D-103
File:
Petrified
Forest

PETO

HISTORICAL OVERVIEW

This section of the bibliography reviews the available literature of the period and documents the change in vegetation, physiography and land use. The literature reviewed includes weekly newspapers from the period, books, journals and personal papers of the pioneer settlers of the area, particularly those of William C. Barnes; and expansion and development articles and historical records. Topics covered by this literature include the vegetation of the time period, the Indians of the area, exploration expeditions, the cattle industry and drought.

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1. Barnes, W.C.

1913

Western grazing grounds and forest ranges.

Breeders Gazette, Chicago. 390 p.

A general history of western ranges is followed by a discussion of individual ranges and their dominant plants. Suggestions for range care and measures to arrest range deterioration include the use of indicator plants and poisonous weeds.

Range management/Indicator plants/Noxious plants/Plant communities/Erosion control

2. Barnes, W.C.

1930

Winning the forest range.

American Forests and Forest Life 36:398-400, 466.

Events and tales from the early days of the U. S. Forest Service are recorded in this volume which also presents descriptions of land use and vegetation in northern Arizona after 1900.

Forest Service/Forests/Range condition/Plant communities/Cattle industry/Sheep industry

3. Barnes, W.C.

1941

Apaches and longhorns.

Ward Ritchie Press, Los Angeles. 210 p.

An excellent history of land use in Apache County during the late 1800's and early 1900's. Included is a description of native vegetation before intensive grazing began and an account of the effects grazing has had upon the land and vegetation.

Grazing effects/Apache County/Range condition/Ungrazed rangeland/Grazed rangeland/Plant communities/Vegetation change

4. Barnes, W.C.

[Personal papers 1871 - 1940]

Arizona Historical Society, Tucson.

Will Barne's personal papers include letters, invitations, magazine articles, newspaper clippings, notes, etc., all pertaining to the west and Arizona in particular. Of special interest are his letters and journal entries during the 1880's drought. These letters contain descriptions of the vegetation conditions and percent of ground cover in northern Arizona during the drought. Barnes was one of the first ranchers in northern Arizona and his papers provide a picture of the topography and vegetation of the region between Holbrook and the Petrified Forest National Park before the influx of livestock to the area.

Drought/Range condition/Physical geography/Grazed rangeland/ Ungrazed rangeland/Plant communites

5. Beale, E. F.

1858

The report of Edward Fitzgerald Beale to the Secretary of War concerning the wagon road from Fort Defiance to the Colorado River.

U. S. House of Representatives, 35th Congress, 1st Session. Executive Document 124.

The journal kept by E. F. Beale as his expedition surveyed the wagon road from Fort Defiance to the Colorado River in 1858 contains an account of the topography, soils and vegetation along the entire trek including vegetation characteristics and surface water of northern Arizona.

Wagon road/Expedition/Physical geography/Beale/Surface water/ Ungrazed rangeland/Vegetation surveys

6. Beale, E. F.

1858

Wagon road: Forth Smith to Colorado River.

U. S. Senate, 36th Congress, 1st Session. Executive Document 42.

This original report filed by E. F. Beale contains a map of his route through northern Arizona and detailed explanations of vegetation, topography and surface water. The data contained in this report provides an understanding of the vegetation of northern Arizona during the 1800's.

Wagon road/Physical geography/Surface water/Beale/Expedition/ Ungrazed rangeland/Vegetation surveys

7. Bigelow, J. M.

1856

Explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean 1853-4: Report on the botany of the expedition.

U. S. House of Representatives, 32nd Congress, 2nd Session, Executive Document 78.

A brief overview of the Petrified Forest area plant community is included in the botanist's report of Lieutenant A. W. Whipple's expedition through northern Arizona.

Railroad route/Whipple/Expedition/Vegetation survey

8. Bryan, K.

1925

Date of channel trenching (arroyo cutting) in the arid Southwest.

Science 62(1607):338-344.

Arroyo formation in southern Arizona can be dated from 1880-1890, and at 1860 in southern Utah, southern Colorado and northern Arizona. Evidence of arroyo cutting on the Rio Puerco is conflicting and no estimation of dates of formation can be made without further review. Causes of arroyo cutting appear to be a combination of overgrazing, climatic change (drought), and geological uplift as none of these factors alone can fully explain this phenomenon.

Puerco River/Grazing effects/Environmental effects/Gully erosion/Drought

9. DeLong, S.R.

1905

The history of Arizona from the earliest times known to the people of Europe to 1903.

Whitaker and Rap Co., San Francisco. 199 p.

A very brief cultural history of Apache and Navajo Counties is included in this general history of Arizona.

Apache County/Navajo County/Cattle industry/Sheep industry/ Settlement

10. Dittmer, H.J.

1951

Vegetation of the Southwest: past and present

Texas Journal of Science 3(3):350-355.

The present vegetation of the Southwest is studied. A survey of historical records, principally from the middle of the 19th century, indicates that the Southwest had a much more extensive grassland vegetation on its plains and mesas than it does today. Vegetative changes are explained as the result of recent land use.

Vegetation change/Grazing effects/Grassland/Burning

11. Farish, T.E.

1918

History of Arizona.

Filmer Brothers Electrotype Co., San Francisco. 64 p.

Chapters 13 and 14, composed of the reminiscences of the original pioneers of the area, deal with the history of land use in northern Arizona. Knowledge of former land use patterns is the key to present problems of land deterioration.

Cattle industry/Sheep industry/Grazing effects

12. Ford, R.

Personal letters 1892.

Arizona Historical Society, Tucson.

Letters written on September 8 and 28 and on October 16, 1892 describe the drought conditions in Arizona and provide an account of range conditions as affected by the drought and subsequent overgrazing of cattle.

Drought/Range condition/Overgrazing/Grazing effects

13. Foreman, G., ed.

1941

A pathfinder in the Southwest.

University of Oklahoma Press, Norman. 298 p.

Lieutenant A.W. Whipple's itinerary during his explorations for a railway route from Fort Smith to Los Angeles in the years 1853 and 1854, includes a chapter on the topography, soils, and vegetation of the Petrified Forest area.

Whipple/Expedition/Railroad route/Physical geography/Ungrazed rangeland/Vegetation survey

14. Hackney and Hamill, eds.

July 3, 1886

Arizona Silver Belt.

Globe, Arizona, weekly newspaper.

This general purpose paper covered all newsworthy Arizona topics from 1878 to the present. Regular news items included range events, range condition and land use. The paper includes articles on land use practices during the 1880's and the effect cattle and drought had upon the natural vegetation. Of special interest is an article published in the July 3, 1886 issue which described the poor range conditions of the area.

Range condition/Drought/Grazing effects/Environmental effects/ Cattle industry/Political aspects

15. Haskett, B.

1936

History of the sheep industry in Arizona.

Arizona Historical Review 7(3):1-49.

Names, dates and facts connected with the introduction of sheep into northern Arizona are documented in this history of the sheep industry. The effect of natural phenomena and economic pressure upon the sheep industry are used to explain the growth or reduction of the industry in northern Arizona. No documentation is included on vegetation response to sheep grazing pressure.

Sheep industry

16. Haskett, B.

1935

Early history of the cattle industry in Arizona.

Arizona Historical Review 6(3):1-49.

This history of Arizona's cattle industry lists names of ranchers (by counties) who had a registered brand as of the 1880's. The list for the Apache County cattle industry is the most detailed. A cattle census taken from 1883-1895 illustrates the effect the 1880's drought had upon the cattle industry. Prices paid for cattle were cut in half forcing ranchers to keep all their stock on the range. This combination of overstocking and drought decimated the rangeland.

Cattle industry/Apache County/Drought/Grazing effects/Environmental effects/Political aspects

17. Hilzinger, J.G.

1897

Treasure land: a story.

Arizona Advancement Company, Tucson. 160 p.

This book contains a short chapter on cattle ranching with descriptions of northern Arizona pasture grasses and ranges. As this is a pro-expansion and settlement article, reports are embellished

and are not entirely accurate. However, a feeling for the boom economy and the attitudes of the period toward exploitation of grazing lands are evident.

Range condition/Cattle industry/Political aspects/Grassland

18. Kemp, S.N., ed.

January 12, 1906

Arizona range news.

Willcox, Arizona, weekly paper.

This weekly paper, which has been published since 1884, emphasizes coverage of cattle and range news in the southern Arizona area near Willcox. In the 1890's, the drought in northern Arizona received extensive coverage. The January 12, 1906 issue of the paper provided an in depth account of the range conditions in Arizona and outlined the effect cattle were having upon the vegetation.

Range condition/Grazing effects/Drought/Political aspects/Cattle industry

19. Lesley, L.B., ed.

1970

Uncle Sam's camels: the journal of May Humphreys Stacey, supplemented by the report of Edward Fitzgerald Beale, 1857-1858.

Rio Grande Press, Inc., Glorieta, New Mexico. 289 p.

May H. Stacey kept this journal as he accompanied Edward Beale on the first trip of the United States Army Camel Brigade as it traveled from San Antonio, Texas, to Bakersfield, California in 1857-1858. The expedition surveyed the wagon road that passes through the Petrified Forest. A description is given of the vegetation types and conditions as they occurred along the wagon road.

Camels/Wagon road/Vegetation survey/Beale/Expedition/Physical geography/Surface water

20. Lockett, H.C., and M. Snow

1939

Along the Beale trail: a photographic account of wasted rangeland.

Haskell Institute, Lawrence, Kansas.

Photographs are used to record surface water and vegetation conditions along the Beale wagon road from Grants, New Mexico, to Flagstaff, Arizona. Each photograph is accompanied by an excerpt from Beale's diary describing the land and vegetation as it appeared in the 1800's. The deterioration of range and water resources by overgrazing and poor land management is photographically illustrated.

Wagon road/Illustrations/Surface water/Overgrazing/Range condition/Beale/Grazing effects

21. Love, C.M.

1916

History of the cattle industry in the Southwest.

Southwestern Historical Quarterly (Austin), 19(2):370-399; 20(1):1-18.

This general historical overview of the southwestern cattle business deals with cattle quality improvement, the search for markets and the means of moving cattle to these markets. Causes of range wars and their effects on the range vegetation and conditions are discussed. The pros and cons of public domain land use for both grass and timber are presented in an effort to come to an unbiased decision on its advisability.

Cattle industry/Public domain/Land use/Range condition/Political aspects

22. McClintock, J.H.

1921

Mormon settlement in Arizona.

Manufacturing Stationers, Inc., Phoenix. 307 p.

The Mormon effect on the land in northern Arizona through settlement and land development is well documented and explained

in this text. The Mormons were the first permanent white settlers in northern Arizona and introduced cattle and sheep grazing practices to the region.

Mormons/Settlement/Sheep industry/Cattle industry/Grazing effects/Environmental impact

23. Mollhausen, B.

1858

Diary of a journey from the Mississippi to the coasts of the Pacific.

Longmans, London.

This account of Lieutenant Whipple's expedition which searched along the 35th parallel for a suitable railroad line from Fort Smith, Arkansas, to Los Angeles, California, was written by the naturalist present on the trip. Vegetation and terrain descriptions are given along the line of march.

Whipple/Expedition/Railroad route/Physical geography/Vegetation survey

24. Morrisey, R.J.

1950

The early range cattle industry in Arizona.

Agricultural History 24(3): 151-156.

In this review of Arizona cattle raising, special emphasis is placed upon the overstocking of ranges that culminated with the drought of 1888-1894. The drought destroyed much of Arizona's rangelands and was particularly devastating in the northern part of the state. The article outlines range use by cattle and general land use during the era with the resulting effects on native vegetation.

Cattle industry/Drought/Overgrazing/Grazing effects

25. O'Neill, W.O., ed.

November 12, 1885

Hoof and Horn.

Prescott, Arizona, weekly newspaper.

This newspaper was devoted entirely to the livestock industry in Arizona with emphasis on northern Arizona from 1884 to 1889. For many years it was the cattleman's only source of information for news from other areas of Arizona and the national cattle market, and frequently reported on range and weather conditions and their consequent effect on cattle. Articles which appeared in the November 12 and 19, 1885 issues describe range conditions during the drought of that year and its effect on cattle and rangeland. The reports of May 27 and June 17, 1886, elaborate further on land deterioration due to drought and overgrazing.

Cattle industry/Drought/Overgrazing/Political aspects/Grazing effects

26. Palmer, General W. J.

1868

Report of surveys across the continent in 1867-1868 on the thirty-fifth and thirty-second parallels from a route extending the Kansas Pacific Railroad to the Pacific Ocean at San Francisco and San Diego.

W.B. Selheimer, Philadelphia. 250 p.

This is a pro-development publication written to attract settlers, farmers and tourists to the area proposed for the railroad. Reports on climate, topography and vegetation are very attractively slanted and not always entirely truthful. However, an accurate picture of the natural resources in northern Arizona before the white man's exploitation is presented.

Railroad route/Physical geography/Ungrazed rangeland/Political aspects

27. Potter, A.C.

1901

A brief history of the cattle business in Apache County.

University of Arizona, Tucson, Library Special Collection. [Unpublished manuscript.]

This brief history of the cattle business in Apache County until 1901 includes the major cattle and sheep outfits and the number of stock each grazed on the range. The emphasis of the pamphlet is on prices. Land use and deterioration are also discussed.

Cattle industry/Apache County/Sheep industry/Overgrazing/ Political aspects

28. Potter, A.C.

1905

Report of the Public Lands Commission.

U. S. Senate, 58th Congress, 3rd Session. Executive Document 189.

The acts and laws that awarded public land to qualified individuals are reviewed and their impact assessed from the viewpoint of present public land and range conditions. To aid in range evaluation, questionnaires were sent to stockmen who kept cattle on public lands. The range was found to be in poor condition and recommendations for governmental control were submitted to Congress. As a result, Congress acted upon these recommendations and initiated the first range control laws.

Public domain/Legal aspects/Range evaluation/Grazing effects/ Range management/Political aspects

29. Powell, J.W.

1962

Report on the lands of the arid region of the United States, with a more detailed account of the lands of Utah. Wallace Stegner, ed.

Harvard University Press, Cambridge, Massachusetts. 202 p.

An account of the arid region of the United States written in 1878 and originally presented by Powell to the U. S. House of Representatives (58th Congress, 3rd Session) in 1905 (House Document 189). Subjects covered include physical characteristics of the region; suggestions for land management; rainfall of the western United States; water supply; questions relating to irrigable lands; lands of Utah; land grants in aid of internal improvements; and irrigable lands of the Salt Lake drainage system, the valley of the Sevier River, and that portion of Utah drained by the Colorado River and its tributaries. The author not only

considered the character of the land but also the engineering problems involved in their redemption and suggestions for the legislative action necessary for sound management practices.

Physical geography/Water resources/Powell/Legal aspects/Land management/Range management

30. Raine, W.M., and W.C. Barnes.

1930

Cattle.

Doubleday, Doran and Co., Garden City, New York. 340 p.

Northern Arizona is briefly mentioned in this history of the cattle industry in the West. Land misuse in northern Arizona and the lobbying efforts by the cattlemen's organization for protective legislation are discussed.

Cattle industry/Legal aspects/Range management/Political aspects

31. Simpson, J.H.

1850

Report of Lieutenant J.H. Simpson of an expedition into the Navajo Country in 1849.

U. S. Senate, 31st Congress, 1st Session. Executive Document 64.

This report of the expedition that passed south along the Petrified Forest National Park's eastern border contains a description of surface water found in the area. Comments on riparian vegetation, size of the river bottom, and estimated quantity of water in the river are included.

