retire; he is offered four or five hundred dollars a year by some strong young man for the use of his farm, a bargain is made, and the sapping process is commenced.

The farm is worth ten thousand dollars, it represents the old man's capital; he gets five hundred dollars per annum, or five per cent; but at the end of a few years he begins to realize that it is not the *interest* on his principal that he has been receiving and eating up, but a part of the principal itself. He finds his farm run down, what were once fertile fields, now poor and seeded to noxious weeds; the improvements dilapidated, and, in fact, the farm not worth in the market near as much as when he left it. He finds, in fact, that he has not been living on what his renter paid him as he supposed, but he has actually been eating up his own reserved capital.

Hence if our wealthy retired farmers will be wise in time they will grass their farms, stock them up, and place them in the hands of trusty men on shares, thus holding a certain right of supervision that will not only enable them to preserve the fertility of their lands, but in the end receive a greater dividend upon their investment.

(Copy filed in the Nebraska State Historical Society Library, Lincoln, Neb.)

Prescribed Burning with a Helitorch on the Texas Rolling Plains

Robert A. Masters, G. Allen Rasmussen, and Guy R. McPherson

Historically, redberry juniper *(Juniperus pinchotii)* occurred primarily on rough and shallow rocky slopes and along drainages in xeric regions of the southern Great Plains (Ellis and Schuster 1968). In recent times range deterioration resulting from overuse by livestock and protection from fire has prompted expansion of redberry juniper into more productive range sites. Today, management practices employing fire are increasingly used on redberry juniper infested rangelands.

A recommended management scheme to improve rangeland dominated by redberry juniper consists of sequential mechanical and fire treatments. Initially, infested areas are chained to knock down or uproot established juniper. Subsequent pasture deferment provides the fine fuel needed for the fire treatment. Fire consumes downed woody debris and suppresses redberry juniper seedlings and crown sprouts. Steuter and Wright (1983) recommend a fire frequency of 10 to 15 years after initial burn to maintain redberry juniper in a non-reproductive state. Fire reduces the sphere of influence of juniper plants thus enhancing forage production.

Traditionally, ground ignition methods have been used to ignite prescribed fires in redberry juniper-mixed grass communities. These methods work well on small easily traversed areas. However, ground ignition is difficult on large, rough and dissected areas because of the increased frequency of fuel breaks. In such areas, aerial ignition with a helitorch is a potential tool for prescribed burning. What follows is a description of the current use of the helitorch, helitorch components, decision-making process in determining when to use a helitorch, and organizational considerations of a burn using a helitorch.

Aerial ignition with the helitorch has been successful in forested regions of the northwest U.S. for slash reduction and wildlife habitat improvement. Generally, these burns encompass less than 1,000 acres. Continuous slash depths of 4 ft and fuel loads in excess of 40 tons/acre are common. High intensity fires and difficulty moving across these heavily fueled units create potentially dangerous situations when attempting ignition using ground techniques. Moreover, the helitorch provides good control over ignition pattern and fire behavior. For example, initial ignition of the center portion of the unit to be burned (center fire) builds heat, causing the fire along the unit boundary to pull toward the center thus reduc-

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The authors would like to thank Henry A. Wright and Carlton M. Britton for their help in conduct of the burn and manuscript preparation. We would also like to express our gratitude to a number of staff members and graduate and undergraduate students who assisted in fireline construction and main unit headfire. We wish to thank Jimmy Propst and Gene Kreasey of Propst Helicopter for their patience and expertise with the helitorch and Foard Country Soil Conservation Service Staff for their assistance.

