



Pasture FAQ

<http://www.sheeps creek.com/rural/pasture.html>

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Why pasture?

On many high-productivity farms today, the answer might be "nostalgia" or "to clean up odd corners that the tractors can't reach." Some large, mechanized farms get along with no pasture at all. Dairy cows are fed silage, hay, and grain; market lambs and beef cattle are fattened in feedlots; horses get by on stall feeding. In the interest of efficiency and maximum gains, pasture is sometimes limited to dry cows or rams after breeding.

The economics of large, mechanized farms don't necessarily apply to smaller farms, and especially hobby operations, where pasture can provide excellent low-cost feed, savings in hay and manure handling, reduced use of chemicals and fertilizer, a healthier environment than the barnyard or feedlot, less storage of feed and manure, extra-clean wool or [grass-fed lamb or beef for specialty markets](#), long-term [benefits to the land](#), [retention of nutrients in the soil](#) compared with haying, reduction of [water pollution problems](#) from nitrate and manure run-off, high productivity on aggressively rotated pastures, and the pleasures of watching foals or lambs gambol on a grass field.

How much pasture do I need?

Pasture needs depend on local rainfall, forage quality, the availability of alternate pastures for rotation, the level of fertilizer and other nutrients applied to the pastures, the time and equipment available for pasture maintenance such as clipping or taking a cutting of hay, the length of the grazing season, and whether the pastures are primary or supplementary feed.

The common rule of thumb is that one acre of permanent pasture can support one animal unit (1000 lbs. of grazing animal) through the grazing season. Other units, such as DSE (Dry Sheep Equivalent) are also used to measure livestock carrying capacity. Pasture productivity can vary widely from that guideline. Lush improved pastures can provide grazing for 10-12 ewes with their lambs per acre. Stocking rates for aggressive rotation schemes, with substantial rests for the pastures after each grazing cycle, can reach 200 sheep per acre on improved pastures. At the other end of the scale, a cow or horse would have trouble supporting itself on five or even ten acres of dry Western native grassland, and one sheep per acre is the rule on some Australian sheep stations.

Too much pasture can be as big a problem as too little, unless you can take a cutting of hay when the forage gets ahead of the animals, or use a mower to clip weeds and over-ripe grass to provide fresh grazing. See the [Haying FAQ](#) for information on haying practices and equipment.

Measuring Pastures

Eyeball estimates of the size of a field are often way off. [Calculating the area of a field](#) is not difficult if the field can be divided up into a set of triangles and rectangles, and you can measure the length of each side of each rectangle and triangle with a measuring wheel or tape. An alternative, if you can spend some time with a transit or theodolite, along with a measuring wheel or tape, is the [Survey Worksheet](#). Accurate size estimates are useful in calculating carrying

capacity, fertilizer and lime application rates, and in measuring forage yield for [Management Intensive Grazing](#).

Irrigation

The carrying capacity of pasture land can be extended dramatically, especially in dry areas, with irrigation. The rule of thumb is that irrigation will increase dry matter (DM) production by 40%. You need a reliable source of water, which in the west generally means water rights, and the equipment is expensive: low pressure units adequate for up to 40 acres are \$5,000-\$10,000; high pressure guns are \$15,000-\$50,000 for 20-100 acres; and centerpivots (the round green circles you see when flying cross-country) are \$50,000-\$300,000 for 100-240 acres. Frequent shallow irrigation can be effective, creating a network of surface roots that quickly respond to water; shallow irrigation is only effective if it is continuous. For irregular irrigation, deeper watering will encourage a deeper root structure that is better able to handle dry periods.

Can I graze different animals together?

In most cases, you can graze different animals together, and their different grazing and browsing patterns will increase the productivity of your pastures. Horses and cattle mostly eat grasses, and only occasionally eat forbs or browse brush and trees. Goats eat mostly browse, with a much smaller intake of grass and forbs. Sheep eat younger grasses, forbs, and browse. By taking advantage of the different patterns, you can not only increase the productivity of your pastures, but keep weeds and brushy growth under control with minimal mowing and herbicides.

Often, additional animals of a different species can be added to your pastures without reducing the existing population. As a rule of thumb, adding one ewe for each grazing cow will not require additional pasture. Sheep will eat closer to the cowpies than the cattle, taking advantage of the lush growth from the potassium, nitrogen, and phosphorus in the urine and manure. A few cattle grazing with sheep will consume coarse stems and seedheads that the sheep refuse to eat. Other combinations may require experimentation. Another useful grazing scheme is to rotate different species onto a pasture. After cattle eat the rough growth, sheep will eat the lower grasses and legumes that the cattle cannot reach. In some instances combining species can have advantages: sheep will control leafy spurge that would otherwise limit the productiveness of cattle pastures.

Pastures can also be used for [swine](#) and [poultry](#). Swine on pasture need nose rings to prevent rooting up of the forage, and poultry pastures need periodic rotation to other uses to prevent build-up of diseases, as well as [portable pasture cages](#).

Some cautions in grazing species together: There are some diseases which can be transmitted between species, such as leptospirosis, which horses can pick up by drinking from cattle tanks or ponds. Also, the mineral needs of different species can be far enough apart that mineral mixes or TM salt that is appropriate for one species will include levels of some minerals that could prove toxic for another species. For example, most bovine mineral mixtures carry far more copper than ovines can tolerate. There are even variations among breeds: for example, some tests have shown that Simmental cattle need more copper than other breeds. If you're pasturing animals together, you may have to study the labels on mineral mixtures carefully to make sure you can meet the special requirements of some species (for example, ovines without molybdenum in their diet from forage or a special mineral supplement will have extremely low tolerance for copper). If for special reasons, your animals have widely differing mineral needs, you may have to pasture them separately.

How do I convert woodland, or an old field, to a productive pasture?

The methods depend on whether you have more money or more time. Instant pastures are expensive. If you're willing to spend a few years on the project, it can be done with minimal investment.

Start with a survey of the trees. There may be some trees you want to leave on an overgrown orchard, field, or woodlot, like old apple trees or ancient "wolf" trees on the edges of a field. Most animals enjoy fallen fruit (watch out for drunk sheep if the apples lie too long), and all animals need shade. You may be able to sell mature trees to a logger; otherwise, take advantage of the firewood. If you have access to a chipper, the slash can be chipped for garden mulch and as path coverings. Alternatives for the slash are burning (you'll probably need a permit), or piling in an out-of-the-way area as a wildlife refuge. It will eventually rot down.

Clearing Land

The quick way to a pasture is to hire a bulldozer with a grubber blade, or a backhoe, to clear the stumps and stones. A grubber blade looks like a huge rake, and will clear out stumps and large stones without scraping away the topsoil. A good backhoe operator can also pull stumps and stones without disrupting too much of the topsoil. Some backhoe operators find it easier to pull stumps when the trees are left standing, by using leverage high up on the trunk. It may be wise to ask before you bring out the chainsaw. If you hire a bulldozer without a grubber blade, make sure the operator scrapes the topsoil aside before pulling stones and stumps, and regrades the topsoil afterwards.

If you have more patience than money, saw stumps parallel to the ground — a sharp stump can wreak havoc with tractor tires or the feet of livestock — and where possible, cut the stumps low enough to clear a mower, so you can clip the pasture even before the stumps rot. You may want to hire a backhoe or dozer to pull a few large stones, or learn to live with them. Lambs love a big stone or two for games.

You can cut brush low to the ground with a chainsaw, a saw-blade on a heavy-duty weed-whacker, a heavy-duty brush hog, or a hydroax (a super heavy-duty brush-hog mounted on an excavator). Be careful with light-duty brush hogs on heavy brush or a stony field, or saw-blades on lawn-trimmers. You may be able to scrape away some brush with a bucket-loader on a tractor, though most tractor loaders don't take kindly to being treated as a bulldozer. You may have to mow some brush repeatedly to eliminate the growth.

Be cautious in converting an old orchard or other cropland on which there has been profligate use of chemical sprays to pasture land. [Experiments](#) on former orchards have measured dangerous or production-inhibiting levels of copper, lead, arsenic, and other minerals many years after the last spraying. Thorough [soil tests](#) are a good idea before extensive grazing.

Using Animals to do the Work

Sometimes, it is easiest to use animals to clear the brush. Goats are specialists, often preferring brush to grass and clover. Sheep love poison ivy and bittersweet, and will clean up leafy spurge, which has proved a problem in areas as widespread as the western range states and Rhode Island. Donkeys like young thistle plants. The real masters of brush clearing are pigs, who will eat roots and all if they are put out without nose rings. The trick to getting animals to clear brush and weeds is to confine them to a relatively small area with a tether or temporary fences. If they have an entire pasture to roam, animals seek out tasty new grass, clover or buds. When they are confined to a small area, they eat everything in sight, including brush and weeds. One clever trick for stumps is to drill deep holes in the perimeter of the stump and fill them with corn grain; pigs will work until they have even a large stump out to get the last of the grain.

Watch out for [poisonous plants](#) when "mob stocking" a pasture to eliminate rough or unwanted growth: animals that are pressed may ingest plants that they would avoid under normal grazing conditions.

Once you have the trees and brush cleared, it's time to [upgrade](#) the pasture.

How do I improve the present mix of native grasses and weeds?

The greatest improvements to the soil and the pasture comes from careful and controlled grazing. The addition of animal manures and urine, and the regular ``mowing" of the forage from livestock grazing in large enough numbers, will do wonders for a pasture. Sometimes, a few additional steps can help the animals do their job.

Identifying existing forage

Identifying the existing grasses and legumes in a pasture is important in planning improvements. If you don't recognize some of the forages, Extension offices and the herbicide manufacturers produce manuals with photos, or try the [USDA](#) query engine; there are also plant-identification guides at the [Oregon State](#), [Wisconsin Dairy Grazing](#) and [Grassfarmer](#) sites.

Once you can identify the existing forage, the first step is a [soil test](#). In many areas of the country, pasture land has a pH too low to support the better forage grasses and legumes. The soil test — make sure you specify the target forage when you turn in the sample — will tell you how much lime to add. Some indicators of low pH in a pasture are the presence of wild strawberry plants, buckhorn plantain, red sorrel, moss on the soil surfaces, mole activity, the absence of quackgrass or brome grass in well drained areas, and the absence of reed canary grass in poorly drained areas. In low pH soils, alfalfa will be stunted, with yellow leaves on the newer growth. Even if there are clear signs of low pH, a soil test will give a more precise guide to how much lime is needed.

Lime

[Adding lime](#) to bring the soil up to a pH of 6.0 or 6.5 (possibly even higher for legume pastures, or lower in some areas of the country for warm-season grasses) will encourage more productive legumes and grasses in the pasture mix; increase uptake of calcium and magnesium to the grazing animals; reduce toxicity of minerals like Al and Mn; increase soil flocculation and internal drainage; increase phosphorus availability; improve the activity of micro-organisms in converting ammonia to nitrates and in the breakdown of soil organic matter; and increase the nitrogen fixation of legumes like clover and alfalfa. Small changes can be significant on the logarithmic pH scale: a pH of 5.0 is ten times more acid than a pH of 6.0. On soils that are extremely low on phosphorus, it may be necessary to [add phosphorus](#) before the effects of liming are apparent. Adding more lime than soil test recommendations is not a good idea: as pH rises over 7.0, some essential micronutrients, such as manganese, zinc, copper, and cobalt become less available to plants, even when adequate quantities of the minerals are in the soil.

If you cannot disc in the lime when it is applied, applications of more than two tons/acre may need to be split over a period of a year or so. You can spread lime yourself with a dump spreader (they're often available at auctions or used implement dealers), or a fertilizer spreader on a tractor, but it may be easier and cheaper to have a local blending plant spread it by truck. Spreading lime with a fertilizer spreader is a dusty and inefficient job; the lime will cake up in the spreader, and if it isn't washed off carefully, the metal parts of the spreader will end up looking like swiss cheese. An alternative is to build a [homemade lime spreader](#) on the back of a wagon or truck. A disc harrow is ideal for incorporating lime, which is slow to migrate from the surface of the soil. A tractor-mounted tiller will also incorporate lime, but is slower to use, especially in soils with high clay content. Make sure the soil is relatively dry, especially if you are using a tiller instead of a disc harrow.

Passive Improvements

For low-input passive improvement, you can introduce clovers and other desirable forage species by feeding mature hay on the pastures. Small seeds, such as birdsfoot trefoil, can be added to grain or salt rations of animals. Seed can also be added to each load in the manure spreader, or broadcast in early spring or fall onto a heavily-grazed field. The animals will distribute seeds in their manure, and trample the seeds into the ground as they feed.

You can also change the balance between native clovers and grasses, or the mix of grasses in a pasture, by adjusting the formula and timing of fertilizer application, or by modifying the pH of

the soil. Adding nitrogen-rich fertilizer, and early [fertilizer](#) application, favors grasses; heavier applications of potash and phosphate and later application favors the clovers. Higher pH from applied lime generally favors native clover and other legumes.

Timing your grazing and mowing can also improve the pasture. Grazing heavily early, when grasses come up before the legumes, will favor the legumes. Grazing heavily or mowing when jointed grasses like brome grass have their growing point close to the ground will retard their growth. Alternately, if grasses are allowed to reach boot stage, when seed heads have formed inside the stems, cutting or grazing encourages rapid regrowth.

Reseeding

For more aggressive improvement, once you have the pH up where you want it — usually close to neutral for alfalfa or clovers, a little lower for grasses — you have a choice of reseeding from clean tillage or over-seeding. For lush mono-culture grass pastures, or for planting legumes like birdsfoot trefoil or alfalfa that don't compete well, in some areas clean tillage may be the only possibility. You may need to plow under the old turf; you will certainly need extensive discing. It's hard dusty work, and the animals will have no use of the pasture until the new seeding is well-established. In some cases you may have better results if you plant an interim crop before a final discing and seeding with the desired grass or legumes. Buckwheat that you can harrow in as green manure works well to choke out weeds, or you can plant dwarf Essex rape, turnips, oats or rye, and let your animals graze down the temporary pasture before a final seeding. Keep your animals off the newly seeded pasture until it is well established.