Physical geography/Surface water/Rivers/Riparian vegetation/ Expedition

32. Sitgreaves, Captain L.

1853

Report of an expedition down the Zuni and the Colorado Rivers in 1851.

U. S. Senate, 32nd Congress, 2nd Session. Executive Document 59.

Captain Sitgreaves prepared this report on his expedition that passed just south of the Petrified Forest. The naturalist's report on vegetation encountered is included supplemented by black line drawings of flowers of the area.

Sitgreaves/Expedition/Illustrations/Flowers/Vegetation survey

33. Stinson, H. C., and W. N. Carter

1891

Arizona: A comprehensive review of its history, counties, principal cities, resources and prospects.

University of Arizona, Tucson, Library Special Collection. [Unpublished manuscript.]

This composite portrayal of Arizona in the late 1800's offers some description of vegetation types present during the era. Information is presented with the conviction that the grass and timber resources of Arizona were inexhaustable.

Natural resources

34. Thornber, J.J.

1910

The grazing ranges of Arizona.

Arizona Agricultural Experiment Station, Bulletin 65.

This bulletin discusses the different grazing ranges in Arizona. Descriptions of climatic conditions, the importance and uncertainty of rainfall and forage plant dependance on rainfall are accompanied by black line drawings of the grasses and a history of land abuse by stockmen. The remainder of the bulletin pertains to grazing and a description of a system of cattle management for Arizona rangelands.

Range condition/Climate/Illustrations/Cattle industry/Grazing/Climatic-vegetal relationships/Precipitation/Grasses/Overgrazing/Range management

35. Ward, L. E.

1900

Report on the petrified forests of Arizona.

U. S. Government Printing Office, Washington, D.C. 23 p.

Although the object of this report is to encourage legislation for the preservation of the petrified wood in Arizona, the description given of the terrain as it was in 1900 is very thorough. Vegetation descriptions also add to the value of the report.

Physical geography/Legal aspects/Vegetation survey

36. Wilson, J. A.

1967

Cattle and politics in Arizona, 1886-1941

University of Arizona, Tucson, Ph. D. Dissertation.

This exhaustive research work on land use by the cattle industry in Arizona documents the use and misuse of grazing lands. Less emphasis is placed on the cattle industry in northern Arizona than in other parts of the state.

Cattle industry/Grazing effects/Political aspects/Grazing/Overgrazing

PETRIFIED FOREST NATIONAL PARK: SPECIFIC STUDIES

This section of the bibliography contains annotations to publications which either directly discuss the Petrified Forest National Park or which make direct reference to Park vegetation. Investigations made by Ranger George Johnson and other naturalists comprise the bulk of the vegetation studies done within the Park. Many of these studies record the change of vegetation patterns and recovery rates resulting from exclusion of grazing on Park lands. In addition, annotations are included for several studies which were done to support legislation to make the area a National Park. Other annotations included in this section discuss the soil-plant associations found within the Park.

37. Akers, J.P.

1964

Geology and ground water in the central part of Apache County, Arizona.

U. S. Geological Survey, Washington, D.C., Water Supply Paper 1771.

Groundwater and its quality as found in the geologic formations of central Apache County are emphasized in this study. Descriptions of vegetation, topography, geology and climate of the area supplement the main discussion on groundwater.

Groundwater/Geology/Apache County/Physical geography

38. Anonymous

1966

Petrified Forest National Park, Resources Management Plan.

Petrified Forest National Park Library, Arizona. [Unpublished manuscript.]

The policy, objectives, and goals of the Petrified Forest Resource Management Plan are explained in detail. Support for the Management Plan is taken from the known history of land use, geology, vegetation and climate. The object of the plan is to return the Park flora and fauna to their natural states as they existed prior to European settlement and land use.

Resources Management Plan/Physical geography/Land use/ Petrified Forest National Park

39. Anonymous

1973

Rare and endangered plants of Arizona.

University of Arizona, Tucson, Herbarium. 32 p. [Unpublished manuscript.]

Endangered native plants of Arizona are listed by their scientific and common names. Plants are subdivided into six major plant forms; grasses, grass-likes, forbs, shrubs, succullents, and trees.

Several species thought to be unique to the Petrified Forest National Park area are listed, including Callirrhoë involucrata (poppy mallow), Eriogonum lachnogynum (buckwheat), Peteria scoparia (comote-de-monte), and Grayia brandegei (hopsage).

Endangered species/Rare plants/Species list/Callirrhoe involucrata/Eriogonum/Peteria scoparia/Grayia brandegei

40. Bartlett, K.

1943

Edible wild plants of northern Arizona.

Plateau 16(1):11-17.

Plants are divided into groups based on the parts of the plants edible to man. Individual species are listed by scientific and common name. Accompanying the name is a geographic distribution of the plant and directions for preparation of the edible parts for consumption.

Edible plants/Species list

41. Bradfield, M.

1968

Hopi names for certain common shrubs, and their ecology.

Plateau 41(2):61-71.

Shrubs, with their associated grasses, are grouped into a number of plant associations. These associations are dependent upon the landforms of the region and constitute its principal vegetational cover. Using the Oraibi Valley as an example, the paper describes the landforms, defines the associations into which the common shrubs are grouped and indicates the relation between the original plant cover and the current Hopi agriculture. As the soil and plants are very similar to the Petrified Forest, extrapolation of plant associations and their probable location in the Petrified Forest can be estimated.

Shrubs/Plant communities/Oraibi Valley/Hopi/Plant-soil relationships/Physical geography/Grasses

42. Bradfield, M.

1969

Soils of the Oraibi Valley, Arizona, in relation to plant cover.

Plateau 41(3):133-140.

The relationship between the principal plant associations found in the Oraibi Valley to the soils on which they grow is described. Five soil classes are found there; sand, sandy loam, sandy clay loam, silty clay, and clay. The differences in vegetational cover may be due to surface conditions, moisture-retaining capacity of the subsoil, and/or salinity of the subsoil. Species discussed include plants from the genera Atriplex, Erigonum, Lycium, Sarcobatus, Artemisia, and Chrysothamnus. Similar soil-plant associations are present in the Petrified Forest National Park and this article can be used to project expected soil types or vegetation types when only one component of the association is known.

Plant-soil relationships/Plant communities/Soil types/Oraibi Valley/Shrubs

43. Campbell, R.S., and I. F. Campbell

1938

Vegetation on gypsum soils of the Jornada Plain, New Mexico.

Ecology 19(4):572-577.

On the Jornada Plain, gypsiferous soils with 60-65 percent calcium sulfate lacking in nitrate and shallow loose quartz sand underlain by gypsum, possess chemical and physical characteristics unfavorable for plant growth. Predominant vegetation on the first soil type includes a few grasses and five herbaceous plants. Sparse vegetation, mostly Sporobolus nealleyi, exemplifies scant range forage production not caused by overgrazing. The gypsum soils of the Petrified Forest illustrate similar properties, but with a lower gypsum content the vegetation effect is much less obvious.

Plant-soil relationships/Gypsiferous soils/Grasses

44. Ellison, L.

1960

Influence of grazing on plant succession of rangelands.

Botonical Review 26(1):1-78.

A review of studies on the effects of grazing in various regions, including the northern and southern desert shrub regions into which parts of the Petrified Forest falls. The most recent grazing allowed on the Petrified Forest National Park took place on the desert shrub region.

Grazing effects/Vegetation change/Shrubs

45. Harrell, M.A., and E.B. Eckel

1939

Groundwater resources of the Holbrook region, Arizona.

U. S. Geological Survey, Washington, D.C., Water Supply Paper 836-B.

Groundwater and its quality as found in the geologic formations of the Holbrook area east of the Petrified Forest National Park are emphasized in this study. Descriptions of vegetation, topography, geology and climate of the area supplement the main discussion of groundwater.

Groundwater/Physical geography/Holbrook area/Geology

46. Jameson, D.A.

1969

Rainfall patterns on vegetation zones in northern Arizona.

Plateau 41(3):105-111.

Summer precipitation in northern Arizona is primarily from the Sonoran monsoon, while winter storms are of the same pattern as southern California and the Great Basin. These rainfall patterns encourage growth of short grass in the Little Colorado River Basin where winter precipitation is deficient and summer monsoon rains provide the bulk of the total precipitation.

Climatic-vegetal relationships/Little Colorado River Basin/
Climate/Precipitation/Grassland

47. Johnson, G. E.

1969

A report on an area excluded from the Petrified Forest National Park by early boundary fence construction.

Petrified Forest National Park Library, Arizona. 7 p. [Unpublished manuscript.]

The original National Park fence excluded 350 acres of National Park owned riparian vegetation along the Puerco River. This report is an effort to have the fence changed to include the Puerco River area within the National Park boundary. The Puerco River riparian vegetation, the only wooded area on the park, is a haven for many birds and animals. The present fencing requires twice as much maintenance as would be needed if the fence were changed. The present fence also allows grazing by cattle along the Puerco River on National Park lands.

Puerco River/Riparian vegetation/Park boundary/Wildlife habitat/
Petrified Forest National Park/Grazing effects

48. Johnson, G. E.

1970

Report of evaluation of the tamarisk eradication project on Petrified Forest National Park.

Petrified Forest National Park Library, Arizona. 4 p. [Unpublished manuscript.]

This report evaluates the success of using chemicals to eradicate tamarisk within the Petrified Forest National Park. Based on the poor tamarisk kill results the eradication project was terminated.

Tamarix/Chemical control

49. Johnson, G. E.

1970

Report on bank stabilization of Puerco River.

Petrified Forest National Park Library, Arizona. 3 p. [Unpublished manuscript.]

Efforts to stabilize the Puerco River bank and channel by entrenching the channel, building spider jettys, and planting riparian vegetation have not been as successful as hoped. The report found that vegetation, especially tamarisk, is doing most to contribute to bank stabilization and channel permanence.

Puerco River/Bank stabilization/Riparian vegetation/Tamarix/ Erosion control

50. Johnson, G. E.

1972

A report on a vegetative recovery study made on two study plots in Petrified Forest National Park.

Petrified Forest National Park Library, Arizona. 12 p. [Unpublished manuscript.]

Two plots of land that had previously been excluded from the Park were incorporated by the Park in 1972. Since both plots had been subjected to heavy grazing pressure, a transect vegetation study was made of the areas. Observations of plant species and vegetation conditions were taken at one yard intervals indicating that plant density did not exceed 34 percent in any of the transects.

Unprotected rangeland/Vegetation inventory

51. Johnson, G. E.

1974

Appendix Number One to a report on a vegetative recovery study made on two study plots in Petrified Forest National Park.

Petrified Forest National Park Library, Arizona. 10 p. [Unpublished manuscript.]

Additional work on the transects described by Johnson in his 1972 reports established a pattern of plant species succession. The methods used were identical to those used in the original survey and results allowed computation of increases and decreases in vegetation and speculation on possible causes for any change.

Revegetation/Vegetation change/Vegetation inventory/Protected rangeland

52. Kearney, T. H.

N. D.

Arizona localities of interest to Botanists.

Museum of Northern Arizona, Flagstaff. [Unpublished manuscript.]

Labels from specimens and publications about Arizona plants were used to compile this listing of localities considered to be ideal for plant collection. These areas include the Petrified Forest National Park. This paper illustrates the variety of species present on the Petrified Forest National Park.

Plant collecting/Species list

53. Knipe, T.

1944

The status of the antelope herds of northern Arizona: Pittman-Robertson Project, Arizona 9-R.

Arizona Game and Fish Commission, Phoenix, Federal Aid Division. 40 p.

Vegetation types, climate, range conditions and principal plants are discussed in this study of antelope range in northern Arizona. Overgrazing was seen to be a severe land use problem in Arizona, allowing exotic and weedy species to easily invade the range.

Overgrazing/Antelope/Physical geography/Grazing effects/ Invader species

54. Nequatewa, E.

1943

Some Hopi recipes for the preparation of wild plant foods.

Plateau 16(1):18-20.

This article provides traditional recipes for some of the edible wild plants found in northern Arizona. The classification of foods and the plant names employed in the article Edible Wild Plants of Northern Arizona, by Katherine Bartlett (Plateau, 1943, 16(1):11-17), have been used here.

Edible plants/Species list

55. Spalding, D. M.

1950

Taxonomy of the Petrified Forest National Park.

Petrified Forest National Park Library, Arizona.
[Unpublished manuscript.]

The plants found in the Petrified Forest National Park are categorized. Each sample has the collector's name, location by county, genus, and species and common names. The list was checked for accuracy at the Petrified Forest National Monument herbarium. Family and species numbers from the herbarium are included.

Species list/Petrified Forest National Park

56. Thomas, H. E.

1962

Effects of drought in the Colorado River Basin.

U. S. Geological Survey, Professional Paper 372-F.

The huge Colorado River watershed, the plateau country in which the Petrified Forest is located, plays a key role in groundwater recharge. The sedimentary rocks of the region are a prime acquifer for water conveyance to lower elevations. This tends to rapidly drain the precipitation received by the area causing an arid effect.

Drought/Groundwater recharge/Colorado River Basin/Geology/ Environmental effects

57. U. S. Department of Agriculture, Washington, D.C., Soil Conservation Service

1975

Soil survey of Apache County, Arizona: central part.

Same as author. 163 p.

A general soil survey of central Apache County which includes the Petrified Forest National Park. A brief overview of the vegetation is given. Soils typically associated with certain landforms are listed.

Soil types/Landforms/Plant-soil relationships/Apache County

58. U. S. Department of the Interior, Washington, D.C., National Park Service

1967

Wilderness recommendations for the Petrified Forest National Park.

Same as author. 46 p.

This administrative document provides exact locations and explanations of the Park Service Wilderness Classification System, public hearing records, and the justification for wilderness declaration of the areas.

Wilderness areas/Petrified Forest National Park

59. University of Arizona, Tucson, Cooperative Extension Service; Agricultural Experiment Station

1973

Guide to improvement of Arizona rangeland.

Same as author, Bulletin A-58. 93 p.

The Petrified Forest is located in the Colorado and Green River Plateau region. The region is divided into four vegetative zones;

desert shrub, short grass prairie, pinyon-juniper, and western xeric evergreen forest. The topography, soils, elevation and climatic parameters of these zones are given. Management techniques are suggested for each zone.

Land management/Vegetation zones/Physical geography/Grassland/Shrubs/Pinyon-juniper

60. Walker, M. V.

1938

Wildlife and range survey: Petrified Forest National Monument naturalist's environmental assessment.

Petrified Forest National Park Library, Arizona. [Unpublished manuscript.]

The response of grasses, shrubs, flowering plants and antelope to four years of fencing protection is carefully documented. Of special interest is the change in vegetation growth and vigor after grazing was prohibited on the Park lands.

Antelope/Revegetation/Protected rangeland

ECOSYSTEM AND RANGE MANAGEMENT

The Petrified Forest National Park is at the interface of two biomes, the short-grass prairie and Great Basin desert scrub. The high altitude, short-grass prairie dominates in the southern half of the Park. This grassland is typified by an abundance of short-grasses, mainly blue grama (Bouteloua gracilis) and galleta (Hilaria jamesii), with intermixings of saltbushes (Atriplex) or sagebrushes (Artemisia). The northern border of this grassland is roughly the escarpment paralleling the Lithodendron Wash. North and west of the escarpment is the region identified as the Great Basin desert scrub vegetation type. This region is the highest elevation and coolest desert within Arizona. It is a shrub and grass dominated desert in which the vegetation is of relatively low stature, with just a few species comprising a stand over extensive areas of similar uniform relief. Major shrubs are big sagebrush, (Artemisia), saltbush (Atriplex), Mormon tea (Ephedra), greasewood (Sarcobatus) and rabbitbrush (Chrysothamnus). Geologist J.S. Newberry further divided part of the Great Basin desert scrub region within the Petrified Forest National Park into the Painted Desert when he accompanied J.C. Ives on the Colorado River exploration of 1876-1878.

