Costs and Economics

Designing tall temporary fences that are strong enough to exclude large animals and stand up to snow loading and high winds is a challenge. There may be cheaper alternatives than the fences we tested. Such fences could be more portable and might hold up in environments that are not as harsh. MTDC's goal was to test fences that would last 3 to 8 years, that could be constructed at a reasonable cost, and that could be maintained without a lot of additional labor or materials.

Table 1 shows the cost per foot of each fence design used in this evaluation. These costs are based on 800 lineal feet of each style of fence. Electric fence costs include an energizer, solar panel, and battery. Materials were bought in relatively small volumes, which increased the cost of materials. Labor was supplied by agency staff who were not necessarily fence installation experts, which increased the time needed to construct the fence. Accessibility to the Buffalo Springs site was difficult because of ditches and steep terrain. Large exclosures in open areas should cost less per foot, particularly if materials were purchased in volume and the fence was constructed by experienced laborers using mechanized equipment.

Electric fence energizers are capable of charging more than 800 feet of fence, so the cost per foot will drop for longer fences. Don't try to charge a longer section of fence than the maximum length specified by the energizer's manufacturer. Usually, specifications are based on optimal conditions, which aren't likely to resemble field conditions. Although a lighter version of the polyrope, called polywire or turbo wire, is typically used for portable fences, we did not test polywire. The material costs of the fence could be reduced by almost 10 cents per foot if we had used polywire. We used polyrope because it was more visible and because it looks like more of a barrier than polywire.

Some fence materials may be reusable after 8 years, but the plastic mesh and polyrope will probably need to be replaced. For a cost comparison, a standard 4-foot, 5-strand permanent barbed wire fence costs about 80 cents to $1.50 per foot for materials and labor. Such a fence would not be high enough to keep large animals out.

Table 1—Relative costs of three types of fence used to exclude elk and moose.

Fence Type	Material Cost ($ per foot)	Labor Cost ($ per foot)	Total Cost ($ per foot)
Polyrope electric	2.21	0.51	2.72
Plastic mesh (nonelectric)	1.67	0.45	2.12
High-tensile steel electric	1.60	0.73	2.33

Test Results

There has been no sign that large animals have entered any of the exclosures in the last 2 years. These areas are exposed to pressure from moose and elk, but not to heavy pressure from deer. As the protected areas inside the exclosures begin to outgrow the more heavily grazed area outside, the elk and moose will have more incentive to get inside. Some fences have been damaged by snow and wind during the winter.

These fences are not being tested in areas with high deer populations. Deer are known to be persistent in their effort to get over, under, or through fences. It is not known how well these fences will hold up to heavy pressure from deer.

Polyrope Electric Fence

The polyrope fence shorted out both winters. The first year, the rope slipped out of an insulator at one of the corner braces. To correct the problem, MTDC installed nylon ties that hold the rope in place at all brace insulators (figure 17). During the second year, one of the positively charged ropes appeared to have been pushed down by snow until it shorted out on the ground rope below it. The energizer battery was totally discharged and could not be revived (it probably froze during the early spring). Polyropes tend to sag, especially when new, and require retensioning a couple of times a year. There was some concern about maintaining the electrical circuit when the fine wires braided into the rope were clamped together at connection points, but that has not been an issue.

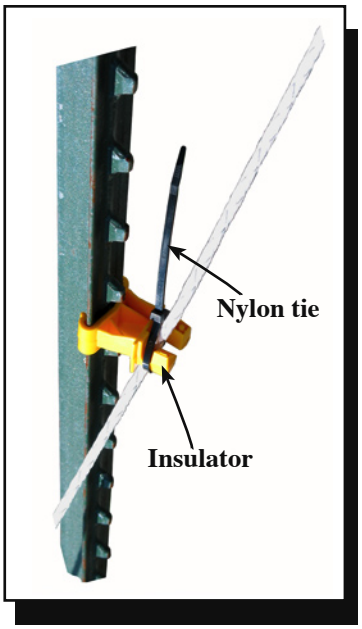


Figure 17—After wind or snow forced the polyrope out of its slot on the T-post insulator, grounding the fence, we used nylon ties to secure the rope to the insulator.

