Mobile Solar Water Pumping

Providing Off-Site Watering as an Aid to Livestock Distribution and Improved Riparian Condition

By Kenneth Primrose and Gary Delaney

Livestock are attracted to riparian areas because of easy access to water, limited slope, shade, thermal cover, and a high quantity and quality of forage relative to the adjacent uplands. Supplemental off-stream water can improve livestock distribution by luring the livestock away from the riparian areas.

The availability of off-stream water can also improve gain on livestock. A study at the Hall Ranch, Union, Oregon, showed that cows with access to off-stream water and trace mineral weighed more than those without off-stream water.[1]

A mobile solar pumping unit was developed to pump water to an off-stream watering site. The pumping system is able to pump from various water sources with variable lift requirements to supplement existing water sources.

Pumping System

A mobile pumping unit uses solar panels for a power source. The solar panels were mounted on a 16-foot × 6-foot 8-inch flatbed trailer for moving from location to location. To prevent damage to the electrical connections on the panels, a wooden frame is used to support the panels when the unit is in transit. It is sufficiently sturdy to tolerate rough roads.

The pumping system consists of four 75-watt solar panels, a submersible pump with a helical rotor, 100 feet of black plastic pipe, and 2 water troughs. Each of the solar panels produces 4.41 amps at 17 volts. The solar panels should have a life of at least 20 years and the submersible pump should pump for at least 15 years.

The current mobile solar unit does not have batteries or a tracker but it is suggested that if one were to construct a similar unit, batteries and a tracker might be desirable.

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The submersible pump was a Grundfos® with a helical rotor. The helical rotor is a shaft bent in a spiral which is placed inside of a Butna® rubber sleeve which is smooth.

The shaft screws the water out of the pump. Helical rotors produce a smooth and even flow and are easy to frostproof. The pump can tolerate a degree of sand in the water but excessive sand will scratch the smooth surface of the Butna® rubber.

Two 10-foot aluminum troughs and 60 feet of steel gate panels were also placed on the trailer. Panels were placed around the trailer to protect the solar unit from livestock.

Performance Evaluation

The mobile solar pumping unit was used for two grazing seasons on the Rockpile Allotment and the Windy Pt. Allotment. Both allotments are in the Grant County, Oregon.

The Rockpile Allotment is located 13 miles south of Dayville, Oregon, in the South Fork John Day River drainage. The pasture consists of steep, adjacent uplands with east-facing slopes along the South Fork John Day River. Elevations in the pasture ranged from 3,000 feet along the South Fork John Day River to 4,200 feet at the western boundary of the pasture.

The majority of the South Fork John Day River is fenced. Grass species along the South Fork John Day River include bluebunch wheatgrass, basin wildrye, and bluegrasses. Herbaceous species include lupines and yarrow. Trees and shrubs include wild rose, snowberry, juniper, and ponderosa pine.

On the dryer upland sites, bluebunch wheatgrass is the dominant forage species. Other grass species include Idaho fescue, Sandberg's bluegrass, bottlebrush squirreltail, and needlegrasses. Forbs include yarrow, buckwheat, lupine, and phlox. Shrub species include bitterbrush, basin big sagebrush, low sagebrush, and rabbitbrush. Junipers at various density

Ken Primrose (BLM) and Ed Teel (NRCS) discuss the solar power unit.

are found throughout the pasture. Cheatgrass or downy brome is common throughout all sites.

Windy Point Allotment, Pasture 7A, is located approximately 4 miles northwest of Dayville, Oregon. Elevation in the pasture ranges from 2,120 feet at the southern boundary to 2,720 feet at the northern boundary. The majority of the acreage in the pasture is public land.

The pasture is a juniper/sagebrush/grass vegetation type with a mixture of herbaceous vegetation, including bluebunch wheatgrass, needle and thread, bluegrass, bottlebrush squirreltail, basin wildrye, and several forbs with primarily cheatgrass at the lower elevations along the John Day River.

The mobile solar unit was used in four pastures during the 2004 and 2005 grazing season.

The watering system minimized the time that the livestock spent in the riparian area. Streambank trampling and damage was negligible. Repeated observations by the livestock owner and the authors consistently indicated that the pump unit accomplished the objective of luring the livestock away from the riparian areas. The system provided enough water even on cloudy days to meet the requirements for livestock. Livestock in small social groups of 10 to 12 head trailed to the watering troughs to drink, then trailed back out to graze. The livestock did not "camp" at the watering trough.

Cattle at off-stream water troughs.

During the 2005 grazing season the pump quit pumping water to the watering troughs. The surface of the Butna® sleeve in the helical rotor became too rough because of excessive sand being suctioned into the helical rotor. If the surface of the Butna® sleeve in the helical rotor becomes too rough, the motor goes into overload and the pump will not start.

When the unit was moved from pasture to pasture, the problem with the excessive sand could have been prevented by placing the submersible pump in a silting well such as a culvert. By utilizing a silting well, which requires a minimum of 12 inches of water for the pump to start, excessive sand would not be suctioned into the helical rotor of the pump.

Perforations cut at the top of the culvert should be at least 6 inches higher than the submersible pump. A metal support could be welded to the inside of the culvert to hold the submersible pump in an upright position to allow the pump to function more efficiently.

It is believed that a centrifugal rotor submersible pump would be a more efficient pump for this application because it can tolerate more sand in the pump and is designed for low head flows.

The helical rotor pump is designed for use in wells and high head flows and has a lower tolerance for sand than the centrifugal rotor pump. It has a higher efficiency and can lift water higher elevations than the centrifugal rotor pump.

Table 1. Actual cost of mobile solar pumping unit

Component	Cost per component	Total cost
Grundfos pump	$1,400.00	$1,400.00
Pole mount	$230.00	$230.00
Four 75-watt solar panels	$349 per panel	$1,396.00
Other components for the solar system (wiring, pump controller, float switch, shipping)	–	$748.10
Trailer (16 feet long × 6 feet 8 inches wide)	$1,695.00	$1,695.00
6 Panels (10-foot)	$84.00 each	$504.00
Two 10-foot aluminum troughs	$345.00	$690.00
Miscellaneous (fabrication of boxes on trailer, etc.)	$200.00	$200.00
Totals		**$6,863.10**

All necessary components and costs for the mobile solar pumping unit are shown in Table 1.

Conclusions

The mobile solar unit demonstrated that solar units successfully can be used to pump water to an off-stream watering site and such units are tolerant of being transported over rough roads. The unit was capable of filling our off-site watering troughs directly from the stream. Use of the mobile solar pumping unit and off-site watering troughs resulted in decreased riparian impact and improved cattle distribution.

Excessive sand in the pump could be a problem if the pump is placed on the bottom of a water source (stream, etc.) and/or by a sudden discharge of sediment in a stream by a storm. By placing the pump in a silting well, excessive sand should not accumulate in the pump.

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Reference

1. DelCurto, T., M. Porath, C. T. Parsons, and J. A. Morrison. 2005. Management strategies for sustainable beef cattle grazing on forested rangelands in the Pacific Northwest. *Rangeland Ecology and Management* 52:119–127.