

Wildlife Friendly Fencing

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Introduction

Many people in Australia, especially wildlife carers, have been concerned for a long time about the entanglement of wildlife on barbed wire fences, and some have investigated local solutions. However the issues surrounding the problem require a coordinated national approach. Carol Booth recognised this, and through the distribution of an Action Plan, galvanised support for such an approach. Carol's support was instrumental in the successful application for a grant from the Threatened Species Network (TSN) of the World Wide Fund for Nature (WWF). The grant to Tolga Bat Hospital, was announced on Threatened Species Day, 7 September 2006 and runs to April 2008.

Although the WWF project has a limited life span, the WWF (Wildlife-friendly fencing) project is on-going. It will gather its own momentum as greater sections of the community become involved. We liken the 'wildlife-friendly' fencing concept to that of 'dolphin-friendly' tuna, and the issues of barbed wire entanglement to that of ghost nets that entangle sea animals.

The WWF project will begin the long process of raising public awareness of the impact of barbed wire on all wildlife, especially those already threatened with extinction. The flagship species for the project are Spectacled flying fox (*Pteropus conspicillatus*), Grey-headed flying fox (*Pteropus poliocephalus*) and Mahogany Glider (*Petaurus gracilis*).

We will introduce the concept of "wildlife friendly fencing" to the public, and trial fencing methods that minimise the likelihood of harm to wildlife. The challenge is to make fencing more visible to animals, especially at night. The project is looking for 'champions' within various industries (eg beef, dairy), various landscapes (eg wet undulating, dry flat) and various regions, who will be the pioneer adopters of new fencing approaches, and be the focus of education & awareness building. The project will develop case studies that are then available for others to gain ideas for their properties.

It is an enormous task as there are millions of kilometres of potentially harmful barbed wire fencing across Australia. Funding from WWF is targeting Queensland, in particular the Atherton Tablelands and south-east Queensland. Bat Rescue Inc will administer the project in southeast Queensland. The full extent of the project will be determined by the amount of interest and co-sponsor support we can muster. So far, Bat Conservation International, RSPCA Queensland, and Australian Ethical Investments have lent their support financially; and RSPCA Australia, Wet Tropics Management Authority and Wildlife Preservation Society of Queensland are providing in-kind support.

Barbed wire is an icon in the Australian landscape that has remained unchallenged for too long. There are non-harmful fencing alternatives that are currently in use and that we are trialling with this project. Fencing is integral to good land management but it needs to be done in a way that is wildlife-friendly.





Photo: Ashleigh Johnson Keeping people out in South America

The WWF will involve the following activities:

1. Working with landholders to develop case studies of wildlife friendly fencing. Each time we rescue an animal off a fence, we will try to engage the landowner in the project. We have budgeted for plain wire and a range of other materials to mitigate the impact of barbed wire. Landowners fall into the following categories:
 - Minimal involvement – education and deterrents
 - Moderate involvement – education, removal of barbed wire & replacement
 - Significant involvement – all of the above on a larger scale, possibly an element of research for inclusion as a case study.
2. Develop communication materials
 - Dedicated website www.wildlifefriendlyfencing.com
 - Brochure and CD / DVD with detailed information
 - Appropriate information at barbed wire outlets
 - Caps, T-shirts, bookmarks
 - A3 posters for rural field days, envirodays, conferences etc
 - Press releases for media – printed, TV, radio
 - Signs for participating landowners
 - An educational film, sponsored by BCI Bat Conservation International (in USA)

The website will provide the project with maximal exposure and accessibility. We will be able to change and update information, as we continue collecting more case studies and more partners. We will seek a link to it from the websites of a broad range of organizations.

3. Invite barbed wire manufacturers, distributors and retailers into partnerships for the provision of educational materials at points of sale.
4. Develop partnerships with NRM groups; NHT committees; peak rural bodies, wildlife and animal welfare groups; wildlife rescue groups and government for distribution of information. We will target industry with high perimeter barbed wire fencing, golf clubs as well as rural landholders.

5. We would like all barbed wire fencing projects funded with public money eg NHT funds, to be assessed for 'wildlife friendliness' and appropriate measures taken before funding is approved eg a conservation agreement describing fencing methods.
6. Raise awareness of the need to monitor barbed wire fences, and the immediate reporting of any entangled wildlife. This will lead to a greater percentage of entangled wildlife being released, as an early rescue usually ensures fewer injuries. It is vital that the public know who to contact for rescue and we are extremely fortunate in Queensland that RSPCA has a 24hour wildlife rescue number 1300ANIMAL.

Injuries - Birds

When a bird flies it does not look directly ahead of itself, but instead will scan the area a distance off. In nature, obstacles such as trees are quite obvious to a flying bird, while the thin strands of a barbed wire fence are not so obvious.

Owls and other birds often fly into the top strands of these types of fences and are then caught in the barbs, unable to struggle free, and so frequently dying slow, agonising deaths. The Birds of Prey Working Group is investigating various methods to make fences more visible, in particular to nocturnal birds, and this will prevent countless unnecessary death'. *Endangered Wildlife Trust, South Africa*



Photo: Jack Shield Kookaburra



Photo: Ashleigh Johnson Ibis



Injuries - Bats

Injuries in flying foxes include:

- Mouth. In desperation many bats will try to bite themselves off the barbs. This can result in severe damage to the roof of the mouth, loss of teeth and even fractures of the jaw.
- Wing membrane. Most bats are caught on the fence by their wings, and this results in tearing, puncturing, severe bruising, inflammation and death of tissue.
- Bones. Bones can be broken, or stripped bare.
- Body. Bats can be entangled by the hair and skin anywhere. The resulting puncture wounds can be of varying severity.

Do not be tempted to rescue the bat and let it go. There is usually a die-back process in the wing that may not be evident for several days. The damage may look quite minimal at first, but lack of blood supply to the wing while it is still entangled can lead to a surprising amount of die-back, or loss of wing membrane



Photo: Ashleigh Johnson. The twisting that can occur. Note barbs have been removed before trying to remove bat from fence.



Photo: Ashleigh Johnson. The dieback that occurs some days after rescue. The resulting slit will make it impossible for this bat to fly.

The Little Red flying foxes are affected more than the 3 larger species of flying foxes, presumably as their flight is weaker in windy conditions. It is not uncommon for large numbers of Little Red flying foxes to get caught over a few weeks, especially when the young cannot fly well enough to cope with windy conditions. On the Atherton Tablelands, these mass events usually occur in August to October. In 1994, 442 Little Red flying foxes were caught, mostly along one 10 km stretch of barbed wire. Little Reds occur across northern and eastern Australia extending inland long distances depending on the availability of flowering trees.