Plastic Mesh Fence (Nonelectric)

During the first year, a 60-foot section of fence bent outward at a 30-degree angle (figure 18). A melting snowbank was the suspected culprit. To repair the problem, the fence posts were straightened and braced with several guy wires inside the exclosure. The longest run between braced tensioning posts is about 400 feet. Testing shows this run may be too long, given animals' attempts to get inside and the heavy snow loads. A run of 200 feet between tensioning posts may work better.

Figure 18—This plastic fence and support posts were probably bent over by a melting snow bank.

The PVC-coated support wires are difficult to retension after they have been tied to the steel posts. Our test fence required retensioning once during the first year. A clip that would allow the wire to stay in position vertically on the post, but slide horizontally would be a great improvement. The fence required no maintenance during the second year. So far, the plastic mesh shows no sign of degrading.

High-Tensile Steel Electric Fence

This fence has proven to be almost maintenance free. Each spring, the wires have a little slack in them and require retensioning. One wire slipped out of an insulator on the wooden bracing post, but did not ground out the fence.

Observations

Table 2 presents a summary of three fences used to exclude elk and moose.

Polyrope Electric Fence

As installed, the polyrope fence is not reliable. The heavy metal posts were used because of the fence's height and the heavy snow loading. The fiberglass or plastic poles typically used with portable polyrope or polywire fences are too weak for 6-foot-high fences. Steel posts and electric wires offer many possibilities for accidentally grounding the fence, making this installation ineffective as an exclosure. The polyrope was selected because of its high visibility. This is the most expensive option of the three fences tested.

Plastic Mesh Fence (Nonelectric)

This fence does not require electrical components. In many locations it would be nearly impossible to keep a battery, energizer, and solar panel from being vandalized or stolen. The fence is relatively quick and easy to install.

Autoloading hog ring pliers are essential for attaching the plastic mesh to the support wires. At least two pairs of pliers are recommended for installation efficiency, even on a small 1-acre exclosure. Overall, the fence is a good choice for fences that don't need electricity. Will the plastic mesh hold up for 8 years at an elevation of 8,200 feet? We'll find out in 6 more years.

High-Tensile Steel Electric Fence

The high-tensile steel fence appears to be the most durable fence in the test. It's closer to a permanent fence than a temporary fence and should hold up for 8 years or longer. Keeping the battery and charging system up and running will be the biggest challenge for this exclosure.

Promising Electric Fences

GEOTEK, Inc., makes a fence that was not tested, but might have promise. The company sells 4- to 6-foot tall fiberglass animal control fences with fiberglass rods. The cost for a 1-acre exclosure is slightly higher than the three fence options tested. The company's contact information is included in the Resources section.

Table 2—A summary of the characteristics of three fences used to exclude elk and moose. The two electric fences used a 12-volt deep-cycle battery with a 20-watt solar panel. Both electric fences have alternating hot and ground wires. The polyrope electric fence uses the Gallagher B260 energizer. The high-tensile steel electric fence uses the Gallagher B160 energizer.

Fence Factors	Polyrope Electric	Plastic Mesh	High-Tensile Steel Electric
Total cost per foot (Materials and labor)	$2.72	$2.12	$2.33
Height	6	7 ½	6
Maximum spacing for tension posts[1]	200 feet	200 feet	1,000 feet, (¼ mile possible in some applications)
Maximum spacing for support posts[2]	20 feet	20 feet	60 feet for support posts, 20 feet for spacing stays[3]
Fence material	7-rope/¼-inch-diameter braided polyethylene	1 ¾-inch square plastic mesh	7-wire/12-gauge high-tensile steel
Dependability	Low[4]	High[5]	High to medium[6]
Maintenance	Medium	Low	Low
Installation	6 people, 1 day	6 people, 1 day	8 people, 1 day
Removal	Plastic insulators must be cut off. Puller will simplify removing T-posts.	Plastic mesh may be brittle and break easily. Mesh may be hard to retrieve or roll up. Retrieving hog rings is slow. Tension wire can be coiled up with a spinning jenny. A puller will simplify removing T-posts.	Tension wire can be rolled up with a spinning jenny. Post braces can be dug up. Wooden posts probably can be cut off at grade.
Reusable components (after 8 years estimated exclosure life)	Metal posts, braces, porcelain insulators, energizer, solar panel	Metal posts, braces, tension wire	Steel wire, braces, porcelain insulators, energizer, solar panel

[1]Tension posts are anchor points for wire and mesh that have been pulled tight.