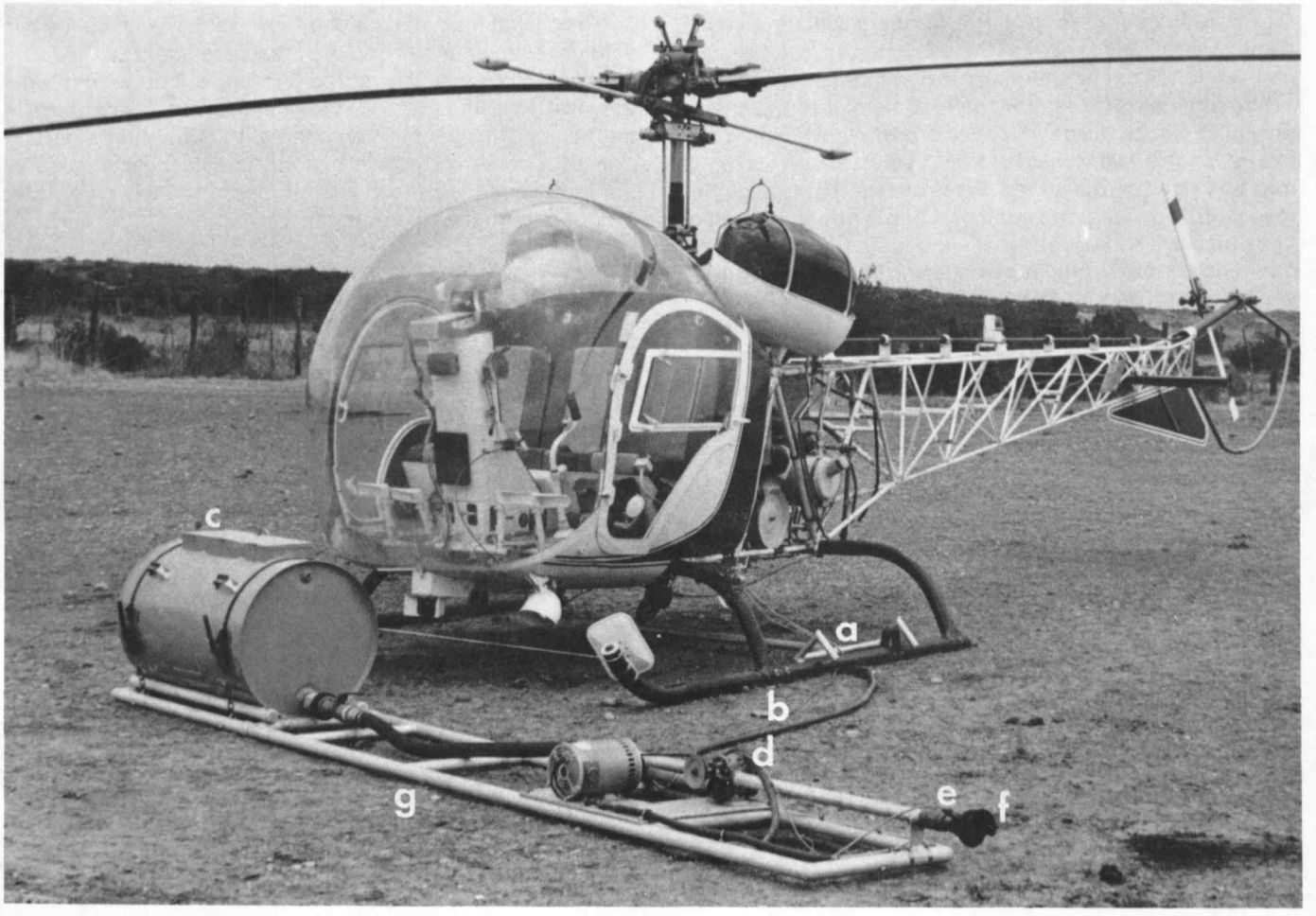

Fig. 1. *Helitorch is composed of a spreader bar (a), electric power cable (b), fuel drum (c), fuel pump (d), ignitor (e), nozzle (f), and support frame (g).*

ing the likelihood of fire escape.

The helitorch is suspended 10 to 15 ft underneath a helicopter (Fig. 1). A spreader bar reduces swaying and circular motion of the helitorch while in flight. Alumagel:gasoline fuel (gasoline mixed with alumagel (fuel thickener) at approximately 4 lbs/10 gal) is pumped through the nozzle and ignited. In heavy woody fuels a nozzle delivering large droplets of fuel with minimal horizontal spread is desirable. Grassland fuels are efficiently ignited using a spreader nozzle which minimizes droplet size and increases horizontal fuel spread.

A helicopter with helitorch can fly between 40 and 50 mi/hr. Seven to 9 miles of line can be ignited with a 55-gal load of alumagel:gasoline fuel in about 9 minutes. During a burn conducted on the Texas Rolling Plains using a helitorch, fuel was applied at 40 mi/hr from a height of 150 to 200 ft. Swath width was about 15 ft and droplets were golfball sized.

Factors Influencing Ignition Method

The first consideration prior to burning is to determine ranch objectives and whether they can be met with prescribed fire. Once the decision has been made to use prescribed fire it is necessary to determine the most efficient and safe method of conducting the burn. Influencing factors are size and topography of the area, number and length of roads on the area, manpower, time availability, safety, and costs.