We have often rescued bats from government-funded fences that are protecting revegetation plantings from cattle. The irony is that one goal of the revegetation plantings is to improve biodiversity, but when bats come to offer their seed dispersal and pollination services, they are caught. As the plantings increase in height, the situation often improves.

Injuries - Gliders

Gliders are commonly caught on barbed wire fences. Good work is being done by the Wildlife Preservation Society of Queensland through their Glider Network.

The Mahogany Glider of far north Queensland is listed at both the federal and state levels as endangered. There have been 10 taken off fences in the last decade, 5 of which died, 2 released and 2 in captivity and 1 currently in care. Daryl Dickson's experience with these animals has shown if the damage is not too severe, the membrane will heal remarkably well without stitching. As with all other species, no one is aware of the real number entangled by fences.



Photo above by Louise Saunders, not a Mahogany glider, a sugar glider

Guidelines

There are two broad options:

- (a) replace or remove the barbed wire and
- (b) make the barbed wire fence more visible.

As far as we know, there has been no research on the relative effectiveness of barbed wire and other fencing options for various purposes, or the impacts on wildlife of different fencing options. The suggestions below are preliminary, so you may use these suggestions at your own risk. We welcome any information you have about fencing and wildlife. We propose to develop a comprehensive wildlife friendly fencing guide once we have sufficient case studies completed.

A. REMOVAL / REPLACEMENT / ALTERNATIVE FENCING MATERIALS

1. Use plain wire or other fencing material: The best option is for barbed wire not to be used at all in fences. Replacing the top one or two strands with plain wire will resolve most problems#. Other fencing options include the use of 'borderline' or 'knightline', which are solid high tension nylon sighter 'wires' (no steel), used mainly for horse fencing. Knightline glows in the dark. They are significantly more expensive than plain wire, but would be useful in high-risk areas.
2. Remove fences: In high risk situations, such as along ridgelines or around wetlands, the best option is to remove the fence altogether and erect else-where if need be.



3. Cover the barbs on existing fences: Barbs can be covered with tubing, particularly in entanglement hot spots. Gadgets have been designed for splitting poly pipe quickly and for applying the pipe to the fence. See photos below. In entanglement hotspots, another option is to install an 'apron' of chicken mesh or similar over the fence.

Ballina Shire has recently replaced the barbed wire on the two top strands of a fence around four sewage treatment ponds (Cheryl Cochran, FFICN, 2005). In Townsville, the 10th Terminal Regiment of the Australian Army installed plain wire on all their fences to avoid entanglements of juvenile bats which are released on its land and other bats at the Ross River colony (Dominique Thiriet, pers. comm. 2006).

4. Use electric fences: Electric fences can be effective to control stock access, although the vegetation management required to maintain them can be costly and time consuming, particularly in northern Australia. Sometimes cattle are prepared to suffer electric shocks, and the fences may not be effective. Some sorts of electric fences may also kill and injure some native wildlife. For example, some animals respond to electric shocks in ways which make them particularly vulnerable to death on electric fences, e.g. snakes often curl around a wire after being shocked, sugargliders may wrap their tails around the wire and echidnas curl up in a ball (Lund & De Silva 1994, cited by Long & Robley 2004). We are still undecided about the efficacy of electric fencing as a WFF option.



Photo: Cheryl Cochran



Photo: Cheryl Cochran

Above: The polypipe splitter device that simultaneously splits and installs the pipe over barbs. The gadget has been developed by a member of the Northern Rivers Wildlife (Cheryl Cochran, Northern Rivers Wildlife Carers pers. comm.. Feb 2006).

B. IMPROVED VISIBILITY

Barbed wire can be made more visible to animals by adding visible and/or audible markers to the fence, such as tape, plastic flags, metal tags, and aluminium cans. Considerations include the danger to cattle, introduction of waste to the environment, the effort required for installation and maintenance, and the cost.

Plastic ribbon or second-hand caryard bunting/flags cannot be used where there are cattle as they may eat stray plastic, suffer digestive problems and die. Plastic flagging can be used to mark fences on army bases or rural rubbish tips.

1. Electric tape: Discarded white electric fence tape can be strung above the top strand of barbed wire, secured to wooden fence posts with fencing staples or to star pickets with cable ties. If tying lengths of tape together, avoid loose ends if likely to tempt grazing livestock. The tape offers good visibility, as it is white and shimmies in the wind; it also acts as a physical barrier. It is cheap, quick and easy to put up, especially over long distances.



Photo: Ashleigh Johnson

Photo: Ashleigh Johnson. Landowner Brian Naughton with old electric fence tape as a marker.

2. Plastic signals: Plastic bunting, flagging made from surveyors tape, or plastic warning tags such as those used on road-works, can be added to barbed wire to provide a visual and aural warning to wildlife. Bunting needs to be replaced annually because of deterioration. Second-hand bunting can be obtained from car yard dealers. Plastic flags made from tape are cheap, but need to be regularly replaced due to deterioration. Flags need to be placed at least every 30 cm or so. A flying-fox has been entangled on barbed wire less than 40cm from flagging (Dominique Thiriet pers. comm. Feb 2006). Plastic should not be used on stock fences.

Bunting has apparently been successful at preventing flying-fox entanglements for >10 years at the Rockhampton rubbish tip (Nigel Tuckwood, Waste Coordinator, Rockhampton City Council, pers. comm. April 2005) and also at the Amberley airforce base (Rebecca Worrill, Civilian Environment Officer, Amberley Airforce Base, pers. comm.. April 2005).

3. Metal signals: Metal tags or other shiny objects, such as metal plates or beer cans, can also act to make barbed wire more visible.
Metal tags have been used on a DPI facility in Cleveland with no bat deaths recorded since (Louise Saunders, Brisbane Bat Rescue, pers. comm. April 2005).
Aluminium one-person pie dishes are simply bent and clamped by hand over the barbed wire (Meredith Ryan, pers. comm. April 2005).



Metal plates have been installed between the top two barbed strands atop a cyclone mesh fence around a power substation in the Pilbara. In this case, barbed wire was required since substations should meet Australian Standards regarding the Restriction of



Photo:Jon Luly. Army Barracks Townsville.



Photo:Jon Luly. Metal tags.

Entry (point 10.4; AS 2067-1984) and plates were considered to be the best alternative (Kyle Armstrong, pers. comm. March 2006).

Beer cans have been used by iron ore mining companies in the Pilbara (Kyle Armstrong, pers. comm. March 2006) and on camel fences at Newhaven, Birds Australia's property in the Northern Territory.

4. *Others*: Brightly-coloured plastic balls (like airstrip powerline markers) have been used to prevent power line strike by cranes in Europe and the US and may also be useful for fences. These would be a relatively expensive option for extensive lengths of fencing.

