AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
Batch 37

1. SUBJECT CLASSIFICATION	A. PRIMARY: Bibliography	Z-AP00-0000-G370
	B. SECONDARY: Agriculture--Natural resources--North America	

2. TITLE AND SUBTITLE
Desertification,a world bibliography: North America

3. AUTHOR(S)
Payiore,Patricia

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1976	64p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
Ariz.

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*
(Pt.of a world survey,input in sections: PN-AAC-380 through PN-AAC-387,incl.)

9. ABSTRACT

10. CONTROL NUMBER PN-AAC-387	11. PRICE OF DOCUMENT
12. DESCRIPTORS Arid land Desertification North America	13. PROJECT NUMBER 14. CONTRACT NUMBER AID/ta-G-1111 211(d) 15. TYPE OF DOCUMENT

AID 590-1 (4-74)

AID/ta-G-1111 211(d)
PN-AAC-387

DESERTIFICATION :
A World Bibliography
N O R T H A M E R I C A

Compiled and Edited by

Patricia Paylore
Assistant Director
Office of Arid Lands Studies
University of Arizona

for

23rd International Geographical Congress, Moscow, 1976
Pre-Conference Meeting of the IGU Working Group on Desertification
Desert Research Institute, Ashkhabad, Turkmen SSR

July 20-26, 1976

University of Arizona
OFFICE OF ARID LANDS STUDIES
Tucson, Arizona 85719, USA

Copyright © 1976
ARIZONA BOARD OF REGENTS
All rights reserved

CONTENTS

		page
Acknowledgments		i
Editor's Preface		ii
Bibliography		
[Regional Introductions precede and Indexes follow each section]		
Worldwide		1
Africa :		45
General	45	
Sahara and Sahelian Region	56	
English Language	59	
French Language	111	
German Language	174	
East Africa and Sudan	192	
Southern Africa	227	
Middle East		273
USSR :		376
Sand Control	378	
Afforestation	381	
Saxaul	384	
Phytoreclamation	386	
Range Improvement	388	
Soils	391	
Wind Action	392	
Environmental Impacts	393	
Desert Development	395	
Bibliographies	397	
Pakistan		398
India		419
China		451
Australia		466
South America :		506
Argentina	509	
Brazil	527	
Chile	535	
Peru	561	
Venezuela	583	
North America		589

ACKNOWLEDGMENTS

As Editor, my greatest obligation in the preparation of this bibliography for publication is to Mrs. Jean Mills, Research Assistant, Office of Arid Lands Studies, who virtually lived for five months in the University of Arizona Libraries verifying information submitted by the several regional contributors, and then barricaded herself in her office while she reconciled a variety of styles to the format of our computer program that stores and retrieves from the data base comprising the Arid Lands Information System (ALIS).

The technical staff — Lynn Lybeck, Systems Analyst, Julie V. Garrettson in charge of terminal operations, and Eleanor Smith who assisted her with data entry — produced the document you hold in your hands, all of them sharing the often tedious work of modifying the computer program where necessary, entering the information on the terminal, reading proof three times, and doing the preliminary preparation of printouts for the photoreduction and photoreproduction that enabled us to compress these hundreds of citations into manageable size. My deepest thanks to all, not least for the interest they took in the project and in the subject as well. I hope each thinks of himself as a minor authority on desertification.

The backup support of the University of Arizona, and particularly that of the Office of Arid Lands Studies, is greatly appreciated. Our Director, Dr. Jack D. Johnson, stabilized the disruptions to the Office, inevitable in a project of this magnitude, by his enthusiastic cooperation. Mary Michael, Information Specialist, and Helen Kassander, Research Assistant, helped us meet our deadline by relinquishing their share of the technical staff's time over a period of months.

I am grateful to my colleague, Dr. Andrew W. Wilson, University of Arizona Department of Geography, Regional Development, and Urban Planning, and Vice-Chairman of the IGU Working Group on Desertification, for his counsel and advice during the year we worked on the bibliography, and to Professor Jack W. Mabbutt, Chairman, Department of Geography, University of New South Wales, Kensington, and Chairman of the IGU Working Group, for his willingness to allow me to go forward on the project in my own way. His keen eye and impeccable judgment sharpened my own approach to the undertaking.

To the collaborators throughout the arid world, as noted elsewhere herein, those recognized authorities on the regions represented by their citation contributions, who responded bravely to all my anguished cables to hurry, hurry, my very best thanks. The bibliography is really theirs, expressing as it does their understanding of particular environments and the impact of desertification thereon.

-Patricia Paylore

Tucson

July 4, 1976

EDITOR'S PREFACE

This bibliography is a selection of largely recent information on worldwide desertification, a greatly expanded listing from that which accompanied a paper on the subject first published by the University of Arizona's Office of Arid Lands Studies in 1973*. It has been compiled and edited for the 23rd International Geographical Congress, Moscow, 1976, more particularly for the Pre-Conference Meeting of the IGU Working Group on Desertification in Ashkhabad, July 1976, since it was under its aegis that the task was undertaken in the summer of 1975.