Importance of size of the area to be burned varies with vegetation type, fuel load, and fuel type. In redberry juniper-mixed grass communities ground ignition is impractical if the area exceeds 4,000 acres, especially if the area is dissected by drainage channels and has abrupt changes in elevation. In addition, roads act as fuel breaks and hinder fire spread, requiring ignition of more lines of fire to ensure uniform fire spread. Personnel safety is directly influenced by size and topography of the area burned, and is more difficult to ensure on large, rough and broken areas with many roads.

A prescribed burn was conducted using a helitorch during the spring of 1985 in the Texas Rolling Plains. The site was dominated by a redberry juniper-mixed grass community. The pasture had been chained in 2 directions 2 to 3 years prior to burning. Chaining coupled with a light stocking rate (1 AU/40 acre) provided abundant fine fuel. The objectives of the burn were to remove downed woody debris, suppress redberry juniper resprouts, kill juniper seedlings, and rejuvenate decadent grass plants.

The pasture was 9,914 acres and dissected with numerous drainages. Over 70 miles of roads ranging from well estab-

lished roads to infrequently used jeep trails crisscrossed the unit. We estimated that it would take 120 man-hours (5 man crew, 4 days @ 6 hr/day) to ignite along roads using ground ignition. If natural fuel breaks were ignited in conjunction with roads, nearly 600 man-hours would be required. However, with aerial ignition only 70 man-hours (7 men, 2 days @ 5 hr/day) were required to burn the pasture.

Organization of the Burn

To enhance planning and execution of the burn a fire use plan developed by Fischer (1978) was used. Included in the fire use plan were site description, burn objectives, treatment constraints, and methodology of conducting the burn (fireline construction, organizational structure, and responsibilities of burn personnel).

Firelines were constructed before main headfire ignition and completed by 20 February 1985. In anticipation of a southwest wind at the time of main headfire ignition, 400 ft wide fireline were placed on the east and north boundaries of the pasture to be burned. Firelines were constructed according to recommendations for high-volatile fuel types by Wright and Bailey (1982). Desired weather for fireline construction (relative humidity: 40-60%, air temperatures: 40-60° F, and wind speed: 0-10 mi/hr) differs from that of the main headfire (relative humidity: 25-40%, air temperature: 70-80° F, and wind speed: 5-15 mi/hr).

During main headfire ignition the workforce was divided into 3 crews and 4 supervisors (Fig. 2). Supervisory personnel were the burn, aerial ignition, holding, and helipad bosses. The burn boss was positioned at a point allowing maximum visibility of the area burned. This individual was the communication link between supervisory team members and had ultimate authority in determining conduct of the burn. Reports from supervisory team members by two-way radios to the burn boss enabled prompt assessment of the fire status and coordination of activities to circumvent potential problems.

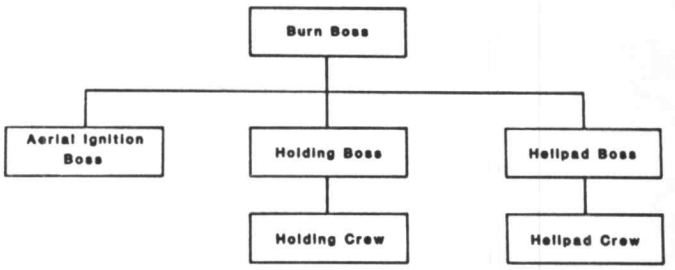

Fig. 2. *Organizational structure used for helitorch burn.*

The aerial ignition boss directed ignition from the helicopter. He reported fire behavior information and suggested alumagel:gasoline fuel mix modifications to the burn boss. An aerial ignition boss is not a critical assignment on burns where the burn boss can maintain visual contact with the helicopter. In such situations the burn boss can direct the pilot during ignition. However, when igniting a large area the burn boss may lose sight of the helicopter and the need for an aerial ignition boss becomes imperative.

The helipad boss responsibilities included directing the helipad crew while mixing alumagel:gasoline fuel and minimizing time required (less than 5 minutes) for helitorch refueling. The helipad boss served as helicopter marshaller, ensuring safety precautions were followed at the helipad and that the helicopter was not approached by the ground crew until it had landed safely.

The holding boss coordinated and directed suppression crews at areas of potential danger of fire escape during aerial ignition. In addition to suppression activities, the holding boss directed ground ignition crews to widen firelines in areas where they might be breeched by the main headfire. Upon cessation of aerial ignition the holding boss supervised mop-up activities.