Many native grass pastures can be renovated without plowing and harrowing to clean tillage. [Soil test](#) results will tell you what fertilizer to apply for the new seeding. You can then over-seed with a no-till seeder (some agricultural extension offices rent or loan them), after killing the existing sod with Roundup™ or another herbicide, or grazing the sod down aggressively with mob stocking of sheep or pigs. Gramoxone (Paraquat™) will provide a "burndown" of the existing vegetation without killing roots, for interseeding in an existing sod. If you don't have access to a no-till seeder, you can graze the existing grasses hard, then overseed with a conventional seed drill; used seed drills are often available cheap, and the small legume seeds can be distributed either through the usual seed bin or through the insecticide bin; the press wheel or an auxiliary chain dragged behind the drill will cover the seed and increase the seed to soil contact.

An alternative, if you don't have access to a seed drill, is a few passes with a disc or a field cultivator to incorporate added fertilizer and lime and disturb from 50% to 100% of the existing grasses. This will allow root space and light to a new seeding and lessen allelopathic effects from existing grasses and legumes (for example, you normally cannot seed alfalfa into an existing stand of alfalfa because of allelopathic effects). Lime and phosphorus input should come 6-12 months before seeding, if possible. If your soil has some clay content and shows frost cracks in late winter, you may not need to disc if you [frost seed](#) in late winter, after the snow is off but while the ground is still frozen. Small-seed clovers, annual and perennial ryegrasses, birdsfoot trefoil, and orchardgrass frost seed successfully, usually with better success into non-rhizomatous grasses; brome grass and kentucky bluegrass can provide too much competition for frost seeding to succeed. The same technique could be used in California to seed into the soil cracks at the end of a dry summer. Broadcast the new seed at a heavy rate and either roll, harrow lightly, or drag with branches, a wooden drag, or an old bedspring to set the seed. A temporary mob stocking with sheep or cattle will also set the seed.

For grasses like bermudagrass that are planted from sprigs, you can either rent, borrow or purchase a sprigger (Bermuda King in Okarche, OK still makes them; ask for Richard Reynolds. Or try Spriggers Choice in Parrott, GA; ask for Jesse or Mary Grimsley), or broadcast the sprigs and cut them in lightly with a disc harrow. The latter procedure is not as efficient, and may require a heavier coverage with the sprigs. Some newer varieties, like Cheyenne Bermudagrass, produce the yield and quality of Coastal Bermudagrass, but can be seeded, avoiding the hassles of sprigging.

Early Grazing

Whenever you seed from clean tillage, or overseed an established field, be careful not to allow grazing animals out onto the field too early. Ruminants and equines eat grasses and legumes by pinching them between teeth or teeth and gum, and tearing them off with a movement of the head or neck. If the root structure of the newly seeded grasses and legumes is not well established, grazing animals can destroy the new seeding in short order. To test whether the new seeding can stand up to grazing, grab a bunch of grass in your fist and tear it off; if roots come up, it is too early to graze. It is a good idea not to let the grass grow too long before grazing. Cows and horses wrap their tongues around long forage and jerk it out. They will do less damage on shorter grass, and grazing before the grass is too long will prevent shading of emerging clovers.

If you are [seeding](#) legumes to upgrade a pasture, when grass growth begins, and as soon as the soil is dry enough to avoid tracking, graze the newly seeded fields with enough animals to keep the grass short. This will open the field to provide light to the new legume seedings. If you cannot graze down the early grass with animals, you may have to mow it to allow light down to the legumes. Keep the animals on the pasture until you see them starting to eat the newly seeded legumes. Then pull the animals off and let the legumes grow undisturbed for 6-8 weeks for clovers, 8-12 weeks for alfalfa. At this stage, don't worry about the weeds; it's more important to get the new seedings established. When the legumes are vigorous, you can begin a regular grazing program.

Don't be discouraged if it takes a while for your new pasture to establish. Germination and establishment rates for most seeded grasses are relatively low. Perennial rye and some of the clovers are an exception, but particularly if you are waiting for native clovers and bluegrass to spread after you have improved the *pH* and nutrient level in the soils, it may take a few years of controlled grazing and clipping before the pasture matures. [Voisin](#), in *Grass Productivity* said that it takes a century to develop a really good pasture. I have no experience of a century of improvement, but I've seen major improvement in one year of controlled grazing. A careful management program, using animals, a mower, and the addition of needed nutrients, can convert woodland or an abandoned field into a productive pasture in a few years at minimal cost.

What should I seed in pastures?

Mono-culture grass pastures are sometimes used on picture-book horse farms, and mono-culture legumes are sometimes used for aggressively rotated paddocks or where a cutting of high quality hay is taken off the pasture in the spring. In general, the most productive and lowest maintenance improved pastures for ruminants are mixed legumes and grass. The advantage of mixing legumes and grass on a pasture is that the clover and grass grow at different times of year, providing good feed through the seasons. And once inoculated clover or other legumes are established, they will generate nitrogen that will in turn fertilize the grass — saving the expense of added nitrogen fertilizer.

Herbs

There is also some recent interest in the use of [herbs](#) in pasture mixes. Animals love the herbs, and some have beneficial medicinal properties, including serving as natural antihelmics. Chicory, lotus, garlic and parsley are favorites in New Zealand. Rosemary and garlic in the pastures would give you pre-seasoned lamb; it takes anywhere from a few weeks to a few months for flavors to begin to affect the meat (pine is quick, apple is slow). Be careful with herbs if you're using or selling the milk from your animals: Thomas Hardy's *Far From the Madding Crowd* is a good example of the perils of garlic in a pasture for dairy cattle. Most herbs cannot tolerate heavy grazing, and are best reserved for special paddocks that are grazed twice a year.

Legumes

Typical legumes for pasture seeding are red, ladino, alsike, or white clover; birdsfoot trefoil; and

alfalfa. Birdsfoot trefoil and alfalfa are often tough to establish except in clean tillage. [Grazing alfalfa successfully](#) requires a fairly aggressive rotation scheme, and precautions so the animals will not bloat, and because alfalfa is auto-toxic (existing alfalfa prevents successful establishment of new alfalfa seeds), it is difficult to maintain a long-term stand of alfalfa. Birdsfoot trefoil produces only about 80% of the dry-matter per acre of alfalfa, is slow-growing in the spring, and does not stand up well to continuous grazing, but it does not cause bloat, picky animals will consume more of the delicate stems than with alfalfa, it retains its palatability well when stockpiled for late season grazing, and it seems to do well in cooler climates and drought conditions. There is some evidence that a diet heavy in birdsfoot trefoil can retard ovulation in ewes. Use an upright variety of birdsfoot trefoil if you are also planning to cut hay from the field.

For renovation seeding, a combination of ladino and red clover works well in many areas. Red clover can handle shading by grasses better than most other clovers; ladino clover has small seeds that do well in partially tilled soils. Some tests have indicated that phytoestrogens in red clover and subclover can retard ovulation in ewes, so they may not be a good choice for a pasture used for flushing sheep before breeding. (The simplest test of phytoestrogens is to put wethers in the paddock and check if their teats enlarge and they show signs of lactation.) Red clover is also susceptible to a mold that causes photosensitivity and slobbering in equines. White clover grows too low to cut for hay, so it may not be a good choice on a pasture where you're planning to take an occasional cutting of hay. Alsike clover grows well on poorer soils, but has been associated with photosensitization, colic, scours, and behavioral aberrations in equines. White clover tolerates close grazing and trampling well, and is a traditional companion seeding for bluegrass or perennial ryegrass. Make sure you inoculate legume seeds before seeding if they are not pre-inoculated. If there is little native clover in your pastures, it may be a good idea to inoculate even pre-inoculated legumes.

Hairy vetch is frequently used as a green manure to improve land. It grows well even on low pH land, and will provide good grazing until it begins to flower. Once it has flowered, it is unpalatable to most animals. Hairy vetch is difficult to mow and almost impossible to dry and rake for hay.

Predominantly legume pastures present the potential danger of [bloating](#) in ruminants, and laminitis and/or founder in equines. [Bloat](#) is a potential concern on pastures with heavy concentrations of clover or alfalfa. The problem can generally be avoided if stock are fed their fill of dry hay the morning they are put on legume-rich pastures, and if stock are not put out early in the morning when the lush forage is damp with dew. Aggressive rotation schemes on mixed grass-alfalfa pastures will help avoid bloat by forcing the stock to consume plenty of high-fiber grasses along with the alfalfa. There is some evidence that the old recommendation of initially rotating stock onto legume pastures for short periods may actually aggravate the potential bloat problem by extending the adaptation to the new rumen flora and fauna. [Bloatguard™](#) or another poloxalene formulation can be administered to prevent bloat in some situations. An alternate solution is to introduce measured quantities of a surfactant like dish detergent into the drinking water, in small enough dosages to avoid foaming and water rejection by the stock; this can be done with automatic dosing devices that are usually used for medications or antihelmics.

Grasses

Among the grasses, orchardgrass, brome grass, timothy, bluegrass, tall fescue, reed canarygrass, bermudagrass, and perennial ryegrass are all popular in pastures. Unless you've cleared to clean tillage, chances are your pasture will be a mixture of grasses. Some farms structure their grazing to provide a rotation between cool-season grasses (bluegrass, brome grass), which do best in the spring and fall, and warm-season grasses like bermudagrass, bluestem, or perennial peanut. There are many favorite combinations, especially among the cool-season grasses: bluegrass and white clover, perennial ryegrass and ladino clover, orchard grass and red/alsike clover. Reed canarygrass does well in wetter areas, but sheep may find it unpalatable, and if not mowed or grazed frequently it turns stemmy; try newer varieties like Palaton, Venture or Rival, which are lower in alkaloids and more palatable. It can be difficult to establish; pre-mixing the seed with saltpeter (potassium nitrate) the night before seeding can help break the dormancy of the seeds.

Local usage may suggest a combination for your area. If you are reconditioning several fields, you may get higher overall productivity by using different combinations in different fields, to take advantage of the different maturity dates of the various grasses.

There are some terrific new varieties of grasses coming from the forage seed companies, such as the [World Feeder Bermuda Grass](#), which has deeper roots and an extended growing season, and new winter-hardy perennial ryegrasses. Remember that even the new varieties cannot perform miracles, and all grasses require appropriate management and conditions. In an area with frequent frosts and without a steady snow cover, most perennial ryegrasses are not likely to survive the winters. Reed canary grass will become stemmy and unpalatable if they are not grazed or mowed aggressively. Even if you can afford fancy new forage grasses in your pasture seeding mix, there is much to say for including old favorites, like Kentucky Bluegrass, which spreads laterally via rhizomes to fill in open areas, creates a dense sod that can survive grazing in wet seasons and over-grazing, and is highly palatable. The ideal-condition productivity of some of the newer grasses is impressive, but most pastures rarely achieve ideal-conditions. You may find the average productivity and palatability of your pastures higher with a mix of grasses and clovers.

Mixes

Some mixes of grasses are less successful than others. For example, in rotationally grazed paddocks, dairy cattle will generally favor orchard grass and white clover and leave fescue ungrazed. Unless other stock can be brought in to clean up behind the lactating cows, the fescue will grow rank. In these circumstances it may be more effective to confine fescue to paddocks that will be stockpiled for late fall and winter grazing.

In many cases native varieties are hardier than fancy and expensive forage varieties. For example, lawn varieties of perennial rye are generally winter-hardy and if purchased locally generally have heat tolerance for local conditions; many of the fancy, imported varieties, which were bred for climates like New Zealand, England, or Holland, are not winter-hardy and/or heat-tolerant in much of the U.S. The trade-off is that lawn varieties are often not [endophyte-free](#), and are not suitable for equines or high-production dairy cattle. An alternative is to frost seed annual ryegrass each spring; the seed is cheap, it makes good feed, and walking the pastures with a hand-cranked broadcast seeder, or driving with an ATV-mounted seeder is pleasant and inexpensive.

In some areas of the U.S., white clover and bluegrass seed are present in the soil and will quickly fill in when the *pH* and nutrient levels in the soil are adequate. These native varieties are generally well-adapted and can produce highly productive pastures. When the conditions are appropriate, you can mow close or over-graze the weeds and other forage, and allow 6 weeks of regrowth, and native bluegrass and white clover will fill in bare spots with no additional seeding.

Common Pasture Forages in the Northeast U.S.

(This table does not reproduce well in text browsers.)

