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Halogeton grazing management: historical perspective

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Abstract

Halogeton [*Halogeton glomeratus* (Bieb.) C. A. Mey], is a fleshy, annual, herbaceous species that was accidentally introduced into the western U. S. during the 20th century. Because it is highly poisonous to sheep (*Ovis aries*), this rather diminutive herb became the center of attention for biological research on Intermountain rangelands during the 1950s. Grazing management for halogeton involves procedures to prevent accidental poisoning of the grazing animals, and management to encourage the density and vigor of competing perennial vegetation to biologically suppress halogeton. Halogeton became most abundant in salt desert rangelands and the lower elevation portions of the sagebrush (*Artemisia*)/bunchgrass zone. In the sagebrush zone the introduced perennial crested wheatgrass [*Agropyron desertorum* (Fisher) Schultes] was widely planted to both suppress halogeton and to provide alternative forage for livestock. In the salt deserts, the management of native chenopod shrubs was the key to suppressing halogeton. The key species in salt deserts was the highly preferred semi-woody species winterfat [*Krascheninnikova lanata* (Pursh) A. D. J. Meeuse & Smit]. In many parts of the Intermountain region, halogeton has declined in importance because of the reduced importance of the range sheep industry and improved range condition. In the south central Great Basin, halogeton is still considered a serious problem.

Key Words: Salt deserts, poisonous plant, plant ecology

Resumen

El "Halogeton" [*Halogeton glomeratus* (Bieb.) C. A. Mey], es una especie herbácea anual carnosa que fue introducida accidentalmente al oeste de los Estados Unidos durante el siglo 20. Debido a que es altamente tóxica para los ovinos (*Ovis aries*), en la década de los años 50 esta diminutiva hierba vino a ser el centro de atención de la investigación biológica de los pastizales Intermontanos. El manejo del apacentamiento para "Halogeton" involucra procedimientos para prevenir el envenenamiento accidental de los animales en apacentamiento y el manejo para promover la densidad y vigor de la vegetación perenne competitiva para suprimir biologicamente el "Halogeton". El "Halogeton" vino a ser mas abundante en los pastizales desérticos salados y en las porciones de baja elevación de la zona de "Sagebrush" (*Artemisia*)/pastizal amacollado. En la zona del "Sagebrush"el zacate perenne introducido "Crested wheatgrass" [*Agropyron desertorum* (Fisher) Schultes] fue ampliamente plantado para suprimir el "Halogeton" y proveer una alternativa forrajera para el ganado. En los desiertos salados, el manejo de los arbustos nativos Chenopodiaceos fue la calve para suprimir el "Halogeton". La especie calve en los desiertos salados fue la especie semi-leñosa altamente preferida "Winterfat" [*Krascheninnikova lanata* (Pursh) A. D. J. Meeuse & Smit]. En muchas partes de la región intermontana el "Halogeton" ha disminuido en importancia debido a la reducida importancia de la industria ovina en pastizales y el mejoramiento de la condición de los pastizales. En la Gran Cuenca sur central el "Halogeton" `todavía es considerado un serio problema.

Searching in 1934 for plants for the USDA, Forest Service herbarium, Ben Stahmann and S. S. Hutchings first collected halogeton [*Halogeton glomeratus* (Bieb.) C. A. Mey] southeast of Wells, Nev. (Young et al. 1999). It took a considerable period of time for the new collection to be identified. When it was finally identified as Halogeton there was virtually nothing in the scientific literature concerning the characteristics of the species. It took much longer to arrive at a species name for the plant. The first choice was *H. sativa* (L.) C. A. Mey, which would place the origin of the introduction in North Africa or Spain. Eventually, it was decided by international experts in taxonomy of the Chenopodiaceae that *H. glomeratus* was the correct taxon. The distribution of the species was roughly indicated as Middle Asia east of the Caspian Sea.

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First Reported Toxicity

By chance, the first reported poisoning of sheep by halogeton occurred near Wells, Nev. (Young et al. 1999). Nick Goicoa lost 160 head from a band of sheep in November 1942. C. H. Kennedy of the Nevada Department of Agriculture made a postmortem and found the stomach filled with leaves he thought were mountain mahogany (*Cercocarpus ledifolius* Nutt.). Kennedy sent the stomach material to C. E. Fleming, Chair of the Department of Range Management at the University of Nevada. Fleming compared the recovered material with herbarium specimens and correctly identified the plant as halogeton.

