James N. Davis

Chapter 3

Research Background

The rangeland in the Intermountain West urgently required a scientific basis for its management, especially after the great mid-1800's livestock buildup, and then the plant die-off following the severe winters and droughts of the late 1800's (Stoddart and others 1975). After examining the Western ranges, Jared G. Smith (1895), an agrostologist with the U.S. Department of Agriculture, wrote that the perennial species were being overgrazed and were disappearing and were being replaced by weedy annuals. He maintained that no more livestock should be put on an area than could safely be carried through a poor season. Gaining public and livestock owners' acceptance of this concept has been a problem ever since (Stewart 1936).

The Associate Chief of the Forest Service in a Congressional report (Clapp 1936) maintained that severe depletion on ranges was universal and that most Western U.S. range types were in a depleted condition (depleted at least 50 percent from their original condition). These generalized Western range types included short grass, Pacific bunchgrass, semidesert grass, sagebrush-grass, southern desert shrub, salt-desert shrub, pinyon-juniper, and mountainbrush. He also indicated that the depleted conditions had far-reaching negative effects on wildlife and recreation.

Formal range research began about 1910, but a comprehensive range research program did not begin until 1935. Land managers, livestock operations, and the public needed research to be better informed on how to incorporate multiple land use management concepts and to take care of the irreplaceable land resources.

Near the turn of the century, some 1,500 attempts were made to improve the badly depleted Western ranges. These attempts largely failed, resulting in low enthusiasm and optimism for range seeding. The failures were thought to be primarily caused by inadequately adapted seed sources (mostly cultivated varieties) and insufficient site preparation (Stoddart and others 1975).

Establishment of the Great Basin Station (now known as the Great Basin Experimental Range) in 1912 quickly generated a variety of range and watershed research within the Intermountain Region. Early research at the Great Basin Station dealt with watershed management, effects of grazing on vegetative cover, and the relationship of these to erosive flooding from high intensity summer storms (Keck 1972).

Shortly after the project began in 1912, researchers tried revegetation with shrub plantings. Cuttings of many adapted shrubs were placed in the heads of mountain streams with the object of helping revegetate these depleted areas to prevent flooding. A short time later, shrub cuttings were placed in gullies and stream channels. Plantings were also made on depleted intervening ranges.

Research later looked at natural seeding by native species and artificial seeding with native or introduced species. Permanent quadrats were established to study the resulting changes in vegetative cover. Experiments with different species, mostly native (some exotics), were conducted to determine which were adapted to areas needing revegetation.

In the 1930s, and broadening in the 1950s, research was centered on plant species of value to wildlife. Still ongoing, this research has emphasized species adaptation, methods of seedbed preparation and seedling, optimum time for planting, and the effect of already established vegetation on the establishment of seeded species.

Research has stressed the importance of selected woody species, in combination with herbaceous species, for range and watershed in the Great Basin. This was a significant departure from research being conducted on herbaceous species only. Such work was done from the late 1920s through the mid-1930s on a seeding within the oakbrush zone (Keck 1972). This work was initiated because drought and heavy grazing within the oakbrush type had greatly reduced understory production. To make the oakbrush more productive, different species and seeding techniques were tried. The research effort on seeding was expanded across the broad geographic area of the Intermountain region in 1935. The study areas were in all life zones up to the much higher subalpine zone.

Since the late 1940s, State and Federal agencies and Western universities have devoted considerable effort in this area of research. In the latter years, the research has dealt with equipment development from collecting to planting seed. New areas of research include selection of races, strains, and varieties of species with regard to vigor, growth rate, and growth form; nutritional characteristics; drought tolerance; cold tolerance; animal preference; adaption; resistance to heavy repeated use; methods of reducing competition of naturally occurring plants; season to plant and methods of planting; species mixture compatibility; seeding rates and planting depths; and the broad ecological effect of the resulting vegetative changes (Plummer and others 1968).

Problems with big game ranges, particularly winter ranges, became important issues during the 1940s and 1950s. State Game and Fish Departments recognized the unrestricted livestock grazing and wildlife use had devastated many critically important winter game ranges. Scientists and research organizations previously affiliated with range research were solicited for their support. Big game habitat improvement and plant materials research began in earnest in Washington (Brown and Martinsen 1959), Idaho (Holmgren 1954; Holmgren and Basile 1959), California (Horton 1949; Sampson and Jespersen 1963), and Utah (Plummer and others 1968).