Ignition of the main headfires was completed in 2 days (10 hr ignition time) with no fire escapes. Refueling time at the helipad was limited to 2 minutes per stop. On the first day (25 February 1985) weather conditions (relative humidity: 30-40%, air temperature: 65-69° F, and wind speed: 6-10 mi/hr) were adequate for a successful burn.

The aerial ignition boss played a crucial role the first day of main headfire ignition. Prior to burning, the supervisory team decided to ignite the headfire along roads and natural fuel breaks. However, during the first attempts at ignition the aerial ignition boss observed fires of low intensity. Upon consulting with the burn boss the ignition pattern was changed to a strip headfire with strips 100 to 300 yd apart ignited in an east to west orientation. Furthermore, the aerial ignition boss suggested that less alumagel be added to the gasoline causing the helitorch fuel to be of a thinner consistency. These two factors improved ignition success and burn objectives were met. During the burn the holding boss directed 2 crews in suppression and ignition activities. One crew, composed of 3 men, were equipped with a truck-mounted 300-gal water pumper and hand tools. They were responsible for initial fire suppression duties along the north boundary of the unit. The second suppression crew, made up of 7 individuals and equipped with a truck-mounted 100-gal water pumper, hand tools, and backpack sprayers, mopped-up after the initial fire suppression crew.

Ignition pattern achieved using a helitorch.

At the time of main headfire ignition it was expected that the wind would be southwesterly. As a result, 400 ft wide firelines were established along the east and north boundaries. However, on the first day, within 2 hours of igniting the

the main headfire the wind shifted to the southeast. The only fireline on the west boundary was a line, 10 ft wide, to mineral soil along the perimeter fence of the pasture. To compensate for the wind shift and resultant fire behavior the 7 person suppression crew was deployed as an ignition crew. They constructed a 400 ft wide fireline along the west boundary using the strip headfire technique. Meanwhile, the 3 man initial suppression crew followed behind the ignition crew preventing fire escapes. With the new fireline in place the helitorch continued igniting the main headfire. By the end of the first day 6,000 acres were burned.

Rainy weather delayed completion of the burn for 11 days. During this time mild temperatures and precipitation stimulated plant growth thus increasing the green or live plant tissue component of the fine fuel. In an effort to conduct a burn before the increasing green portion of the fine fuel reduced the likelihood of success, a less than optimal day was chosen for the final day (6 March 1985) of burning. A cold front had passed 24 hours prior to this day and another was predicted within 36 hours. As a result the weather (relative humidity: 40-50%, air temperature: 54-59° F, and wind speed: 8 mi/hr) was less than desirable for a satisfactory burn. Although ignition, refueling, and communications between supervisory team members proceeded efficiently, burn objectives were not met.

Due to this experience the strategy for prescribed burns using the helitorch in redberry juniper-dominated rangelands was modified. In the future, all firelines will be in place by February 1, thereby enabling the fire workforce to take advantage of warm days which might occur earlier in the winter. To further enhance flexibility in burning, the helicopter, pilot, and support crew will be on standby starting February 1.

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The Western Range

Under a spreading Sagebrush tree
A single bunch grass stands;
This grass, a mighty plant is she;
The binder of our sands;
But seedlings of this refugee
Are weak as rubber bands.

The lambies going out to graze
Look here and there for feed.
They love to eat the seedlings rare—
Both stem and leaf and seed.
To save their lives they needs must graze
Each shrub, and grass, and weed.

Week in, week out, from dawn to dusk
They vainly hunt new shoots—
Their herder trudging after them
With worn and dusty boots.
No tops are left, and, if they could,
They'd even eat the roots.

The sheepman's not to blame, you know,
He does the best he can,
(His kids needs shoes; his wife needs more
Than a healthy coat of tan).
To pay his tax, his interest, too,
And he owes 'most every man.

But soils devoid of grass and weeds
Are very apt to blow,
And sudden rains are sure to cause
A heavy run-off flow,
And wash away the soil, and flood
The farmers' field below.

And so we try, as best we can,
To regulate the range—
To leave some grass to go to seed
To some may seem quite strange—
But when the seedlings grow up tall
They're grateful for the change.

For when the soil is held in place,
The grass stems hold the snow,
And heavy rains sink in the soil
And cause the springs to flow,
And sheep and sheepmen are amazed
How fast the grass does grow.

Vernon T. Heidenreich (1940)