The Working Group came into being at the IGU's Montreal Congress, 1972, as a successor to the former Commission on the Geography of Arid Lands. Its stated aim was "to collect evidence on the nature and causes of environmental changes constituting an extension of deserts into marginal areas or an intensification of desert conditions within arid regions." Two subsequent field meetings of the Working Group were held: in Alice Springs in the early winter of 1974; and in Cambridge, England, in the early fall of 1975. When the Editor was co-opted to the Working Group, it was agreed that she would depend to a large degree on contributions from various regional collaborators for coverage of specific areas. Those persons are listed here, many of whom are also authors of the brief introductory remarks which precede most sections of the bibliography itself:

Worldwide:	Ronald F. Peel, University of Bristol
Saharan Region and Sahel:	A. T. Grove, Cambridge University (English)
	Monique Mainguet, Reims University (French)
	Horst Mensching, University of Hamburg)
	F. N. Ibrahim, University of Hamburg) (German)
	Wolfgang Meckelein, University of Stuttgart)
East Africa:	Leonard Berry, Clark University, Worcester
Southern Africa:	Peter D. Tyson, University of Witwatersrand
Middle East:	Peter Beaumont, University of Durham
USSR:	Michael Petrov, Leningrad University
Pakistan:	Mushtaqur Rahman, Iowa State University
India:	H. S. Mann, Central Arid Zone Research Institute, Jodhpur
Australia:	J. A. Mabbutt, University of New South Wales
South America:	Hans J. Schneider, University of New South Wales
North America:	Andrew W. Wilson, University of Arizona

Many of the Regional Organizers have been assisted by local correspondents, who are in effect Corresponding Members of the Working Group.

---

* Sherbrooke, W. C. / Paylore, P. (1973) World Desertification: Cause and Effect. A Literature Review and Annotated Bibliography. University of Arizona, Office of Arid Lands Studies, Arid Lands Resource Information Paper 3. 168 p.

The following framework was suggested to the regional contributors early in the project, as a guide to selection of references. While not all items are represented in each gathering, the presence of citations dealing with any of these concepts can be determined from the index for each region.

A. Natural Trends:

1. Climatic changes in the historical period
2. Hydrologic changes
3. Changes in landforms due to the action of water
4. Changes in landforms due to the action of wind
5. Changes in soils
6. Changes in natural vegetation

B. Man's Influence on the Processes of Desertification:

1. Agriculture, dryland or irrigated
2. Pastoralism, rural settlement, and nomadism
3. Forestry, with emphasis on collection of fuel
4. Urbanization
5. Population changes
6. Mining (including oil and gas) and pipeline construction
7. Transportation, including construction of roads, railways, airfields
8. Tourism and recreation

C. Preservational Measures:

1. Studies of status and trend of the environment
2. Regional assessments of natural resources
3. Studies of natural hazards
4. Establishment of natural parks and reserves
5. Other controls of land use

D. Preventive and Remedial Measures:

1. Climate: climatic stress, rainmaking, evaporation suppression, shelterbelts
2. Water supplies: inventories of water resources, water balance or hydrologic cycle, improvement of supplies for drinking, stock or irrigation; water harvesting schemes
3. Erosion control: stabilization of dunes and drift sands, monitoring of processes, measures against water and wind erosion
4. Improvement of desert vegetative cover: surveys of the extent of degradation, range and grazing studies, revegetation of bare areas, pasture improvement, afforestation
5. Control of land use: pastoral, dryland / irrigated agriculture
6. Control of population and settlement: nomads, rural settlement, urban planning, communications
7. Development of alternative resources: regional development, mining, industry tourism, recreation, health care

It was also suggested that we attempt to keep within a timeframe of the past decade. This was done to a large extent, but earlier papers of a classic nature are still included where it is generally agreed that their presentation has not been improved upon.

Because of the massive infusion of bibliographic information, which (even with what, at times, must have appeared to be brutal editorial cuts) still far exceeds the total number of references envisaged when we began, we have had to be arbitrary in the manner in which we have handled some of the information. Where we have departed radically from the format employed to display the greatest percentage of information, such as the USSR, we have appended an explanation following the regional contributor's Introduction. We have included several hundred documents from our own Arid Lands Information System (ALIS) to enhance the coverage submitted by our regional colleagues.

Much work was done at Arizona to bring these hundreds of references into the format required by our computer program. Many references were dropped because of lack of adequate information to identify and locate copies should users so require. For those without the services of skilled documentalists and/or bibliographers to call upon, it has always seemed to us that our meticulous and sometimes fussy insistence on full bibliographical information is the sine qua non of good bibliography. In this respect, while much of the documentation in this bibliography was very difficult indeed, we believe that the smallest percentage humanly possible is included that has not been verified by our staff. We trust, therefore, that because of this care, users will find the full documentation more readily accessible than they would otherwise.