This section of the bibliography contains annotations to publications which investigate the species and associations of the two vegetation zones. Publications explaining these zones cite the environmental factors which explain their existance. Available information onthe vegetation zones is included to aid in management and preparation of the natural resources plan and recommendations that will be prepared at a later date.

61. Albertson, F.W. and J.E. Weaver

1946

Reduction of ungrazed mixed prairie to short grass as a result of drought and dust.

Ecological Monographs 16(4):449-463.

Drought, unaided by overgrazing, reduced an area of mixed prairie to a disclimax of short grasses over a period of 20 years. Mid-grasses; little bluestem (Andropogon scoparius), side oats grama (Bouteloua curtipendula), and western wheat grass (Agropyron smithii) and tall grasses; big bluestem (Andropogon furcatus), Indian grass (Sorghastrum mutans), and nodding wild rye (Elymus canadensis) were totally replaced by blue grama (Bouteloua gracilis) and buffalo grass (Buchloe dactyloides). Blue grama is more drought tolerant than other prairie grasses and is the dominant prairie grass in the Petrified Forest National Park.

Drought/Grasses/Succession/Environmental effects

62. Aldon, E. F.

1970

Fourwing saltbush survival after inundation.

U. S. Forest Service, Albuquerque, New Mexico, Rocky Mountain Forest and Range Experiment Station, Research Note RM-165. 2 p.

Four-week-old fourwing saltbush transplants experience high mortality rates if planted in areas subject to inundation for longer than 30 hours.

Atriplex canescens/Viability/Transplants

63. Aldon, E. F.

1972

Critical Soil Moisture Levels for Field Planting Fourwing Saltbush.

Journal of Range Management 25(4):311-312.

Fourwing saltbush (Atriplex canescens) had a survival rate of 80% when transplanted into alluvial field sites where the soil moisture

was at least 14% by weight or at tensions between 1/3 and 2 atmospheres.

Atriplex canescens/Vegetation establishment/Soil Moisture/ Viability/Transplants

64. Aldon, E. F.

1975

Establishing Alkali Sacaton on Harsh Sites in the Southwest.

Journal of Range Management 28(2):129-131.

Alkali sacaton (Sporobolus airoides) must be planted in moist soil during rainy periods. Large seeds must be mulched to maintain darkness and slow evaporation.

Vegetation establishment/Sporobolus airoides/Soil moisture/ Germination

65. Arle, H. F.

1960

Saltcedar control with chemicals. In:

Arizona Watershed Symposium, 4th, Phoenix, 1960, Proceedings. p. 27-29.

Studies show that single spray applications of herbicide at relatively low rates (1.25 and 2 pounds per acre of 2,4-D or mixtures of 2,4-D and 2,4,5-T) on mature tamarisk or regrowth following mechanical clearance results in a high percentage kill of top growth but seldom reduce the plant population. Amine formulation of 2,4-D was much less effective than ester forms of 2,4,5-T at equivalent rates, 2,4,5-T acid (silvex) applications are more effective than 2,4-D or 2,4,5-T. After four years experimentation, no herbicide was found to be effective in completely eradicating plants.

Tamarix pentandra/Chemical control

66. Arnold, J. F., D. A. Jameson, and E. H. Reid

1964

The pinyon-juniper type of Arizona: effects of grazing, fire and tree control.

U. S. Department of Agriculture, Washington, D.C., Research Report 84. 28 p.

Pinyon and juniper have invaded and, in some areas, taken over grassland communities within Arizona, and densities of established stands have increased markedly. Characteristics of the pinyon-juniper vegetation type, invasions into grasslands, the effects of invasions on other plants, methods used to control invaders, response of grass and shrub vegetation to tree control, and costs and resulting benefits of control are described.

Pinus edulis/Juniperus monosperma/Invader species/Plant relationships/Grazing effects/Burning/Pinyon-juniper control

67. Arthur, G.B.

1939

Common range plants, Arizona and New Mexico.

Civilian Conservation Corps., Washington, D.C. 118 p.

Keys for identification of grasses, taxonomic descriptions and palatability tables for grasses, browse plants and weeds are given.

Range plants/Grasses/Weeds/Key/Species list/Browse plants

68. Ball, E.D.

1936

Food plants of some Arizona grasshoppers.

Journal of Economic Entomology 29(4):679-684.

Many grasshoppers are beneficial in helping check weeds that would otherwise overrun overgrazed ranges. Grasshoppers eat some of the worst weeds including burroweed, snakeweed, ragweed, mallow, creosote bush, atriplex spp. sunflower, goldenrod, and arrowweed. The majority of the 250 species of Arizona orthoptera are either interesting or beneficial. Injurious species are few in number and confined to two groups of omnivorous feeders.

Insects/Grasshoppers/Weeds

69. Bekele, E., R.D. Pieper, and D.D. Dyer

1974

Clipping height and frequency influence growth response of nitrogen fertilized blue grama.

Journal of Range Management 27(4):308-309.

Unclipped Bouteloua gracilis used nitrogen fertilizer more efficiently than when clipped. Clipping of unfertilized plants was much less effective than clipping of fertilized plants. Fertilizer treatments can accelerate plant growth enough to weaken the natural vigor of the plant.

Bouteloua gracilis/Fertilizer/Plant growth/Clipping

70. Benedict, H.M. and G.B. Brown

1944

The growth and carbohydrate responses of Agropyron smithii and Bouteloua gracilis to changes in nitrogen supply.

Plant Physiology 19:481-494.

Lack of nitrogen reduced total dry weight of both species, favoring root growth to top growth while abundant nitrogen favored top growth over root growth. Lack of nitrogen increased the sucrose percentage in both species, when nitrogen was made available this percentage was reduced.

Bouteloua gracilis/Plant growth/Fertilizer

71. Benson, L.

1969

The cacti of Arizona, 3rd Edition.

University of Arizona Press, Tucson. 218 p.

A semi-technical reference on native cacti of Arizona that supersedes earlier editions. Included are photographs, descriptions of cacti species and varieties, keys to genera and species, synonymous names, details on distribution within Arizona, and a chapter on the culture and care of cacti.

Cactaceae/Illustrations/Key/Species list

72. Benson, L., and R.A. Darrow

1954

Trees and shrubs of the southwestern deserts.

University of Arizona Press, Tucson and University of New Mexico Press, Albuquerque. 437 p.

Keys to identification are accompanied by geographic distribution maps, illustrations, description of species and habitat, and information on the use of wood plants by man and other animals. The introduction discusses desert climate and physiography. An illustrated profile through a desert mountain range and basin shows vegetational types and soil conditions commonly developed on the various land surfaces. A map shows the arid and semi-arid areas of the southwest; each area is discussed and the common type of vegetation for the area is presented.

Trees/Shrubs/Vegetation maps/Illustrations/Plant uses/Climatic-vegetal relationships/Plant-soil relationships/Key

73. Billings, W.D.

1949

The Shadscale Vegetation Zone of Nevada and Eastern California in Relation to Climate and Soils.

American Midland Naturalist 42(1):87-109.

A discussion of plant distributions in the shadscale (Atriplex confertifolia) and associated plant communities. A major emphasis is placed on the effect of climate and soils on plant distribution.

Plant distribution/Plant-soil relationships/Climatic-vegetal relationships/ Atriplex confertifolia

74. Bleach, A.T./et al.

1965

Problems in Artificial and Natural Revegetation of the Arid Shadscale Vegetation Zone of Utah and Nevada.

Journal of Range Management 18(2):59-65.

Studies were conducted to assess why revegetation of the arid shadscale regions was not successful. Climate, soil, and dormancy factors were used to evaluate all the shrubs and grasses typical of a shadscale community in a search for possible interrelations that may hinder revegetation.

Revegetation/Atriplex/Climatic-vegetal relationships/Viability/Plant-soil relationships/Vegetal relationships

75. Brown, D.

1954

Methods of surveying and measuring vegetation.

Commonwealth Bureau of Pastures and Field Crops, Bulletin 42. 223 p.

A systematic treatment of the many and varied vegetation measuring techniques developed by botanists throughout the world is given. These techniques are classified and compared. The discussion is directed to the needs of all who study grasslands. This publication was a world literature review on the methods used in quantitative ecological studies and grazing lands from the 1920's to the mid 1950's. The book is divided into four major parts: vegetation and its sampling, botanical analysis, productivity and utilization.

Vegetation Inventory/Sampling techniques/Viability/Plant communities

76. Brown, D.E., and C.H. Lowe

1974

A digitized computer-compatible classification for natural and potential vegetation in the southwest with particular reference to Arizona.

Arizona Academy of Science, Journal 9(2). 11 p.

Brown and Lowe's digitized computer-compatible hierarchy for natural vegetation classification is explained and examples are given for application techniques. The first digit is natural vegetation, the second; plant formation, the third; climatic zone, the fourth; biome, the fifth; community, the sixth; association and the seventh; composition. The example hierarchial breakdown in the text is not complete in the fifth, sixth and seventh communities.

Digitized hierarchy/Climatic zone/Plant communities/Biotic communities/Ecotone

77. Brown, D.E., and C.H. Lowe

1974

The Arizona system for natural and potential vegetation: illustrated summary through the fifth digit for the North American southwest.

Arizona Academy of Science, Journal 9(3):1-56.

An illustrated report of Brown and Lowe's digitized computer-compatible hierarchy for natural vegetation classification. Photographic examples and short descriptions are used to explain the seven digit classification system.

Digitized hierarchy/Illustrations/Biotic communities/Climatic zone/ Ecotone

78. Bryan, K.

1928

Change in plant association by change in ground water level.

Ecology 9(4):474-478.

Arroyo cutting of streams is associated with overgrazing by domestic animals where the resultant loss of vegetation greatly increases the erosive power of the streams. The consequent lowering of the water table after the arroyo cutting causes a vegetation change because of the water loss to the original vegetation.

Grazing effects/Vegetation change/Groundwater/Gully erosion/ Overgrazing

79. Clark, L.D. and N.E. West

1971

Further Studies of Eurotia lanata Germination in Relation to Salinity.

The Southwestern Naturalist 15(3):371-375.

The germination rate of E. lanata seeds from three sources was tested at four concentation levels on four salts. Germination decreased as salt increased but seeds from different sources showed different reduction rates. Chloride salts caused a greater reduction than sulfate salts.

Germination/Salinity/Eurotia lanata

80. Clements, F.E.

1920

Plant indicators: the relation of plant communities to process and practice.

Carnegie Institution of Washington, Publication 290. 388 p.

Plants are used as indicators of past and present events and for qualitative and quantitative data gathering. This paper presents a thorough description of indicator plants present in the southwest and includes information about their significance in range evaluation.

Indicator plants/Succession/Invader species

81. Copple, R.F., and C.P. Pase

1967

A vegetative key to some common Arizona range grasses.

U. S. Forest Service, Fort Collins, Colorado, Rocky Mountain Forest and Range Experiment Station, Research Paper RM-27. 72 p.

This publication is to be used in conjunction with Arizona Range Grasses (R.R. Humphrey, 1956) or Manual of the Grasses of the United States (A.S. Hitchcock, 1951). An illustrated key is presented for the identification of 77 common Arizona range and pasture grasses using their vegetative characteristics. The key is designed to be used for identification of grasses when no flower stalks are present.

Grasses/Key/Illustrations

82. Cords, H.P.

1966

Root temperature and susceptibility to 2,4-D in three species.

Weeds 12(2):121-124.

There is a high correlation between optimum root temperature and a high herbicide kill percentage. Temperatures of 75^{o}F

resulted in the highest death rate after a 2,4-D treatment of rubber rabbitbrush (Chrysothamnus nauseosus (Pall.) Britton). Temperatures of 90°F with Canadian thistle and 60°, 75°, and 90°F in Russian knapweed following 2,4-D applications showed the best kill percentage.

Roots/Chemical control/Chrysothamnus nauseousus/Plant physiology

83. Cords, H.P. and A.A. Badiei

1964

Root reserves and susceptibility to systemic herbicides in two phreatophytes.

Weeds 12(4):299-301.

Salt cedar (Tamarix pentandra Pall.) and woods rose (Rosa woodsi Lindl. var. ultramontana (Wats.) Jeps.) were treated with systemic herbicides over a two-year period. Periodic root samples were taken throughout the two years and analyzed for total available carbohydrates. No correlation was found between root reserves and response to the herbicides. This illustrates the fact that herbicides may top kill these plants for a season.

Tamarix pentandra/Roots/Chemical control/Plant physiology

84. Cox, W.T.

1936

Do droughts explain the prairies?

American Forests 42(12):556-557.

The article takes the point of view that extended periods of alternating drought and heavy precipitation over a long term cycle of approximately 300 years are the cause of continued prairies where trees should be able to survive but don't.

Drought/Grassland/Climatic-vegetal relationships

85. Dana, J.D.

1865

On the origin of prairies.

American Journal of Science and Arts, Ser. 2. 40(120):293-304.

An abundance of soil moisture is directly connected with a tree cover and a lack of soil moisture is connected with a grass cover. Grass-regions may invade forest regions or vice versa according to the dryness or moistness of the soil. A change in moisture content is capable of changing the vegetation of the affected area.

Grassland/Soil moisture/Succession

86. Dayton, W. A.

1931

Important western browse plants.

U. S. Department of Agriculture, Miscellaneous Publication 101. 214 p.

Important range pasture browse plants are listed separately with a brief description of individual characteristics and geographic distribution.

Browse plants/Species list/Plant distribution

87. Decker, J. P.

1961

Salt secretion by Tamarix pentandra Pall.

Forest Science 7(3):214-217.

Tamarisk salt bloom is secreted by dome-shaped salt glands imbedded in epidermal pits. Glands consist of at least two cells which are non-vacuolate and densely filled with granular material. Salt initiates as minute, granular, whisker-like columns arising from the glands. Whiskers often deliquesce and recrystallize as larger cubes.

Tamarix pentandra/Plant physiology/Salt secretion

88. Decker, J. P., W. G. Gaylor, and F. D. Cole

1962

Measuring transpiration of undisturbed tamarisk shrubs.

Plant Physiology 37(3):393-397.

Evapotranspiration (ET) of Bermuda grass-tamarisk plots increased linearly with the amount of tamarisk present. A reduction of ET could be projected if there were a conversion of tamarisk stands to grass cover. ET generally followed changes of light intensity and humidity deficit.

Tamarix pentandra/Evapotranspiration/Grasses/Environmental effects

89. Detling, J.K. and L.G. Kilboff

1973

Physiological Response to Moisture Stress as a Factor in Halophyte Distribution.

American Midland Naturalist 90(2):307-318.

Species in four halophytic communities were studied for their photosynthetic and respiratory response to moisture stress. Suaeda depressa and S. fruticosa had lower water potentials than Sarcobatus vermiculatus and Distichilis spicata. S. fruticosa had a higher photosynthetic rate than S. vermiculatus or D. spicata. Relative tolerance to severe moisture stress partially controlled species distribution.

Moisture stress/Plant distribution/Drought tolerance/Halophytes/ Plant physiology

90. Dollahite, J.W., and T.J. Allen

1959

Feeding perennial broomweed to cattle, swine, sheep, goats, rabbits, guinea pigs and chickens.

Texas Agricultural Experiment Station, Progress Report 2105. 6 p.

Feeding trials showed that dried broomweed (Gutierrezia microcephala) from sandy soil produces abortions in cows, sheep, angora goats and rabbits but not Spanish goats. Baby chicks fed broomweed didn't gain as fast and sows had delayed breeding.