C. OTHER OPTIONS

1. Remove food trees: Food trees close to barbedwire could be removed if this is the reason flying-foxes are getting caught. Unless the tree is a weed, however, this is not a good option for wildlife, and can be expensive.
2. Manage vegetation: In some cases, managing the height of vegetation may prevent entanglements. Birds and bats tend not to be caught on surrounding barbed wire once closely-planted trees grow to fence height. Where fenceline grass is long, bat deaths may be reduced. Furthermore, hedges of vegetation can be planted to replace barbed wire fences – prickly vegetation may inhibit access as well as barbed wire. Regular vegetation management is probably not feasible on relatively large properties.
3. Check fences: Improved surveillance of fences and timely rescues would save some entangled creatures, however this will not address the causes of entanglement. While it may not be realistic to expect farmers with many kilometres of fences to regularly check them, this could reasonably be asked of landholders with short fences, such as those in industrial areas or rural residential areas. It should be requested in addition to other measures.



For up-to-date information visit www.wildlifefriendlyfencing.com

Fencing Guidelines for Wildlife

Revised Version

Habitat Extension Bulletin

No. 53

Big game animals—deer, pronghorn, elk, moose, bear—seen freely roaming the mountainsides, prairie, national parks and forests, and other terrain are integral to Wyoming's scenery. While fences that limit access and movement of big game may be necessary to protect crops and livestock, they can impede seasonal migration as well as daily movements to food, cover, and water

needed for survival. This bulletin discusses the effects of electric and traditional fences on wildlife. It represents a major revision of the original written by Roger Wilson in 1995.

Recommendations are given on the best types of fences for containing livestock while either excluding wildlife or allowing passage of big game animals. A summary of fence types and their primary purpose is included as Appendix A following the Conclusion Section of this bulletin.

FENCES COMPATIBLE WITH BIG GAME PASSAGE: Traditional Fence Designs

Before building a fence, ask yourself "Is a fence necessary?" If a fence must be built, then several factors need to be considered: the type of livestock being contained, the species of big game present, their abundance, the occurrence



Mule deer buck having little trouble negotiating a fence during the fall.

of daily and/or seasonal animal movement and the presence of young animals. The location of the fence may also be critical to the well-being of animals present.

Fences Primarily on Deer and Pronghorn Range

Pasture Fences: The height of a barbed or woven-wire fence on deer range should not exceed 42 inches. The space between the top 2 strands should be a minimum of 10 inches, but a 12-inch space is preferred. This top space is very important to deer because of the manner in which they jump fences. Whitetails and mule deer draw their legs under their bodies as they leap a fence. If one or both hind legs fail to clear the top wire, the legs may catch between the top two wires as the deer continues over the

fence. The wires twist tightly, entangling the lower portion of the leg or legs, resulting in serious injury and often death.

Some pronghorn are capable of jumping fences of 42 inches or more, but pronghorn prefer to go under the bottom strand of wire. This preference is the key to allowing pronghorn to pass through a fence.

To allow passage of deer and pronghorn on cattle ranges, a 4-Wire Cattle Fence¹ having three barbed wires, the top wire 42 inches high, and a smooth bottom wire 16 inches above the ground is recommended (Fig. 2). If compatible with other uses, an 18 inch smooth bottom wire is preferred.

Where deer and pronghorn share the range with domestic sheep, a 4-Wire Sheep Fence² with a top wire no higher than 32 inches and a smooth bottom wire at least 10 inches above the ground is suggested. If both cattle and sheep graze in the pasture a 4-Wire Sheep/Cattle Fence³ may be constructed. On this fence the top wire may be raised to 38 inches as long as there is at least 10" between the top two wires and the bottom smooth wire height of 10 inches is maintained.

Woven wire fences severely impede pronghorn movements. If pronghorn are the primary big game species in the area, woven wire fences should not be used. If however, deer are the primary big game species in an area and pronghorn only occasionally use the range, a Woven Wire Sheep Fence⁴ with a total height not to exceed 38 inches, using 26 inch woven wire and 2 strands of barbed wire above the woven wire, 10 inches apart, is acceptable.

Highway Right-of-Way Fences: The Wyoming Department of Transportation (WYDOT) has fence standards for right-of-way fences. Minimum WYDOT fence

heights are based upon internal operating policy 19-4 which establishes a minimum fence height of 45 inches. Landowners adjacent to a Wyoming highway can have considerable influence on the type of fence constructed.

To allow deer and pronghorn movement across a highway, WYDOT fence standard Type E, 4-Wire Fence⁵ is recommended. This fence has a total height of 45 inches with wire spacing from the ground up of 16-25-33-45. The bottom strand should be smooth wire.

In areas where domestic sheep graze, 5 strands of barbed wire (Type G Fence⁶) or 26 inch woven and 2 strands of barbed wire above the woven wire, (Type C Fence⁷), are often used, but not necessarily needed. When combined with good management practices and a herder, 4-Wire Type E⁵ has been demonstrated in Southeastern Wyoming to provide good containment of domestic sheep.

Let-down Fences or Extra Gates: Deep snow in the winter can hamper the ability of a big game animal to cross a fence that during any other time of the year may not present a problem. Therefore, in areas of important wildlife crossings, let-down fences⁸ or extra gate openings are recommended.

Both barbed and woven wire let-down



Mule deer doe and fawns have some difficulty negotiating a fence during winter.

fences can be constructed. Line posts may be wooden or steel, but wooden posts are more durable where there is heavy snow. Line braces are necessary at least every 1/4 mile, but seldom less than every 100 feet. Topography and the characteristics of big game migration routes dictate the length of let-down fence sections.

For both types of let-down fences, 2 stays are needed between fence posts spaced 16.5 feet apart. For woven wire let-down fences, it is recommended that there be shorter sections between line brace posts and that a ratchet type tightener be installed for each section. With both the barbed and woven wire let-down fences, wire loops at the top and bottom of the line posts support those stays positioned at the line posts. To lay down the fence, the wire loops are lifted over the top of the stays, the stay is lifted out of the bottom loop, and the fence laid flat on the ground. Figure 1 illustrates a portion of barbed wire let-down fence.

A simple alternative to a let-down fence is to design new fences or retrofit existing fences with extra gates. Installation of double gates in big game travel corridors and at fence corners that are left open when livestock are not present can be an effective means to facilitate wildlife passage. As with let down fences, it is imperative that a reliable person is assigned the responsibility of opening and closing the gates at specific times to be certain that the benefit to wildlife is realized.