Cool-season Grasses							
Species	Soil moisture	Soil fertility & optimum pH	Drought tolerance	Maturity & Production	Persistence	Growth habit	Height
Kentucky Bluegrass	well-drained to moist	good to medium, 6.0-6.5	poor	early spring & late fall	long	dense sod	short
Timothy	well-drained to moist	medium to fair, 6.0-6.5	poor	late spring & fall	long	bunch	tall
Smooth brome grass	well-drained	high to good, 6.5-7.0	good	spring, summer, fall	long	open sod	tall

Orchardgrass	droughty to moist	medium to fair, 6.0-6.5	very good	early spring, summer, fall	4-5 years	bunch	tall
Reed canarygrass	droughty to wet	medium to fair, 5.5-6.0	very good	early spring, summer, fall	long	open sod	tall
Perennial ryegrass	well-drained to moist	good to medium, 6.0-6.5	poor	early spring & late fall	3-4 years, easy to reseed	bunch	short
Tall fescue	droughty to moist	medium to fair, 5.5-6.0	very good	early spring, summer, fall	long, with fertilization	variable ¹	tall
Matua prairiegrass	droughty to moist	medium to fair, 5.5-6.0	very good	early spring, summer, fall ²	long	bunch	tall

Warm-season Grasses

Species	Soil moisture	Soil fertility & optimum pH	Drought tolerance	Maturity & Production	Persistence	Growth habit	Height
Switchgrass	droughty to moist	poor to fair, 5.5-6.0	excellent	summer	long	bunch	tall
Big bluestem	droughty to moist	poor to fair, 5.5-6.0	excellent	summer	long	bunch	tall

Legumes

Species	Soil moisture	Soil fertility & optimum pH	Drought tolerance	Maturity & Production	Persistence	Growth habit	Height
Alfalfa	well-drained	high to good, 6.5-7.0	very good	spring, summer, early fall	4-6 years	bunch	tall
Red clover	well-drained	good to medium, 6.0-6.5	fair	spring, summer, fall	2 years	bunch	tall
Birdsfoot trefoil	droughty to wet	medium to fair, 5.5-6.0	very good	spring, summer, early fall	4-6 years, sometimes longer	bunch	variable ³
White clover	moist	medium, 6.0-6.5	poor	spring, fall	self-reseeds	spreading	short
Ladino clover	moist	good to medium, 6.0-6.5	poor	spring, summer, fall	2 years	spreading	short

1. Bunches under lax cutting; forms a sod under intense cutting or grazing.

2. Depends on winter temperatures and fall management.

3. Available in both creeping and upright varieties.

Pasture seed companies like Hodder & Tolley in New Zealand, Cotswold Grass Seeds in Gloucestershire, UK, and [Eastbrook Seed Company](#) have developed cultivars of permanent grasses with improved cool weather tolerance, to extend grazing seasons well into and in some areas right through the winter. There are also new cultivars of fescues and perennial ryegrass which tolerate continuous grazing far better than older varieties. Local seed catalogues are the best source of cultivars for your area; most large farm supplies like Agway and many of the seed companies have pasture seed catalogues. You may also be able to find recommendations for your locale on the [Forage Information System](#). The alternative for extending grazing seasons is [annuals](#).

What do I need to do to maintain my pastures?

To maintain their productivity, pastures need adequate nutrition, clipping or controlled grazing to eliminate weeds and over-ripe grass, and protection from overgrazing. Fertilizers and added manure provide the nutrition. The simple [soil tests](#) available from fertilizer companies and university labs that receive funding from fertilizer companies are a useful guide test to soil pH and NPK (nitrogen, phosphorus, potassium), the three elements used in sufficient quantity to be profitable to fertilizer companies. Simple soil tests may recommend heavier application of NPK than your pastures need, and ignore other micronutrients.

Nutrients

The most accurate tests of nutrient levels are analyses of plant tissues taken from the pasture. These tests are moderately expensive compared to a soil test. There are also simple signals of some deficiencies. For example, [earthworms](#) are generally a good indicator of a organic matter in the soil. Remember that the uptake of most of these nutrients depends on maintaining the *pH* of the soil in the appropriate range.

nitrogen

Nitrogen is quickly taken up by grasses and promotes growth. Nitrogen application on a mixed grass-legume pasture will tend to shade out the clovers and allow the grasses to predominate. Animal urine is high in nitrogen. The usual sign of nitrogen deficiency is yellowish leaves, especially the older leaves of forage. Nitrogen is typically added as urea; an alternate source, which is less volatile on exposure to air, is ammonium nitrate. Don't try to mix them: even small amounts of urea will make ammonium nitrate so hygroscopic that the mix will set up to a consistency somewhere between a heavy sludge and a solid block.

phosphorus

Unlike nitrogen and potassium, phosphorus leaching through the soil is minimal. Grasses quickly take up available phosphorus; if the level in the soil is low, the clovers will not do well. Phosphorus is returned to the soil in manure, which needs to be broken down to be used by the plants. Clover growing better in areas where manure has decomposed is a sign that the pasture needs more phosphorus. Black spots on the undersides of clover or alfalfa leaves that do not go all the way through are a sign of low phosphorus, as are ryegrass leaves with a purple tinge.

potassium

Grasses absorb more potassium than they need. If additional potassium is not returned to the pasture in the form of animal urine or supplemental potassium, the legumes in particular will suffer. Clover growing well in urine-patches and sparsely elsewhere is a sign of potassium deficiency. Too much potassium can lower the uptake of magnesium, calcium, sodium, and boron.

sulphur

Because it cannot easily be measured in soil analyses, sulphur is often ignored in soil tests. Symptoms of low sulphur include poor clover growth and yellowish leaves on forage, especially clovers. Unlike nitrogen deficiency, the yellowing from sulphur deficiency appears first on the younger leaves. Urine patches that are brighter green than the other forage may indicate sulphur deficiency (urine supplies sulphur, nitrogen, and potassium). Sulphur can be supplemented with application of ordinary superphosphate (phosphorus, calcium, sulphur), gypsum (sulphur, calcium), or ammonium sulphate (nitrogen, sulphur). Even in some apparently sulphur-rich environments, like volcanic soils, additional sulphur can dramatically improve the growth of clovers. If you suspect sulphur deficiency, add 40 lbs/acre of sulphate S if the *pH* is above 6.3; otherwise, 50 lbs/acre of elemental S.

calcium

Calcium is directly related to the soil *pH*, and is usually corrected when the field is limed. Calcium also contributes to the soil structure by aggregating clay and humus into granular soil particles. Calcium deficiency is more likely to show up in animals grazing a pasture than in the forage. Typical indicators of low calcium in a pasture are heavy infestation of dandelions, soil particles sticking to earthworms instead of earthworms emerging from the soil slimy and clean, and clover leaves which are smaller than normal.

magnesium

Magnesium is crucial for photosynthesis. A shortage shows up in the loss of healthy green color between leaf veins. The color gradually changes to yellow, then to reddish purple. In some forage, the leaves appear striped. Magnesium deficiency in grazing animals is called grass tetany or hypomagnesaemia. Magnesium is available in dolomite limestone or potassium-magnesium-sulphate (sulpmag).

boron Boron is important to alfalfa and clovers. The sign of a deficiency is shortened, rosette-shaped plants. The leaves turn yellow and appear drought-damaged, with hard, brittle edges. Burgundy color is another sign of boron deficiency. Boron deficiency is most likely to show up during dry spells or after application of lime. Boron can be added to fertilizer at a blending plant. 2 lbs/acre every three years is usually sufficient for alfalfa or clovers. Too much boron can kill grasses.

molybdenum

If the root nodules of clover, examined with a low-power microscope, are white instead of pink or brown, and they generate little or no nitrogen, it may be a sign of molybdenum deficiency.

copper, chlorine, cobalt, iron, zinc, manganese

These micronutrients are all important to pasture growth. The quantities necessary are minute. If you have tried everything else and still have problems with stunted forage, or if tests of your pasture forage tissues show deficiencies in these micronutrients, be cautious in getting second opinions and be extremely cautious that you do not apply toxic amounts of these micro-nutrients. If you do need one or another of these micronutrients, the small amounts should be well mixed into large quantities of other fertilizer for even distribution.

Fertilizer

If you cannot get soil or plant tissue tests, and do not have an opportunity to study the forage for signs of deficiencies, the typical guidelines are that legume or mixed legume-grass pastures generally need 30-60 lbs of phosphate (P_2O_5) and 90-120 lbs of potash (K_2O) per acre once a year, with the lower rates for pastures where you spread manure or have fertile soils. Good legume-grass pastures need no additional nitrogen (N). Straight grass pastures typically need 80-120 lbs of N per acre annually in split applications (usually a first application in early spring in the east, late fall in California, and a second application sometime after first cutting of hay in your area), with 40-90 lbs of P_2O_5 and 60-100 lbs. of K_2O per acre annually. If you spread manure on the pasture, application rates as low as 40-60 lbs N, 20-30 lbs. P_2O_5 , and 30-40 lbs K_2O are probably sufficient. Taller grasses, like orchardgrass and reed canarygrass, generally need the higher rates.

If you don't have access to a blending plant, or don't have the equipment to use bulk fertilizer, you may have to select from available bagged fertilizer, or mix two or more blends of bagged fertilizer to get the formulation you need. A good starting point for legume or mixed legume/grass pasture is 300-600 lbs/acre of 0-10-40 or 0-15-30. A starting point for grass pastures is a split application of 400-600 lbs/acre of 15-8-12.

One caution with applied fertilizer. Fertilizer application interacts with soil *pH* and with the uptake of micronutrients and minerals. For example, heavy applications of superphosphates can lower soil *pH* which in turn can lower the uptake of selenium and other minerals by forage. A soil which had adequate selenium content to avoid white muscle disease in sheep or equines may suddenly see a drop in selenium uptake to the forage if very heavy doses of superphosphate are added to increase clover production in the pasture. Cautious steps and frequent soil tests will avoid most problems.

Manure

Applied manure, in addition to the animal droppings, is good for a pasture. Ten tons per acre of cow manure (two-thirds that amount of sheep manure), well-flailed and spread after grazing has stopped (late fall in the east), is ideal. Chicken manure application should be no more than 3-4 tons per acre, and the high level of copper in chicken manure may be too much for sheep pastures.

If you don't have a manure spreader, you may be able to borrow one, or hire a neighbor to custom spread your manure. Small ground-driven manure spreaders are often available at auctions and used implement dealers; two manufacturers of new small spreaders are Mill Creek Manufacturing (717.656.3050) and Fuerst (800.435.9630). If you have problems with parasite worms in your livestock, it may help to compost the manure thoroughly before applying it.

Clipping

Unless you are using a very aggressive rotation scheme on small paddocks, you will probably need to clip your pastures at least once per year to control weeds, and to present fresh new growth to the grazing animals. Twice is better — once around the time of first cutting of hay to eliminate ungrazed old growth, and a second mowing late in the growing season to get the weeds. Pastures with tall-growing grasses like orchardgrass or reed canarygrass may need three clippings per year. Some livestock, like horses, are selective eaters; they won't graze near deposits of horse manure or eat weeds, so an untended pasture soon consists of rank areas with eaten down grass inbetween. Domesticated deer will graze the legumes and herbs heavily and leave rank growth of grass. Frequent clipping will restore the health of these pastures by eliminating the woody overgrowth in favor of palatable fresh growth, and by depositing a mulch that will extend the growing season of cool-season grasses like bluegrass. Even on heavily rotated paddocks, clipping after each rotation can do wonders to eliminate nasty weeds like thistles.

Timing is all-important when you are mowing to eliminate weeds. You want to hit them before they produce seeds. Mow too late, and your brush hog will actually distribute the weed seeds in your pasture. Some grasses, like fescue, become so unpalatable when they are rank that if you cannot control your rotation to graze the fescue when it reaches 6-inches, you may need to clip the pastures before the animals graze. Be careful when clipping pastures before grazing that there is no cherry or maple on the pastures: the wilted leaves of either are [toxic](#).

A sickle bar mower set at 3 inches will do an excellent job of clipping a pasture if it is [adjusted](#) well. A brush hog will also do a good job if the blades are sharp. For a nicer cut on pastures, use *hay blades* on the brush hog; these blades have a finer edge and a lift wing on the back that provides some lift to the grass, like a lawnmower. On a stony pasture, a brush hog will function as a missile launcher, so be careful. Flail mowers do a good job on stony pastures. If your pastures are free of stumps and stones, you can use a heavy-duty finishing mower or lawn mower. For smaller pastures, a walk-behind sickle-bar or DR-style mower will do a fine job of clipping. The best time to mow is just after a heavy grazing cycle. Some mowers may scatter the manure, or you can use a spike harrow or drag to break up and distribute clumps of manure. An alternative or supplement to mowing is a wether goat or two in with your other animals, if you've got the fences and secure enough gates to hold a goat.

An alternative to mowing is to take a cut of silage off the field when the forage is beyond the optimum grazing stage. [Bruces clean pastures](#) makes a convincing argument that taking a cut of silage not only provides winter or dry season feed, but can dramatically improve the palatability and productivity of a pasture.

Grazing too early or late in the growing season takes a toll on a pasture. When a pasture is grazed too early, the young shoots are quickly nibbled off, plant root systems are destroyed, and weeds move in. Animals then churn the wet sod searching for palatable plants, turning the pasture into a muddy, eroding feedlot. Grazing too late strips the growth that forage grasses and legumes need to build up root systems during the winter or dormant season. Fields reserved for succession grazing on [annuals](#) can extend the grazing season.

How do I take soil and/or tissue tests?

There is a [technique](#) to soil sampling. It's easiest with a testing instrument, available from larger farm supplies and catalogs. The instrument is pushed into the soil and brings up a core. An alternate is an auger or a shovel. Be sure the instrument is clean before you try to take samples.

Generally, You need 10-30 soil samples for each field you are testing. If the fields have significant variances, such as bottomland, slopes, and/or substantial dry or wet areas, you should take separate samples for those areas. Walking a Z pattern over the field while taking cores will normally give a good distribution. The sample should be from 1-6 inches down for pastures. Avoid areas where the animals congregate, recently fertilized or manured areas, and urine patches. Mix all of the samples for a field thoroughly in a clean bucket, making sure no manure or plant matter is in the sample, then take a small portion of the mixed samples in a clean plastic bag for the laboratory. The soil test printout will be more useful if you specify exactly what you want to do on the field, such as *mixed grass-legume pasture* or *bermudagrass horse pasture*, and whether it is for maintenance or a new seeding. Remember that while you are sampling the level of the soil where most grass roots are, deeper rooted alfalfa and legumes may reach soil levels with quite different *pH* and mineral levels. The usual soil test (Standard Morgan) tests for available calcium, potassium, *pH*, and may include a texture estimate. For diagnostic purposes you may want to order more extensive tests, including micronutrients and soil organic matter. The soil testing labs of state university agriculture departments frequently charge more for out-of-state tests; you may find that commercial soil-testing labs provide a wider range of tests for less money and with quicker turn-arounds than the state university lab.