Fleming sent his assistant Fred Harris, to Wells to investigate the apparent halogeton poisoning (Young et al. 1999). With the help of local sheep herders, Harris was able to identify several other fairly large scale losses that previously occurred in halogeton patches, but were not connected with the invasive weed. L. M. Burge of the Nevada Department of Agriculture launched a survey of the area infested around Wells and was amazed to discover the exotic species occurred over much of northern Nevada.

M. R. Miller (1943), an agricultural chemist at the University of Nevada, published in Science that dried sample of halogeton herbage contained total oxalates equivalent to 19% (later determined as high as 20%) anhydrous oxalic acid. The poisonous agent of halogeton had been identified. Professor Miller initially used a gold pan to recover the oxalate crystals.

Eco-physiology of Halogeton

The range sheep industry became very alarmed about the potential danger from the newly recognized poisonous plant. After World War II, research was initiated on many aspects of the ecology and toxicity of halogeton. When it was discovered that halogeton infestations existed in California, Utah, Idaho, and Wyoming, the research became regional in nature. National publicity about what was termed the "killer" weed brought USDA, Agricultural Research Service (ARS) into the fight against halogeton (Young 1988). Initially, many of the ARS scientists working on halogeton were transferred from Forest Service Experiment Stations.

The autecology of halogeton was enumerated as an annual species that was highly adapted, but not restricted to salt affected soils. Individual plants were capable of tremendous seed production. It became apparent that halogeton was not a highly competitive species, but essentially populations exploded in the ecological void left by repeated disturbance such as livestock trails, un-surfaced roads that were periodically graded, trampled areas near watering points or corrals and most significantly in rangeland areas denuded by excessive grazing (Young et al. 1999). Halogeton had a competitive advantage in that leachate from its herbage concentrated salts on the soil surface (Kinsinger and Eckert 1961). In time, the salt concentrations prohibited the establishment of plants other than halogeton.

Lack of understanding the nature of the dimorphic seeds produced by halogeton and their inherent germination ecology was to interact with subsequent management strategies. Early in the autecological studies of halogeton it was noted that both black and brown seeds were produced by the same plant (Tisdale and Zappettini 1953). The black seeds proved to be highly germinable. The seed consisted of a tightly coiled embryo with a minimal covering. Germination started almost as soon as the seeds were moistened. The brown seeds had very low or no germinations (Cronin 1973). Many people made the assumption that the brown seeds were obviously immature and therefore not viable. This led to the assumption that all halogeton seeds would germinate in a given year with no persistent seedbank. Therefore, if a given crop of halogeton was entirely prevented from setting seed the plant could be eradicated. M. C. Williams (1960) determined that brown seeds were produced first by halogeton plants and shorter day lengths induced black seed formation. A long term, regional study of the longevity of buried black and brown halogeton seeds confirmed the brown seeds (brown because of retained bracts) remained viable and germinable in the soil for almost 10 years (Robocker et al. 1969). Halogeton seeds had both simulations and continuous germination strategies.

Halogeton Control Measures

The initial approach to halogeton infestations was to attempt to eradicate the poisonous pest (Young et al. 1999). It was soon determined that infestations were much too extensive to make eradication feasible. The Nevada Department of Agriculture, under the direction of L. M. Burge, launched an extensive halogeton control program using weed oil and the relatively new herbicide 2,4-D [(2,4-dichlorophenoxy) acetic acid]. Both herbicides were very effective in killing halogeton, but unless the weed was replaced with a desirable perennial plant, halogeton reappeared the next year. Re-infestation came from the large seedbanks of brown seeds.

Halogeton Biological Suppression

In 1933, a wildfire burned several hundred acres of degraded sagebrush range east of Wells, Nev. (Young et al. 1999). J. H. Robertson was conducting research on range revegetation for the Intermountain Forest and Range Experiment Station of the Forest Service. Robertson borrowed an old drill and towed it around the burn with his pickup, seeding representative soil types to crested wheatgrass [*Agropyron desertorum* (Fisher) Schultes]. Halogeton invaded the burned area. Robertson took range managers and ranchers on tours of his meandering seeding showing how the perennial grass suppressed halogeton.