Noxious plants/Grazing/Gutierrezia

91. Dwyer, D.D., and K. Wolde-Yohannis

1972

Germination, water use, and production of Russian thistle (Salsola kali L.).

Agronomy Journal 64(1):52-55.

Emergence of Salsola kali occurred with 7.6 milliliters of water during optimum germination temperatures of 7° to 35°C. Water efficiency was best at 19 percent field capacity, using only 98 grams of water per gram of dry weight. At field capacity Russian thistle used 181 grams of water per gram of dry weight of shoot and root.

Salsola kali/Plant growth/Germination/Water requirements/Plant physiology

92. Eckert, R.E., and R.A. Evans

1968

Chemical control of low sagebrush and associated green rabbitbrush.

Journal of Range Management 21(5):325-328.

Low sagebrush (Artemisia arbuscula Nutt. and Artemisia longiloba (Osterhous) Beetle) was controlled with low volatile esters of 2,4-D at two pounds per acre. Green rabbitbrush (Chrysothamnus viscidiflorus (Hook) Nutt.) was effectively controlled with applications of 2,4-D at three pounds per acre, or a combination of picloram plus 2,4-D.

Artemisia/Chemical control/Chrysothamnus/noxious plants/Shrubs

93. Emerson, F.W.

1932

The tension zone between the grama grass and pinyon-juniper associations in northeastern New Mexico.

Ecology 13(4):347-58.

Juniper is the pioneer invader followed by pinyon. Juniper's horizontal and vertical root system give it an unrestricted site habitat enabling

it to grow on a variety of soils and often on rocky ledges. Difference in precipitation does not seem to account for geographic distribution.

Juniperus monosperma/Pinus edulis/Invader species/Roots

94. Frost, K.R. Jr., and K.C. Hamilton

1960

Report on the Wellton-Mohawk salt cedar clearing studies.

Arizona Agricultural Experiment Station Report 193. 54 p.

Under cutting and raking of salt cedar (Tamarix pentandra) in the Gila River bottom showed a 99 percent areal cover reduction, an 88 percent density reduction in two months and a 92 percent areal reduction and 72 percent density reduction in one year. No reinfestation of wood or bushy species other than salt cedar and arrowweed occurred. Soil type and terrain had no effect on regrowth but surface water and a high water table produced a large salt cedar regrowth that rapidly took over the cleared area within a few years.

Tamarix pentandra/Mechanical control

95. Fautin, R.W.

1946

Biotic Communities of the Northern Desert Shrub Biome in Western Utah.

Ecological Monographs 16:251-310.

A study, with descriptions of the shadscale, greasewood, Tetradymia, Eurotia, black sage, pickleweed and little rabbitbrush biotic communities in western Utah. The effect of climate and other environmental factors on the flora and fauna of the area are discussed.

Biotic communities/Shrubs/Sarcobatus vermiculatus/Chrysothamnus nauseosus/Eurotia lanata/Atriplex confertifolia/Climatic-vegetal relationships/Environmental effects

96. Fernandez, O.A. and M.M. Caldwell

1975

Phenology and Dynamics of Root Growth of Three Cool Semi-Desert Shrubs Under Field Conditions.

Journal of Ecology 63(2):703-714.

Atriplex confertifolia, Ceratoides lanata and Artemisia tridentata occur in almost monospecific stands. Root growth was initiated several days prior to active shoot growth in the spring and root growth lasted several months after shoot growth terminated in the fall. A. confertifolia transpires and maintains positive net assimilation during the hot growing season due to the great depths the roots penetrate.

Roots/Plant growth/Shrubs/Atriplex confertifolia/Artemisia tridentata/ Climatic-vegetal relationships

97. Fireman, M. and H.E. Hayword

1952

Indicator Significance of Some Shrubs in the Escalante Desert, Utah.

Botanical Gazzette 114(2):143-155.

The reliability of the basic assumptions that Artemisia (sagebrush) indicates soils well suited for agriculture, Atriplex confertifolia (shadscale) indicates soils less well suited, and Sarcobatus vermiculatus (greasewood) indicates soils unfavorable for agriculture were studied by examining the soil and environmental factors. Soil pH and salt content were the factors most stressed.

Plant indicators/Plant-soil relationships/Soil chemical properties/ Saline soils/Atriplex confertifolia/Sarcobatus vermiculatus/Artemisia

98. Gardner, J.L.

1950

Effects of thirty years of protection from grazing in desert grassland.

Ecology 31(1):44-50.

Measurements and observations were taken in 1946 and 1948 on vegetation in a 320-acre tract of grassland protected from domestic animals since 1918 situated near Silver City, New Mexico, at an elevation of 5600 feet. Average grass density and vigor increased steadily with grazing protection and the grass formed a sod. The dividing line between formerly plowed and unplowed areas was still sharp after 15 years and there were different vegetative species on the formerly plowed areas. Under protection arroyos were healing; outside of the protected areas they were raw and eroding.

Experimental plots/Grasses/Gully erosion/Vegetation inventory

99. Gary, H. L.

1963

Root distribution of five-stamen tamarisk, seepwillow, and arrowweed.

Forest Science 9(3):311-314.

Root systems of three phreatophytes were taken from alluvial banks along the Salt River in central Arizona. Tamarix pentandra occupied the capillary zone, with some roots in the zone of saturation. Seepwillow (Baccharhis glutinosa) was shallow rooted, with branch roots in the upper soil profile. Arrowweed (Pluchea sericea) had a lateral type root system.

Tamarix pentandra/Phreatophytes/Roots

100. Gates, D. H./L. A. Stoddart/C. W. Cook

1956

Soil as a Factor Influencing Plant Distribution on Salt Deserts of Utah.

Ecological Monographs 26(2):155-175.

Studies were conducted on the shrub species; Artemisia tridentata, Atriplex confertifolia, A. nutallii, Eurotia lanata, and Sarcobatus vermiculatus, to determine what soil factors, if any, were responsible for the shrub distribution. Soil factors examined included pH, exchangeable sodium and potassium, base eschange capacity, salts, calcium content, permeability and infiltration rates.

Plant-soil relationships/Plant distribution/Shrubs/Artemisia/Atriplex/Sarcobatus vermiculatus/Eurotia lanata/Soil physical properties/Soil chemical properties

101. Gesink, R.W., H.P. Allen, and C.A. Lee

1973

Vegetative response to chemical control of broom snakeweed on a blue grama range.

Journal of Range Management 26(2):139-143.

All rates of picloram, alone or with 2,4-D, controlled broom snakeweed (Gutierrezia sarothrae) on a blue grama range. There was an initial injury to the grass but with time an over-all renovating effect on the range occurred associated with the removal of snakeweed.

Gutierrezia/Bouteloua gracilis/Chemical control/Noxious plants/Grassland

102. Goodman, P.J.

1973

Physiological and Eotypic Adaptation of Plants to Salt Desert Conditions in Utah.

Journal of Ecology 61(2):473-494.

The existence of the artificial boundaries in the "mosaic" vegetation pattern and the vague boundaries in the "subdominant species" vegetation pattern are explained by the existence of broad ranges of plantecotypes. The specific plant communities examined include Atriplex, Eurotia, Allenrolfea, Sarcobatus, Suaeda and Salicornia.

Plant distribution/Atriplex/Sarcobatus/Erotia lanata/Shrubs/Plant physiology/Salt tolerance

103. Gould, Frank W.

1973

Grasses of Southwestern United States.

The University of Arizona Press, Tucson, Arizona: 343 p.

A discussion of the role of grasses in Arizona biomes is followed by a short explanation of the structure of grasses and Keys to the tribes and genera. Keys to the species accompany listings of all grasses

by genera. The morphology of each species is accompanied by black line drawings and an explanation of its biome.

Grasses/Key/Plant morphology/Illustrations/Biotic communities/ Species list

104. Green, C.R., and W.D. Sellers

1964

Arizona climate.

University of Arizona Press, Tucson. 503 p.

This book is a revision of an earlier edition. Station climatographies form the bulk of the information presented. The climate for each station is described in summary form and tables are presented for temperature and precipitation means and extremes, average monthly temperatures and total precipitation (monthly and annually). An attempt is made to give the average length of the growing season for each station. The text includes an article by William D. Sellers ("The Climate of Arizona") which summarizes physical features, precipitation, temperature, relative humidity and temperature-humidity index, surface winds and cloudiness for the state. There is a short geographical description of the Petrified Forest National Park included with the meteorological statistics.

Climate/Physical geography/Climatic-vegetal relationships

105. Hanson, H.C.

1924

A study of the vegetation of northeastern Arizona.

University of Nebraska Studies 24:85-175.

In this vegetation study emphasis is placed on the sagebrush zone which is found below 5200 feet elevation. This area in northeastern Arizona is the southern most extension of sagebrush Artemisia-Atriplex association.

Artemisia/Atriplex/Shrubs/Plant distribution

106. Harris, D.R.

1966

Recent plant invasions in the arid and semi-arid southwest of the United States.

Association of American Geographers, Annals 56(3):408-422.

Several plant communities in the southwest have been drastically altered within the last century by the rapid spread of a small number of wood species. The habitats principally affected have been the intermediate elevation plateaus and plains that formerly supported grassland and which now have been invaded on a massive scale by native shrubs, and the stream courses that are now extensively occupied by tamarisk, an alien species from Eurasia. Historical evidence and field observations suggest that these invasions have resulted primarily from occupation of the southwest by American settlers. The development of commercial livestock ranching led to increased seed dispersal, overgrazing, and the suppression of grass fires, the combined effects of which favored the invasion of grassland by woody plants. Short-term climatic fluctuations towards greater aridity have tended to accentuate rather than to initiate the processes of invasion.

Invader species/Grazing effects/Shrubs/Tamarix pentandra/ Unprotected rangeland/Burning/Climatic-vegetal relationships/ Phreatophytes/Plant distribution/Environmental impact/Overgrazing

107. Hastings, J.R./Turner, R.M.

1965

The Changing Mile; An Ecological Study of Vegetation Change With Time in the Lower Mile of an Arid and Semi-Arid Region.

University of Arizona Press, Tucson, 317 p.

Surveys the principal climatic and ecological features of the Sonoran Desert, reviews the regions history, emphasizing the cultural factors that bear on the problems of vegetation change and arroyo cutting. Three chapters compare photographic pairs spanning a period of 80 years: oak woodland, desert grassland, and desert. Vegetation changes and hypothesis that have been proposed are presented and reviewed. Considerable attention is given to the effects of grazing, rodents and jackrabbits, fire, and climatic change. The authors conclude that a new vegetation has resulted from the combination of climatic and cultural stress during the last 80 years.

Vegetation change/Grazing effects/Photo points/Animal damage/ Burning/Gully erosion/Environmental impact/Climatic-vegetal relationships

108. Heerwagen, A.

1956

Mixed prairie in New Mexico. In: J.E. Weaver and F.W. Albertson, Eds.

Grasslands of the Great Plains, 284-300.

Johnson Publishing Company, Lincoln, Nebraska.

Information about the physiographic characteristics and soils of this grassland area is provided as is brief information about the climate. The various grassland communities are characterized and related to the soil texture. Invasion of the grasslands by woodland and shrubs is relatively minor. The most prevalent woody plant invaders are Juniperus scopulorum and Juniperus monosperma. Relatively broad ecotones exist where the mixed prairie joins the desert plains grassland.

Juniperus monosperma/Grassland/Soil properties/Plant-soil relationships/Invader species/Plant distribution

109. Hem, J.D.

1967

Composition of saline residues on leaves and stems of saltcedar (Tamarix pentandra Pall.).

U. S. Geological Survey, Professional Paper 491-C.

Collected tamarisk leaves and stems were analyzed for inorganic ions. From a few tenths of a percent to more than 3 percent of the dry weight of the leaves consisted of inorganic ions which could be washed off by rainfall. Most samples had a predominance of sulfate, but where the trees were growing in an area with highly saline water, sodium and chloride were the dominant inorganic anions.

Tamarix pentandra/Salt secretion/Salinity

110. Hitchcock, A.S.

1935

Manual of the Grasses of the United States.

United States Department of Agriculture, Miscellaneous Publication No. 200: 1051 p.

Brief discussions of the morphology and nomenclature of grasses are followed by Keys to the different tribes. Discussions on individual grasses make up the bulk of the text. Keys to the genus and species accompany line drawings and the discussions on individual grasses.

Grasses/Plant morphology/Key/Illustrations/Species list

111. Hitchcock, A.S., and A. Chase

1951

Manual of the grasses of the United States.

U. S. Department of Agriculture, Miscellaneous Publication 200. 1051 p.

A discussion of the importance of grasses is followed by descriptions of subfamilies, genera and species. Keys to the genera and tribes are included. Black line drawings and a geographic locator map of each species accompany the descriptions.

Grasses/Illustrations/Key/Species list

112. Hodgkinson, H.S.

1975

Evaluation of Winter fat in Washington.

Journal of Range Management 28(2):138-141.

Winter fat (Eurotia lanata) is high in nutrition, with a crude protein content of approximately 17.4% in the fall months. Winter fat can also withstand up to 80% clipping in the winter months.

Eurotia lanata/Clipping/Forage plants/Nutrients/Plant growth

113. Hollingsworth, E.B., P.C. Quimby, Jr., and D.C. Jarmillo

1973

Root plow herbicide application as a new incorporation technique.

Weed Science 21(2):128-130.

A new method for incorporating herbicides into the root zone of saltcedar (Tamarix pentandra) severed the roots as herbicide was simultaneously sprayed into the cut-root zone. This method offers more potential for herbicide safety, pollution reduction, and selective kills than other methods.

Tamarix pentandra/Chemical control/Roots/Mechanical control

114. Horton, J.S.

1957

Inflorescence development in Tamarix pentandra Pallas (Tamaricaceae).

Southwestern Naturalist 2(4):135-139.

Tamarix pentandra Pallas on the Salt River in Arizona was observed to bloom in early spring with racemes sprouting on last season's wood. Within a month terminal panicles appeared on new shoots and a succession of panicles continued to form until September with the last bloom. This shifts the plant from the Aestivales group to the Vernali-Aestivales group.

Tamarix pentandra/Flowering/Plant morphology

115. Horton, J.S.

1960

Ecology of saltcedar.

Arizona Watershed Symposium, 4th, 1960, Proceedings, 19-21.

Studies of tamarisk plants in absolute humidity under tents showed that a tamarisk area gave off two to three times as much water vapor as a bermuda grass sod area. The ability of tamarisk seeds to germinate on wet soil or on water surfaces and then float to land is responsible for its rapid spread. Seedlings grow slowly and

are susceptible to drought. Above ground parts of tamarisk will produce roots and shoots if buried in moist soil, but roots left in the ground after clearing do not sprout. Thus shrubs must be cut below the sprouting zone when the soil is dry to effectively eliminate it. Spread is somewhat unpredictable but should occur in areas subject to overflow in warm months, where seedlings will have wet soil for several weeks and where groundwater is available.

Tamarix pentandra/Viability/Mechanical control/Evapotranspiration/Germination/Roots/Soil moisture

116. Horton, J.S.

1964

Notes on the introduction of deciduous tamarisk.

U. S. Forest Service, Research Note RM-16.

Tamarix pentandra Pall. was introduced into the United States during the last century. It has become aggressively naturalized and occupies extensive areas of floodplain lands. The earliest authentic records of tamarisk in the Southwest was in 1856 when it was advertised in nursery catalogues from California. It was then cultivated as an ornamental and spread naturally from cultivation.

Tamarix pentandra/Invader species

117. Horton, J.S.

1966

Problems of land management in the various phreatophyte zones.