If let-down fences or extra gates are installed, they should be located where big game can become accustomed to them. Preferably the

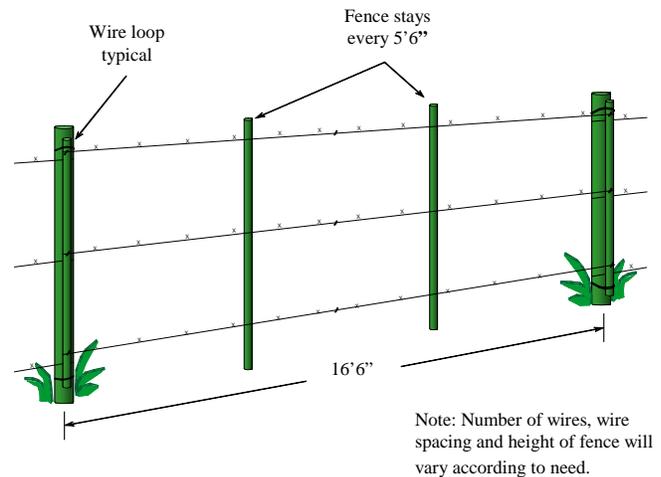


Figure 1. Let-down barbed wire fence.

fence should be let down or the gates opened prior to the arrival of big game into the area. Obviously, livestock management must be timed so that livestock are absent during the season when the fence is down. If fawns are numerous, the openings should be maintained from June 1 to September 1 to allow their passage. For spring, fall, or winter big game movements, local observations will best dictate when the fence is let-down or gates are opened.

Fences Primarily on Elk and Moose Range

Most adult elk and moose are capable of jumping over standard pasture or highway right-of-way fences; however, calves may have difficulty getting through woven wire fences or barbed wire fences with narrow wire spacing. To reduce fence maintenance, a wooden top rail is recommended in areas of frequent crossing.

This top rail is visible to big game animals even in poor light and can withstand repeated contact of hind legs and hooves.

There are several ways of attaching top rails. The most reliable and preferred method of the two described here is to lag bolt the rail to the side of the posts (Fig. 3a). A less preferred method is to notch and nail the rail to the top of the post as shown in Figure 3b. Wooden posts should

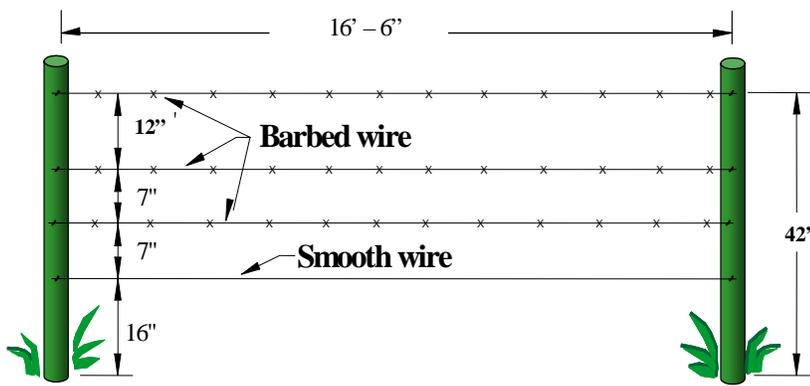


Figure 2. 4-wire cattle fence.

not be more than 14 feet apart and rails should be at least 4 inches in diameter.

On areas where cattle or horses are grazed and elk densities are low and/or where elk crossing is infrequent, a 4-Wire Cattle Fence¹ having three barbed wires, the top wire 42 inches high, and a smooth bottom wire 16 inches above the ground is recommended (Fig. 2).

In high density elk areas or at locations of frequent elk crossing, a 2-Wire Cattle Fence⁹ with the bottom wire 16 inches above the ground and a top rail no higher than 38 inches above the ground is recommended as shown in figures 3a and 3b.

On elk winter ranges, where elk crossing is frequent, a 3-Wire Elk Winter Range Fence¹⁰ is acceptable, with spacing from the ground up of 10-18-27 and a top wooden rail not over 38

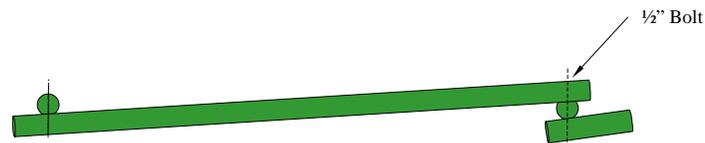
inches. This fence is acceptable on winter ranges because by November, calf elk are able to jump 38 inch high fences.

In areas of frequent elk crossing during one or more seasons of the year, let-down fences or extra gates as described for deer and pronghorn can be substituted for rail-topped fences. When let down, fences should be placed flat to the ground to avoid elk entanglement in the wires.

Highway Right-of-Way Fences: For elk movement across highways, WYDOT Type E⁵, 4 strand barbed wire fence is the least restrictive. A top rail is recommended in areas of frequent elk movement, although none of the WYDOT standard fences include a top rail.

FENCES COMPATIBLE WITH BIG GAME PASSAGE: Electric Fence Designs

The key to successfully containing or excluding any animal with electric fence is the design. Design characteristics such as number of wires, wire spacing, post spacing, post type, the use of stays, and arrangement of hot and ground wires are all important factors to consider when designing and building an electric fence to contain one animal, but let another animal easily pass. The design, and resulting ability of a fence to target and transfer a painful shock to an animal, will determine if it is ultimately effective. For example, a 10-inch spacing between a hot and a ground wire on a three-wire fence is designed for a domestic cow to contact both wires at the same time with its head. Doing so will transfer a more painful shock than touching just the hot wire. If a deer fawn goes between the wires at the same fence, 10 inches is usually enough space for the animal to get its head through the wires without touching both wires at the same time. And, unless the fawn touches the hot wire with its wet nose or ears, it will not likely be shocked. Narrow this spacing a couple of inches and the fence is more of a barrier to big game species. Increase the spacing by a few inches and the fence will become less effective at containing cattle or bison. Unlike barbed wire, high-tensile electric wire does not bind and



Plan View

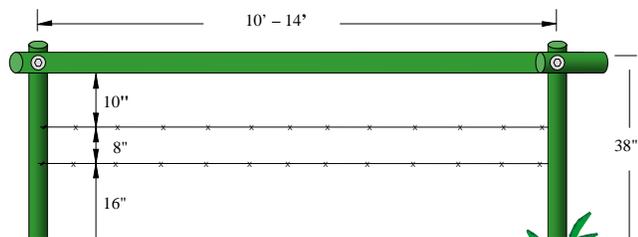


Figure 3a.

Note: Top rails are 4-inch diameter and notched at each end.