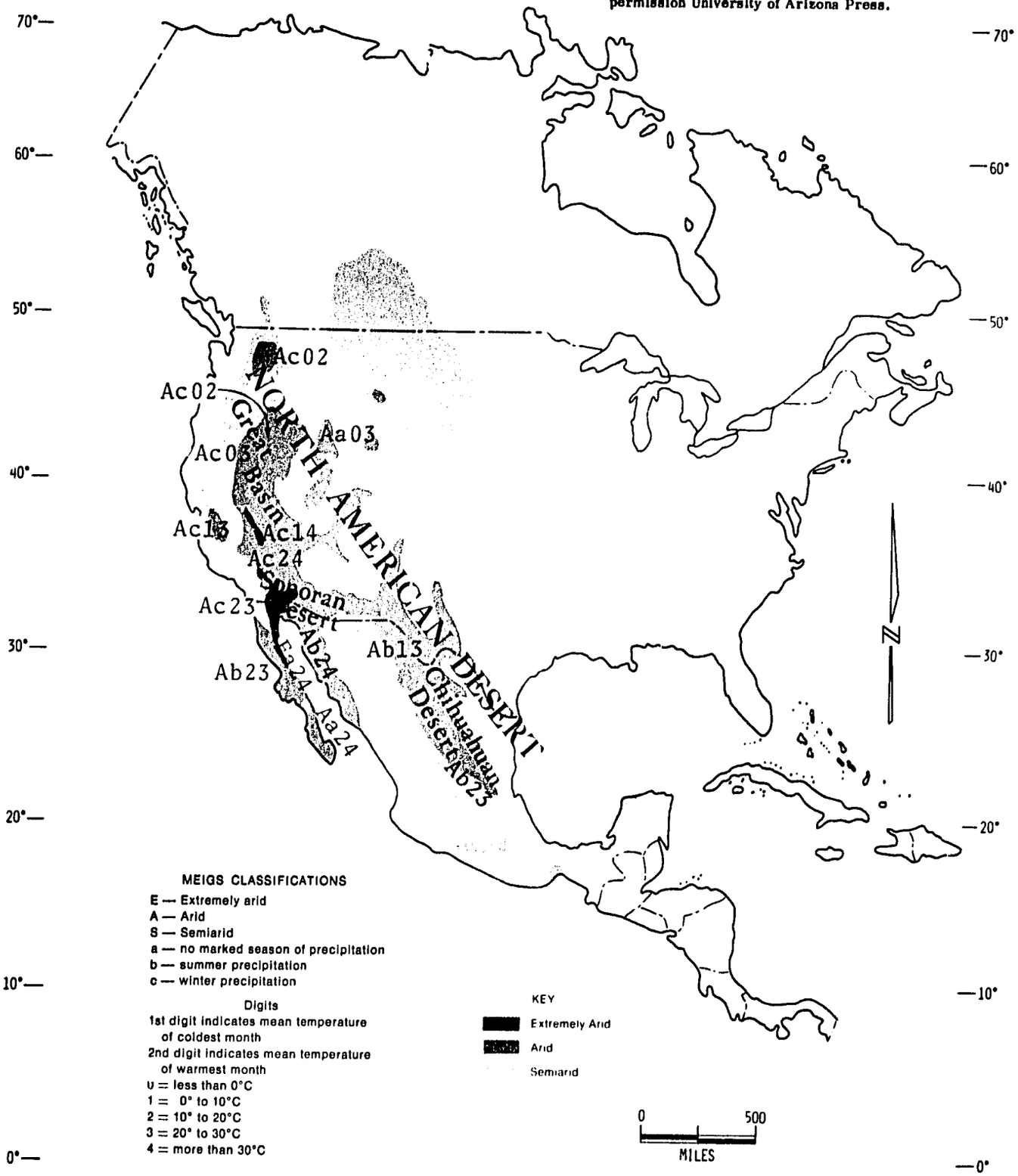
Indexing (except for the USSR) was done from the Thesaurus of Arid Lands Terminology (c1974), developed and used by the Office of Arid Lands Studies for its computerized data bank; and to make the use of the bibliography less cumbersome, subject keywords and authors appear as computerized lists following each section. The documentation from the USSR was sorted out into ten overall categories, and no indexing of individual citations was undertaken.

An effort was made to eliminate all references that did not contribute to an understanding of the phenomenon of desertification itself, rather than to permit the bibliography to become a general arid lands compilation. That we did not always succeed must be attributed not only to our inability to distinguish at times, but also to the disagreements and confusion existing among desert experts as to exactly what constitutes desertification. For those users who miss their favorite citations - their own or others - we ask you to take this constraint into account.

The Editor takes full responsibility for the choice of references carried, and for all shortcomings of coverage or format. I hope the latter will be outweighed by the work's overall usefulness at this critical time in the world's understanding of a biological and physical process that is affecting the lives of millions.

NORTH AMERICA

Reprinted from DESERTS OF THE WORLD: An Appraisal of Research into Their Physical and Biological Environments. McGinnies, Goldman, and Paylore, eds., c1968, by permission University of Arizona Press.