Pacific Southwest Interagency Committee, Albuquerque, New Mexico, Meeting August 30, 1966.

Land occupied by phreatophytes presents a problem not solely in plant eradication, but also in land management in order to bring about proper use of all resources inherent in the west. Tamarisk or saltcedar, which is a very common phreatophyte, is discussed with respect to origin, ecology and position as an aggressive phreatophyte in the west. Cutting of vegetation along perennial and intermittent streams in the southwest will have a compounding effect since the removal of shade will increase water temperature, which will create greater evaporation losses that may not be compensated in full by reduced transpiration from the smaller number of trees.

Land management/Phreatophytes/Tamarix pentandra/Invader species/ Eradication/Environmental impact/Mechanical control

118. Horton, J.S.

1972

Management problems in phreatophyte and riparian zones.

Journal of Soil and Water Conservation 27(2):57-61.

Riparian and phreatophyte zones of the southwest show a variety of influences due to man's activities over the last one hundred years. Previously management of phreatophytes was aimed at complete removal to increase water supplies, but studies used as the basis for this action have shown conflicting data in terms of applying experimental results to the field. Actual figures of water savings after phreatophyte clearing are lacking. Management decisions cannot be based on water yield alone but must consider such factors as dependent wildlife, invasion by other vegetation, hunting, esthetics, and increasing recreational demands.

Riparian vegetation/Phreatophytes/Eradication/Environmental impact

119. Horton, J.S., and J.E. Flood

1962

Taxonomic notes on Tamarix pentandra in Arizona.

Southwestern Naturalist 7(1):23-28.

To help clarify the uncertain relation of Tamarix pentandra Pallas to the old world shrub, specimens collected in Arizona have been described in detail. The American species is similar to the Russian Tamarix ramosissima Ledeb, but does not relate to any species or form listed for Israel.

Tamarix pentandra/Taxonomy

120. Horton, J.S., F.C. Mounts, and J.M. Kraft

1960

Seed germination and seedling establishment of phreatophyte species.

U. S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Station Paper 48. 26 p.

Phreatophyte species were studied for viability and environmental influences on fresh seeds. Seeds of tamarisk and cottonwood lose their viability rapidly (2 to 4 months) but seeds of seepwillow, broom baccharis, and arrowhead retained their viability for more than a year. Viability of both tamarisk and seepwillow seed was prolonged by cold storage. High temperatures decreased tamarisk seed viability. Studies of moisture, temperature, and light influences on fresh tamarisk seed germination showed that germination is dependent upon saturated soils, temperatures above 100 degrees centigrade reduce germination to zero, and seeds germinate with and without light. Fresh seeds germinate in 24 hours. Seedlings grow slowly and are very sensitive to drying. In drought tests no tamarisk seedling survived two days of drought and no seepwillows four days. Studies suggest four to six weeks of submergence will kill a majority of tamarisk seedlings and a shorter period will kill seepwillow. The establishment of some seedlings on the Salt River is described. Appendix of charted data is included.

Phreatophytes/Germination/Viability/Environmental effects/Tamarix pentandra

121. Horton, J.S., T.W. Robinson, and H.R. McDonald

1964

Guide for surveying phreatophyte vegetation.

U. S. Department of Agriculture, Handbook 266. 37 p.

In the arid and semi-arid region of the western United States, water losses from stream channels, floodplains, bottom lands and delta areas by evapotranspiration are serious. In spite of water losses and creation of additional flood hazards, vegetation growing along streams or on floodplains may have considerable economic value for recreational use, grazing, wildlife, or flood control. Survey methods have been developed to determine kinds and quantities of plants.

Phreatophytes/Survey methods/Vegetation inventory

122. Hughes, E. E.

1965

Basal and stump sprays for control of saltcedar.

Weeds 13(4):338-340.

Basal and stump herbicide application of ester and an oil-soluble amine formulation of silvex proved to be effective in control of Saltcedar (Tamarix pentandra Pall.). Trunks two inches or larger were harder to kill than smaller trees and retreatment was often needed. Cutting larger trees and spraying the stump increased kill effectiveness.

Tamarix pentandra/Chemical control/Mechanical control

123. Hughes, E. E.

1966

Research in chemical control of various phreatophytes.

Pacific Southwest Inter-Agency Committee, Phreatophyte Subcommittee, Phreatophyte Symposium, 4th, Albuquerque, N. M., 1966. 19-25.

Problems in chemical treatments of phreatophytes arise from damage to nearby susceptible crops, inability to kill undesirable species only, inability of one treatment to kill several species located in the same area or plants of the same species in different development stages, and contamination of surface runoff. Cited briefly are studies (giving chemicals, concentrations, and results) using basal spray applications granular and soil-spray herbicides, foliage-applied herbicides, and dormant-applied spray treatments on saltcedar. Also discussed are treatments for control of willows, wild rose, mesquite, greasewood, cottonwood, and Russian olive.

Phreatophytes/Chemical control/Shrubs/Trees

124. Hughes, E. E.

1966

Single and combination mowing and spraying treatments for control of saltcedar (Tamarix pentandra Pall.).

Weeds 14(3):276-278.

None of the first year mow-spray combinations reduced a tamarisk stand more than eight percent. A second year follow-up spray of silvex at four pounds per acre increased plant kill up to 60 percent.

Tamarix pentandra/Mechanical control/Chemical control

125. Hughes, E.E.

1967

Influence of environment on shoot growth and total carbohydrate reserves of saltcedar.

Weeds 15(1):46-49.

Environmental factors that may have an effect on the growth of saltcedar are air and soil temperatures, relative humidity, wind, solar radiation, barometric pressure, evaporation from a free water surface, water table height and waste quality. No factor or combination of factors was found to be responsible for determination of shoot growth or carbohydrate storage in undisturbed saltcedar (Tamarix pentandra Pall.) or in regrowth of a treated plant. The experiment could therefore come to no conclusion as to which factors have an influence on shoot growth and carbohydrate storage.

Tamarix pentandra/Plant growth/Shoots/Environmental effects/ Plant physiology

126. Hughes, E.E.

1968

Hygroscopic additives to phenoxy herbicides for control of saltcedar.

Weed Science 16(4):486-488.

When one of three hygroscopic compounds was added to water solutions of phenoxy herbicides, it significantly increased kill effectiveness in treatments of saltcedar (Tamarix pentandra Pall.). The increased kill was effected by rate of additive, temperature, humidity, and herbicide formulation.

Tamarix pentandra/Chemical control/Environmental effects

127. Hughes, T.D., J.D. Butler and G.D. Sanks

1975

Salt Tolerance and Suitability of Various Grasses for Saline Roadsides.

Journal of Environmental Quality 4(1):65-68.

Grasses were studied for forage yields, seedling survival, and tolerance to foliar salt applications. Forage yield of Puccinella distans was least effected by the addition of 20,000 ppm sodium. The addition of 30,000 ppm salt completely inhibited seedling survival of Agropyron cristatum, A. smithii, Elymus triticoides, P. distans, P. lemmoni and Sporobolus airoides. There was no relationship between salt tolerance and amount of Na in the blades.

Grasses/Salt tolerance/Forage yield/Viability

128. Hulett, G.K. and G.W. Tomanek

1961

Effects of some environmental factors on germination of saltcedar (Tamarix pentandra Pall.).

Kansas Academy of Science, Transactions 64(2):96-101.

Saltcedar seeds remain viable for ten months. Seeds germinate when completely immersed in water or when planted if the top inch of soil is saturated. The highest rate of germination occurred in a soil with a pH between 5.6 and 7.0. There was only a slight decrease in germination with a soil pH as low as 2.2.

Tamarix pentandra/Germination/Viability/Plant-soil relationships

129. Humphrey, R.R.

1955

Forage production on Arizona ranges. IV: Coconino, Navajo, Apache Counties; a study in range condition.

Arizona Agricultural Experiment Station, Bulletin 266. 83 p.

Forage production on rangeland is determined by productivity of the site, weather, and management. This bulletin attempts to present a general method of determining range conditions and to illustrate its application. Range condition factors include forage production, composition of vegetation, ground cover, litter, forage vigor, seed production, and degree of erosion. Four generalized forage types are recognized in these counties; grasslands, browse, juniper-pinyon and conifer-aspen forest. Finer breakdowns are necessary because in each case the subtypes do not intermix, but grow separately under different soil or climatic conditions.

Range evaluation/Forage production/Range management/Climatic-vegetal relationships/Soil properties/Plant-soil relationships/Apache County/ Navajo County

130. Humphrey, R.R.

1959

Your range: its management.

University of Arizona, Tucson, Agricultural Extension Service Special Report 2.

Several articles contained in this volume discuss range management in the vegetation zones occupied by the Petrified Forest National Park in addition to reports on other vegetation zones in the state.

Range management

131. Humphrey, R.R.

1962

Range ecology

Ronald Press Company, New York. 234 p.

A fundamental approach to the principal factors that affect forage production on the rangelands of North America. Rangelands of the southwest and west receive major emphasis. The roles of climate, soils, soil water, physiography, biotic factors, fire and fire control are discussed separately and their roles in range condition elaborated. Each factor is shown to be an integral part of range ecology.

Forage production/Plant-soil relationships/Grasslands/Burning/ Climatic-vegetal relationships/Environmental effects/Soil moisture

132. Humphrey, R.R.

1970

Arizona range grasses: their description, forage value and management.

University of Arizona Press, Tucson, 159 p.

Originally issued as a bulletin of the Arizona Agricultural Experiment Station in 1956 and reprinted in 1960, this publication now appears in revised format as a paper-back book. It contains descriptions of 71 important range grasses of Arizona and gives their identifying characteristics, seasonal forage value, and notes on management practices.

Grasses/Range management/Forage production/Species list

133. Hyder, D.N., F.A. Sneva, and V.H. Freed

1962

Susceptibility of big sagebrush and green rabbitbrush to 2, 4-D as related to certain environmental, phenological and physiological conditions.

Weeds 10(4):288-295.

Mixed stands of big sagebrush (Artemisia tridentata Nutt.) and green rabbitbrush (Chrysothamnus viscidiflorus (Hook) Nutt.) were sprayed with butyl ester 2, 4-D herbicide at rates of 1, 2 and 4 pounds per acre on six dates in 1956, 1957 and 1958. Big sagebrush was easily killed at a rate of two pounds per acre when soil temperatures and moisture content were satisfactory for vigorous growth. Eighty percent control of green rabbitbrush occurred with applications of three pounds per acre after the new twigs were three inches long and soil moisture was sufficient for active growth.

Artemisia/Chrysothamnus/Chemical control/Shrubs

134. Isom, W.H., L.S. Jordan, and W.W. Wright

1967

Chemical control of Russian thistle.

Down to Earth 22(4):12-13.

Complete control of Russian thistle (Salsola kali L.) was observed with application rates of 0.5 pounds per acre of Tordon herbicide. Growth and development of the plant at applications of 0.25 pounds per acre were very poor. Applications of 0.0625 pounds per acre resulted in considerable growth control, indicating that application of 0.25 pounds per acre is the most practical treatment.

Salsola kali/Chemical control/Noxious plants

135. Jackson, C.V.

1928

Seed germination in certain New Mexico range grasses.

Botanical Gazette 86(3):270-294.

A seed germination study of several range grasses from the Jornada experimental range indicated that the amount of rainfall during the growing season affects the vitality of seed. Bouteloua eriopoda and Bouteloua gracilis do not seed often and most of the florets are sterile. Sporobolus cryptandrus and Sporobolus flexuosus seeds have a hard seed coat that retards germination. The seed coat of Sporobolus airoides is more permeable and therefore germinates more rapidly.

Grasses/Bouteloua gracilis/Sporobolus airoides/Germination/ Protected grassland/Viability/Experimental plots

136. Jameson, D.A.

1962

Effects of burning on a galleta-black grama range invaded by juniper.

Ecology 43(4):760-763.

Juniper tree invasions of grasslands are greatly reducing grass production on large areas in the western United States. Grass fires are being tested among other methods for the control of small juniper trees. To test the effectiveness of grass fires in killing one-seed juniper (Juniperus monosperma (Engelm.) Sarg.), two burns were made in January and March, 1956, by the Coconino National Forest in Arizona. A wildfire in June of the same year on Wupatki National Monument provided additional information. The burns were in a juniper invaded grassland community of galleta (Hilaria jamesii (Torr.) Benth.) and black grama (Boutcloua eriopoda Torr.). The experiments have shown that juniper invasion of grassland can be satisfactorily controlled by grass fires.

Juniperus monosperma/Invader species/Burning/Grassland

137. Jameson, D.A.

1966

Pinyon-juniper litter reduces growth of blue grama.

Journal of Range Management 219(4):214-217.

Pinyon and juniper trees reduce blue grama (Bouteloua gracilis) cover mainly by tree litter rather than canopy shading.

Juniperus monosperma/Bouteloua gracilis/Pinus edulis/Species interaction/Vegetal relationships/Litter

138. Jameson, D. A.

1968

Species interactions of growth inhibitors in native plants of northern Arizona.

U. S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Research Note RM-113.

Laboratory experiments tested the radicle growth of newly germinated seeds of bottlebrush squirrel, blue grama, and ponderosa pine as affected by extracts from Utah juniper, ponderosa pine, pinyon pine, bottlebrush squirrel, Arizona fescue, and blue grama. The effect of inhibitors from these species varied with the species of the test seedlings. Extracts from tree leaves inhibited blue grama growth more than grass extracts did. Utah juniper extracts almost completely inhibited bottlebrush squirrel tail growth. Seedling growth was less than 20 percent in extracts from pinyon and ponderosa pine. Results indicate that control of inhibiting plants may be required before forage plants can become established.

Bouteloua gracilis/Plant growth inhibitors/Vegetation establishment/Species interaction

139. Jameson, D. A.

1970

Juniper root competition reduces basal area of blue grama.

Journal of Range Management 23(3):217-218.

Juniper root competition was found to slightly reduce the basal area of blue grama grass.

Bouteloua gracilis/Juniperus monosperma/Roots/Grasses/Species interaction

140. Jameson, D.A.

1970

Value of broom snakeweed as a range condition indicator.

Journal of Range Management 23(4):302-304.

Changes in population of broom snakeweed (Gutierrezia sarothrae) on a northern Arizona pinyon-juniper range appeared to be the result of oscillating population rather than an indication of range condition. Snakeweed is not a reliable range condition indicator.

Gutierrezia/Indicator plants/Pinyon-juniper

141. Jameson, D.A., and J.D. Dodd

1969

Herbage production differs with soil in the pinyon-juniper type of Arizona.

U. S. Forest Service Rocky Mountain Forest and Range Experiment Station, Research Note RM-131.

Field observations and data show that herbage production on Springerville soils in Arizona is similar to production on Gem and Tortugas soils where there are few pinyon and juniper trees, but that Springerville soils produce much less perennial herbaceous vegetation than the other soils when there is appreciable tree cover. From the behavior of experimentally studied corn and side-oat grama grasses the differences in the soils observed in the field did not appear to be due to soil moisture, nitrogen, or phosphorus content.

Plant-soil relationships/Forage production/Pinyon-juniper/Vegetal relationships

142. Kearney, T.H., and R.H. Peebles

1960

Arizona flora.

University of California Press, Berkeley. 1085 p.

Includes taxonomic keys for the identification of plant families, genera and species occurring in Arizona. Approximately 3,370 flowering plants, ferns and fern allies are described. Formal descriptions are given of the families and genera, but not species. Common names are listed in some cases. The first part of the text describes the entire state including physiography, climate and vegetation.