The Bureau of Land Management (BLM), USDI, launched a massive program of halogeton suppression through seeding crested wheatgrass. Seedings ranged in area from small patches to a single seeding of 15,000 acres (6,000 ha) (Mathews 1986). This program was encouraged by Marion Clawson when he was the Director of the BLM. He correctly saw halogeton as the symptom of the true problem which was a vastly overgrazed range resource. Crested wheatgrass seeding enlarged the forage base. The technology necessary to make perennial grass seedings successful came from a dynamic group of talented researchers that included A. C. Hull, Jr., Jerry Klump, A. P. Plummer, and J. H. Robertson (Young and MacKenzie 1985).

Unfortunately, crested wheatgrass is not adapted to salt affected soils. Attempts to seed halogeton infested sites on the margins of the salt deserts resulted in failure (Young et al. 1999). The lack of adapted plant material for revegetation in the salt deserts was a major stumbling point in the entire halogeton program.

Winterfat

The native plant species that was closely tied to negative aspects of halogeton invasion was winterfat [*Krascheninnikovia lanata* (Pursh) A.D.J. Meeuse & Smit]. In an environment where most shrubs are not highly preferred by domestic livestock, winterfat was a significant exception. It has been suggested that winterfat is the plant that made domestic livestock possible in the Great Basin (Young and Sparks 1985).

Winterfat is a key forage species in salt desert communities. The browse of this semi-woody species is highly preferred by domestic livestock during the winter months. Winterfat is a component species of many plant communities in the salt deserts (Billings 1945). It is best known for the extensive, near mono-specific plant communities it forms on certain soils in the deserts (Gates et al. 1956). These expanses of nearly pure winterfat constituted excellent winter ranges.

Winterfat communities historically were not subject to stand renewal by wildfires because of a lack of herbaceous vegetation to carry fires. The relatively dense monocultures were subject to natural catastrophic stand renewal caused by outbreaks of native insects (Young et al. 1999). In the Great Basin, winterfat often is found growing under near truly arid conditions where the annual depth of wetting in the soil profile may be less than 25 cm. Winterfat is often growing in a very fragile environmental setting. The classic management formula for winterfat winter ranges is to remove livestock in the early spring while there is still sufficient soil moisture available to allow for growth and replenishment of carbohydrate reserves for fall flowering.

Unfortunately, many winterfat communities were excessively grazed and once halogeton was introduced it rapidly colonized any openings in winterfat communities (Eckert 1954). This remains a very serious problem in the central Great Basin. It is further complicated by the exotic annual cheatgrass (*Bromus tectorum* L.) replacing halogeton on some of the winterfat sites.

Management of Grazing Animals

Much of what is known about managing livestock to prevent halogeton poisoning has been developed by the Poisonous Plant Research Unit of USDA, ARS, located at Logan, Utah. Lynn F. James, the research leader for the Poisonous Plant Laboratory, and his associates have contributed much of the literature concerning halogeton intoxication of herbivores and livestock management strategies (Young et al. 1999). James and Cronin (1974) offered the following management points to minimize range sheep losses from halogeton poisoning: 1) avoid over grazing that creates habitat for halogeton, 2) develop grazing management programs that result in improving range condition, 3) reduce grazing pressure during droughts, 4) avoid late spring grazing that injures native perennials, 5) supply adequate water, 6) observe the sheep and know what they are grazing, 7) allow time for rumen microorganisms to adapt to oxalates, 8) introduce animals to halogeton-infested areas gradually, 9) do not unload animals from trucks into halogeton patches unless there is supplemental feed and water, 10) never allow hungry animals to graze in large, dense patches of halogeton, and 11) do not trail thirsty animals into watering places surrounded by halogeton without food supplement. The continued use by the Great Basin range sheep industry of non-resident herders, often from countries with vastly differing environments, has contributed to the occurrence of halogeton poisoning (Ralphs and Sharp 1988). Adequate training of such herders is often hampered by language barriers.