Tissue samples of forage growing in the pasture cover far more minerals and nutrients than soil tests, and by measuring the actual uptake of minerals into the forage can detect deficiencies that will not show up on a soil test. To take tissue samples, make certain your hands are clean, and that you avoid any recently manured, fertilized, or urine-patch areas, or contaminants such as mineral water, animal water-troughs, or perspiration. Wearing disposable latex gloves is a good idea. Tear the grass or legumes off at ground level, making sure that no soil goes into the test sample. Clippers can introduce contaminants. Clean paper bags are better for tissue samples than plastic. The samples should be air-dried in a warm, dry environment, in an oven at 120° F., or with short (2-3 minute) bursts in a microwave. Laboratory analysis of tissue samples is relatively expensive, so the procedure is best applied where you have questions arising either from the growth pattern of the forage or animal health issues from livestock grazing the pasture.

Using tissue samples as the basis of balancing animal rations is tricky. *Average* samples may fairly represent the distribution of forages on a paddock, but they will not represent the consumption pattern of the animals, who generally will favor the more desirable forage and ignore the stemmier or less palatable forage. I find it more useful to watch the grazing pattern of the flock or herd and target tissue samples to the areas of forage they consume most heavily. Remember too that the nutritional levels of samples will vary depending on the stage of growth of the forage and the nutrient and mineral level in the pasture. To refine models of grazing consumption, some labs and farmers are now using fecal sampling. The fecal samples are analyzed by near-infrared spectroscopy to determine the crude protein, digestible organic matter, and percentages of *N* and *P* consumed. The tests are approximately \$30-40 per sample. For more information on fecal sampling, contact the Grazing Animal Nutrition Lab at Texas A & M, telephone 1.409.845.5838.

What is the best fence for pastures?

Fences have two purposes: keeping animals in and keeping predators out. The wood fences of fancy horse farms or New England stone walls may succeed at the former, unless you're trying to keep a bull away from cows in season, or unweaned lambs away from their mothers. To keep predators out, you will probably need woven wire, high-tension, or electric fences. Stopping a mother coyote who is trying to feed her kit may require 48-inch woven wire with additional strands of barbed wire at ground level and above the woven wire, or 6-7 strands of high-tension electric fencing.

Cattle and horses that are trained well to electric fences can be fenced in with a single wire. Many horse farms prefer to use a highly visible wire or one of the wide braided conductors. Smaller animals and animals with heavy coats need multi-wire fences to contain them, and pigs need carefully-placed ground level wires — barbed or electric — to keep them from digging their way

out.

Woven wire fences are relatively simple to install. Depending on local supplies and aesthetic needs, you can use metal T-posts, pressure-treated commercial posts, or homemade posts of a resistant wood like cedar or locust. T-posts or sharpened wooden posts can be started with a pry bar and driven in with a post pounder. Corner posts should be stout, dug deep and may need braces. Use a fence-stretcher or a tractor to tension the fence before you staple it to the posts, and leave the staples loose on intermediate posts to allow the fence some play. A convenient tool for fence-stretching is a pair of 2 x 6 boards, longer than the height of the fence, drilled for 3 to 5 strong bolts. Sandwich the end of the fence between the two boards and tighten the bolts to hold the fence, then hitch a chain from the tractor or fence stretcher to the sandwich-boards to stretch the fence evenly. The newer high-tension woven wire makes a neat fence on level ground with fewer intermediate posts.

High-tension fences work best for long runs on level land, where they require few intermediate posts. Because of the tension in the wires, the corner posts need to be well dug and braced, or better yet, pounded in place with a hydraulic post-setter; old telephone poles can be cut up to make good corner posts. They generally need bracing in the form of an H-brace, diagonal brace, or a deadman, a bed log set in a trench next to the post in the direction of pull. In some cases high tension fences do not need to be electrified, but to look good and perform well, they require careful installation and no stinting on tensioners and other hardware.

For temporary fencing, portable electric fences using "polywire" or electrified netting are quick to set up and move. The various reel devices are useful if you plan to move the fence often. Gallagher sells hardwood posts that require no insulators, at least in relatively dry climates, which are convenient as end and corner posts for temporary electric fences. Welded hog or cattle panels can also be used for temporary holding pens.

Electrified [scare wires](#), generally 6-8 inches off the ground and at the top, or on offset brackets, can be used as an adjunct to stone walls, woven-wire, or wooden fences to deter [predators](#).

[Premier Fence Systems](#), [Gallagher](#) and [Kencove](#) distribute catalogs with excellent ideas for electric and high-tension fencing. See also the excellent installation tips, including ideas for inexpensive and easily built braces for corner posts, by University of California [extension agents](#) and from the [Sustainable Farming Connection](#). Reliable electric fences require adequate charger strength, good [grounds](#), lightning protection, clearance from heavy or wet vegetation, good insulators, animals trained to fences by high-powered chargers or a training fence, and some thought to gateways, streams, and abrupt changes in terrain. For the longest life from fences, the wires should not be fastened to every post (don't drive staples all the way in), so the elasticity of the wire can absorb animal loads and stretching/shrinkage from temperature changes.

What else besides forage and fences does a pasture need?

Animals on pasture need a supply of clean water and salt. A running brook or stream in a pasture can supply water, although it is sometimes difficult to keep animals from trampling and fouling the banks of a stream or pond. In general, sheep, which prefer dry upland grazing areas, will do less damage to stream or pond banks than cattle. If you don't have a natural supply of water, you will need a watering tank, and possibly equipment to keep the water supply frost-free in the winter. During spring flush, animals on pasture may not require much water in addition to what is available from the forage. In hot summer months or during lactation, the water needs are high. In some areas, carefully planned use of snow fencing in the winter can maximize the use of runoff in the spring.

Water

You can supply water with buried pipe, hoses or surface-level pipes in summer or in areas with mild winters, or by hauling water. PVC pipe buried below the frost-line and frost-free hydrants are

the most reliable, but in stony soils it can be a real chore to bury long lengths of pipe. A modified sub-soiler on a powerful tractor or a rented ditch-witch can be used to bury pipe in stone-free soils; otherwise you may need a backhoe. The hardest part to keep from freezing is the riser pipe up to the waterer. Running vertical waterline inside a 6-inch diameter plastic or tile pipe, with minimal joints and the waterpipe centered will allow rising ground heat to keep the pipe from freezing. You generally need a poured concrete pad at the surface for the waterer. For aggressive rotation schemes, PVC pipe run on top of the soil along fence lines and quick-detach couplers can make hookup of the water tanks a simple and quick job. Larger pipe will allow for increased carrying capacity, avoids problems with occasionally clogging, and is less susceptible to gnawing by rodents; it is also more expensive and may be more susceptible to trampling. The heavier-grade piping will resist trampling and abrasion from stones, but are considerably more expensive than the cheaper pipes; if you can inspect frequently, it is quick and cheap to repair occasional problems with the lightweight piping.

Especially with cattle, the area around waterers, even those in intensively rotated paddocks, can quickly get trampled into a muddy area that is bad for hooves. Unless you have a watering scheme that permits you to move waterers continuously, a good layer of coarse gravel, perhaps with [geotextile fabric](#) underneath, is a good idea for the area around the waterers to provide a dry surface underfoot.

It takes sense to plan a system in advance; the advice on [water systems for controlled grazing](#) is primarily directed to cattle, but can be adapted for other livestock. There are commercial suppliers of piping, quick-detach connectors, and tanks, but you can do just as well, for less cost, buying ordinary PVC pipe, T-fittings, and inexpensive hose valves at a plumbing or farm supply. A plastic 55-gallon or 30-gallon drum cut in half makes a good portable tank. The inexpensive float valves sold at farm supplies are fine if you check your pastures and waterers frequently, or you can build your own float valve from a floatless toilet tank valve (The *Fillpro* brand is inexpensive and reliable) and some pipe adapters to set the top of the valve at the desired water level. Toilet valve fittings are intended for the thickness of a china toilet tank, so you may need some shims made from an old inner-tube around the mounting holes in the waterer, along with pipe fittings to adapt from the tank valve thread to a garden hose thread for a supply hose. Hose clamps will work to attach PVC pipe to the plastic fittings, but a [ClampTite](#) tool and stainless steel wire is cheaper for quantities of fittings and some farmers have found them more effective; for information on the tools or stainless wire, contact [Senora Early](#). One option for remote pastures is a [solar pump](#); you will need water storage for at least three days for cloudy days or when the pump needs servicing.

The cooler the water, the more your livestock will drink. If you can't bury the pipe, covering it with woodchips will keep it cool and prevent early deterioration of the pipe from UV rays; as the chips rot, grass and clovers filling in over the pipe will keep it cool. At gateways or other areas where the pipe is subject to animal or vehicle traffic, it can either be buried or protected by a shield of a larger size of rigid PVC pipe.

The alternative to installed pipe is to haul water. Empty garbage cans in the back of a pickup, special pickup-bed tanks, water trailers, and tank trucks all work. In some situations it may be better to bring the animals to the water daily or every other day instead of hauling water.

Keeping pasture water frost-free in the winter is a challenge. Floating electric heaters work, but they are expensive to operate, and if the water level drops low, they can burn through rubber or plastic water tanks. The submersible heaters are safer. Some tanks, like the Rubbermaid units, have provisions for heaters that fit in the drain holes. For any electric heater, the exterior outlet should be a GFCI, and any extension cords should be rated for the heater load and for exterior use. Use shrink-wrap tubing or plastic electrical tape around the junction of the electrical cords. It is a good idea to have some sort of indicator light on the GFCI outlet, in case it trips.

Insulating a tank and leaving a hole only large enough for the animals to reach the water can save on water heating bills. There are also donut-shaped devices that sit in the bottom of a tank and release a regulated stream of propane bubbles to keep a tank frost-free; a five-gallon tank of

propane will power one for up to two months.

One alternative to heating water is the insulated waterers like the Mirafont or the pasture waterer sold in the NASCO catalog; these waterers rely on enough animal population using the waterer to keep the water flowing. Too few animals and the waterer will freeze up.

Another option, if your winters aren't too cold, is to set waterers into holes lined with manure or a manure and hay/straw mix. Heat from the composting manure will keep the water thawed. Rubber or plastic 55-gallon drums cut in half are good for these naturally heated waterers. You can break up surface icing with a stick, and if it isn't too deep the animals will break it with their noses or hot breath.

Salt & Minerals

Along with water, animals need salt. Salt blocks are popular for cattle. Loose salt works better for sheep. Often TM (trace mineral) salt is used to supply additional minerals, or minerals are added to the salt to supplement the regular diet. You may want to speak with your local veterinarian or local producers, and possibly test your forage and grain, before adding minerals or using a TM salt. Minerals are important, and many are not stored so that animals need a daily supply. For example a shortage of zinc or a combination of an excess of molybdenum and a shortage of copper can cause hoof problems or runny eyes. At the same time, the line between minimal requirements and toxicity is a fine one for many minerals, especially copper and selenium, and trace mineral mixes intended for some livestock may be inappropriate for other animals. Selenium, especially, has a narrow range: too little and an animal can suffer white-muscle disease, which leads to limpness and eventually death as it affects the heart muscles; too much can lead to restricted blood flow to the extremities, with effects like hooves falling off. The FDA standards for most mineral mixtures are based on nation-wide standards, with little allowance for the local levels of selenium in soil and plants. (The labels on trace mineral bags can be confusing: *ppm* or parts-per-million is the same as *mg/kg*; to convert from percentage (%) to *ppm*, move the decimal point 4 places to the right. $0.0032\% = 32 \text{ ppm}$).

If your animals are getting their trace minerals from an on-demand TM salt mixture, be careful when you change their feed to, for example, hay that has been treated with salt. The animals may reduce their consumption of the trace-mineral mixture and deficiencies of essentials like selenium may show up.

Remember that the forage may be providing a substantial portion or all of your animals' requirements of some minerals. The uptake of minerals by forage grasses and legumes can be controlled by a careful selection of applied [fertilizers](#). You can check on the daily needs of animals and the mineral content of various forages in the *Nutrient Requirements* publications of the [National Academy Press](#), which are available for dairy cattle, swine, horses, sheep, beef cattle, goats, and poultry.

What is rotation grazing and how do I do it?

To obtain this constant supply of fresh grass, let us suppose that a farmer who has any extent of pasture ground, should have it divided into 15 or 20 divisions, nearly of equal value: and that, instead of allowing his beasts to roam indiscriminately through the whole at once, he collects the whole number of beasts that he intends to feed into one flock, and turns them all at once into one of these divisions; which, being quite fresh, and of sufficient length of bite, would please their palate so much as to induce them to eat of it greedily, and fill their bellies before they thought of roaming about, and thus destroying it with their feet. And if the number of beasts were so great as to consume the best part of the grass of one of these inclosures in one day, they might be allowed to remain there no longer; - giving them a fresh park every morning, so as that same delicious repast might be again repeated. And if there were just so many parks as there required days to make the grass of these fields advance to a proper length after being eat bare down, the first field would be ready to receive them by the time they had gone over all the others; so that they might be thus carried round in a constant rotation.

Some pasture forages require a period of rest after a period of heavy grazing. Many other forage species also respond well to alternating cycles of grazing and rest. Most grazing animals, when they are confined to a limited area, will eat everything in sight, including weeds and coarse forage, instead of nibbling only the tender shoots that grew the night before. Rotation grazing takes advantage of these patterns of forage growth and animal habits to increase pasture productivity.