A cooperative effort between the Utah State Division of Fish and Game and the Intermountain Forest and Range Experiment Station of the USDA Forest Service began formally in 1955. This enhanced effort focused on pinyon-juniper woodlands and associated sagebrush-grass communities in poor condition, where there were heavy deer losses, especially during the severe winter of 1948 to 1949. The aim stressed the urgency of restoring forage production for both wildlife and livestock and improving soil stability. Species adaptation trial work has been done at more than 70 sites throughout Utah (including plant communities in the salt desert up to subalpine). Since 1955, the project has evaluated 39 genera and 244 species of grasses (2,000 accessions); 207 genera and 527 species of forbs (1,800 accessions); and 90 genera and 270 species of shrubs (2,000 accessions). To date, this project has evaluated more than 6,000 accessions of plants.

As early as 1957, this cooperative project was offering practical solutions to problems of inadequate production and suitable species to help relieve game range problems (Plummer and others 1957). Beginning with

the first initial 1957 report, annual reports were published through 1967 (Plummer and others 1966a). The reports were culminated and summarized in a book, *Restoring Big Game Range in Utah*, by Plummer and others (1968). The reports began by identifying site factors that limited the establishment of some of the commonly planted species. Researchers studied species adaptation to help determine desirable forage plants that could be grown on the various vegetative communities (emphasis was on pinyon-juniper sites) throughout Utah. Work has continued on recognizing suitable sites and determining how to identify potential production on sites. Research has also looked at viability of native seeds and the environmental conditions favorable to their germination. Germination requirements were determined for many grasses, forbs, and shrubs, which helped develop better methods and equipment for planting these species. Studies determined "onsite requirements" to prepare for seeding and the basic practical methods for preparing wildland sites and for planting inaccessible areas.

Various equipment development centers and the Range Seeding Equipment Committee helped develop research on more effective equipment for collecting, cleaning, storing, and planting wildland seed. Considerable effort has been put into design, construction, testing, and field demonstrations. The demonstrations include use of some of the following equipment or techniques: cables, anchor chains (light to heavy, smooth, or Ely chains), shrub seeders, seed dribblers, aerial seeding, shrub transplanting, interseeding, diskchaining, Rangeland drills (using a mixture of seeds from shrubs, forbs, and grasses), and pipe harrows (Larson 1982; Roundy and Call 1988; USDA Forest Service 1992b).

Early efforts dealt with problems associated with the depredation of seeds by rodents, rabbits, birds, insects, and other biotic factors. Another major concern was the high population of grazing rabbits consuming mostly succulent forb species (Plummer and others 1968). These biotic factors do not appear to be as much a problem for range revegetation work as they used to be because of the decline in rabbit populations and late fall planting and seeding of larger areas. However, rodent depredation of shrub seeds (primarily bitterbrush) is considered as major a problem today as it was in the 1950s (Brown and Martinsen 1959; Everett and Stevens 1981; Holmgren and Basile 1959). Long-range studies were established using fourway exclosures to help determine compositional development of seeded and native species after chaining juniper-pinyon woodlands and how protection from grazing then affected deer, rabbits, and livestock.

Restoring wildlife habitat by artificial seeding of shrubs and broadleaf herbs has been somewhat hindered because of erratic germination characteristics of various species, the inability of shrub seedlings to compete with herbs, and the lack of equipment capable of operating on steep, mountainous, and undulating terrain. Considerable progress has been made in selecting and developing useful shrub and forb species, ecotypes, and cultivars for wildlife and range seedings (Plummer and others 1968). Official releases or cultivars come primarily through cooperative efforts of the USDA Forest Service, Intermountain Research Station (now called Rocky Mountain Research Station), the Utah Division of Wildlife Resources, and USDA Natural Resources Conservation Service (McArthur and others 1985; Monsen and Davis 1985; Stevens and others 1985c; Stutz and Carlson 1985). Today, seed growers know more about seed production and how to use marginal croplands to produce quality seed from official releases, or how cultivars of these selections could become more widely available in larger quantities and also be less expensive to use in wildland revegetation work.

Shrub research has been expanded significantly since 1960 by numerous scientists, agencies, and universities. But, although we have considerable information, techniques of shrub plantings and long-term performance of shrub-herb seedings still have not been thoroughly investigated. Current research is trying to further refine basic principles and techniques for the conversion and successful establishment of selected species mixtures onto wildlands. Some of these inquiries seek to understand the fundamentals of successional trends for these rehabilitated communities and how management can alter these trends for a longer lasting and productive conversion. Other work looks at species relationships and how compatible the associations of seeded and native species are during succession. Researchers seek alternative methods to enhance critical wildlife habitats without damaging key species or plant associations that are in poor vigor and density because of competition from unrealistically high densities of undesirable species.

This book is a compilation of research and experience acquired since the conception of the Great Basin Station. It reflects decades of cooperative work between the Forest Service's Intermountain Research Station, the Utah State Division of Wildlife Resources, and many other agencies and universities. The book is our gift of knowledge and our wish for a productive future for our Nation's rangeland.