Arid Lands of North America (after Meigs)

Professor Andrew W. Wilson
Department of Geography, Regional
Development, and Urban Planning
University of Arizona
Tucson, Arizona 85721, USA

NORTH AMERICA

The deserts and semi-deserts of North America are found in three countries the Commonwealth of Canada, the United States, and Mexico. In both Canada and the U. S., the dry lands lie between highly-developed more humid areas of the nation, while in Mexico they make up one of the most highly-developed agricultural areas of that country, the result of extensive irrigation projects. In the English speaking areas, while irrigation and grazing are practiced, they are of less importance than other economic activities such as manufacturing, tourism, and mining.

In all three nations, the dry lands are parts of countries which contain much humid area, the the pressure for development of food production, therefore, is not so strong as in countries largely or entirely desert. Especially in the relatively warm and dry deserts of the southwestern U. S., the valleys have become a winter refuge from snow and cloud and an all-year refuge from humidity. The bright clear air and sunshine have attracted so many urban dwellers that the cities of the desert are some of the fastest growing in the nation.

To the urban dweller, the most significant element of desertification is the loss of an urban water supply. A number of papers on water supplies, their development and conservation, are included in the bibliography which follows. Blowing dust is a little covered problem for the city's inhabitants.

Other aspects of desertification are of more concern to the grazer. Changing vegetation, from prehistoric to modern times, is discussed in a number of papers indexed herein. Changes have occurred, but how much is because of climatic variation and how much is the result of man's impact is an analysis on which even the experts disagree.

Two aspects of desertification are of interest to the farmer: erosion and salinization of soils. Salinity plays a special and severe role in northwestern Baja California, Mexico, and in the Wellton-Mohawk project in the extreme southwestern corner of Arizona, but it is not absent elsewhere. Erosion appears along stream channels and in some of the more sloping field areas. In most cases it is not yet too serious, and papers are few.

Basically, however, desertification is not considered a major problem in North America by most authorities, and the literature shows little direct approach to the subject as it is perceived elsewhere in the arid world.

1

ALDON, E.F.

1972

REACTIVATING SOIL RIPPING TREATMENTS FOR RUNOFF AND EROSION CONTROL IN THE SOUTHWESTERN U.S.

ANNALS OF ARID ZONE 11(3-4):154-160. GA 74A-1166.

SOIL RIPPING IS AN EFFECTIVE, BUT TEMPORARY, MEASURE TO CONTROL RUNOFF AND EROSION ON SEMI-ARID WATERSHEDS. ITS EFFECTIVENESS NORMALLY 3 TO 5 YEARS IN THE SOUTHWESTERN U.S., DEPENDS ON STORM AMOUNTS AND INTENSITIES. RE-RIPPING PREVIOUSLY TREATED AREAS MAY BE A LOW-COST WAY TO EXTEND TREATMENT EFFECTIVENESS UNTIL VEGETATION CAN BE ESTABLISHED. IN THIS STUDY, OPENING OLD RIPS THAT WERE SEALED OVER WITH SEDIMENT WAS AS EFFECTIVE IN CONTROLLING RUNOFF AS RIPPING BETWEEN OLD RIPS. RE-RIPPING BY EITHER METHOD REDUCED RUNOFF BY TWO-THIRDS COMPARED WITH UNTREATED CHECK PLOTS. RIPPING MUST BE DONE CAREFULLY TO AVOID SUBTERRANEAN CHANNEL FORMATION (EROSION BY SOIL PIPING). (AUTHOR)

SOUTHWEST U.S./EROSION CONTROL/RUNOFF/WATERSHED MANAGEMENT/LAND CONSERVATION

2

ANDERSON, R.Y./KIRKLAND, D.W.

1969

PALEOECOLOGY OF THE RITA BLANCA LAKE AREA.

GEOLOGICAL SOCIETY OF AMERICA, MEMOIR 113:141-157. GA 71B-1367 (ANAG).

THE LAKE OCCUPIED A DEFLATION BASIN DURING A BRIEF INTERVAL IN THE PLEISTOCENE ON WHAT IS NOW THE HIGH PLAINS. CHEMICAL STRATIFICATION PRESERVED SEASONAL VARIATIONS AS VARVES. THE DEPTH WAS BETWEEN 30 AND MORE THAN 125 FEET. THE AREA AROUND THE LAKE WAS SLIGHTLY ROLLING WITH A CALICHE CAPROCK AND THE DRAINAGE BASIN WAS MAINLY IN SANDSTONE MANTLED BY CHERNOZEM SOIL. THE SHORELINE VEGETATION WAS MESIC, SURROUNDED BY XERIC FLORA WITH A MODERATELY WELL-DEVELOPED GRASS COVER. SAGE WAS ALSO COMMON. FOSSIL AND VARVE EVIDENCE SUGGESTS THE LAKE WAS MEROMICTIC. SEASONAL CHANGES AND LONG-TERM CHANGES CAN BE IDENTIFIED IN THE STRATIFICATION ALSO. A COOLER CLIMATE THAN THE PRESENT IS INDICATED FOR BLANCAN TIME, BUT NO DOGMATIC STATEMENT CAN BE MADE.