Rotation patterns can vary from super-aggressive "forward paddock grazing" which may move the animals two or three times daily, to a casual rotation between two pastures every three or four weeks. Two weeks is generally the minimum rest for a pasture; three or four weeks is better. Some farms rotate different livestock onto pastures in sequence, taking advantage of the different grazing habits of cattle and sheep. After the cattle eat the coarse growth, sheep are brought in to eat the fine grasses and clovers the cattle missed.

Livestock can be rotated between separate pastures, or between paddocks carved out of pasture areas with stone walls, cross-fencing, or portable electric fencing. Portable fencing is versatile, but requires more work to move and set up than the advertisements in the catalogs and magazines suggest. The alternative of permanently divided paddocks can be inconvenient for mowing, fertilizing, or taking an occasional cutting of hay. Whatever the rotation pattern, you will need shade, water, and mineral feeders in each paddock or pasture area; if you don't use portable fencing, you will need gates or bar-ways between the paddocks or pastures. Some farms save water piping and labor by arranging their paddocks around central islands with waterers and mineral/salt feeders; by opening and closing two gates, or moving a hog or cattle panel, they can rotate the stock to a new paddock. The disadvantage is that the areas around fixed water tanks and mineral feeders get trampled, overgrazed, and over-manured.

Strip grazing (sometimes called the Voisin system or MIG, *management intensive grazing*) uses one or two electric fences, moved as often as daily, to allow the livestock to graze fresh forage. On some operations, the lambs or calves are allowed to graze a paddock or strip first; when they move on to fresher grass and clover, the ewes or cows are brought in to clean up the old paddock. The biological activity and regrowth pattern in aggressively rotated pastures is so high that weeds are quickly choked out, and deposited manure quickly decomposes into soil additives. Often dragging and mowing that would be necessary with less-frequent rotation are not necessary when intensive grazing is alternated with substantial rest periods.

There are many schemes for rotation, from those which [measure](#) the total dry mass on the pasture, to those which use estimates based on the number of new leaves on forage or forage height to determine when to begin and when to end grazing of a paddock. Whichever scheme you use, the important distinction is that grazing intervals should be controlled by the amount and state of the forage available on the paddocks, and not by a fixed calendar rotation. Graze before the forage on a paddock gets rank; stop grazing before the pasture is grazed so low that regrowth is retarded.

A few rotational grazing cautions: some forages, like bermudagrass and tall fescue, show little or no response to rotational grazing. Jointed grasses, like timothy or brome grass, do not respond well to grazing when the growing points are elevated to grazing height, and are better suited to haying or long rotation periods. The best results for intensive rotational grazing come from legumes, kentucky bluegrass, perennial ryegrass, and orchard grass. Recent research suggests that rotation does not help with parasite control unless the animals are wormed frequently enough to keep the parasite populations low. The typical rotation periods of 2-6 weeks are not long enough for the parasitic organisms in the idle pasture to die, and the longer ungrazed growth of an idle pasture may actually shelter parasites from sunlight. A field generally will not be parasite-free unless the animals have been off it for a full year. In many situations, overall production (weight gains, milk production) from rotational grazing do not exceed production from continuous grazing of the same amount of land. Excessive pressure on forage, when animals are forced to consume all of the forage, can actually lead to significant drops in production.

But, if your pastures are predominantly alfalfa or timothy, or if animal management needs such as

predator control make it advisable to confine the flock or herd to smaller pastures, or if you are using animals to aid in the improvement of pasture by forcing them to graze areas hard, rotation grazing can do wonders for your pastures.

Before rotation onto a clean pasture is an optimum time to worm your animals. Even if you don't have a planned rotation scheme, when you see animals moving about restlessly in search of forage, it may mean the pasture is temporarily exhausted and needs a rest. If you don't have an alternate pasture, it may be time to confine the stock to a feedlot until the pasture recovers, or at least to take pressure off the pasture by feeding supplementary hay or silage.

How do I measure pasture yield?

The term *yield* can have two meanings here. First, there is the question of what nutritional elements the animals are deriving from the pasture forage. For a dairy farm, ewes in lactation, breeding horses, lambs on pasture, and other programs which are trying to derive maximum gains on pasture, the protein and energy yield of the pasture is important in formulating a total diet. Lush spring pasture, for example, is often overly rich in protein; animals cannot use the excess protein, which they excrete in their urine (an ammonia smell is a good indication of excess protein in the diet). Under these conditions, an optimum ration for the animals may require added energy in the form of grain or fibre-rich supplements like soy hulls or beat pulp. On stockpiled pasture, when the protein levels of the grass is often lower than the animals' requirements, supplemental protein in the form of soy or other protein supplements can enable the animals to better utilize the available pasture forage.

The second, more common, use of *yield* is as a measure of dry matter (DM) available on the pasture. For very aggressive rotational grazing programs, such as the daily movements of animals that are required to maintain optimum forage for dairy cows, it is important to estimate the DM available on the pastures to plan a rotation scheme for the full grazing season. Some recent research compares [sward height and yield relationships in grazed pastures](#). For an approximation of yield by month, use the following chart, which is based on figures from Pennsylvania, and may need to be adjusted for your climate and soil conditions.

Typical Forage Yields & Availability

(This table does not reproduce well in text browsers.)

Forage	Yield ¹ (lbs.) DM/acre/year	% available									
		April	May	June	July	Aug	Sept	Oct	Nov	Dec	
Bluegrass	4000	5	30	30	10	5	10	10	-	-	
	2000	-	35	40	10	5	5	5	-	-	
Orchardgrass	8000	5	25	30	10	10	15	5	-	-	
	3500	-	35	40	5	5	10	10	-	-	
Perennial Ryegrass	5500	5	30	30	10	5	10	10	-	-	
	2500	-	35	40	10	5	5	5	-	-	
Timothy	6500	-	30	45	5	5	10	5	-	-	
	3000	-	35	45	5	5	5	5	-	-	
Tall Fescue	7000	5	30	30	10	5	10	10	-	-	
	3500	-	40	35	5	5	5	10	-	-	
Tall Fescue ²	7000	5	25	25	5	-	-	10	15	15	
	3500	-	30	30	5	-	-	10	15	10	
Smooth Bromegrass	6500	-	30	45	5	5	10	5	-	-	
	3000	-	35	45	5	5	5	5	-	-	
Reed Canarygrass	8000	5	25	25	15	10	15	5	-	-	
	3500	-	30	40	15	5	5	5	-	-	

Sorghum/ Sudangrass	10000	-	-	-	55	45	-	-	-	-
	5000	-	-	-	45	55	-	-	-	-
Switchgrass	9000	-	-	15	35	35	15	-	-	-
	6000	-	-	15	45	35	5	-	-	-
Alfalfa & Grass	10000	-	25	35	15	10	10	5	-	-
	4500	-	35	35	15	10	5	-	-	-
Clover & Grass	9000	5	30	30	10	5	10	10	-	-
	4000	-	40	30	15	5	10	5	-	-
Birdsfoot Trefoil & Grass	8500	-	20	30	30	10	10	-	-	-
	3500	-	20	30	30	10	10	-	-	-
Winter Rye	3000	60	20	-	-	-	-	-	15	5
	1300	60	15	-	-	-	-	-	15	10
Oats	3500	-	-	-	-	-	20	55	25	-
	1600	-	-	-	-	-	25	60	15	-
Brassicas ³	10000	-	-	-	20	40	40	-	-	-
	5000	-	-	-	25	40	35	-	-	-
Brassicas ⁴	9000	-	-	-	-	-	-	15	45	40
	4000	-	-	-	-	-	-	20	45	35

1. Higher yield figures are for pastures which have been limed, with adequate levels of NPK applied, and rotational grazing. Lower figures are no fertilizer and continuous grazing.

2. Stockpiled.

3. Spring seeded.

4. Summer seeded.

Measuring Yield

By measuring the available DM on the paddocks, you can plan rotations and harvesting of surplus growth. The goal is to graze pastures when they are in the optimum range of 1100-2700 lbs. of available DM/acre. A good device for measuring available DM from the height and density of forage growth is a [rising plate meter](#) which can be made from a scrap of thin acrylic and a yardstick. With an adequate [sampling](#) of the pasture forage, which you can do in a quick walk around the pasture, you can look up the average measured forage height on a [calibrated chart](#) to determine the available dry matter. The chart is generally accurate for typical (bluegrass / orchardgrass / perennial-rye / white-clover pastures) in temperate climates. You may need to adjust the figures slightly for different forage or weather zones. On alfalfa pastures, especially with livestock like sheep that graze leaves and leave stems, the rising plate meter could give misleading readings on fields with old stemmy growth. You can also buy a commercial [pasture gauge](#) which measures the forage growth electronically; some models include PC software.

An alternative to a rising plate meter is to actually weigh and measure the dry matter in a square yard of pasture. Use a yardstick to measure the sampling areas, and a hand clipper to cut the forage to the target grazing level. Weigh the sample as soon after collection as possible; a postage scale is convenient. Be sure to subtract the weight of the paper plate or other container used to hold the sample. Then dry the sample in a microwave. (*NB.* Be sure to place a cup of water in the microwave with the sample; 3 minutes at a high setting of the microwave oven is usually enough to dry a 0.5 lb sample of forage.) Weigh again.

$$\text{dry matter percentage} = (\text{wet weight}) / (\text{dry weight})$$

$$\text{moisture percentage} = 1 - \text{dry matter percentage}$$

$$\text{DM/acre} = \text{weight of sample from 1 yard}^2 \times \text{dry matter percentage} \times 4,840$$

There are commercial programs available that will track the yield of your paddocks and help to establish rotation periods. You may find that a simple spreadsheet configured for your own needs is easier to use and more economical.

Even if you use no measuring device and keep no records, it is a good idea to walk the pastures frequently, watching for areas that the animals avoid, areas that get eaten quickly, areas where manure accumulates, and other telltale signs. If you have lawns of turf type grasses, watching the growth pattern of your lawn can give you some good clues to pasture growth. The period when you have to mow the lawn weekly or more often is the time when you may need to take cuttings for hay or silage. The periods when the lawn growth slows and the turf starts to turn brown is when you may want to think about supplementing the animals with stored feed or reducing the number of animals grazing your paddocks.

What about seasonal rotation, with alternate forages?

You can extend the grazing season, and gain maximum production (milk from cows, growth in lambs) by rotating stock to different forage depending on the season. On permanent pastures, you could rotate between grasses that grow better in the spring and fall (bluegrass, brome grass) and mid-summer grasses (bermudagrass). Trying to mix cool-season grasses and legumes with warm-season forage in the same field usually fails; the cool season grasses are generally more palatable, and get grazed down to where they cannot compete with the aggressive warm-season grasses. You can also rest pastures by turning animals into hayfields to clean up the aftermath. In some areas, fall grazing of alfalfa fields by sheep is a tradition; the grazing can replace some herbicide and fertilizer use on subsequent hay crops. Be careful that you don't graze hayfields when the ground is too wet and/or the stocking density is too high: mechanical damage to shallow root systems and damage to the relatively high crowns of hay-type alfalfas can retard the next season's growth.

Some old-time dairy farmers developed sophisticated grazing programs to take advantage of the growth patterns of a variety of forage, and may be a good source of advice. One caution: ruminants and equines may develop scours when they are moved abruptly from one forage variety to another; it is generally a temporary condition and disappears when the stomach flora adapt to the new forage.

You can also extend the grazing season by reserving a field or portion of a field for annual plantings of supplemental grazing crops. Winter rye and/or wheat seeded in the fall can provide early spring grazing before the permanent pastures are ready. Oats seeded in the spring can provide grazing in the summer when regular pasture growth slows. On heavier soils, Japanese millet can provide mid- to late-summer grazing. [Brassicas](#) like rape or turnips can provide temporary grazing in 4 to 6 weeks, and allow grazing well into the winter. Some brassicas can be heavily grazed, rested for a month, and grazed again. Sheep will trample and waste root crops if they aren't confined to a few days worth of grazing with temporary fencing, and sometimes sheep need an experienced lead animal to show them how to eat root crops. Some sources of brassica seeds include [Albert Lea Seed House](#) and [Modern Forage Systems](#).

Sudangrass (forage sorghums) will produce a tremendous amount of forage in a short growing period, but is not recommended for temporary pastures because it releases a compound called *dhurrin* which is broken down in the digestive tract to release cyanide, especially in ruminants. The dhurrin levels are much higher when the sudangrass is young and short. The usual recommendation is not to graze sudangrass when it is shorter than 18-inches. The regrowth after grazing or haying can also have high concentrations of dhurrin.

Some varieties of brassicas (turnips, rape, kale) contain high levels of certain glucosinolates, which under some conditions will cause goiter in sheep or cattle by interfering with thyroid function or iodine uptake by the thyroid. As a precaution, make sure animals on brassica pastures have access to a trace mineral salt containing iodine, and that they are consuming the salt.

Stockpiling

Supplemental pastures and/or grazing hay aftermath may allow you to bank grass (field hay) on your permanent pastures for late season grazing. Temporary fencing may be useful; you can put up fences even on frozen ground by using small round fiberglass posts, and drilling holes in the ground with a masonry bit on a battery-powered drill. A fall application of nitrogen fertilizer (~60lbs/acre) will green up the grass; sheep and cattle can graze snow-covered pastures as long as there is no heavy icing. Horses are effective at clearing crusty snow off pastures and will often clear areas that other animals can graze. [Tall fescues](#) and orchardgrass seem to respond best to fall applications of nitrogen for stockpiling, but even mixed grass/clover pastures which generate their own nitrogen during the growing season can sometimes profit from a fall application of nitrogen to encourage grasses like perennial ryegrass over early-dormant, low-nutrition grasses like redtop. In some cases, like fescue, a frost will bring out natural sugars in the plant, increasing palatability of the forage. Unfertilized banked pasture is generally low nutrition feed. If the quality falls below the 45% IVDMD (In Vitro Dry Matter Digestability) of good hay, the animals may need relatively expensive supplements of grain or silage.