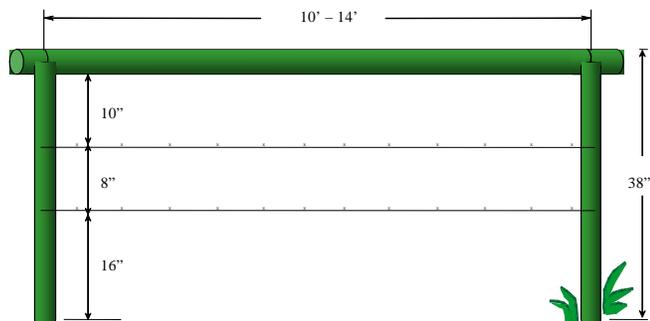


Figure 3b. Pole-top fence.

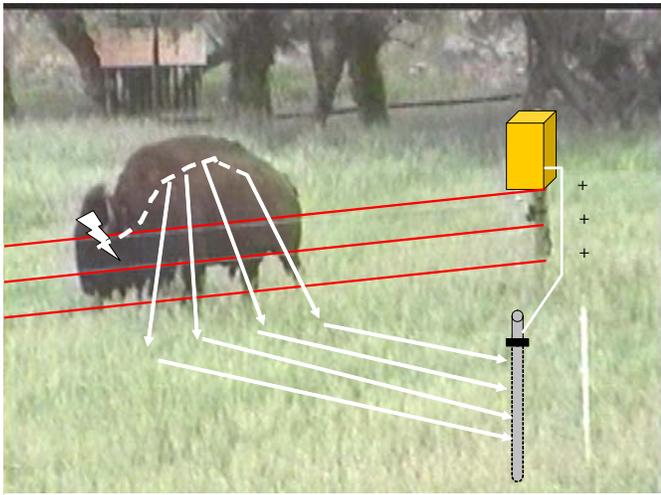


Figure 4. Earth return system.

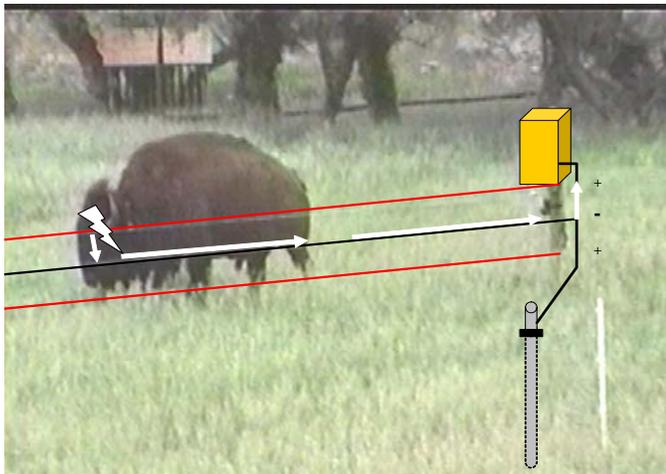


Figure 5. Wire return system.

catch when twisted. For this reason, and because electric fences are generally more flexible than traditional fences, the recommended 12 inches between top wires to minimize big game entanglement is not necessary.

An electric fence is designed more to act as a mental barrier rather than a physical barrier. In general, animals will avoid contact with electric fence wires once they have received a shock. If the animal cannot traverse a fence without receiving a shock, the fence will contain all but the most determined individuals. In order for an animal to receive a shock, it has to complete an electrical circuit. There are two ways in which this can occur: 1) Earth return:

where an animal contacts a hot wire and the charge travels through the animal's body and into the soil through its feet and back to the energizer to complete the circuit (Fig. 4) or 2) wire return: where an animal contacts both a hot and a ground wire and the current travels from the hot wire through the animal and back to the ground wire and energizer to complete the circuit (Fig. 5). The earth return system works well in areas with high soil moisture, but not so well in dry soils. Wire return systems work much better in dry soils and is generally better for soil moisture conditions that exist in Wyoming.

Electric Fences on Deer, Elk, or Pronghorn Ranges

*Three-Wire Electric Fence*¹¹: Properly constructed and maintained three-wire electric fence (Fig. 6) will effectively contain cattle or bison, yet is relatively easy for both young and adult deer, elk, or pronghorn to traverse. The 3-wire electric fence is comprised of a hot-ground-hot wire configuration with spacing of 22-32-42 inches. Line posts are 0.74-inch – 1-inch diameter x 60 inch tall solid fiberglass spaced at 50 foot intervals. All pronghorn and most deer will easily cross under the 22-inch bottom wire while the majority of the elk will jump the fence.

*Two-wire electric fence*¹²: A two-wire electrified fence (Fig. 7) is comprised of a ground wire at 20 inches and a “hot” wire at 30 inches. All fences should use 0.74-inch – 1-inch diameter x 48-inch tall solid fiberglass line posts spaced at 50-foot – 60-foot intervals. Two wire electric fences generally provide good containment of cattle and are easily traversed by deer and elk, but are difficult for pronghorn to negotiate. If pronghorn frequent the area, a 3-wire design is recommended instead. Two-wire electric fence has not been tested for bison or domestic sheep containment.

*Four-Wire Electric Fence*¹³: This design (Fig. 8) is comprised of a hot-ground-hot-hot wire configuration with spacing of 22-32-42-52 inches. Line posts are .74-inch – 1-inch diameter x 72-inch tall solid fiberglass spaced at approximately 50-foot intervals. Four-wire electric

fence will provide excellent control of cattle or bison but has not been proven to provide better containment than the three-wire electric fence design. Pronghorn and deer can successfully traverse four-wire electric fence, but it is difficult for elk to traverse. If elk frequently use the area, this fence design should be avoided. Limited direct observations of cow moose with calves also indicate they have a hard time traversing four-wire electric fence, but are able to traverse the shorter three-wire design.

Electric Fences for Sheep Containment

Sheep can be contained by electric fences, but designs needed to contain sheep generally require a wire spacing of eight inches or less and are therefore restrictive to pronghorn and possibly deer fawns and elk calves. The two-, three-, and four-wire designs presented in this bulletin have not been tested against sheep. A design that will contain sheep, but still allow wildlife, especially pronghorn, to pass with relative ease has not been identified.

FENCES THAT EXCLUDE WILDLIFE

Traditional Fence Designs

*Eight-Foot Woven Wire*¹⁴: Deer, elk and moose damage to gardens, young shelterbelts and hay stacks can be prevented with an eight-foot woven and smooth wire fence. This fence should be constructed with a bottom course of 47-inch woven wire, a top course of 26-inch woven wire and two strands of smooth wire above the woven wire (Fig. 9).