PLAINS/PLEISTOCENE EPOCH/CLIMATIC GEOMORPHOLOGY/LAKE BASINS/PALEOECOLOGY/ TEXAS/CLIMATIC CHANGE/STRATIGRAPHY

3

AXELROD, D.I.

1950

EVOLUTION OF DESERT VEGETATION IN WESTERN NORTH AMERICA.

CARNEGIE INSTITUTION OF WASHINGTON, PUBLICATION 590:215-306.

DESERT VEGETATION OF MODERN CHARACTER DEVELOPED DURING THE TERTIARY PERIOD BY THE GRADUAL ADAPTATION OF MORE MESIC PLANTS TO SLOWLY EXPANDING DRY CLIMATES. SUBTROPICAL AND WARM-TEMPERATE FORESTS DOMINATED OVER THE LOWLANDS OF THE PRESENT DESERT REGION FROM UPPER CRETACEOUS INTO EARLY TERTIARY TIME. TEMPERATE DECIDUOUS AND CONIFER FOREST, ARID SUBTROPICAL FOREST, ARID SUBTROPICAL SCRUB, LIVE OAK WOODLAND, AND CHAPARRAL CHARACTERIZED THESE AREAS DURING THE MIDDLE AND LATER TERTIARY. GRASSLAND AND SCRUB BECAME PROMINENT DURING THE MIDDLE PLIOCENE. THE PRESENT DESERT ENVIRONMENTS OF SUBCONTINENTAL EXTENT MUST BE OF LATEST CENOZOIC AGE. (OALS)

OALS/WGM/NPS-ONS/EVOLUTION/PHYTOGEOGRAPHY/DESERT PLANTS/DESERTS/ CLIMATIC-VEGETAL RELATIONSHIPS/GEOGRAPHICAL ORIGIN/SOUTHWEST U.S./ SONORAN DESERT/CHIHUAHUAN DESERT/GREAT BASIN/CLIMATIC CHANGE/SWERVE/ VEGETATION CHANGE

4

AYRES, J.E.

1971

MAN, THE DESERT FARMER. IN HYDROLOGY AND WATER RESOURCES IN ARIZONA AND THE SOUTHWEST, VOL. 1.

AMERICAN WATER RESOURCES ASSOCIATION, ARIZONA SECTION/ARIZONA ACADEMY OF SCIENCE, HYDROLOGY SECTION, PROCEEDINGS OF THE 1971 MEETINGS, TEMPE, ARIZONA, P. 373-379.

THE PRE-COLUMBIAN HOHOKAM INDIANS OCCUPIED THE MAJOR RIVER DRAINAGES OF CENTRAL ARIZONA, AND HAVE BEEN THE SUBJECT OF MUCH INTENSE ARCHAEOLOGICAL RESEARCH. EVIDENCE INDICATES THAT THE HOHOKAM BEGAN USING RIVER WATER FOR CROP IRRIGATION ABOUT 300 B.C., AND MODIFIED AND IMPROVED THEIR IRRIGATION SYSTEMS OVER TIME, UNTIL THE MAXIMUM EXTENT OF THESE SYSTEMS WAS ACHIEVED ABOUT 900 A.D. TWO TYPES OF WATER CONTROL SEEM TO HAVE BEEN UTILIZED: 1) THE DIRECT EXPLOITATION OF RIVERS THROUGH THE USE OF IRRIGATION CANALS, 2) INDIRECT USE THROUGH CONTROLLED RUNOFF WITHIN MICRODRAINAGES AT HIGHER ELEVATIONS BEFORE IT REACHED THE RIVERS. AT FIRST, PROBABLY ONLY THOSE PARCELS OF LAND WITH OPTIMAL SOILS AND DRAINAGE WERE USED, BUT APPARENTLY POPULATION INCREASES FOSTERED BY AGRICULTURE ITSELF, COMBINED WITH INCREASING SOCIAL AND POLITICAL COMPLEXITY, NECESSITATED MORE AND MORE EXPLOITATION OF MARGINAL LANDS. EVENTUALLY SOIL PROBLEMS INCREASED IMPOSING SEVERE LIMITATIONS ON AGRICULTURE. THESE INVOLVED SALT AND ALKALI ACCUMULATION DUE TO INADEQUATE DRAINAGE, SOIL DENSITY AND WATERLOGGING. ADDITIONALLY, THE EXTENSION OF CROPPING REQUIRED THE CLEARING OF NATURAL VEGETATION, WHICH RESULTED IN INCREASED EROSION AND DECREASED AVAILABLE NATIVE FOOD RESOURCES FOR PERIODS WHEN CROPS FAILED. THE CULTURE VANISHED COMPLETELY ABOUT 1450 A.D., PROBABLY MAINLY BECAUSE OF THEIR MANNER OF RIVER EXPLOITATION FOR IRRIGATION. MORE RECENT ARCHAEOLOGICAL STUDIES ARE CONCENTRATING NOT ONLY ON RIVER USE BUT ALSO ON RIVER ABUSE. (OALS)

OALS/HISTORY/ARIZONA/IRRIGATION PRACTICES/SONORAN DESERT /SOIL PROPERTIES

5

BECKER, R.J.