In some cases, aftermath grazing can have additional benefits. Grazing aftermath alfalfa (after the first frost) will often control or reduce the population of alfalfa weevils. And a concentrated grazing period on any crop aftermath will add useful manure to the soil. To avoid weed seeds in aftermath-grazed hayfields, it is a good idea to isolate the livestock for 3-5 days after they come off a weedy pasture.

Stockpiling spring growth is less successful, especially in orchardgrass pastures. A better solution, if you own or can borrow or hire the harvesting equipment, is to round-bale excess growth and leave the haybales in place behind fences, covered, or just on the field. When the animals have exhausted the fresh growth they will turn to the baled hay, even in heavy snow. See the [Haying FAQ](#) for more information on combined grazing and forage schemes.

With carefully planned succession grazing, rotation of permanent pastures, fall nitrogen application, and banked grass, it is possible to extend the grazing season to as long as 10.5 months in a climate like Wisconsin, and possibly to all year in milder climates. The trade-off for the elimination of manure and hay handling is the time, [fuel and cost](#) of harrowing, seeding and fertilizing supplementary grazing crops.

How can I control weeds?

Managed intensive grazing or [mowing](#) is often sufficient to control weeds. Goats or sheep are effective ``mowers" for weeds like poison ivy, bittersweet, or leafy spurge. At Maple Lawn Farm, our flock of Cotswolds gradually eliminated poison ivy and bittersweet from our pastures, including infestations of bittersweet that completely covered stone walls. Mixed grazing, of sheep and cattle, or even sheep or goats with equines, can do much to control weedy growth. For hard-to-mow nasties like [Canada Thistles](#), it sometimes works to walk the field with a scythe or a metal-bladed weed-whacker.

For weeds that grazing will not control, the first step is identification; try the [weed images](#), [Western Society of Weed Science](#), or [weed identification](#) sites if you have trouble identifying the culprits. There are essentially three strategies for weeding: aggressive grazing or mowing timed to favor the desirable species; cultivation to disrupt the growing pattern of undesirable species; and herbicides, either selective or broad-spectrum, with the latter followed by reseeding or overseeding with desirable species. Some weed problems may require a combination of strategies, and a deliberate rotation of herbicides, in a program of IWM (Integrated Weed Management).

Herbicides require that you rotate your livestock off the field for periods. Banvel™, Curtail™, Crossbow™ or Weed-B-Gone™ will attack broadleaf weeds without killing the pasture grasses; it is best to apply these broadleaf herbicides when the grass is not stressed, and when plants are building up their root systems. Fall, after the second or third cutting of hay in your area, is a good time. Persistent woody weeds like multiflora rose, hawthorn, or Russian olive can be controlled

with Ally™. Overspray will stunt the growth of grass for a few weeks, but the pasture can be regrazed quickly when regrowth starts after the brownoff.

For spot application on [Canada thistle](#), or if the weedy patches are limited, you can apply Roundup™ or another broad-spectrum herbicide by spot-spraying or by using a cotton glove over a rubber glove and rubbing the herbicide on the weed leaves by hand. Or you can build a wick applicator from a handle-length of PVC pipe, stoppers, and a length of canvas soaker hose. Cement a 45° elbow and an extension to the bottom of the handle pipe, and end with a stopper with a small hole at the bottom to seep the herbicide onto the canvas soaker hose that is tied over the end of the pipe. Fill the pipe with herbicide and stopper the top. You need to swing the pipe around a few times to start the wicking action. Then walk the field, carefully wiping the herbicide onto the weeds. The [Weed Mop](#) is a commercial version. For stubborn weeds, you may need a 1:2 dilution of Roundup™ and water, applied at a period in the growing season when translocation in the plant is downward, such as between flowering and podset, or after a fall frost.

For large pastures and/or heavy infestations of weeds, you can use a tractor or truck mounted boom-sprayer or hire a custom operator to spray herbicide. A more selective approach is to spread either a broad-spectrum or targetted herbicide using a [Weedswiper](#) which uses a hydrostat to electronically monitor and control the supply of herbicide to pads, or a [Death Roller](#)™ pulled behind an ATV or tractor. An alternative for selectively applying herbicides is to use knotted cotton cords dangling from holes in a length of PVC pipe mounted on a 3pt hitch or bucket loader. Cap both ends of the PVC pipe, fill it with herbicide, then adjust the height of the rig so the knotted cords drag against the weedy growth but miss the grass and clovers as you drive over the field. For a large field, you can rig a tank and piping to automatically refill the PVC pipe with herbicide. Weeds with persistent root systems, like bindweed or poison ivy, may require repeated herbicide treatments. It may be wise to change herbicides to avoid promoting the development of resistant weed varieties. Recently, in Australia, varieties of [ryegrass resistant to Roundup](#)™ have appeared.

For areas that are infested with foxtails, woolly cupgrass, or other undesirable grasses, there is sometimes no alternative to broad-spectrum herbicides followed by no-till or minimum-till reseeding, or as an alternative, discing and reseeding an area of the pasture. We had good luck at Maple Lawn Farm harrowing up the weedy area after the spring flush, late-summer seeding a mixture of dwarf essex rape and winter rye, and using temporary fences to keep the stock off until the regular pastures are exhausted in late October or November. We then strip graze the rape and winter rye, which extends our grazing season for another month or so. In the spring, we let the stock graze down the early regrowth of winter rye, then harrow and seed oats in the early spring, graze the oats down in mid-summer, and finally harrow and seed a permanent grass and clover mix in late August or early September. The tillage and interim plantings of allopathic winter rye and oats disrupts the cycle of the undesirable grasses without taking away valuable pasturing acreage, and without the use of broad-spectrum herbicides. Buckwheat is another allopathic interim crop; it cannot be grazed, but is good green manure if it is plowed or disced in before the regular pasture mix is planted.

Are there any catches or disadvantages to pastures?

The major potential disadvantages to pastures are predators, parasites, and poisonous or toxic plants. The [Predator FAQ](#) includes suggestions on how to control the impact of predators. Parasites, especially worms, are a challenge in any grazed area. Long-term rotation, regular programs with antithelmics, careful monitoring of your livestock, and periodic testing and inspection of feces will usually keep parasites under control. Some shepherds like to rotate their flocks onto a seldom used area, like a lawn, immediately after worming; the theory is that the sheep shed the eggs on the lawn instead of carrying them to the next pasture rotation. If worms are a severe problem, or in cases like meningeal worms (*Parelaphostrongylus tenuis*, normally hosted in white-tailed deer), where a small infestation of worms can kill sheep, llamas or goats, it may help to fence off swampy areas of a pasture, and/or keep livestock off the pasture in the evening

and early morning hours when snails or other worm hosts, and worm larvae, are active on the dew-damp grass.

In general, the only way to guarantee a worm-free pasture is to keep the livestock off for a full year, either by rotating another species (for example, cows instead of sheep) onto the land, or by putting the land into hay or another crop. Veterinarians and state university agriculture schools generally offer tests of fecal samples; as an alternative, with a used lab microscope and a flotation test kit, available from vet or lab supply companies, you can do your own fecal tests. Except in cases of severe infestations or aggravating circumstances, a regular schedule of antihelmics, rotation, and clipping to allow sunlight into the grass after each rotation will control parasite populations.

Endophytes

Some tall fescue pastures, appealing because of the high forage yields, long growing season, and minimal management required, produce disappointing growth in livestock. The problem is "fescue toxicosis," caused by an endophyte fungus named *Acremonium coenophialium* (earlier identified as *Epichloe typhina*) which infects as much as 95% of tall fescue pastures in the US. Some symptoms of [fescue toxicosis](#) include rough hair coats, excessive nervousness, salivation, lameness, low tolerance for hot weather, constant low-grade fever, reproductive problems, abortions, and stillbirths. The fungus is carried in the fescue seed, and the presence seems to correlate with increased levels of naturally occurring alkaloids. There are new cultivars of Kenhy, Johnstone, and Triumph tall fescue available from fungus-free seeds. The endophyte-free fescues are somewhat less vigorous in very hot weather, and may require more careful grazing management. Reseeding a stand of infected fescue will probably require a plow-down or broad-spectrum herbicide and an interim crop. In general, endophytes from a neighboring stand of fescue will not infect an adjacent new seeding.

An alternative to plowdown and reseeding of endophyte-infected grasses (usually fescue, but some non-forage perennial ryegrasses) is to graze them hard each spring. The endophyte growth trails the stem growth by a few days. If the grass is grazed or mowed hard before it reaches 4-8 inches in height, the endophyte will have nowhere to go. The early grazing or mowing will force tillering, and the new growth will be relatively endophyte-free. Restricting use of endophyte-infected fescue pastures to spring and fall grazing will minimize the impact of the endophytes on livestock.

Some nutritionists and animal scientists at the University of Kentucky are studying whether part of the poor performance of animals on some fescue forage may be due to copper deficiency because fescue doesn't *give up* its copper as readily as other forages.

In some cases, meat animals fattened on green pasture develop a yellowish tinge to their fat from the stored carotene. Some packers will reject meat with yellow fat. Restaurants and private customers may prefer the grass-fed meat, not only for the taste and texture, but because pasture-fattened animals tend to have less marbling; the fat is on the edge of cuts and easily removed. If your market is to packers who reject yellow-tinged fat, finishing the animals on a feedlot for 60 days, or grazing for a few months after the green flush of spring pasture, will bring back the snow-white fat.

In some areas, the issue of nitrogen run-off has been raised as a potential problem with intensive grazing. Recent research on [Nitrogen Flow in Intensively Grazed Pasture Systems](#) suggests that groundwater contamination is not a significant problem in well-managed grazing programs.

Can I just turn my stock loose in a woodlot or overgrown meadow?

You can, and if there are no [poisonous plants](#) or other dangers, the animals will browse grass and brush. Some species to watch out for: choke cherry and elderberry (the leaves are toxic if a branch is cut or knocked down by a storm), water hemlock, spotted hemlock, rhododendron, locoweed,

lupine weed, jimson weed, horsenettle (nightshade), milkweed, and some laurels. Be careful with suckers growing from the stumps of cut wild cherry; the suckers are tasty and poisonous to lambs. Buttercups and houndstongue are poisonous if they are consumed in quantity. The bark of black locust is poisonous to cattle. Excessive consumption of Ponderosa Pine needles can cause abortion in cattle. Red maple leaves can be toxic to horses, producing lysis (rupture) of red blood cells, anemia, plugged kidneys, jaundice; in general, horses have to be starving to eat red maple leaves in toxic quantities. Many species of yew contain Taxol, which is used in some chemotherapies for human cancer, and is toxic to livestock consuming the yew needles. Western nasties include fiddleneck, brackenfern, larkspur, tansy, and yellow star thistle. Sheep can be used to control tansy, which is toxic to horses and cattle. Your local Agricultural Extension office will probably have brochures and charts to identify noxious and poisonous plants in your area. Most stock will avoid poisonous plants unless they are hungry; be careful in dry periods, or when you are [mob stocking](#) to improve a pasture. For more details on poisonous plants which affect livestock, see the Canadian [animals poisoned by plants](#) site and [problem forages](#).

Unimproved pasture like woodlots or brushy slopes generally won't provide more than maintenance feed for cattle or sheep. But if you already have a regular feeding program and need only supplemental grazing, or if you are using animals to maintain the land, low-input grazing may be just the ticket. On some farms, feeding supplementary grain to animals on unimproved pasture may be more practical than improving pastures with heavy inputs of lime, fertilizer, and tractor time.

Who wrote this FAQ?

The author is [Ronald Florence](#), PhD, a [novelist and historian](#) who raised Cotswold sheep in Stonington, Connecticut. Additional information was provided by

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Predator FAQ

<http://www.sheeps creek.com/rural/predator.html>

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Do coyote really kill sheep?

Yes. Coyote, wolves, bears, mountain lions, foxes, eagles, hawks, wild pigs, dogs, feral cats, and ravens kill lambs, sheep, kids, goats, calves, foals and other livestock. The losses can be substantial. In some ranch areas, losses to predators, primarily from coyote, but also from wolves, bears, mountain lions, lynx, bobcats, wolverines, eagles, and hawks are often the difference between profit and serious losses for sheep raisers. Now that coyote have spread throughout all 48 lower states, Canada and Mexico, farm flocks, including flocks in semi-rural areas, are beginning to suffer significant predation losses from coyote. Predator [statistics](#) are available to document the damage in some areas, and there are procedures to [evaluate the predation on livestock and wildlife](#). Because large predators like bears and wolves can carry off their prey and consume prey without leaving evidence, official statistics may not reveal the full extent of losses to predators.

This FAQ is written primarily for small producers and hobby farms. I am not anti-coyote or anti-wolf or anti- any other predator. In the wild, many of these predators are beautiful and intelligent animals. The coyote and fox are valuable as a control on rodents, and wolves may help control excess deer. But as a sheep farmer, I have seen a coyote kill and disembowel a lamb. I have suffered the loss in income and the personal sense of violation when a coyote has taken bottle-fed lambs. The small producer, in particular, can ill afford losses to predators.

One shepherd who raised Rambouillets in Eastern Washington wrote that predators 'were not much of a problem unless the herder got drunk, the guard dog run off or the mice died off.' The purpose of this FAQ is to suggest ways to minimize or control those risks.

In some areas, especially South Africa, but also in portions of the Western USA, stock theft (*rustling*) is so extensive that farmers and ranchers are quitting livestock enterprises to raise game or are going out of business. Solutions to this problem are beyond the range of this FAQ, except to suggest that sometimes the usual suspects are not the guilty predator.

Aren't many of these losses really from dogs or *coydogs*?