Pronghorn prefer to go under fences. The key to excluding pronghorn is a fence constructed to prevent them from going under the

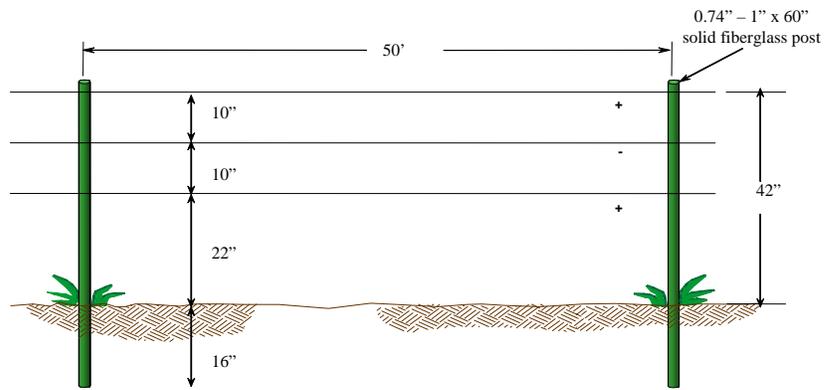


Figure 6. 3-wire electric fence.

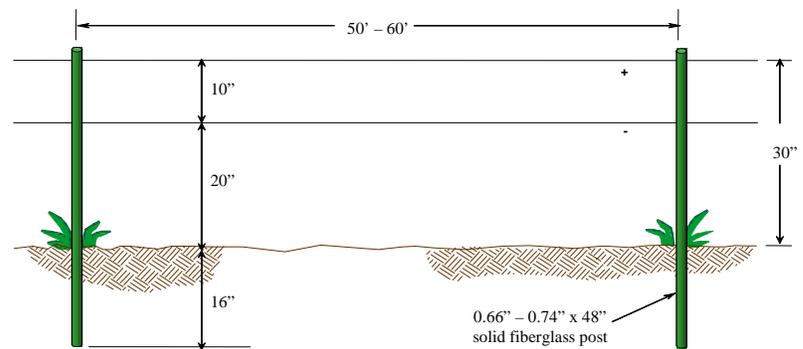


Figure 7. 2-wire electric fence.

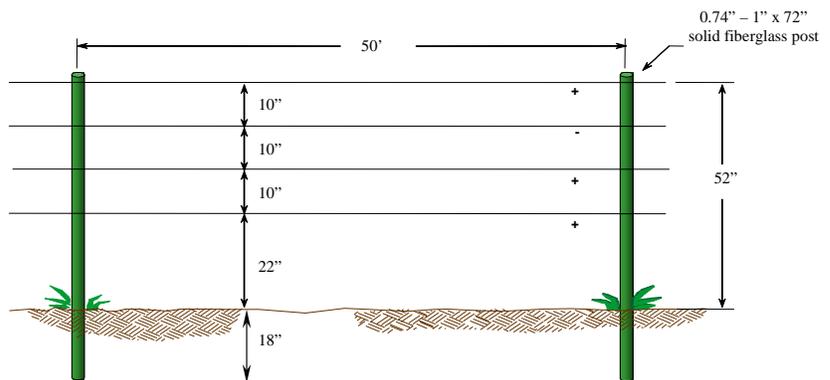


Figure 8. 4-wire electric fence.

fence, such as a fence of 32-48 inch woven wire and 1-3 strands of barbed wire above the woven wire¹⁵.

FENCES THAT EXCLUDE WILDLIFE

Electric Fence Designs

Electric Fences to Exclude Deer

*Eight-Wire Slant*¹⁶: Slant fence has been used for many years to protect orchards and nursery crops, but the original designs were nearly as expensive to build as standard eight-foot woven wire fence. Now with fiberglass posts and high-tensile electrified wire, the slant fence (Fig. 10) can be built for a reasonable cost and is very effective. Deer, pronghorn, elk, and bears can all be controlled with electric slant fence; but the fence is primarily designed to exclude mule and white-tailed deer.



Fences can keep wildlife from crossing highways.

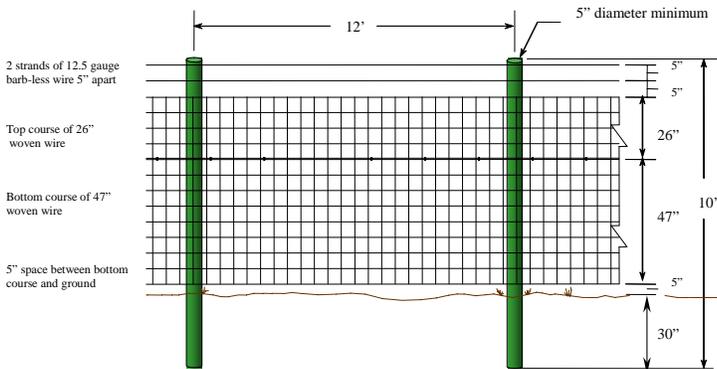


Figure 9. Eight-foot woven wire fence.

Figure 9. 8-foot woven wire fence.

*3-D fence*¹⁷: This fence design (Fig. 11) costs less than eight-wire slant fence and can be constructed in a short amount of time. It has been very successful at excluding white-tailed deer from orchards, tree farms, and vegetable gardens in many places throughout the United States. It has not been tested thoroughly in Wyoming against mule deer; however it has been tried in the Bighorn Basin around vegetable gardens and has worked very well. It is unknown whether or not this fence will effectively exclude other species. The basic principle behind this fence design is similar to eight-wire slant in that deer are not comfortable jumping a fence that has both height and depth. Depending on your goals, this fence can be constructed with high-tensile wire (permanent

fence) or with poly-rope or tape (temporary).

*Fifteen-Wire fence*¹⁸: When properly constructed and maintained, a fifteen-wire electric fence (Fig. 12) will exclude all but the most determined coyotes, bears, wolves, deer, elk, moose, and pronghorn. A fence of this magnitude is generally not needed, but has been used to exclude predators from small calving or lambing pastures and to exclude wildlife and livestock from commercial and private airport runways.

Electric Fences to Exclude Black and Grizzly Bear from Bee Hives¹⁹

Bears occasionally cause serious damage and economic loss when they get into bee hives.

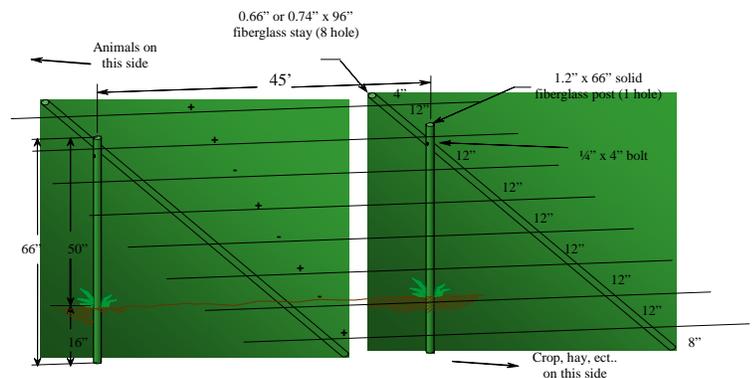


Figure 10. 8-wire slant electric fence.