Key/Species list/Climatic-vegetal relationships

143. Keppel, R.V.

1960

Water yielf from southwestern grassland.

American Association for the Advancement of Science, Southwestern and Rocky Mountain Division, Committee on Desert and Arid Zones Research. Contribution 4:39-46.

Water yields from grassland and juniper-pinyon watersheds are considered for portions of Arizona, Colorado, New Mexico, and Utah. It has been estimated that only two percent of the water falling as precipitation reaches a point of downstream use. Transmission losses in the channel systems are a significant factor for the highly ephemeral type of flows characteristic of southwestern Arizona watersheds. Geology of each individual watershed must be carefully considered in deciding whether the water lost in the channel system has percolated to the groundwater table or whether it was removed by evapotranspiration.

Grassland/Water yield/Pinyon-juniper/Geology/Evapotranspiration/ Groundwater recharge

144. Kleinkopf, G.E., A. Wallace and J.W. Cha

1975

Sodium Relations in Desert Plants: 4. Some Physiological Responses of Atriplex confertifolia to Different Levels of Sodium Chloride.

Soil Science 120(1):45-48.

Atriplex confertifolia seedlings were grown in irrigation water containing different levels of salt. Fifty milliequivalents per one sodium chloride treatment gave the maximum yields. Large,

succulent leaves with nitrogen deficiencies were produced at higher salt levels. At 30°C improved water use efficiency was indicated by decreased transpiration rates.

Atriplex confertifolia/Plant physiology/Salt tolerance/Water utilization/Salinity

145. Knipe, O. D.

1968

Effects of Moisture Stress on Germination of Alkali Sacaton, Galleta, and Blue Grama.

Journal of Range Management 21(1):3-4.

Alkali sacaton, galleta and blue grama seeds were germinated in media representative of 0, 1, 4, 7, 10, 13, and 16 atmospheres of moisture tension. Alkali sacaton was effected the most by moisture stress. This partially explains why alkali sacaton is found in low lying, frequently flooded areas. Galleta and blue grama were less effected by stress and they are commonly found in drier upland areas.

Moisture stress/Germination/Sporobolus airoides/Hilaria jamesii/ Bouteloua gracilis

146. Knipe, O. D. and H. W. Springfield

1972

Germinable Alkali Sacaton Seed Content of Soils in the Rio Puerco Basin, West Central New Mexico.

Ecology 53(5):965-968.

Soil samples were collected three times each year for three years from barren sites and grassed areas in native stands of alkali sacaton (Sporobolus airoides Torr.). The emerging sacaton seedlings were counted in both areas and fewer viable seeds were found in the barren soil than within the stands. However as many as 40-50 seeds/sq. ft. were found in barren sites 25-50 feet from the grass areas.

Viability/Sporobolus airoides/Germination/Plant-soil relationships

147. Kruse, W.H.

1970

Temperature and moisture stress affect germination of Gutierrezia sarothrae.

Journal of Range Management 23(2):143-144.

Germination of broom snakeweed (Gutierrezia sarothrae) occurs best between 60° and 70° F and is inversely related to moisture stress.

Gutierrezia/Germination/Moisture stress/Climatic-vegetal relationships

148. Laycock, W.A., and T.A. Phillips

1968

Long-term effects of 2, 4-D on lanceleaf rabbitbrush and associated species.

Journal of Range Management 21(2):90-93.

The best kill of lanceleaf rabbitbrush (Chrysothamnus viscidiflorus var. lanceolatus (Nutt.) Greene) when using 2, 4-D occurred when soil moisture was high and rabbitbrush was almost in full leaf. There was no kill with low soil moisture or when rabbitbrush was in bloom.

Chrysothamnus/Chemical control/Soil moisture

149. Little, E.L.

1968

Southwestern trees: a guide to the native species of New Mexico and Arizona.

U. S. Department of Agriculture, Agricultural Handbook 9.

Trees native to the two states are listed by genus with associated keys to the species. Generic characteristics are given along with more specific species characteristics. Cholla cacti are also included in this handbook.

Trees/Cactaceae/Species list/Keys

150. Livingston, B. E., and F. Shreve

1921

The distribution of vegetation in the United States, as related to climatic conditions.

Carnegie Institution of Washington, Publication 284. 590 p.

Climatic conditions are used as the basis for vegetation zones within the United States. The climatic condition of each zone is explained individually with explanation of how the vegetation of the zone is adapted to the climate. Precipitation, temperature, winds, evapotranspiration and elevation are parameters used in determining vegetation zones.

Climatic-vegetal relationships/Vegetation zones/Phytogeography

151. Lowe, C. H.

1961

Biotic communities in the Sub-Mogollon region of the inland southwest.

Arizona Academy of Science, Journal 2:40-49.

Five formation-types are represented in the Sub-Mogollon region of the inland southwest: tundra, forest, woodland, grassland, and desert. The term formation and formation-type are preferable to biome and biome-type. Within the world formation-types there are a number of formations (biomes) which are arranged with reference to Merriam's life-zones in the inland southwest. The biotic community, or any natural assemblage of plants and animals can occur at any one point in space and time only as the result of the coincidence of the amplitudes of the genetically controlled ecological tolerances of the comprised species. Merriam effect (an indirect environmental factor complex affecting association discrepancy phenomena within the genetic climax) is briefly discussed, as are other environmental factors affecting vertical and horizontal biotic gradients. Problems regarding southwestern interformational ecotones are discussed. Ecotones are prominent features of the southwest, where, as inevitable results of the genetic basis of the climax, they occur between all adjacent biotic communities regardless of rank.

Ecotone/Biotic communities/Vegetation zones/Vegetal relationships/Environmental effects/Climatic-vegetal relationships/Evolution/Plant communities

152. Lowe, C. H.

1964

Arizona's natural environment.

The University of Arizona Press, Tucson. 136 p.

This zonal breakdown of vegetation within Arizona provides an illustrated account of the natural settings for the habitats of animals and plants in the state and a discussion of the systems used by biologists to classify them. After a brief introduction which includes a discussion of habitats, vegetation climax patterns and climate; the world formation-classes are applied to Arizona. The bulk of the text is an illustrated breakdown of the life zones found in Arizona.

Habitats/Illustrations/Vegetation zones/Climatic-vegetal relationships/ Plant communities/Plant distribution/Ecotone

153. Lowe, C. H., ed.

1964

The vertebrates of Arizona.

University of Arizona Press, Tucson. 259 p.

In addition to ecological descriptions of life zones and biotic communities, faunal areas, floristic elements, and aquatic habitats, this work includes checklists of fishes, amphibians and reptiles, birds and mammals, with details on distribution, habitats, status, abundance, and other pertinent data.

Vertebrates/Habitats/Vegetation zones/Biotic communities/Ecotone

154. Lowe, C. H., and D. E. Brown

1973

The natural vegetation of Arizona.

Arizona Resources Information System, Phoenix, Cooperative Publication 2.

A description of the natural vegetation of Arizona by biotic communities includes a discussion of vegetation types, geographic distribution, elevational range, precipitation, temperature and prominent species.

Possible reasons for geographic distribution of vegetation types receive major emphasis in the text.

Biotic communities/Climatic-vegetal relationships/Species list/ Phytogeography/Ecotone

155. Martin, N.L.

1973

Common Range Plants-Navajo Reservation Cooperative Extension Service, The University of Arizona: 4 p.

Most of the common plants found in Northern Arizona are listed by their common name, scientific name, and Navajo name.

Range plants/Species list

156. McCleary, J.A. and K.A. Wagner

1973

Comparative Germination and Early Growth Studies of Six Species of the Genera Yucca.

American Midland Naturalist 90(2):503-508.

The effects of temperature and light on seed viability and seedling growth were studied for Yucca baccata, Y. glauca, Y. angustissima, Y. Kanabensis, Y. elata, and Y. brevifolia.

Yucca/Germination/Viability/Plant growth/Environmental effects

157. McCulloch, C.Y.

1966

Cliffrose browse yield on bulldozed pinyon-juniper areas in northern Arizona.

Journal of Range Management 19(6):373-374.

Where large pinyon and juniper trees were killed 4 to 6 years earlier by bulldozing, yield of cliffrose browse, a deer food, was 3.5 pounds per acre greater than on untreated sites.

Most of the vegetation gain represented growth on cliffrose plants established before treatment and not an increase in population numbers.

Cowania Mexicana/Browse plants/Range Management/Pinyon-juniper control/Mechanical control

158. McCulloch, C.Y.

1971

Cliffrose reproduction after pinyon-juniper control

Journal of Range Management 24(6):468.

Age classes determined by ring counts showed that stand density of cliffrose did not increase after bulldozing a sparse stand of pinyon and juniper trees in northern Arizona. There also was no apparent tendency toward gains in cliffrose stand density eleven years after tree control.

Cowania Mexicana/Pinyon-juniper control/Browse plants/Mechanical control

159. McDougall, W.B.

1973

Seed plants of northern Arizona.

Museum of Northern Arizona, Popular Series 8. 594 p.

The seed plants of northern Arizona are listed by genus with associated keys to species. General genus characteristics are given and species are listed with a brief description.

Seed plants/Key/Species list

160. McGinnies, W.G., and J.F. Arnold

1939

Relative water requirements of Arizona range plants.

Arizona Agricultural Experimental Station, Technical Bulletin 80:165-246.

Studies determined relative water requirements of range plants, the correlation of water requirements with various weather conditions, and the relation of relative water requirements to distribution and abundance of plant species. Water consumption of individual species are listed in tables throughout the text.

Water requirements/Climatic-vegetal relationships/Plant distribution/ Range plants

161. McKell, C.M.

1975

Shrubs, a neglected resource of arid lands.

Science 187(4179):803-809.

Shrubs are the dominant vegetation of many arid and semiarid regions, yet their use by humans is much less than their potential. Several misconceptions about shrubs are reviewed and disputed. Shrubs are not all worthless invaders, spiny and unpalatable to livestock, and of little feed value, and they should not be eradicated indiscriminately for range improvement. The various adaptations of shrubs to arid conditions are summarized, including heat, drought, and salinity tolerance, efficient root systems, transpiration reduction, allelopathy, food storage, and rapid regrowth. Several uses for which shrubs have greater potential are suggested: livestock and wildlife feed, special products (such as fibers, oils, and fruits), wildlife habitat, soil stabilization, ecosystem functioning, and aesthetic low-maintenance landscaping.

Shrubs/Plant uses/Salt tolerance/Drought tolerance/Roots/Plant physiology/Plant morphology/Erosion control

162. Martin, P.S.

1963

The last 10,000 years: a fossil pollen record of the American Southwest.

University of Arizona Press, Tucson. 87 p.

Geologic, climatic and vegetation changes are considered in the light of past evidence and in relation to the fossil pollen record described herein. The classic Bryan-Antevs climatic model,

which is deeply enmeshed in the literature of southwestern prehistory and Pleistocene geology, related prehistoric erosion to drought. However, Martin believes the tree ring data to be misinterpreted and that fossil pollen and the biogeographic record support a model in which post glacial erosion is attributable to periods of intense summer rainfall. He finds no reliable pollen evidence that postglacial droughts, if they occurred, were sufficient to shift biotic zones above their present level. He attributes the extinctions of large mammals in North America 8,000 to 10,000 years ago to the predatory activities of Paleo-Indians, rather than any changes in climate.

Climate/Vegetation change/Geology/Paleoclimatology/Palynology

163. Mitchell, J.E./N.E. West/R.W. Miller

1966

Soil Physical Properties in Relation to Plant Community Patterns in the Shadscale Zone of Northwestern Utah.

Ecology 47(4):627-630.

Soils in pure stands of Eurotia lanata and Atriplex confertifolia were studied to determine their influence on the vegetation pattern. Homogeneity of the two soils physical properties showed that soils were not responsible for the plant community diversity.

Plant-soil relationships/Plant distribution/Atriplex confertifolia/ Eurotia lanata/Soil physical properties

164. Munns, E.N.

1950

Tamarisk: friend or foe?

American Forests 56(7):18-19.

This brief history of the genus Tamarix pays special attention to the advantages and hazards inherent in their use. A history of a Tamarix invasion of an irrigation dam reservoir is presented.

Tamarix pentandra/Invader species

165. Nelson, R.A.

1970

Handbook of Rocky Mountain plants.

Dale Stuart King, Tucson. 331 p.

This illustrated handbook contains descriptions of more than 975 different plants in 88 families native to the Rocky Mountains above 5,000 feet from northern Arizona and New Mexico to Canada. Special emphasis is given to plants of the national parks and monuments. Several pages of line drawings explain plant structure, flower parts and technical terms. Descriptions include details on size, color and habitat, Indian use, and biological information. Family and genetic characteristics are emphasized. Introductory information is given on climate, adaptation of plants, soil building, landscape shaping, plant succession, and geographic vegetation zones.

Rocky Mountain plants/Plant morphology/Keys/Plant uses/ Illustrations/Species list

166. Nichol, A.A.

1952

The natural vegetation of Arizona.

Arizona Agricultural Experiment Station, Technical Bulletin 127: 189-230.

This description of the natural vegetation of Arizona by biotic communities includes discussions of vegetation types, geographic distribution, elevational range, precipitation, temperature, and prominent species. The geographic distribution of vegetation types receives major emphasis, but quantitative data is limited. Grassland covers about 25 percent of the state, mostly in the southeastern and northeastern parts where it borders the forestland. A map illustrates the distribution of natural vegetation types in Arizona.

Biotic communities/Phytogeography/Vegetation maps/Climatic-vegetal relationships

167. O'Rouke, J.T., and P.R. Ogden

1969

Vegetative response following pinyon-juniper control in Arizona.

Journal of Range Management 22(6):416-418.

Calcium carbonate levels of 13 percent and pinyon-juniper ground litter were associated with the lack of sod increase in Bouteloua gracilis after 4-5 years of pinyon-juniper control.

Bouteloua gracilis/Vegetal relationships/Pinyon-juniper control/ Plant-soil relationships/Soil chemical properties/Litter

168. Parker, K. F.

1958

Arizona ranch, farm, and garden weeds.

Arizona Agricultural Extension Service, Circular 265. 288 p.

A readable and useful compendium on the weeds of ranch and farm and those often found along roadsides. Many illustrations aid in identifying the common weeds. Poisonous and noxious characteristics are described.

Weeds/Noxious plants/Illustrations/Species list

169. Parker, K. F.

1972

An illustrated guide to Arizona weeds.

University of Arizona Press, Tucson. 338 p.

General information given covers name and classification of weeds and U. S. Department of Agriculture prohibited and restricted noxious-weed seeds. The section on weed species of Arizona, constituting the greatest portion of this work, contains distribution, descriptions, and detailed drawings. There is a brief list of references, and an index by both scientific and common names.

Weeds/Noxious plants/Species lists/Illustrations

170. Parker, K.W., and G.E. Glendining

1942

General guide to satisfactory utilization of the principal southwestern range grasses.

U. S. Forest Service, Southwestern Forest and Range Experiment Station, Research note 104.

This paper presents a rating system for range evaluation. Of special interest is a table that gives a method to quantitatively evaluate a species' condition by using indicator plants and to draw conclusions from the evaluation as to what was responsible for the species' appearance.

Range condition/Range evaluation/Indicator plants/Grasses

171. Pase, C.P.

1966

Grazing and watershed value of native Arizona plants.

American Association for the Advancement of Science, Southwestern and Rocky Mountain Division, Committee on Desert and Arid Zones Research. Contribution 8:31-40.

