is especially useful in cool areas, as it is very tolerant of cold temperatures and frost heaving. It does not tolerate droughty conditions or hot temperatures and is not well adapted to sandy soils or shade.

Aliske clover produces abundant palatable foliage on fertile soils. It is most productive in mixtures with grasses. Bloat is a potential problem. To reduce bloat problems in grazing situations, limit aliske clover to 25 percent of a mixed stand and seed at 1.5 pounds per acre. Seed requires inoculation with N-fixing bacteria before planting. See chapter 4 for proper inoculum.

Grazing management—Aliske clover is best if grazed in spring. Begin grazing after about 6 inches of growth or at the quarter- to half-bloom stage. In spring and early summer, a rest period of 21 to 35 days is recommended. Regrowth is excellent in spring when temperatures are low and soil moisture is available, but poor later in the summer. A stubble height of 3 inches should remain at the end of the grazing period or season.

CLOVER, RED (TRIFOLIUM PRATENSE)
Red clover is a short-lived (2 to 3 years), perennial legume.

Adaptation and use—Red clover is adapted to irrigated conditions or to dryland where effective annual precipitation is at least 25 inches. It requires well-drained soils and produces best under medium acid to neutral soil conditions (pH 6.0 to 7.5). It is tolerant of shade, but does not tolerate flooding, saline conditions, or waterlogged soils. It does not tolerate drought or hot temperatures.

Red clover is suited primarily for hay and silage. It is compatible with white clover and grasses in pasture mixtures. Because red clover is short lived, production is usually greater in the second year than in the first or third. This species will reseed and spread under favorable conditions.

Bloat is a potential problem. To reduce bloat problems in grazing situations, limit red clover to 25 percent of a mixed stand and seed at 1 pound per acre. Seed requires inoculation with N-fixing bacteria before planting. See chapter 4 for proper inoculum.

Grazing management—Red clover is best if grazed in spring. Begin grazing after about 6 inches of growth or at the quarter- to half-bloom stage. In spring and early summer, a rest period of 21 to 35 days is recommended. Regrowth is excellent in spring when temperatures are low and soil moisture is available, but poor later in the summer. A stubble height of 3 inches should remain at the end of the grazing period or season.

CLOVER, WHITE (LADINO) (TRIFOLIUM REPENS)
White clover is a long-lived, shallow-rooted, stoloniferous, low-growing, perennial legume.

Adaptation and use—White clover thrives in cool, moist mountain and intermountain areas with winter snow cover. It can be grown under irrigation or on dryland where effective annual precipitation is at least 18 inches. In general, it is best adapted to clay and loam soils in humid and irrigated areas. It grows successfully on sandy soils with a high water table or on irrigated, droughty soils when adequately fertilized.
White clover seldom roots deeper than 2 feet, making it adapted to shallow soils as long as adequate soil moisture is available. It is not tolerant of strongly acid or strongly alkaline conditions or of poor drainage. It does not tolerate drought or high temperatures.

White clover is suited primarily for pasture and is best grazed in spring. It is compatible with red clover and grasses in pasture mixtures and will reseed and spread under favorable conditions. Bloat is a potential problem. To reduce bloat problems in grazing situations, limit white clover to 25 percent of a mixed stand and seed at 1 pound per acre. Seed requires inoculation with N-fixing bacteria before planting. See chapter 4 for proper inoculum.

This species is also a good erosion-control plant, although usually lacking in persistence.

**Grazing management**—Begin grazing after about 6 inches of growth. In spring and early summer, a rest period of 21 to 35 days is recommended. Regrowth is excellent in spring when temperatures are low and soil moisture is available, but poor later in the summer. A stubble height of 3 inches should remain at the end of the grazing period or season.

**MILKVETCH, CICER (ASTRAGALUS CICER)**

Cicer milkvetch is a long-lived, slow-establishing, late-maturing, grazing-tolerant, winter-hardy, introduced, rhizomatous, non-bloat legume.

**Adaptation and use**—Cicer milkvetch is adapted to cold lowland areas and to soils with high water-holding capacity that receive at least 14 inches of annual precipitation. It is moderately tolerant of flooding.

Cicer milkvetch is a heavy seed and forage producer with nutritious forage. The best time to utilize cicer milkvetch forage is summer and fall. This species is very tolerant of livestock trampling. It is a good species for fall and early-winter stockpiled forage, as nutrients are retained in later growth. Hay yield is nearly equal to that of alfalfa.

Cicer milkvetch is very compatible with irrigated pasture grasses. It can substitute for alfalfa at higher elevations where alfalfa winter kills, or where a high water table limits alfalfa production.