[2]Support posts, set between the tension posts, maintain the wire spacing and hold materials upright.

[3]Spacing stays maintain the spacing of the alternating hot and ground wires.

[4]Rope grounds out easily on metal posts. When ice builds up on the ropes, they sag and ground each other out.

[5]Even when snow bent posts over, the fence would have kept animals out. Eventually (after 8 to 10 years of so), the plastic will begin to degrade.

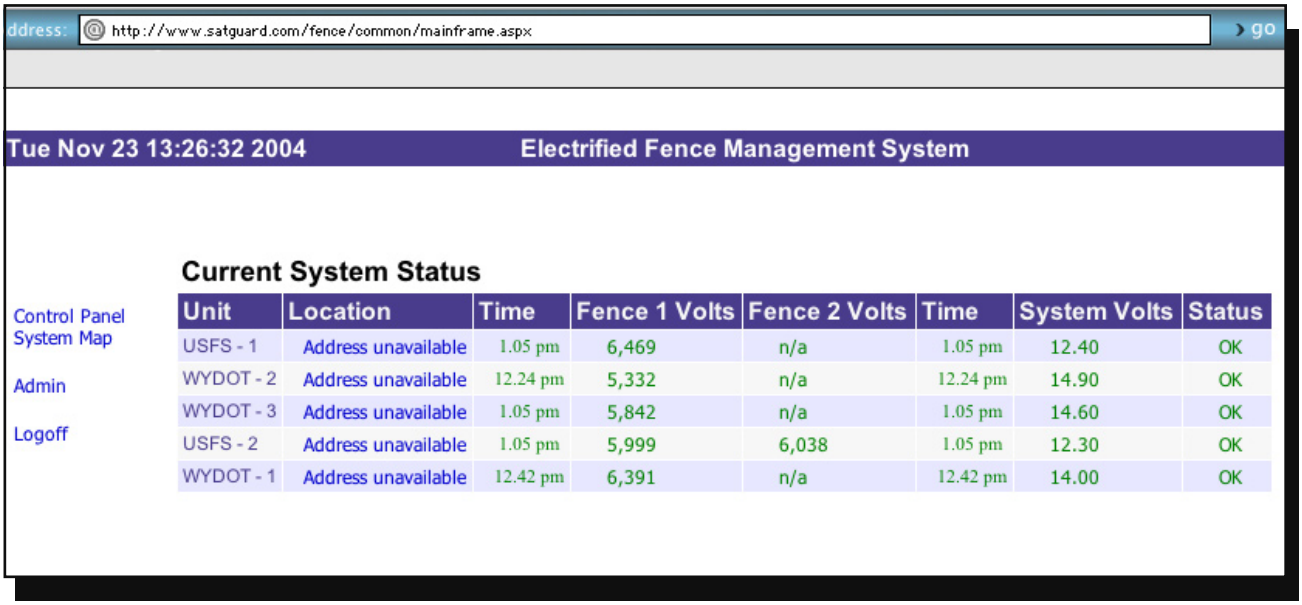
[6]The fence itself is dependable, but the power to the fence is not, especially in cold weather.

Monitoring Electric Fences

MTDC is using a satellite transmitter to monitor the electric fences at Buffalo Springs remotely. This monitor transmits hourly fence and battery voltage readings from the area, which is not easily accessible and does not have radio or cell phone coverage. The monitor, Model AQF-2000 developed by AIRSIS LLC, costs about $1,000 (figure 19). AIRSIS downloads hourly readouts of the fences to a Web page for about $50 per month. There is a one-time $40 hookup fee. Figure 20 shows the Web page.

Figure 19—The satellite transmitter sends fence voltage readings hourly, updating a Web page.