Present Status of Halogeton

The range of halogeton continues to expand (Young et al. 1999). It is now found east of the Missouri River and in Canada on the northern Great Plains (see Young et al. 1999 for maps of the progression of halogeton spread over time). In the Great Basin, halogeton has largely declined in importance except for the previously mentioned continued colonization of winterfat stands. The range sheep industry has greatly declined. This decline in sheep numbers, coupled with greatly improved grazing management, has resulted in improved range condition in many salt desert winter ranges.

Halogeton has faced increased competition from more vigorous native vegetation and from competing exotic annuals. Barbwire Russian thistle (*Salsola paulsenii* Litv.) has invaded much of the Great Basin and it overlaps in ecological requirements with halogeton to a greater extent than Russian thistle (*S. targus* L.) (Young and Evans 1979). The invasion of the upper portions of the salt desert ranges by cheatgrass has also contributed to the decline in the distribution and abundance of halogeton (Young and Tipton 1990).

The general decline in the range sheep industry in the Great Basin can not be blamed only on halogeton poisoning. Labor cost, predation and economic factors also contributed to the reduction in sheep, but for individual operators who suffered large death losses, halogeton poisoning was very significant.

Literature Cited

Billings, W. D. 1945. The plant associations of the Carson desert region, western Nevada. Bulter Univer. Botany Studies 7:89–123.

Cronin, E. H. 1973. Pregermination treatment of black seed of halogeton. Weed Sci. 21:125–127.

Eckert, R. E., Jr. 1954. A study of competition between whitesage and halogeton in Nevada, J. Range Manage. 7:223–225.

Gates, D., L. A. Stoddart, and C. W. Cook. 1956. Soil as a factor influencing plant distribution on the salt deserts of Utah. Ecol. Monogr. 26:155–175.

James, L. F. and E. H. Cronin. 1974. Management practices to minimize death losses of sheep grazing halogeton infested ranges. J. Range Manage. 27:424–426.

Kinsinger. F. E. and R. E. Eckert, Jr. 1961. Emergence and growth of annual and perennial grasses and forbs in soils altered by halogeton leachate. J. Range Manage. 14:194-197.

Mathews, W. L. 1986. Early use of crested wheatgrass seeding in halogeton control. pp 27–28. *In:* K. L. Johnson (ed.) Crested Wheatgrass Symposium. Utah State Univ., Logan, Utah.

Miller, M. R. 1943. *Halogeton glomeratus,* poisonous to sheep. Sci. 97:227–229.

Ralphs, M. H. and L. A. Sharp. 1988. Management to reduce livestock loss from poisonous plants. pp. 391–407 *In:* L. F. James, M. H. Ralphs, and D. B. Nielson (eds.) The Ecology and Economic Impacts of Poisonous Plants on Livestock Production. Westview Press, Boulder, Colo.

Robocker, W. C., M. C. Williams, R. A. Evans, and P. J. Torell. 1969. Effect of age, burial, and region on germination and viability of halogeton seeds. Weed Sci. 17:63–65.

Tisdale, E. W. and G. Zappettini. 1953. Halogeton studies on Idaho ranges. J. Range Manage. 6:225–236.

Williams, M. C. 1960. Biochemical analyses, germination, and production of black and brown seed of *Halogeton glomeratus.* Weeds 8:452–461.

Young, J. A. 1988. The public response to the catastrophic spread of Russian thistle (1880) and halogeton (1945). Agr. History 62:122–130.

Young, J. A. and R. A. Evans. 1979. Barbwire Russian thistle seed germination. J. Range Manage. 32:390–394.

Young, J. A. and D. McKenzie. 1982. Rangeland drill. Rangelands 4:108–113.

Young, J. A. and B. A. Sparks. 1985. Cattle in the cold desert. Utah State Univer. Press, Logan, Utah

Young, J. A. and Tipton, F. 1990. Invasion of cheatgrass into arid environments of the Lahontan Basin. pp 37–41 *In:* McArthur, E. D., Romney, E. V., Smith, S. D., and Tueller, P. T. (eds.) USDA, Forest Service, Gen. Tech. Report INT-276, Ogden, Utah.

Young, J. A., P. C. Martinelli, R. E. Eckert, Jr., and R. A. Evans. 1999. Halogeton. Misc. Publ. 1553. Agr. Res. Serv., USDA, Washington, D. C.