1975

NON-CONSERVATION IN ARIZONA: ESTIMATES OF SOME COSTS.

ARIZONA ACADEMY OF SCIENCE, JOURNAL 10(2):90-97. SWRA W76-00191.

DAMAGE CAUSED BY MAN IN ARIZONA TO LAND, WATER AND AIR IS DISCUSSED AND COST ESTIMATES OF THE LOSSES ARE MADE. LAND IS DAMAGED BY EROSION WHEN THE PLANT COVER IS DESTROYED. LAND IMPROVEMENTS FOR FARMING ARE LOST BY CITY GROWTH AND BY DECLINING WATER TABLES. WATER IS LOST WHEN THE HYDROLOGIC CYCLE IS DISRUPTED AND LESS RAIN FALLS; WHEN GROUNDWATER IS PUMPED OUT AND NOT ALLOWED TO RECHARGE; WHEN FORMERLY DRY AREAS ARE FILLED WITH WATER; OR WHEN WET AREAS ARE DRAINED. AIR IS LOST WHEN ITS CARRYING CAPACITY FOR WASTES HAS BEEN EXCEEDED, AS IT HAS IN MANY PARTS OF ARIZONA. (OALS)

SOUTHWEST U.S./ENVIRONMENTAL IMPACT/COSTS/ARIZONA/SOIL EROSION/DEGENERATION/ AIR POLLUTION/WATER LOSS/LAND USE

6

BENNETT, H.H./CHAPLINE, W.R.

1928

SOIL EROSION, A NATIONAL MENACE.

U.S. DEPARTMENT OF AGRICULTURE, CIRCULAR 33. 36 P.

PART I BY BENNETT DISCUSSES WASTING AREAS, WITH STATISTICS ON WASTAGE, GEOGRAPHIC EXTENT OF SOIL EROSION IN U.S., EROSION IN DRIER AREAS, RELATION TO FLOOD CONTROL AND WARNINGS OF WHAT MAY HAPPEN IF NOTHING IS DONE TO STOP EROSION. PART II BY CHAPLINE COVERS SOIL EROSION ON WESTERN GRAZING LANDS. DISCUSSION INCLUDES EROSION AGENCIES ON RANGE LANDS INCLUDING NATURAL AGENCIES, FIRES, MINING AND OVERGRAZING; THE SERIOUS EFFECTS OF EROSION INCLUDING FLOOD DAMAGE TO MOUNTAIN VALLEYS, SILTING OF RESERVOIRS AND REDUCED PRODUCTIVITY OF RANGE LANDS. THE LAST PORTION IS DEVOTED TO A DISCUSSION OF WHAT NEEDS TO BE DONE.

OALS/WGM/SOIL EROSION/UNITED STATES/EROSION/EROSION CONTROL/LAND MANAGEMENT/SOIL CONSERVATION/SOIL STABILIZATION/SOIL MANAGEMENT/ WATERSHED MANAGEMENT/FLOOD CONTROL/RANGE MANAGEMENT/GRAZING/ PERTURBATION/BURNING/GULLY EROSION/FLOODS/MINING/SWERVE

7

BENTLEY, H.L.

1898

CATTLE RANGES OF THE SOUTHWEST. A HISTORY OF THE EXHAUSTION OF THE PASTURAGE AND SUGGESTIONS FOR ITS RESTORATION.

U.S. DEPARTMENT OF AGRICULTURE, FARMERS BULLETIN 72:1-32.

THE RANGES OF CENTRAL TEXAS WERE USED TO SHOW WHAT HAPPENED TO THE RANGES AND WHAT COULD BE DONE TO IMPROVE CONDITIONS. IN THE MIDDLE 1800 S GRASS WAS 1 TO 3 FEET HIGH BUT LATER CARRYING CAPACITY DECLINED. WITH THE COMING OF THE RAILROAD, CATTLE AND SHEEP PRICES WENT UP AND SO DID THE HERD SIZE, RESULTING IN OVERGRAZING. MANY RANCHERS EXPLOITED THE PASTURAGE WHILE THEY COULD WHEN CATTLE PRICES CONTINUED TO GO UP. A GENERAL LACK OF INTEREST IN RANGE IMPROVEMENT, PERIODICAL DROUGHTS, ANIMAL PESTS SUCH AS PRAIRIE DOGS AND JACKRABBITS, AND THE INCREASE OF PRICKLY PEAR AND THORNY SHRUBS ON THE RANGE ACCELERATED THE DEGENERATION OF THE RANGE. (OALS)

OALS/WGM/RANGES/SOUTHWEST U.S./HISTORY/TEXAS/RANGE MANAGEMENT/GRAZING/LIVESTOCK/GRASSES/CARRYING CAPACITY/DROUGHTS/LEPUS/PERTURBATION/OPUNTIA/SHRUBS/SEEDING/FORAGE SUPPLY/FORAGE PLANTS/VEGETATION CHANGE/SWERVE

8

BIROT, P./DRESCH, J.