Monitoring high-voltage electric fences has its problems. The quick 7,000-volt pulse must be converted into a signal that can be read and transmitted by the satellite. The first voltage converter in the AIRSIS transmitter proved unreliable and was not accurate enough. A second converter was more accurate, but faltered as the temperatures dropped. AIRSIS is correcting the problem caused by low temperatures, and MTDC will test the new design during the winter of 2004–2005. Satellite monitoring of electric fences has not proven reliable so far. MTDC is investigating other satellite technologies that may be more cost effective.



Unit	Location	Time	Fence 1 Volts	Fence 2 Volts	Time	System Volts	Status
USFS - 1	Address unavailable	1.05 pm	6,469	n/a	1.05 pm	12.40	OK
WYDOT - 2	Address unavailable	12.24 pm	5,332	n/a	12.24 pm	14.90	OK
WYDOT - 3	Address unavailable	1.05 pm	5,842	n/a	1.05 pm	14.60	OK
USFS - 2	Address unavailable	1.05 pm	5,999	6,038	1.05 pm	12.30	OK
WYDOT - 1	Address unavailable	12.42 pm	6,391	n/a	12.42 pm	14.00	OK

Figure 20—A typical Web page showing the status of the electric fence.

Resources

Fences

- **Gallagher Power Fence, Inc.**

Phone: 800–531–5908

Web site: *http://www.gallagherusa.com*

- **Specialty Agricultural Products, LLC**

Phone: 800–483–8889 or 203–387–3458

Web site: *http://www.nodeer.com*

- **Wayside Fence Co.**

Phone: 631–968–6828

Web site: *http://www.waysidefence.com*

- **Quik S'port fence bracing**

Web site: *http://www.electric-fence.com/nf_prod.html*

- **GEOTEK, Inc.**

Phone: 800–533–1680

Web site: *http://www.geotekinc.com*

Satellite Transmitters

- **AIRSIS, LLC**

Contact: Jim Drewett

Phone: 619–585–0435

Web site: *http://www.airsis.com*

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About the Author

Gary Kees is a project leader specializing in reforestation and nurseries, facilities, recreation, and GPS projects at MTDC. He received his bachelor's degree in mechanical engineering from the University of Idaho. Before coming to MTDC in 2002, Gary worked for the Monsanto Co. in Soda Springs, ID, as a mechanical/structural engineer and project manager.

Library Card

Kees, Gary. 2004. Fencing out wildlife: plastic mesh fences and electric fences monitored by satellite telemetry. Tech. Rep. 0424–2838–MTDC. Missoula, MT: U.S. Department of Agriculture Forest Service, Missoula Technology and Development Center. 18 p.

Describes the results of 2 years of tests on three types of fences designed to keep elk and moose out of 1-acre areas being used for research. All but one of the fences are on a steep, north-facing slope at an elevation of 8,200 feet near the Continental Divide in the Beaverhead-Deerlodge National Forest in Montana. The other fence protects a willow patch along the Middle Fork of Rock Creek near Philipsburg, MT. The fences are intended to last for at least 8 years and cost from $2.12 to $2.72 per lineal foot to install. The types of fences being tested include: a 7 ½-foot-tall plastic mesh fence and two 6-foot-tall electric fences, one using polyethylene rope with metal wires braided into the rope (polyrope) and the other using high-tensile steel wire. The electric fences use 7,000-volt pulses. They are powered by a 12-volt deep-cycle battery and a 20-watt solar panel. A satellite telemetry system was used to monitor the electric fences, which are in an area that is difficult to access and that lacks radio and cell phone coverage. So far, the telemetry system has not proved reliable. The high-tensile steel electric fence has proven to be almost maintenance free. The polyrope electric fence, installed with metal posts because of the fence's height and the heavy snow loads on the Continental Divide, has shorted out many times. The plastic mesh fence proved to be reliable.

Keywords: Beaverhead-Deerlodge National Forest, elk, exclosures, fences, moose, plastic, polyrope, steel

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Fax: 406–329–3719
E-mail: wo_mtdc_pubs@fs.fed.us

For additional information about wildlife fencing, contact Gary Kees at MTDC.
Phone: 406–829–6753
Fax: 406–329–3719
E-mail: gkees@fs.fed.us

Electronic copies of MTDC's documents are available on the Internet at:
http://www.fs.fed.us/t-d
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http://fsweb.mtdc.wo.fs.fed.us/search