There is little evidence that coyote cross-breed with dogs in the wild. Dogs, wolves and coyote are genetically close, but for behavior reasons coyote × dog crosses are unlikely in the wild. Much damage attributed to *coydogs* is probably due to domestic and feral dogs.

It is usually not difficult to identify whether an attack was by dogs or coyote. The appearance of the coyote is distinctive, with a long snout, erect ears, and a bushy tail. Their fur and stature give them the appearance of being larger than they are; typically, a mature coyote weighs 9-16 kg. (20-35 lbs), with the males generally about 2 kg (4.5 lbs) larger than the females. Western coyote are generally smaller and reddish; the eastern coyote can be a slightly larger animal, and range from black to grey/brown to strawberry blond to white. There is some evidence of coyote crossing with red wolves, which may account for the larger size of the eastern coyote. Coyote are efficient predators. Eastern coyote usually hunt alone at night. They select their victims carefully, singling out a weak member of the flock, often a sheep with a limp or a lamb. They kill efficiently and eat

selectively, making an almost surgical opening and taking innards first. In the case of small lambs, they will carry away the victim. Even if they return to an undisturbed carcass, they will remove flesh methodically. Western coyote, on open range, may hunt in packs, especially for deer or cattle.

By contrast, dogs frequently attack in packs, and whether single or in a pack, they tend to run through a flock, maiming as many animals as they can catch. Animals that are not maimed or killed may be in shock from being chased. Feral dogs can be vicious in their attacks, bringing down ponies, llamas and other pets.

If you see animals scouting your flock and are not sure whether they are coyote or dogs, look for footprints or scat. Dog footprints are round and all four claw marks are visible; coyote tracks are distinctly oval and only the front two claw marks are visible. Both coyote and dogs frequently defecate near a kill: dog feces are essentially recycled Alpo; coyote scat is usually stringy from undigested fur, bones, feathers, and vegetable matter, and distinctly elongated.

I found a dead sheep [calf, goat]; how do I identify the killer?

Predators have distinctive styles. It is worth examining the carcass, both to decide on future protective measures, and because you may in some instances be eligible for [compensation](#). For ranchers suffering large-scale predation, there are systematic [predation evaluation procedures](#).

Coyote

Coyote kill by strangulation and/or by severing the jugular vein. They attack the throat just behind the jaw and ear, clamping down on the animal's windpipe, and leaving puncture wounds below the lower jaw. Bleeding from a severed jugular vein may be subdermal. A small coyote can kill a large sheep or calf, and the process is silent; the victim cannot bleat or make noise with its throat shut. Typically, the coyote will roam around the flock, waiting for a straggler or a lamb with insufficient flocking instinct, sometimes a large, strong lamb, that tries to run. Or coyote will wait by a calving cow and snatch the newborn calf before the cow is on her feet again. Western coyote, especially in northern areas where the stock are concentrated, will often attack calving cows in packs, and wait for the afterbirth in preference to the calves. Coyote will often drag a carcass to a quiet area, and follow a distinctive eating pattern. They make an almost surgical opening in the thorax, consuming the heart, lungs, liver, and internal organs, except the stomach. They sometimes return later to pick at bones or haunches.

Wolves

Wolves are usually organized pack hunters, and may leave many dead. Unlike dogs, they usually eat what they kill. In a typical wolf attack on cattle, the first bites are at the base of the tail (the wolf grabs the vulva). The second and third bites are in the flanks, generally both sides. The wolves may begin eating the cow before it has bled to death. Wolves typically immobilize a horse by grabbing the ham string. Wolves have an uncanny ability to spot the slightest limp or other weakness when they are selecting prey. Two yearling wolves can bring down a large cow elk; even healthy domestic livestock is little challenge to a wolf. They can also clear high fences and may have little fear of guard dogs. Healthy wolves in the wild do not attack humans; there have been instances of wolves conditioned to humans attacking children or other vulnerable individuals.

Dogs

Dogs typically will attack many victims in a flock. The characteristic bite marks are on the flanks, rear legs, backs, or rear ends of the animals. Sometimes a pack of dogs will concentrate on the head of a victim like a pony or llama. The victims often carry multiple wounds, and frequently no portion of the animal is eaten. Sheep have been known to die from exhaustion or shock after being chased by dogs. An attack by a juvenile coyote may resemble a dog attack. Because they are smaller and less experienced, juvenile coyote tend to grab anything they can get — a leg, a back

end, even an ear — leaving behind a severely injured and traumatized victim.

Bear

A bear leaves distinctive tracks and scat, and will generally maul the entire carcass, peeling back the skin, and eating the meat. Tom Tomsa of the Pennsylvania Animal Damage Control says, 'Basically, it looks like a truck ran over the sheep when a bear gets done with it.'

Bobcat & Cougar

Bobcat kills have claw marks on the carcass and subcutaneous hemorrhaging. Mountain lion kills exhibit tooth punctures, usually about two inches apart, and claw marks on the neck or shoulders. Lion and bobcat kills are often dragged some distance from the point of attack and partially or completely covered with twigs, dirt, and leaves.

Feral Cats

Feral cats take lambs as they are being born, sometimes damaging the ewe at the same time. They have been reported as a considerable problem in Australian flocks.

Raptors

Eagle talons leave distinctive puncture marks. Unlike a bear kill, the skeleton is intact; the head and neck remain attached. An eagle will frequently feed on the brain of a kill, along with meat from other portions of the carcass. Turkey vultures and buzzards are sometimes seen near a freshly dead lamb, but they are carrion-eaters, not predators; their relatively weak beaks and lack of talons leaves them incapable of grasping and killing prey; keyhole-shaped wounds in the head of a lamb are characteristic of turkey vultures. Turkey vultures and other carrion-eating birds are protected by law, and for good reason: by consuming carrion they prevent the spread of disease. Ravens will peck the head of an animal, then gouge out the eyes, ultimately killing the animal by fracturing the skull. Magpies have also been known to peck at the back of a sheep, just ahead of the pelvis, until the body cavity is open. Black-headed buzzards peck the eyes out of nannies and ewes when they are kidding/lambing, steal the newborn, and return for the carrion when the ewe or nanny dies.

Is there a season when predators are most active?

The danger in temperate farm areas seems to be greatest in the late spring and early summer, when coyote kits are big enough to need solid food, but too small to hunt on their own. The mother coyote will do whatever she needs to bring them food. If the supply of her usual food, rabbits and other small mammals, is limited, the coyote will go for lambs, kids, sheep, goats, and cats. Coyotes are wily and strong enough to wait while a cow is calving and disembowel the newborn calf before the cow can get up, or in northern areas of the West, where stock are often concentrated, to wait for the afterbirth.

In heavy snow areas, such as northern Canada, the worst predator pressure may come in late January and February, when the mice and other small prey are under the snow cover. Coyotes and wolves will then turn to livestock, not only sheep, calves, and deer, but cows, horses, and moose.

If there is any danger from predators in your area, you probably cannot count on a seasonal pattern for protection. Predators will hunt down livestock whenever their regular food supply is short. If they acquire a taste for sheep or goats or chickens after discovering that fences are easy to breach and penned livestock are easy to kill, they will be back until the fences are secure enough to keep them out, or you have [guard animals](#) to protect your flock.

What do I do if I see a coyote (or a pack of dogs) chasing my sheep?

In most communities, the laws are clear on this situation. Whether the predator is a coyote, wolf,

or a toy poodle from down the road, you have the right to shoot an animal that is chasing your stock in your pasture. It isn't fun to shoot a neighbor's pet dog, but once an animal gets a taste for sheep, or a passion for chasing sheep, you may find that you have no choice. Pet owners often won't believe their pets are instinctive predators. 'Little Boopsy wouldn't chase sheep,' they will insist. 'She's a _____ [pet, darling, sissy, sweetie].' Unless the owner agrees to keep the dog safely restrained, or you have dog-proof [fences](#), you can be fairly sure the dog will be back.

Some flock owners have discovered that the only solution to dogs in the pasture is to '*shoot quick, bury deep, and don't talk*' rather than face the arguments, lawsuits, and retaliation of unbelieving pet owners. Sometimes, a neighbor's dog can be trained not to chase sheep or other livestock. Vigilance and a strong deterrent, such as a few loads of .22 birdshot in the backside, seems to be the most successful approach.

Compensation

In many jurisdictions, you are entitled to compensation if your stock is killed or wounded by wild predators or dogs. In Connecticut, as one example, the state will compensate coyote losses if you can prove that you had adequate fencing in place, which they define as four-foot high woven-wire fencing in good condition, if you prove that the loss was greater than one hundred dollars, *and* if a wildlife agent certifies that it was a coyote kill. In some cases they will require a necropsy to determine that the animal did not die of natural causes. Local jurisdictions often have funds to compensate losses to dogs. Be prepared to document the value of the stock when you file a claim.

If you lose animals to predators, be careful in burying or otherwise disposing of the remains. Some carrion-eaters are capable of digging down several feet. Lime and stones on the remains before a hole is filled in are a good idea. In the winter, in hard-frozen ground, you may have to cover remains with heavy stones.

What kind of fence does it take to stop coyote and dogs?

Tall, strong, and without weak points. Coyote are smart and persistent. They can and will find the holes in a fence. They can jump a 48-inch fence. In one night they can dig under a fence in soils where you had a devilish time digging fence post holes. At seaside or lakeside pastures, they will swim around fences that end in deep water.

In most terrain, a good five-foot fence built of woven wire topped with several strands of barbed wire and with a strand of barbed wire at ground level will stop coyote. So will a [well-built](#) five-foot high high-tension electric fence. If dry soils mean you need alternating hot/ground wires, make sure the wire nearest the ground and the top wire are hot. To avoid sags and loose wire that a coyote can crawl under, you will need stout, well-set corner posts, and fences tensioned enough to remain taut in winter and summer. Be especially careful with gates; coyote will find an open gate or even a weak latch.

The most important step in building coyote-proof fences is to set the posts well. Posts that are not deep enough to hold up against wire tension or freezing will leave a fence vulnerable to sags. In stony soils, digging fence holes deep enough to go below the frost line can be a chore. Tractor-mounted augurs that are quick on some soils bog down or break shearpins at an intolerable rate on stony soils. Often the best solution is to hire a post-driver, or to use the bucket on a tractor or large loader as a hammer to drive the post. Filling the bucket with stone will make it more effective. A manual post-driver can be used to drive line posts.

On many farms where coyote-proof fencing of all of the pastures is impractical, too expensive, or impossible to maintain, an alternate is to provide a coyote-proof yard where the animals can be penned at night and where the most vulnerable animals, such as lambs, can be confined. Lights may help deter coyote, although coyote have been known to sneak into a well-lighted barnyard.

Is there a way to make old fences coyote-proof?

Some farms have had success with electric scare wires built outside existing fences. Coyote explore with their noses close to the ground, and will approach a fence at ground height. Installing an electric scare wire eight inches off the ground, and perhaps another wire or two at the height of the fence, just outside an existing fence, may deter predators. For a stone wall or low woven-wire fence, you can install one or two hot wires and one grounded wire over the existing fence or wall. In some instances terrain or ownership problems make it impossible to install a scare wire outside the existing fence. You can put one inside, but it will probably work to trap the predators *inside* your pasture. The trapped predator will be easier to shoot, but you may sustain losses in the process.

The major electric fence [companies](#) have stand-off insulators to install a scare wire fence on existing wooden or metal fence posts.

Can I shoot or trap predators before they cause trouble?

Coyote are smart enough to be tough to trap. Some farmers have had luck with snare traps installed in holes in fences, or with No. 3 or No. 4 leghold traps. One experienced trapper recommends a #3 double long spring trap with offset jaws. Often traps will get juveniles, and coyote who have lost a foot to a trap are notorious livestock killers. Live trap boxes which catch the animal unharmed may be effective for dogs or bobcats; they are not effective for coyote.

You may have better luck with a gun. I shot two coyote in our pastures at Maple Lawn Farm, missed a couple of others, and frequently saw coyote on our hayfield and on the stone walls, sometimes even in daylight. Our [guard donkey](#) once set up a coyote for me to shoot.

If you're willing to leave a kill in place and undisturbed, and if you can stake out a good hiding place downwind from the kill, you may have some luck shooting a coyote revisiting the kill on the next night. A coyote can only hold about five pounds of food in its stomach, and will often return to an undisturbed previous kill.

If you see a coyote acting strange during the day, suspect rabies and use your gun. Then call the local EPA or other agency in charge of confirming rabies cases; they will want the head of the animal. Rabies seems to be more prevalent in raccoons and foxes than in the larger predators.

A coyote is not a large animal. A .243 Winchester is more than adequate even for a long shot to a distant corner of a pasture. A shotgun with #4 buckshot will do the job out to 40 yards range. Some hunters have special whistles and lures to [call coyote](#) by imitating wounded animals, and you may be able to persuade a hunter to search for the coyote in your area. Coyote are territorial animals. If you trap or shoot the coyote that are attacking your flock or herd, others will probably move into the territory.

There is some evidence that coyote respect the territorial markings of foxes, at least until the food supply is extremely short. You may discover that in trapping or shooting foxes you are inviting coyotes to fill their place.

What guard animals can protect my flock?

[Guard donkeys](#), [guard dogs](#), and [guard llamas](#) have all been used successfully to protect livestock. The choice depends on the livestock being protected, local terrain, acreage, predator threats, budget, and personal preference. Whichever animal you choose, count on some training, extra feed, vet care, and housing expenses. Some donkeys and llamas do not take well to guarding; there are many stories of llamas who don't like sheep and keep apart from the flock they are supposed to guard; donkeys who chase the sheep they are supposed to guard; and dogs that never quite learn their job.

In some cases you may need more than a single guard animal to protect a flock. Guard dogs can work together to patrol large areas and to fight off marauding packs of feral dogs, coyote, or

wolves that would overwhelm a single guard dog. Dogs and llamas sometimes can be trained to work together.