In a 50 percent mixed stand, a seeding rate of 4 pounds per acre is recommended. This species establishes slowly due to very hard seed. Scarification of seed is recommended. Seed requires inoculation with N-fixing bacteria. See chapter 4 for proper inoculum.

**Grazing management**—Begin grazing after cicer milkvetch has reached a 4-inch height. After grazing, new shoots grow from buds on the rhizomes, crowns, and nodes of the lower leaves, allowing for relatively rapid recovery and growth. Rest periods of 35 to 42 days are recommended. Stubble should be 3 inches at the end of the grazing period or season.

**SAINFOIN (ONOBRYCHIS VICIIIFOLIA)**

Sainfoin is a deep-rooted, medium-lived, drought-resistant, introduced, cool-season, non-bloating legume.

**Adaptation and use**—Sainfoin is adapted to deep, well-drained, medium-textured soils, to high lime content, and to slightly alkaline soils. It is adapted to irrigated conditions and to dryland with at least 14 inches of annual precipitation. It is not tolerant of wet soils or high water tables.

Sainfoin can be grazed or used for hay. It blooms early, but is not as productive as alfalfa. It is highly palatable.

The recommended seeding rate for a 50 percent mixed-stand pasture is 17 pounds per acre. Sainfoin has good seedling vigor, but seedlings are not competitive against weeds or other plants. Seed requires inoculation with N-fixing bacteria before planting. See chapter 4 for proper inoculum.

Stands seldom live more than 10 years due to problems with stem and root rot. To maintain a stand long-term, allow established plants to reseed every 3 or 4 years.

**Grazing management**—Begin grazing in the early-bloom stage or at about 12 inches of height. Rest periods of 35 to 42 days are recommended. A stubble height of 6 inches should remain at the end of the grazing period or season.

**SWEETCLOVER, YELLOW AND WHITE (MELILOTUS OFFICINALIS AND M. ALBA)**

Sweetclover is an introduced, tall, stemmy, deep-rooted, biennial legume.

**Adaptation and use**—Sweetclover is adapted to many sites, but does not tolerate acid soils. It is the most drought-tolerant legume commercially available.

Sweetclover produces abundant forage the first 2 years and is commonly utilized as a cover crop for perennial seedings. It is also suited for green manure or green-chop haylage under irrigation or on dryland where effective annual precipitation is at least 9 inches.
Sweetclover reseeds and maintains good stands in years of above-normal spring precipitation, as long as perennials do not crowd it out. Forage quality is poor in mid- to late summer. Bloat is a potential problem. To reduce bloat problems in grazing situations, limit sweetclover to 25 percent of a mixed stand and seed at 1 pound per acre. Seed requires inoculation with N-fixing bacteria before planting. See chapter 4 for proper inoculum.

**Grazing management**—Begin grazing after sweetclover has reached 8 inches in height. In spring and early summer, a rest period of 28 to 35 days is recommended. This species has excellent recovery and growth in spring and early summer if soil moisture is available. Stubble height should be at least 6 inches at the end of the grazing period or season.

Sweetclover contains coumarin, a derivative of dicoumarol, a blood anticoagulant. Death may occur in animals foraging on pure stands or consuming spoiled hay or silage.

**TREFOIL, BIRDSFOOT (LOTUS CORNICULATUS)**

Birdsfoot trefoil is a short-lived, deep tap-rooted, non-bloat, introduced legume.

**Adaptation and use**—Birdsfoot trefoil can be grown under irrigation or on dryland where effective annual precipitation is at least 18 inches. It is very winter-hardy where protected by snow cover and is useful in high-elevation settings. It tolerates poor drainage and waterlogged soils. Under ideal growing conditions, it may invade adjacent areas.

Birdsfoot trefoil is suited for use as pasture or hay. Compared to alfalfa, it retains higher quality forage on mature growth. The decumbent and intermediate types tolerate close grazing better than erect types. This legume is quite vigorous and is an excellent plant for erosion control.

For grazing situations in a 50 percent mixed stand, a seeding rate of 1.5 pounds per acre is recommended. If the mixture includes grasses, alternate-row planting is recommended to allow birdsfoot trefoil to establish. Seed requires inoculation with N-fixing bacteria before planting. See chapter 4 for proper inoculum.

Birdsfoot trefoil is short lived (2 to 4 years), making reseeding necessary. However, if plants are allowed to go to seed, stands will persist for many years.

**Grazing management**—New stands establish slowly and should be hayed the first growing season. On established stands, grazing can begin after 6 inches of new growth. Regrowth initiates from buds formed in the leaf axils. Allow 28 to 36 days between grazing periods. Terminate grazing 3 to 4 weeks before the first killing frost to allow buildup of food reserves for winter survival. Stubble height should be at least 3 inches at the end of the grazing period or season.

For more information