1966

PEDIMENTS ET GLACIS DANS L'OUEST DES ETATS UNIS.

ANNALES DE GEOGRAPHIE 75(411):513-552.

SONT ETUDIES SUCCESSIVEMENT LES TYPES DE GLACIS EN ROCHES TENDRES DU COLORADO TABULAIRE, DU PIEMONT ET DES ROCHEUSES SEPTENTRIONALES, LES GLACIS ET PEDIMENTS DE L'ARIZONA ET DU NOUVEAU MEXIQUE. LEUR GENESE, LEURS RELATIONS AVEC LES CHANGEMENTS DE CLIMAT, PLUVIAX, AU SUD, GLACIAIREA AU NORD, ET LEUR CHRONOLOGIE SONT ANALYSEES.

WEST U.S./PEDIMENTS/BASINS/LANDFORMS/GEOMORPHOLOGY/QUATERNARY PERIOD/GEOCHRONOLOGY/PLIOCENE EPOCH/CLIMATIC GEOMORPHOLOGY/ROCKY MOUNTAIN REGION

9

BOCHERT, J.R.

1971

THE DUST BOWL IN THE 1970'S.

ASSOCIATION OF AMERICAN GEOGRAPHERS, ANNALS 61(1):1-22. GA 72C-0326.

MAJOR DROUGHTS IN THE GRASSLAND REGION OF THE CENTRAL UNITED STATES HAVE OCCURRED RHYTHMICALLY DURING THE PERIOD OF INSTRUMENTAL RECORD. THE TIME FOR THE NEXT ONE MAY BE NEAR. EARLY DROUGHTS DISASTROUSLY REDUCED FARM INCOME THROUGH LOSS OF CROPS AND LIVESTOCK. SINCE THE 1930'S THEY HAVE ACCELERATED CONTEMPORARY BASIC CHANGES IN AMERICA WITHIN THIS REGION: FEWER, BIGGER, AND MORE FRAGMENTED FARMS, PUBLIC CONTROLS AND SUBSIDIES, CONSOLIDATION OF URBAN BUSINESS AND SERVICES, AND GREATER MANAGEMENT. THE NEXT MAJOR DROUGHT WILL AGAIN ACCELERATE LONG-TERM AGRICULTURAL TRENDS, BUT A SHARP INCREASE IN URBAN FEDERAL ASSISTANCE IS LIKELY, AND REVOLUTIONARY CHANGES IN SETTLEMENT COULD BE INITIATED. (AFTER AUTHOR)

DROUGHTS/SOCIAL ASPECTS/GREAT PLAINS/AGRICULTURE

10

BOWDEN, C.

1975

THE IMPACT OF ENERGY DEVELOPMENT ON WATER RESOURCES IN ARID LANDS: LITERATURE REVIEW AND ANNOTATED BIBLIOGRAPHY.

UNIVERSITY OF ARIZONA, TUCSON, OFFICE OF ARID LANDS STUDIES, ARID LANDS RESOURCE INFORMATION PAPER 6. 278 P.

WATER IS BASIC TO EHERGY CONVERSION SYSTEMS, NATURAL AND MAN-MADE. THIS PAPER EXPLORES THE CONSEQUENCES OF ENERGY EXTRACTION AND CONVERSION IN ARID LANDS WHERE WATER IS SCARCE. THE HISTORICAL PAST IS USED AS A RECORD FOR CASTING MODERN DEVELOPMENT PLANS INTO PERSPECTIVE WHERE THE WORLDWIDE GROWTH IN ENERGY CONSUMPTION RATES IS CONSIDERED THE MOTIVE FORCE BEHIND MANY CURRENT ENERGY PROJECTS IN ARID LANDS. ENERGY SOURCES (COAL, OIL, GAS, OIL SHALE, SOLAR ENERGY, ALTERNATIVE ENERGY SOURCES: FISSION, FUSION, AND GEOTHERMAL) ARE REVIEWED IN TERMS OF THEIR CONSEQUENCES ON THE AIR, LAND, WATER, AND INHABITANTS OF SUCH REGIONS. TWO RIVERS, THE COLORADO AND THE MISSOURI, PROVIDE SMALL-SCALE MODELS OF THE REWARDS AND HAZARDS OF HEAVILY EXPLOITING WATER-SHORT AREAS. IN BOTH INSTANCES, IT IS FOUND THAT ENERGY DEVELOPMENT PLANS, AS NOW PROPOSED, WILL SERIOUSLY DEPLETE THE WATER SUPPLY, ALTER THE QUALITY OF THE WATER, LAND, AND AIR, AND CAUSE AN INFLUX OF POPULATION TO THE AREAS. (AUTHOR)

OALS/BIBLIOGRAPHIES/ARID LANDS/COLORADO RIVER BASIN/SOUTHWEST U.S./ WATER SHORTAGE/STRIP MINING/ENERGY/GREAT PLAINS/FOSSIL FUELS/ ALTERNATIVE FUELS/GEOTHERMAL POWER/SOCIAL ASPECTS/WATER ALLOCATION(POLICY)/ENVIRONMENTAL IMPACT/ENERGY CONVERSION

11

BREED, C.S.