There are nine plant communities in Arizona: southern desert shrub, semidesert grassland, northern desert shrub, short grass or plains grassland, chaparral and oak woodland, juniper-pinyon, ponderosa pine-douglas fir, spruce-fir, and mountain grassland. For each are given location, vegetation types, grazing value to livestock and wildlife, runoff and erosion patterns from these vegetations, and water yield potentials. Appropriate studies are cited briefly when applicable. Important water yield range sources are in juniper-pinyon, open stands of ponderosa pine, areas surrounding spruce-fir stands, and mountain grasslands.

Water yield/Forage production/Vegetation zones/Shrubs/Grassland/ Pinyon-juniper/Forage plants/Plant communities

172. Patraw, P.M.

1951

Flowers of the southwest mesas.

Southwestern Monument Association, Globe, Arizona, Popular Series 5. 112 p.

All flowering plants of the Southwest are included with pencil drawings and a brief description of their characteristics and geographic distribution.

Flowers/Illustrations/Species list

173. Paulsen, H.A., Jr., and J.C. Miller

1968

Control of parry rabbitbrush on mountain grasslands of western Colorado.

Journal of Range Management 21(3):175-177.

Parry rabbitbrush (Chrysothamnus parryi (A. Gray) Greene) was controlled with a two pound application of Tordon 22-K. Treatments increased grass cover while decreasing forbs in number and size.

Chrysothamnus/Chemical control

174. Pinkey, F.C.

1969

Factors affecting the distribution of Hilaria species in Arizona.

University of Arizona, Tucson, (M.S. Thesis).

Geographic distribution of galleta (Hilaria jamesii), curly mesquite (Hilaria belangeri), tobosa (Hilaria mutica), and big galleta (Hilaria rigida) in Arizona were determined. Texture analyses were made on soils supporting different Hilaria species. Galleta was found in the north and east portions of the state, mostly north of the Mogollon Rim. Mean monthly minimum temperatures were significantly different for sites on which the four species of Hilaria occurred. Precipitation and elevation were important factors correlated with species distribution. Soil texture appeared to be an important factor in local areas.

Hilaria/Plant distribution/Plant-soil relationships/Climatic-vegetal relationships/Soil physical properties

175. Plummer, A.P., and N.C. Frischknecht

1952

Increasing field stands of Indian ricegrass

Agronomy Journal 44(6):285-289.

Treating Oryzopsis hymenoides seeds with sulfuric acid increased sprouting percentage. Both acid and non-acid treated seeds had a better germination percentage when subjected to moist cold temperatures for 4-10 weeks. Under clay soil conditions light acid treatments gave much better seedling stands than the untreated seed.

Oryzopsis hymenoides/Germination/Seed treatment/Planting management/Forage production

176. Potter, L.D.

1967

Plant succession with released grazing on New Mexico rangelands.

Journal of Range Management 20(3):145-151.

Line transects were made over alternating grazed and ungrazed grassland plots in New Mexico. Protected plots had three times more grass ground cover than grazed plots.

Succession/Grazing effects/Experimental plots/Protected rangeland

177. Rasmussen, D.I.

1941

Biotic Communities of Kaibab Plateau, Arizona.

Ecological Monographs 11(3):229-275.

Surveys the biotic communities of the Kaibab Plateau. The discussion includes physical environment, history, description of four major plant communities and several minor ones, a list of vertebrates and plants, and a partial list of insects.

Biotic communities/Vertebrates/Insects/Kaibab Plateau

178. Rauzi, F., L.I. Painter, and A.K. Dobrenz

1969

Mineral and protein contents of blue grama and western wheat grass.

Journal of Range Management 22(1):47-49.

With an increase in maturity both blue grama (Bouteloua gracilis) and western wheat grass (Agropyron smithii) showed a decline in mineral and crude protein levels.

Bouteloua gracilis/Nutrients

179. Richard, W.H., J.F. Cline and R.O. Gilbert

1973

Soil Beneath Shrub Halophytes and Its Influence Upon the Growth of Cheatgrass.

Northwest Science 47(4):213-217.

Cheatgrass was grown under and between the shrubs greasewood (Sarcobatus vermiculatus) and hopsage (Grayia spinosa). Greasewood added sodium and hopsage added potassium and both added nitrogen to the soil from their litter. The cheatgrass produced higher bio-mass under greasewood with its higher pH and sodium content. The shrubs provided a richer mineral nutrition to the soil than the adjacent grass dominated areas.

Plant-soil relationships/Halophytes/Shrubs/Sarcobatus vermiculatus/Grasses/Vegetal relationships/Soil chemical properties/Litter

180. Riedl, W.A., K.H. Asay, J.L. Nelson and G.M. Telwar

1964

Studies of Eurotia lanata (winter fat).

University of Wyoming, Agricultural Experiment Station. Bulletin 425. 18 p. Laramie, Wyoming.

Germination and seedling tests run in several locations on Eurotia lanata showed large seeds had fast emergence but poorer total

germination. There was a large range of seedling vigor within sites, indicating possible superior seedling-vigor lines. E. lanata grows on soils with a high pH and relatively high calcium carbonates levels but which are low in soluble salts and exchangeable sodium. Plants grew better and were significantly larger with a 16 hour day and with at least 40°F night temperatures.

Eurotia lanata/Germination/Viability/Plant-soil relationships

181. Robinson, T.W.

1965

Introduction, spread and areal extent of saltcedar (Tamarix) in the western states.

U. S. Geological Survey, Professional Paper 491-A.

Tamarix are highly water-consuming, salt tolerant, naturalizing shrubs that have escaped from cultivation and spread rapidly from one stream valley to another. In dense growth along stream channels it presents a barrier to flood flows and thereby increases sediment deposition and bank stabilization. Total area of Tamarix growth has increased from 10,000 acres in 1920 to 1-1/3 million acres in 1965.

Tamarix pentandra/Invader species

182. Rogler, G.A.

1960

Relation of seed dormancy of Indian rice grass (Oryzopsis hymenoides (Roem and Schult) Ricker) to age and treatment.

Agronomy Journal 52(8):470-473.

Oryzopsis hymenoides seed germination rate increased with age of the seed up to 6 years; thereafter it showed a gradual decrease for 11 years. Subjecting seeds to a 40 day period of temperatures from 2-4°C greatly increased germination rates.

Oryzopsis hymenoides/Germination/Seeds

183. Rollins, M.B., A.S. Dylla, and R.E. Echert, Jr.

1968

Soil problems in reseeding a greasewood-rabbitbrush range site.

Journal of Soil and Water Conservation 23(3):138-140.

Reseeding the unproductive, variable soils on a greasewood (Sarcobatus vermiculatus (Hook.) Tou.) - rabbitbrush (Chrysothamnus nauseosus (Pall.) Britton) range with a good replacement species seems to be economically impractical due to a need for irrigation water and the use of expensive soil reclamation measures.

Vegetation establishment/Sarcobatus vermiculatus/Chrysothamnus nauseosus/Plant-soil relationships

184. Sampson, A.W.

1914

Natural revegetation of rangelands based upon growth requirements and life history of the vegetation.

Journal of Agricultural Research 3(2):93-148.

A revegetation study done in Oregon illustrates scientific procedures, techniques and research that can be applied to any area where revegetation is being considered.

Revegetation/Experimental plots/Range evaluation/Range condition

185. Sampson, A.W.

1919

Plant succession in relation to range management.

U. S. Department of Agriculture, Agricultural Bulletin 791. 76 p.

Overgrazing sets into motion soil processes that effect the normal development of vegetation. Ground trampeling, soil compaction, and stock habits also severely effect the vegetation. A time table is included for vegetation recovery in areas that had a stock concentration, such as holding pens and water tanks.

Succession/Grazing effects/Revegetation/Plant-soil relationships/ Range management

186. Sampson, A.W.

1923

Range and pasture management.

John Wiley and Sons, New York. 422 p.

A practical working knowledge of range management is provided by systematic instruction on grazing and range control, range revegetation, forage maintenance, range protection, range improvements, and research methods used for evaluating range conditions.

Range management/Revegetation/Range evaluation/Grazing

187. Sampson, A.W.

1924

Native American forage plants.

John Wiley and Sons, New York. 426 p.

Explains the application of botany principles to range management, general structure and composition of pasture plants, laws of plant physiology as related to grazing, environment of native forage plants in relation to pasture management and the classification of forage plants. The bulk of the text discusses forage genera and species with respect to their identity and distribution, growth requirements and life history, and their forage value for different classes of livestock. The text gives a good overall view and would be of value to the layman botanist or range manager.

Plant physiology/Plant morphology/Range management/Forage plants/Species list/Grazing

188. Sampson, A.W.

1939

Plant indicators: concept and status.

Botanical Review 3:155-178

Plants as land use and condition indicators give invaluable information about an area. The natural vegetation of an area can be used to

deduce the topography; the hardier the plant the more fragile the environment. Keys to using plants for land evaluation are given with emphasis on range evaluation. Plants can show past damage, indicate unsatisfactory soil conditions, and show present range deterioration.

Indicator plants/Range evaluation

189. Sampson, A.W.

1952

Range management: principles and practices.

John Wiley and Sons, New York. 570 p.

This study balances considerations of the care and management of rangelands and grazing animals with the sciences upon which sound practices must be based. Separate sections emphasize range management in perspective, native range forage plants, improvement and management of range and stock and protection of range resources and range livestock. The book gives concise information applicable to management of the Petrified Forest National Park.

Range management/Forage plants/Cattle industry/Grazing

190. Sauer, C.O.

1950

Grassland climax, fire and man.

Journal of Range Management 3(1):16-21.

The broad climatic-ecological theory is discussed using as an example grassland climax vegetation. Despite the fact that the climate remains the same an ecosystem can be changed from grassland to woods by the suppression of fire.

Climatic-vegetal relationships/Grassland/Succession/Woodland/Burning

191. Schmutz, E.M.

1971

Estimation of range use with grazed-class guides.

University of Arizona, Tucson, Cooperative Extension Service and Agricultural Experiment Station bulletin a-73. 16 p.

The use of photo points to gage vegetation conditions after grazing is explained.

Range evaluation/Photo points/Grazing effects

192. Schmutz, E.M., and D.E. Little

1970

Effects of 2,4,5-T and picloram on broom snakeweed in Arizona.

Journal of Range Management 23(5):354-357.

On a short grass range in central Arizona broom snakeweed (Gutierrezia sarothrae) was controlled with foliar application treatments of 2,4,5-T at four pounds per acre. Effectiveness was dependent upon soil moisture and stage of plant growth.

Gutierrezia/Chemical control/Noxious plants/Soil moisture

193. Shantz, H.L. and R.L. Piemeisel

1940

Types of Vegetation in Escalante Valley, Utah, As Indicators of Soil Conditions.

USDA, Technical Bulletin No. 713: 46 p.

Plant communities are grouped into non-saline soil associations and saline soil associations. Non-saline associations are Sagebrush, Galleta grass, Little Rabbitbrush, Winterfat, Fourwing Saltbush and Juniper. Saline associations are Shadscale, Greasewood, Salt Grass, Pickleweed, Red Samphire, Salt Sage, and mixed vegetation on sand dunes or sand hummocks. Possible reasons for different plant community occurrences within saline or non-saline areas are discussed. Topographical relations, botanical composition, appearance, soil conditions, adaption of plants to soil conditions and possible secondary succession of the area is discussed for each plant community.

Indicator plants/Plant communities/Halophytes/Plant-soil relationships/Salt tolerance/Saline soils/Shrubs/Plant physiology

194. Sharkawi, H.M. -El and B.E. Michel

1975

Effects of soil salinity and air humidity on CO_2 exchange and transpiration of two grasses.

Photosynthetica 9(3):277-282.

Increased soil salinity increases the osmotic potential in the leaves of Bouteloua gracilis and Sporobolus airoides. Reduction of transpiration with lower humidity was attributed to a high resistance of the stomata to water vapor loss. Tests were run on the effects of different soil water osmotic potentials and air humidity on photosynthesis, respiration, and transpiration of both grasses.

Grasses/Soil Salinity/Plant-soil relationships/Plant physiology/ Sporobolus airoides/Bouteloua gracilis

195. Sinclair, J.D., and A.W. Sampson

1931

Establishment and succession of vegetation on different soil horizons.

Hilgardia 5(7):155-196.

Annuals and perennials were grown in soils that were eroded to the A, B, and C horizons. In all cases growth was definitely better in the A horizon than the B or C. Growth was better in the B horizon than the C. This illustrates the importance of keeping the A horizon intact to achieve maximum plant growth and the fallacy of using perennials to stop soil erosion.

Vegetation establishment/Succession/Plant-soil relationships/Soil erosion/Soil physical properties/Erosion control

196. Smith, J.G.

1899

Grazing problems in the southwest and how to meet them.

U. S. Department of Agriculture, Division of Agrostology, Bulletin 16.

Although the study area for this bulletin was the Texas High Plains, similar land abuse and vegetation damage were recorded during this time in Arizona. The bulletin records the history of land abuse, its effects and possible solutions to correct the deteriorating conditions.

Grazing effects/Range management/Range evaluation/Overgrazing/Cattle industry

197. Smoliak, S.

1965

A comparison of ungrazed and lightly grazed Stipa-Bouteloua prairie in southeastern Alberta.

Canadian Journal of Plant Science 45(3):270-275.

Ungrazed land favored a Stipa-Bouteloua cover with large amounts of surface dry matter and undisturbed underground plant material. Lightly grazed land resulted in a less productive Bouteloua-Stipa cover with shorter Stipa-comata plants increasing. The ecologic influence of light grazing favors short-grasses over mid-grasses.

Grazing effects/Bouteloua/Grasses/Protected rangeland/Grassland

198. Snyder, L.A., and J.R. Harlan

1953

A cytological study of Bouteloua gracilis from western Texas and New Mexico.

American Journal of Botany 40:702-707.

A consistent correlation between growth habit and chromosome number was not found in Bouteloua gracilis. Ecological and geographical factors showed a correlation to chromosome number with the polyploids having a greater geographical distribution than the diploids.

Bouteloua gracilis/Plant morphology/Chromosomes/Phytogeography

199. Sperry, O.E., and E.D. Robinson

1963

Chemical control of perennial broomweed.

Texas Agricultural Experiment Station, College Station, Progress Report 2273. 7 p.

High soil moisture content to stimulate growth and plant vigor are essential for a satisfactory use of herbicides on perennial broomweed (Xanthocephalum spp., syn. Gutierrezia spp.). Amine and ester forms of 2,4-D at one pound per acre gave the most consistent kill results. The addition of diesel oil gave earlier top-kill but lower total plant kills. The addition of surfactants failed to improve results and in most tests two years of treatment were necessary for eradication.

Chemical control/Gutierrezia/Soil moisture/Noxious plants

200. Springfield, H.W.

1972

Optimum Temperatures for Germination of Winterfat.

Journal of Range Management 25(1):69-70.

Seed germination of winterfat (Eurotia lanata) for four consecutive years were tested at temperatures from $33^{\circ}-110^{\circ}$F. Optimum germination temperatures were found to be from $50^{\circ}-80^{\circ}$F. Germination was almost complete in five days at temperatures higher than 59°F.

Eurotia lanata/Germination

201. Stark, N.

1968

Spring transpiration of three desert species.

Journal of Hydrology 6(3):297-305.

Dry weight of leaves is a more desirable reference for transpiration rate of desert plants than is leaf area which is used for broad-leaved plants. Transpirometer data which are not corrected for weight differences show that sagebrush (Artemisia tridentata Nutt.) loses

more water per plant per minute than does rabbitbrush (Chrysothamnus nauseosus albicaulis (Nutt.) Hall and Clen.) on a dry site. With corrections for dry leaf weight differences, the reverse is true.