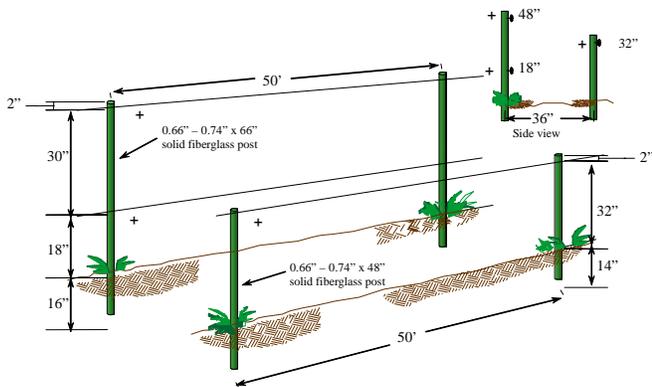


Figure 11. 3-D electric fence.

Many different five- and six-wire electric fence designs have been used with varying degrees of success. The design however, that has the most success in Wyoming combines a permanent

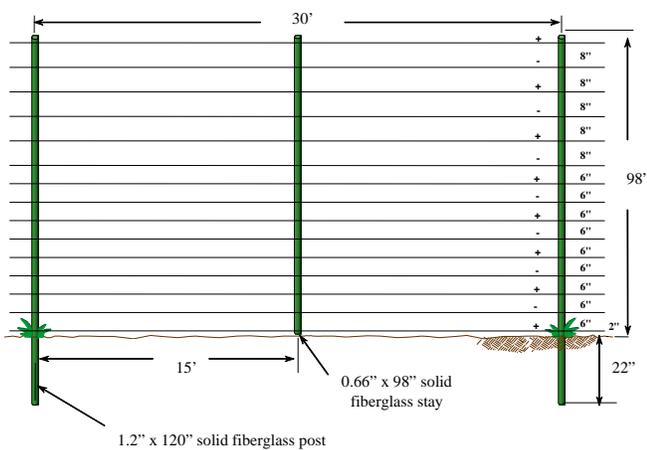


Figure 12. 15-wire electric boundary fence.

three-wire electric fence with a physical barrier fence. The three-wire electric fence is constructed with all hot wires spaced at 10-20-30 inches; a permanent fence made of 48-inch hog panels, chain-link fence, or corral panels is then placed 12 inches to the inside of the electric fence.

Electric Fences to Exclude Coyotes and Dogs²⁰

Often electric fences are used to keep

coyotes and dogs away from sheep, goats and poultry flocks. Various five to eight wire fences with alternating hot and ground wires have been successful. Also, woven wire fences with two or three electrified wires attached to insulated horizontal supports a few inches out from the woven wire fence are effective in excluding predators.

ELECTRIC FENCE CONSTRUCTION RECOMMENDATIONS

If not constructed and maintained properly, electric fence will not function as intended and will eventually fail. The following detailed recommendations are included to help the reader construct a well built fence that will operate properly and last for many years.

End and Corner Bracing: Standard H-braces can be used for electric fence construction and are ideal for 4-wire designs. However, a bed-log design (Fig. 13) is better suited for use with two- and three-wire fences and is cheaper to construct than an H-brace. On H-brace construction, electrified wires have to be insulated with nail on plastic insulators where they may contact the outside brace post. On all main corner posts and on wood posts used where the fence line changes direction, wires should be insulated to the inside of the direction change using bull-nose porcelain insulators. Wire should be threaded through the insulator when constructed and allowed to move freely for tightening and flexibility purposes. Plastic insulators of similar design may be used, but they will need replaced more often.

Line Posts and Spacing: Line posts should be solid pre-drilled fiberglass with a diameter between 0.66 inch and 1.2 inch, depending on design and purpose. If holes need to be drilled or re-drilled to the correct spacing, it can be done with a standard power drill and 1/4-inch high-speed drill bit. Steel or wood posts should not be used as line posts because they are not flexible and reducing the flexibility of the fence reduces its ability to allow wildlife passage. For the same reason, post spacing should stay con-

sistent with fence design recommendations

Attaching Wire to Fiberglass Line Posts:

Wires should be connected to line posts and stays using manufactured wire clips instead of threading the wire through each individual post. The fence will be much easier to maintain in the future if wire clips are used in the initial construction.

Gates: Electric fences do not require the use of special gates. Any gate used on standard barbed or woven wire fences can be used with electric fencing. In fact, electrified spring gates should be avoided because they are often a point of failure and can easily become tangled and unusable.

On all gate openings, specially insulated electric fence wire should be buried to carry the electric charge from one side of the opening to the other. On wire-return-ground systems another insulated wire to return the ground to the energizer via the grounded fence wire, should be buried across the gate opening as well. Household electrical cable should never be used because it is made to carry a maximum of 440 volts. Indeed, all copper wire should be avoided because connecting the copper wire to the galvanized steel fence wire will cause electrolysis and increased maintenance.

Wire Type: Fences should be constructed with high tensile, 12.5 gauge Class III galvanized wire with a tensile strength of 170,000 PSI and breaking strength of 1308 PSI. Similar galvanized wire with a tensile strength of 200,000 PSI may also be used, but can be more expensive, harder to work with, and does not necessarily reduce future maintenance costs. The 170,000 PSI wire is adequate and arguably more desirable in most electric fencing situations, including bison fence.

Polywire or tape of any kind is not intended for permanent fence construction and should be avoided unless used for a short period (one month or less) on a temporary or movable fence.

Wire Tension: Proper wire tension is also extremely important. Fence wires should be tightened to approximately 150 PSI with no visible sag between posts.

Most people over tighten high-tensile electric fences figuring that a tighter fence will contain their cattle or bison better. In reality a fence that is too tight is more likely to break than a fence that is properly tensioned. The name “high-tensile” electric fence can mislead people into believing the name is synonymous with “high tension” fences. The “high-tensile” refers to a

high breaking strength, but also to a harder, more brittle wire that is easily broken if tightly bent or kinked.

Grounding: **The number one cause of electric fence failure is improper grounding!** It is extremely important to make sure the fence is grounded properly. Always follow fence energizer manufacturer recommendations for proper grounding techniques. When in doubt, add an additional grounding rod to the system. If possible locate ground rods at the end and beginning of every fence and periodically in between. Always place grounding rods in moist or wet soils when possible.