Guard animals can be effective, but in some situations, packs of coyotes will defeat the most diligent guard animals. If you are following an aggressive rotational grazing program, with flocks in several paddocks at the same time, you may need a guard animal for each paddock. Sometimes, even in a small field, a single guard animal can be overwhelmed. There are documented instances of coyote packs dividing, with one group surrounding and killing a guard dog while the rest of the pack attacked the unprotected flock.

How do guard donkeys protect a flock?

Donkeys have been used for centuries to protect sheep and other herding animals. Donkeys are extremely intelligent, with acute hearing (there is a reason for those big ears) and sight, and they are conservative by nature: they do not like change in their surroundings, and will drive off a coyote or stray dog as much because it is an intruder as from any instinctive dislike of canines.

At Maple Lawn Farm, our flock of Cotswold sheep was guarded for 10 years by Rosie, a donkey who came to our farm with no experience of sheep. She was four years old and had never seen a sheep before coming to the farm.

Once here, Rosie quickly established a routine. Whenever the flock was rotated to a new pasture, Rosie insisted on conducting a perimeter check; she ran at top speed around the inside of the walls of the pasture (we were in Southeast Connecticut, with stone-walled pastures), before finally braying her *All Clear*. When a coyote snuck into a pasture, Rosie had a rehearsed battle plan. She first herded the sheep into a tight formation, running around them and nudging them until she was satisfied that they were safe. She then mounted her attack, squaring off against the intruder, and trying first her front hooves, then a biting attack, and finally the karate kick with her back hooves. Coyotes are smart enough to retreat in the face of an attack by a 500 pound donkey. Twice Rosie set up coyote that I was able to shoot.

Donkeys are easy to care for — good grazing or hay and water is all they need — and delightful barnyard pets, if you accept that they are clever and rigid. For us, *Rosie's Rules* were part of the farm routine. Some of her rules were helpful, such as when she insisted that small lambs not wander more than an arbitrary distance from the barn; watching a donkey, whose head is three times the size of a lamb, nudge the lamb back toward the barn is a delight. Other rules were less charming. Rosie would not allow a white sheep to eat hay next to her at a feeder. Colored sheep and lambs were allowed. She also insisted on being present when lambs are born. The first sound every lamb born at the farm heard was Rosie's loud bray, announcing the birth to the world. When visitors come, Rosie positioned herself between a visitor and *her* lambs. Rosie also built what we called *on-deck circles* in the pastures, cleared areas where she could roll over to scratch her back.

Quirks aside, except for one year when a coyote snuck in and grabbed two bottle-baby lambs, we suffered no predator losses when Rosie was on guard. But not all donkeys are instinctive guards. Some will ignore an intruder, and there are stories of donkeys who run away from intruders, and donkeys who attack the sheep and goats they are supposed to protect. If you're shopping for a guard donkey, stay away from intact (stallion) jacks in favor of a gelded jack or a jenny (female). Some breeders test and/or train donkeys for guard duty and will sell them with an agreement that will allow you to exchange the donkey for another if it doesn't work out as a guard. Remember too that a jenny with a foal may be too busy to watch a flock. Even a jenny in season is thinking more about jacks than about coyotes. Two donkeys together may spend their time playing donkey games instead of watching for predators.

How about guard dogs?

Guard dogs have been used to protect flocks from prehistoric times. The breeds used have ranged from mix-breed dogs used by native Americans in the American west to the traditional guard dog

species: Akbash (Turkey), Maremma (Italy), Komondor and Kuvasz (Hungary), Liptok or Chuvatch (Czechoslovakia), Tatra or Podhalanski (Poland), Ovcharka (Caucasus), Shar Planinetz (Yugoslavia), and the Great Pyrenees (France). By tradition most guard breeds are light-colored; the light colored dogs are all-but-invisible to predators when they bed down with the flock, and they are easily distinguished by a shepherd from darker-colored coyotes, wolves, or other predators.

Guard dogs have been bred and trained to enhance a trio of traits. To be effective, the guard dog must bond with the animals it is protecting, it must be courageous in the face of a predator, and it must accept the responsibility of its job. The dog lives day and night with the flock it is protecting, and can be stand-offish toward people. Despite this essential independence, the owner needs to establish him or herself as the *alpha* figure in the dog's world.

Guard dogs have a repertoire of techniques to defend their flocks from predators. They are sensitive and primitive enough to be able to *read* the intent of a predator, and to use the minimum measures necessary to defend the territory and flock. Attacking the predator is the last resort, after other measures have failed. The first line of defense is a perimeter marking with feces and urine that warns predators to *Stay out!* If the markings do not deter a prowling predator, the guard dog will warn the predator with a staccato bark that announces *Stay where you are; I can see/smell/hear you*. If that fails, the bark escalates to a loud warning. If the predator persists in the face of the warnings, the guard dog will advance and charge at the predator, barking. The next step is a shoulder blow to the predator, saying, *I can expose your jugular and kill you if you persist*. The final defensive action could include killing the predator.

Guard dogs are bonded with the flocks they are supposed to protect by being introduced to stock as puppies, generally from 8 to 12 weeks. Once bonded, dogs accept the animals they are guarding as equals, or even as dominant. It takes some training and patience to get the bond right; puppies are playful, and will sometimes chase, bite, or even kill stock. Eventually, a good guard dog learns its role, and will acknowledge an irate ewe guarding her lambs by moving away, lying down, or averting its eyes. Guard dogs live with the stock they guard, bedding down with the sheep. Most guard dogs are fed with the stock. Sometimes stock will eat the dog's food, although most dogs learn to protect their food.

Guard dogs are by disposition independent. Most will make their rounds at some time during the day, and spend a good deal of time at a favorite spot where they can watch the flock and the surroundings. It takes training and experience to teach a guard dog to accept pets and other adults, while not losing its instinctive wariness toward predators. When it spots an intruder, the dog will position itself between the intruder and the flock and make threatening gestures toward the intruder. If the intruder does not withdraw, the dog will attack. These are brave dogs, not afraid to attack predators much larger than themselves. Komondors have been known to kill wolves.

Some potential problems with guard dogs include wandering, chasing or playing with stock, and dogs that are territorial rather than bonded to the flock. The early training of the dog needs to take place in an enclosure so the dog learns not to wander. Some dogs later need a strand of electric fencing around the pasture to remind them where they should stay. Animals that chase or play with stock must be curbed immediately; the challenge, sometimes, is to teach a dog how to hold its own against aggressive sheep or goats. There are also cases of dogs with territorial instincts. A territorial dog can do a good job as a guard, as long as the flock doesn't move to a new grazing area while the dog is protecting the old turf. Finally, coyote or other predators can overwhelm even the best guard dogs; in some instances guard dogs may solve a coyote problem for a number of years, until the number of coyotes is so great that losses return to pre-guard dog levels. A guard dog may be successful against some large predators, even small cougars, but a full-grown cougar, wolves, and other large predators may overwhelm a trusted guard dog.

Guard dogs are not pets. To do their job, they need to have a primary identity and bond with the flock they protect, rather than with the owner or family of the owner. Trying to mix the roles will confuse the dog, and lessen or destroy the effectiveness of the dog as a guard. For more

information on guard dogs, see the [On Guard](#) listing of WWW pages, the USDA publication *Livestock Guarding Dogs: Protecting Sheep from Predators* (USDA Agriculture Information Bulletin No. 588), or the [livestock guard dog](#) site.

How about a guard llama?

Llamas are intelligent, instinctively dislike canines, and are capable of protecting a flock from some predator attacks. A tall, alert 300-pound llama can be intimidating to a coyote. Because they are ruminants, llamas can eat the same diet as a flock of sheep or goats they are guarding. They can be expensive to purchase, and in most areas vets have little experience with llamas. A guard llama should always be gelded. It is generally recommended that llamas not be gelded before one year of age because of problems in the growth of leg bones if the male hormones are not available.

Although the snorting and stomping of a llama can be an effective deterrent against a prowling coyote, llamas can themselves be vulnerable to packs of coyotes, dogs, wolves, and cougars. Many llama breeders now refuse to sell llamas as livestock guards because their guarding manner — out of natural curiosity, a llama walks *toward* a marauding predator — can increase their vulnerability. Many sheep farms have had good luck with llamas as guard animals, but See [Llamas as Guardians](#) for some negative experiences with guard llamas. Some llama breeders use guard dogs for their llamas.

Can any animals protect themselves?

Recent research at the Texas A&M University Research Station in Sonora, Texas and at New Mexico State University has found that sheep and cattle will bond when grazed together, so the cattle serve as natural protectors for the sheep. The same experiment has not worked as well with goats, which lack a strong flocking instinct. Co-grazing cattle and sheep may also provide excellent utilization of pasture resources, as the cattle eat the coarse growth and the sheep eat the lower and finer growth. (See the [Pasture FAQ](#) for more information on pasture utilization.) Even in a mixed herd, cows can be susceptible to losses of newborn calves from bold coyote.

What killed my chickens and what can I do about it?

The usual predators of chickens are raccoons, foxes, weasels, and coyote. If you find an explosion of feathers, the culprit was probably a raccoon or fox, although owls and hawks have been known to grab chickens. Raccoons will go after caged animals, pulling a head or feet through the fence and eating them. They are very adept with their paws, and will often drag off a bird and eat all of the meat, leaving an almost intact carcass. If you find dead chickens with wounds around the neck and the crop eaten, the likely culprit is a weasel. Weasels will sometimes try to drag the carcass of the chicken through a small hole. Dogs will kill a chicken and often not eat it. Opossums and skunks rob eggs and will eat chicks. Spreading finely powdered lime around the chicken coop may show up identifiable foot prints, or snake tracks, of the predator.

Scarecrows and similar devices are rarely effective against determined chicken predators. Jerry Fry, in Missouri, keeps a scarecrow in his chicken yard, and each evening changes the position of the scarecrow and puts his sweaty shirt from that day on the scarecrow, claiming that no downwind predator will ever come close to the area. Blinking red lights, like the [Niteguard](#) may help against owls. Some chicken owners report that a radio in the coop playing country & western music deters weasels, foxes, and raccoons.

The only effective protection against most chicken predators is to lock the chickens in a safe coop at night. Secure wire fencing, either with the bottom buried or with a strand of barbed wire along the ground, and with no holes or weak points, will do the job against raccoons and foxes. Raccoons especially are clever enough to scout a fence for a weak spot. PVC fencing on heavy rebar posts (surplus mine roof bolts, for example), is effective for fowl, especially with electric scare wires at 2 inches and 7 inches off the ground around the exterior perimeter. PVC fencing 5.5

feet high, with a pattern roughly like a chain-link fence, has been used to protect and hold chickens, emus, guineas, peafowl, and geese. One supplier of PVC fencing is BF Products in Harrisburg PA (1.800.255.8397).

If the problem is weasels, you will need either solid walls and doors for the coop, or a fine mesh fencing like hardware cloth. A weasel can get through a quarter-sized hole, and when one gets into a coop they can do a lot of killing in one night.

Netting over a fenced-in run may be necessary to deter hawks and owls. Be sure to put some visible barrier up with the netting, such as surveyors tape; otherwise the netting may be invisible to the raptors, especially at night.

If your own dog is the problem, some farms have reported success in teaching a dog not to chase chickens by tying a dead chicken around the dog's neck for a few days. It is also possible to train a dog to not chase chickens. There are reports of Anatolian shepherd dogs trained to guard poultry, and Anne Williams, in Darien, Connecticut, has trained her huge Irish wolfhounds to round up the chickens each day and bring them into the coop. The dogs carry the chickens in their mouths and hardly ruffle a feather.

An alternative to coops, which works in some areas, especially with tough breeds of chickens like Modern Games, is to allow the chickens to roost in nearby trees. If you can't always get home to lock them in a coop, or if predators have terrorized free-ranging chickens so they're reluctant to go into a coop at night, allowing them to roost in trees may protect them from most predators. Chickens roosting in trees are vulnerable to owls, raccoons, and occasionally foxes, bobcats, or bold feral cats.

What about poison baits and sterilization?

The air-dropped baiting programs used extensively in some countries, like Australia, are sharply restricted in the U.S. The USDA Experimental Range Station at Dubois, Idaho and other agencies have done extensive research on predators. They built experimental fences and put bitches in heat behind them to see what would hold a coyote or dog. They have experimented extensively with poison baits and sterilization drugs, often dropped by air.

From the 1940s until the late 1960s, the Humane Coyote-Getter, a baited device which uses a small charge in a .38 Special cartridge to fire sodium cyanide powder into the mouth of an exploring coyote, was popular. The Coyote-Getter has now been banned by the EPA. The replacement is the M-44, a mechanical device which fires a plastic capsule of sodium cyanide. The devices are baited with a fetid scent, and are very selective for canines. The exploring dog or coyote pulls upward on the device, triggering the charge. Recent restrictions, imposed by the EPA in 1975, sharply curtail the use of these devices.

Toxic collars, which are attached to sheep and kill a coyote attacking the sheep, are a relatively new innovation, authorized in many areas, such as Virginia. A number of toxicants have been tested; Compound 1080, sodium monofluoroacetate, is the most promising. The disadvantage of the collars is cost, around \$18 per collar; the difficulty of keeping the collars on, especially on lambs that are the most likely victims; and coyote sensitivity to the 'oddness' of the sheep wearing collars,

Toxic chemical baits are not registered by the EPA, and while potentially effective are not selective. Sterilizing or fertility-reducing drugs have also been tested. Many of these poisoning techniques are not safe for small producers and hobby farms. Even rat and mouse poisons are dangerous to use in a farm setting, because cats and other pets, or livestock, may accidentally ingest the poison or poisoned animals. Poison techniques, such as collars or the M-44 explosive devices, cannot be used in conjunction with guard dogs.

Who wrote this FAQ?