Artemisia tridentata/Chrysothamnus nauseosus/Shrubs/Transpiration/Plant physiology

202. Statler, G. D.

1967

Eurotia lanata Establishment Trials.

Journal of Range Management 20(4):253-254.

Late spring proved to be the best time and 1 cm the best planting depth in studies run on Eurotia lanata germination rates at Laramie, Wyoming.

Eurotia lanata/Vegetation establishment/Germination

203. Stevens, G. A.

1943

Russian thistle: life history and growth.

North Dakota Agricultural Experiment Station, Fargo, Bulletin 326. 20 p.

A description of the life cycle of Russian thistle (Salsola kali) is emphasized in this report which also includes a short history of the plant since its introduction into the Americas.

Salsola kali/Photogeography/Noxious plants/Invader species/Plant growth

204. Stewart G. and W. Keller

1936

A Correlation Method for Ecology as Exemplified by Studies of Native Desert Vegetation.

Ecology 17(3):500-514.

A correlation study determined the relationships between species on a shrub desert. The dominant species is distinctly influenced by the presence of different subdominants. The species studied were: Atriplex confertifolia, Bouteloua gracilis, Eurotia lanata, Hilaria jamesii, and Oryzopsis hymenoides. Other genera studied include Haplopappus, Artemisia, Agrogyron, Cercocarpus, Elymus, Ephedra, Forsellsia, Gutierrezia, Kochia, and Sporobolus.

Shrubs/Vegetal relationships/Dominance/Grasses

205. Stokes, S.G.

1936

The Genus Eriogonum: A Preliminary Study Based on Geographic Distribution.

J.H. Neblett Pressroom, San Francisco: 124 p.

Keys to Eriogonum species found worldwide are accompanied by brief descriptions of each species. A short section on the Eriogonums biome and geographical distribution preceed this.

Eriogonum/Key/Species list/Plant distribution

206. Stubbendieck, J., et al

1973

Stoloniferous blue grama.

Journal of Range Management 26(3):230-232.

Bouteloua gracilis formed stolons under natural and greenhouse conditions. Stolon formation was induced by temperature control, a shortened photo period, and reduced light intensity.

Bouteloua gracilis/Stolons/Plant growth

207. Stutz, H.C., J.M. Melby, G.K. Livingston

1975

Evolutionary studies of Atriplex: A Relic gigas diploid population of Atriplex canescens.

American Journal of Botany 62(3):236-245.

A small endemic population of a gigas form of A. canescens is found on sand dunes in central Utah. The gigas form is often twice the height of the normal A. canescens and has a 2u = 18 compared to A. canescens 2u = 36. The normal form is probably an autotetraploid of the gigas form.

Atriplex canescens/Evolution/Chromosomes/Plant morphology

208. Talbot, M.W.

1937

Indicators of southwestern range conditions.

U. S. Department of Agriculture, Farmers Bulletin No. 1782.

Range indicators are used as guides to recognize the condition of a range; non-use, satisfactory use, or abuse, either in the past or present. Indicators are related not only to forage and its condition, but also to soil, topography, and climate. Indicators of range condition are explained along with their significance, how to detect deterioration in its early stages, and other indicators of proper and improper range use.

Indicator plant/Range evaluation/Range condition

209. Thomas, H. E.

1962

The meteorologic phenomenon of drought in the southwest.

U. S. Geologic Survey, Professional Paper 372-A.

The southwest is separated in to meteorologic zones based on topography. Information for each zone is dealt with individually. Possible reasons for drought occurrence in each zone are explained by reviewing the parameters of precipitation and their interactions, types of precipitation, cause and orographic effects. A short explanation of meteorologic conditions over the entire southwest proceeds the zonal breakdown.

Drought/Climate

210. Thompson, W. P.

1912

The Anatomy and Relationships of the Genus Ephedra.

Annals of Botany 26(IV):1077-1104.

The anatomical study of the genus Ephedra includes the species E. altissima, E. californica, E. distachya, E. fragilis, E. gerardiana, E. monostachya, E. trifurca, E. viridis, and E. vulgaris.

Ephedra/Plant morphology

211. Tidestrom, I.

1941

Flora of Arizona and New Mexico

Catholic University Press, Washington, D.C. 897 p.

One of the original works cataloging southwestern flora, this early publication is of interest as an historical record of vegetation in Arizona.

Key/Species list

212. Trlica, M.J. and J. L. Schuster

1969

Effects of fire on grasses of the Texas High Plains.

Journal of Range Management 22(5):329-333.

Fall, spring, and summer burns reduced the total foliage of the Plains, however the vigor of desirable grasses such as Bouteloua gracilis seemed to benefit from the burns while less desirable grasses declined in number.

Grasses/Burning/Bouteloua gracilis

213. Tueller, P.T. and R.A. Evans

1969

Control of green rabbitbrush and big sagebrush with 2,4-D and picloram.

Weed Science 17(2):233-235.

Picloram applications proved effective for rabbitbrush (Chrysothamnus viscidiflorus (Hook) control at application rates of one-half and one pound per acre, but not for sagebrush (Artemisia tridentata Nutt.). The 2, 4-D resulted in poor rabbitbrush control but good sagebrush control. The combination of 2,4-D and picloram gave good rabbitbrush control but only fair sagebrush control. After three years of control the native grass density was greatly increased.

Chemical control/Chrysothamnus/Artemisia/Grasses/Noxious plants

214. U. S. Department of Agriculture, Washington, D.C.

1948

Grass: the yearbook of agriculture.

U. S. Government Printing Office, Washington, D.C. 892 p.

From the perspective of grass as an agricultural crop, this book describes range use and management, diseases of grass and the effects of insects.

Grasses/Range management/Diseases/Insects/Forage production/ Plant uses

215. U. S. Department of Agriculture, Washington, D.C., Agricultural Research Service

1970

Selected weeds of the United States: agriculture handbook 336.

U. S. Government Printing Office, Washington, D.C. 463 p.

This handbook illustrates, describes and locates 224 species of important weeds in the United States. A general organization by family name follows a listing of evolutionary complexity, with the

simplest (Chara) first. Within each family genera and species are arranged alphabetically according to scientific name. The common name and a description is provided for each species.

Weeds/Species list/Illustrations/Noxious plants/Key

216. U. S. Forest Service, Washington, D. C.

1937

Range plant handbook.

U. S. Government Printing Office, Washington, D.C. 842 p.

Prepared for Forest Service field officers who were not trained botanists, this book evaluates the relative importance of more than 300 western range key plants as they pertain to grazing, watershed protective cover and recreation. It also provides a key for ready field identification of these plants in order to ensure proper management.

Range plants/Key/Species list/Illustrations/Indicator plants/Forage plants/Plant uses/Range management

217. U. S. Forest Service, Washington, D.C., Management Research Branch

1970

Range and wildlife habitat evaluation: a research symposium.

Same as author, Miscellaneous Publication 1147. 220 p.

Thirty papers presented at a U. S. Forest Research Symposium held in Tempe, Arizona, in May of 1968, discuss forage evaluation for livestock and wildlife, remote sensing in range and wildlife habitat evaluation, and status, applications and challenges of range and wildlife habitat ecology. Extensive bibliographies are included with most papers.

Range evaluation/Remote sensing/Bibliographies/Biotic communities/ Wildlife habitat/Forage plants

218. Vasey, G.

1890

Grasses of the Southwest.

USDA, Division of Botany, Bulletin No. 12: 200 p.

One of the original works on grasses of the arid southwest. There are no keys and some scientific names have since been changed. The author takes each of the 100 grasses individually and describes their physical features. Each grass has an accompanying black line drawing.

Grasses/Illustrations/Plant morphology/Species list

219. Vines, R.A.

1960

Trees, shrubs and woody vines of the southwest.

University of Texas Press, Austin. 1104 p.

Woody plants are listed by genus with associated keys to the species. General genus and more specific species characteristics are presented.

Trees/Species list/Key/Shrubs

220. Vozzo, R.D. and E. Halskaylo

1974

Endo- and Ectomycorrhizal associations in Five Populus Species.

Bulletin of Torrey Botanical Cub 101(4):182-186.

In soils innoculated with mycorrhizal fungi:, Populus fremontii, P. gradidentata and P. tremuloides formed ectomycorrhiza. P. deltoides and P. deltoides var. occidentalis formed ecto- and endomyccorhizae. P. heterophylla failed to form mycorrhizae.

Fungi/Populus/Plant-soil relationships/Symbiosis

221. Wallace, A.

1970

Water use in a glasshouse by Salsola kali grown at different soil temperatures and at limiting soil moisture.

Soil Science 110(2):146-149.

Transpiration and evapotranspiration in Salsola kali were influenced more by soil temperature than by soil moisture. A tendency for increased transpirational efficiency indicated a physiological resistance to water movement across the roots during soil moisture stress.

Salsola kali/Evapotranspiration/Moisture stress/Soil temperature/ Water utilization/Plant physiology

222. Wallace, A., W.A. Rhoads, and E.F. Frolich

1968

Germination behavior of Salsola as influenced by temperature, moisture, depth of planting and gamma irradiation.

Agronomy Journal 60(1):76-78.

Salsola kali seeds contain differentiated seedlings which uncoil in minutes with favorable temperature and moisture. Germination can occur at 17°C and 9.1 percent soil moisture with a planting depth of 7.5 centimeters.

Salsola kali/Germination/Soil moisture/Soil temperature

223. Weaver, J.E.

1919

The ecological relations of roots.

Carnegie Institution of Washington, Publication 286. 128 p.

This publication classified vegetation into zones and the growth habits, root and shoot structures of representative sample species from each zone are explained in the text with accompanying drawings. Of interest is the ecological relationship among the root systems of all species in a zone. Bouteloua gracilis and Gutierrezia sarothrae were chosen as representative species of the short grass prairie zone. A great deal of researched information necessary for proper range management is presented.

Roots/Plant growth/Plant morphology/Shoots/Bouteloua gracilis/ Gutierrezia/Illustrations/Vegetation zones/Range management

224. Weaver, J.E.

1920

Root development in the grassland formation.

Carnegie Institution of Washington, Publication 292. 151 p.

This publication places the Petrified Forest National Park in the short-grass or mixed prairie vegetation zone. Root development of the grasses within the short-grass prairie favors broken sod with prevalent bare spots. The grass roots occupy these bare spots and prevent further vegetation growth by absorbing all available moisture.

Roots/Grasses/Grassland/Plant distribution

225. Weaver, J.E., and W.E. Bruner

1954

Nature and place of transition from a true prairie to mixed prairie.

Ecology 35(2):117-126.

The gradual changes in vegetation from true to mixed prairie or short-grass prairie are described as they occur over an ecotone about 50 miles wide in Kansas and Nebraska. Mixed prairie moved eastward during the drought years even without the impact of grazing. This vegetation type is very well adapted to drought conditions and can be found whenever low precipitation occurs in a prairie situation.

Drought/Grasses/Grassland/Ecotone

226. Wideland, P., E. F. Frolich and A. Wallace

1971

Vegetative Propagation of Woody Shrub Species from Two Northern Mohave and Southern Great Basin Deserts.

Madiono 21(3):149-152.

Stem cuttings were used to root 16 desert perennials. Larrea divaricata, Atriplex hymenelytia, A. confertifolia, and Caleogyne ramosissima rooted more readily in soil than in vermicalite. Some species rooted

better with mist rooting while Grayia spinosa, Eurotia lanata, Ephedra viridis and Thamnosina montana did better under dry conditions. Ephedra viridis rooted better when bottom heated.

Shrubs/Propagation

227. Wilgus, F. and K.C. Hamilton

1962

Germination of saltcedar seed.

Weeds 10(4):332-333.

Fresh seed of Tamarix pentandra Pall. germinated at temperatures from 36° to 132°F., but the ideal range was 66° to 110°F. Seed stored at the same relative humidity maintained viability best at low temperatures. Stored at a low relative humidity, viability continued high for six months over a wide range of temperatures, but viability was reduced in 15 days by a relative humidity of 90 to 95 percent.

Tamarix pentandra/Germination/Viability

228. Wilkinson, R.E.

1966

Adventitious shoots on saltcedar roots.

Botanical Gazette 127(2/3):103-104.

Saltcedar (Tamarix pentandra Pall.) roots produced adventitious shoots that originated near the vascular cambium layer. Root cuttings produced adventitious shoots in 21 percent of the tests when buried vertically and in 8 percent of the tests when buried horizontally.

Tamarix pentandra/Roots/Shoots/Propagation

229. Willard, E.E., and C.M. McKell

1973

Simulated grazing management systems in relation to shrub growth responses.

Journal of Range Management 26(3):171-174.

Little rabbitbrush (Chrysothamnus viscidiflorus (Hook) Nutt.) and snowberry (Symphoricarpos vaccinioides Rybd.) were clipped for five years under deferred rotation, alternate rest, and rest-rotation grazing systems at 30, 60 and 90 percent removal rates. All removal intensities found increased number of new sprouts and lowered carbohydrate reserves. Only rabbitbrush reduced the sprout length.

Chrysothamnus/Shoots/Grazing systems/Experimental plots/Shrubs/Range management/Grazing effects

230. Williams, S.E., A.G. Wollum, and E.F. Aldon

1974

Growth of Atriplex canescens (Pursh) Nutt. Improved by Formation of Vesicalararbuscular Mycorrhizae.

Soil Service Society of America Proceedings 38(6):962-965.

The symbiotic association of A. canescens and endomycorrhizal fungi was studied. Mycorrhizal fourwing saltbush had a greater dry weight and retained more phosphorus than non-mycorrhizal plants. Plants that were innoculated with an endomycorrhizal fungus showed greater growth than uninnoculated plants.

Atriplex canescens/Symbiosis/Plant growth/Fungi

231. Workman, J.P. and N.E. West

1969

Ecotypic Variation of Eurotia lanata Populations in Utah.

Botanical Gazette 130(1):26-35.

Ecotypic variation in four different Eurotia lanata stands was revealed by large differences in the soil soluble salt percentages of the different Eurotia stands. Seeding experiments and reciprocal seeding transplants showed significant differences in germination and seedling response depending upon origin of the plant or seed and what soil it was planted in. Seed germination and seedling response was best for each plant in its "home soil."

Plant-soil relationships/Germination/Eurotia lanata/Transplants/Viability/Saline soils

232. Wright, N. and L.J. Streetman

1958

Past performance and future potential of black grama for southwestern ranges.

Journal of Range Management 11:207-214.

This review of the previous work on Bouteloua eriopoda is designed to appraise its present status, evaluate possible limiting factors, and suggest possible ways for usage improvement. Aspects of management, nutritive value, cytology, growth, and reseeding are discussed. Bouteloua eriopoda, a major species in Arizona, New Mexico and adjacent parts of Mexico and Texas, is drought tolerant both during seedling establishment and as a mature plant. It is a dependable and nutritous forage in both summer and winter, withstands grazing well, is a natural source of reserve feed, provides good soil protection and spreads easily.

Bouteloua/Drought tolerance/Range management/Grasses/Forage plants/Grazing

233. Zander, A.D.

1967

Some effects of juniper-grass vegetation on soil characteristics and soil-water relationships in east-central Arizona.

University of Arizona, Tucson, M.S. Thesis.

This study done in the pinyon-juniper vegetation type describes some effects of undisturbed juniper litter, lateral juniper roots and livestock trampling and grazing on soil characteristics and water movement into and through the soil profile. Soil bulk density and compaction were found to be considerably less on undisturbed juniper litter sites than on those sites influenced by lateral juniper roots and livestock trampling and grazing. Infiltration and percolation increased with less bulk soil density.

Grazing effects/Soil moisture/Litter/Pinyon-juniper/Soil/Physical properties/Soil water movement

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