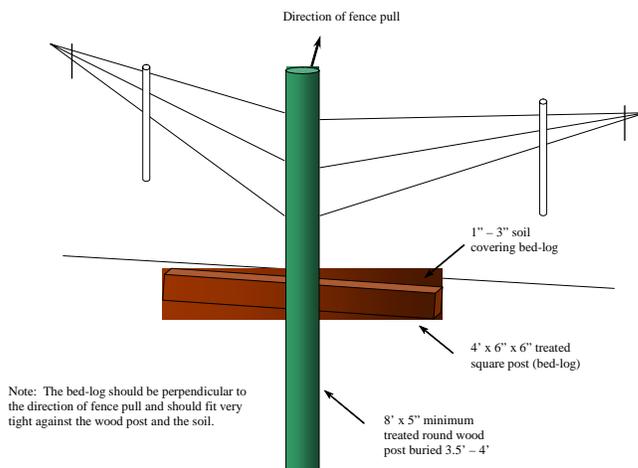


Figure 13. Bed-log brace design.

CONCLUSION

The abundance of wildlife and our many opportunities to enjoy it, yearlong, are among the unique aspects of Wyoming. As stewards of the land, we have an obligation to use the land with the least adverse effects upon the soil, the water, and the wildlife, for our neighbors, ourselves, and generations to come. This bulletin is intended to aid landowners in attaining this goal with respect to big game animals and domestic livestock.



Pronghorn crossing a fence.

Some Additional Informational Sources on Fencing for Wildlife:

- Huygens, O.C. and H. Hayashi. 1999. Using electric fences to reduce Asiatic black bear depredation in Nagano prefecture, central Japan. *Wildlife Society Bulletin* 27(4):959-964.
- Karhu, R.R. and S.H. Anderson. 2002. Evaluation of high tensile electric fence designs on big game movements and livestock containment. Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming, Laramie, Wyoming. 31pp.
- Knight, J.E., E.J. Swensson, and H. Sherwood. 1997. Elk use of modified fence-crossing designs. *Wildlife Society Bulletin* 25 (4):819-822.
- Palmer, W.L., J.M. Payne, R.G. Wingard, J.L. George. 1985. A practical fence to reduce deer damage. *Wildlife Society Bulletin* 13 (3):240-245.
- USDI Bureau of Land Management and USDA Forest Service. 1988. *Fences*. Missoula Technology and Development Center, Missoula, MT. 210 pp.
- Wyoming Game and Fish Commission. 1999. *Fencing Policy No. VII I*. Issue Date: 12/07/99. *Standard Specifications and Contract Documents for Fence Maintenance Contracts*. Wyo. Game and Fish Department, Services Division.

Appendix A: Summary of wildlife fence designs recommended based on primary purpose and species of wildlife present.

	Wildlife	Fence Design and Wire Spacing (bw=barbed wire, sw=smooth wire) (Allow Big Game Passage)	Primary Purpose
	Traditional Designs		
1	Deer, pronghorn, elk, moose	4-Wire Cattle Fence (16" sw, 23" bw, 30" bw, 42" bw) (see Figure 2)	Deer, pronghorn, elk or moose range w/cattle and/or horses
2	Deer, pronghorn	4-Wire Sheep Fence (10" sw, 17" bw, 24" bw, 32" bw)	Deer and Pronghorn range w/sheep
3	Deer, pronghorn	4-Wire Sheep/Cattle fence (10" sw, 18" bw, 26" bw, 38" bw)	Deer and Pronghorn range w/cattle and sheep
4	Deer	Woven Wire Sheep Fence (26" ww, 28" bw, 38" bw)	Deer range with sheep
5	Deer, pronghorn, elk, moose	WYDOT* Type E (16" sw, 25" bw, 33" bw, 45" bw)	WYDOT* standard fence w/cattle and/or horses
6	Deer, pronghorn	WYDOT* Type G (6"bw, 14" bw, 24" bw, 36" bw, 48" bw)	WYDOT* standard fence w/sheep (often used but not recommended)
7	Deer, pronghorn	WYDOT* Type C (26" woven wire, 33" bw, 45" bw)	WYDOT* standard fence w/sheep (often used but not recommended)
8	Deer, pronghorn, elk, moose	Barbed and/or woven wire let-down fence sections (see Figure 1)	Frequent big game crossing areas
9	Deer, pronghorn, elk, moose	2-Wire Cattle Fence with Pole Top (16" bw, 24" bw, 38" wood pole). (see Figures 3a and 3b)	Deer, pronghorn, elk or moose range w/cattle and/or horses
10	Elk, moose	3-Wire Elk Winter Range Fence (10" bw, 18" bw, 27" bw, 38" pole top)	Elk winter range and moose range w/cattle, sheep, and/or horses
	Electric Designs		
11	Deer, elk, pronghorn, moose	3-Wire Electric Fence (22", 32", 42" hot-ground-hot) (see Figure 6)	Allow deer, elk, pronghorn, or moose passage while containing cattle or bison
12	Deer, elk, moose	2-Wire Electric Fence (20", 30", ground-hot) (see Figure 7)	Allow deer, elk or moose passage while containing cattle
13	Deer, pronghorn	4-Wire Electric Fence (22", 32", 42", 52", hot-ground-hot-hot) (see Figure 8)	Allow deer and pronghorn passage while containing cattle or bison.
	(Exclude Big Game or Predators)		
	Traditional Designs		
14	Deer, elk, moose	8' Woven- 2 strands smooth, 2 courses of woven wire (see Figure 9)	Protect gardens, young trees, stored crops
15	Pronghorn	32" to 48" woven wire, 1 to 3 strands barbed wire	Protect stored crops, small fields
	Electric Designs		
16	Deer	8-Wire Slant Electric Fence (see Figure 10)	Protect stored crops
17	Deer	3-D Electric Fence (see Figure 11)	Protect gardens, young trees, stored crops
18	Most medium or large terrestrial species	15-Wire Electric Fence (see Figure 12)	Protect nurseries, high value crops, airport runways
19	Black bear, grizzly bear	Electric/physical barrier combination (3-wire electric, 20", 30", 40" all hot with physical fence 12" to the inside)	Protect beehives
20	Deer, black bear, coyotes, dogs	5 to 8-Wire Electric Fence with alternating hot-ground wires	Protect trees, gardens, small fields, beehives, sheep, goats, poultry

*WYDOT is Wyoming Department of Transportation. We only recommend WYDOT designs when the fence will function as a state highway right-of-way fence and must follow WYDOT fencing policy that requires a minimum fence height of 45".

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