1971

PHYSIOGRAPHIC LIMITATIONS UPON THE USE OF SOUTHWESTERN RIVERS. IN HYDROLOGY AND WATER RESOURCES IN ARIZONA AND THE SOUTHWEST, VOL. 1.

AMERICAN WATER RESOURCES ASSOCIATION, ARIZONA SECTION/ARIZONA ACADEMY OF SCIENCE, HYDROLOGY SECTION, PROCEEDINGS OF THE 1971 MEETINGS, TEMPE, ARIZONA, P. 367-372. SWRA W72-02235.

SOUTHWESTERN RIVERS ARE FEW IN NUMBERS AND LOW IN DISCHARGE. THE PHYSIOGRAPHIC AND CLIMATIC REASONS FOR THIS ARE DISCUSSED. TO THE EAST OF THE 100TH MERIDIAN, RAINFALL IS RELIABLE AND AGRICULTURE IS STABLE; TO THE WEST, THERE IS A CHRONIC DEFICIT OF WATER, DROUGHTS ARE FREQUENT AND LIFESTYLES MUST BE ACCORDINGLY ADJUSTED. DAM BUILDING RESULTS IN GREATLY INCREASED SILTING BEHIND THE DAM IN BOTH THE RIVER AND ITS TRIBUTARIES AND ACCELERATED CHANNEL EROSION BELOW THE DAM. TOTAL FLOW MUST ALSO DECREASE DUE TO WITHDRAWALS AND INCREASED EVAPORATION FROM RESERVOIRS. THE CORRECTION OF APPARENT ERRORS IN MEASURING THE VIRGIN FLOW OF THE COLORADO RIVER NOW INDICATES THAT THIS FLOW IS ABOUT 15 MAF/YR. CURRENT LEGAL ALLOCATIONS TOTAL 17.5 MAF/YR OF RIVER WATER, INCLUDING THE CENTRAL ARIZONA PROJECT (CAP), WHICH WILL WITHDRAW 1.2 MAF/YR. WHILE THE RIVER IS BEING DAMMED AND OVERALLOCATED BEYOND ALL REASON, THE WATER TABLE IS BEING MINED AT THE ALARMING RATE OF 20 FT/YR. IN CENTRAL ARIZONA, IT HAS DROPPED TO ABOUT 250 FEET BELOW THE SURFACE, AND EVEN IF ALL WITHDRAWALS CEASED IMMEDIATELY, IT WOULD TAKE MANY CENTURIES OF DESERT RAINS BEFORE IT WOULD RETURN TO ITS FORMER LEVEL OF 50 FEET. THE CAP WATER WILL CANCEL ONLY ABOUT 1/2 OF THIS OVERDRAFT ANNUALLY. A GLANCE AT THE PHOENIX AREA TODAY SHOWS THAT RAIN FOLLOWS NEITHER THE FARMERS PLOW NOR THE SUBDIVIDERS BULLDOZER. (OALS)

SONORAN DESERT/OALS/ARIZONA/ARID LANDS/COLORADO RIVER BASIN/WATER TABLE/ WATER LOSS/WATER RESOURCES DEVELOPMENT/GEOMORPHOLOGY/DAMS/GROUNDWATER MINING/ WATER MANAGEMENT/HYDROLOGY/RIVER BASINS/COLORADO RIVER/POLITICAL ASPECTS

12

BROWN, A.L.

1950

SHRUB INVASION OF SOUTHERN ARIZONA DESERT GRASSLAND.

JOURNAL OF RANGE MANAGEMENT 3(3):172-177.

VELVET MESQUITE (PROSOPIS JULIFLORA VELUTINA), BURROWEED (HAPLOPAPPUS TENUISECTUS), AND OTHER SHRUBS HAVE SERIOUSLY REDUCED THE CARRYING CAPACITY ON EXTENSIVE AREAS OF THE DESERT GRASSLAND. TWO THEORIES HAVE BEEN ADVANCED TO EXPLAIN THIS INVASION: 1) GRASSLAND IS A FIRE SUBCLIMAX TO DESERT SHRUB; AND 2) GRASSLAND IS A CLIMAX WHICH HAS BEEN INVADED BY SHRUBS AS A RESULT OF POOR LIVESTOCK MANAGEMENT. ALL SHRUBS EXCEPT BURROWEED AND MESQUITE INCREASED AS MUCH OR MORE UNDER PROTECTION AS UNDER GRAZING DURING AN 18 YEAR STUDY. MESQUITE INCREASED UNDER ALL TREATMENTS BUT INCREASED LEAST UNDER TOTAL PROTECTION. BURROWEED DECREASED SLIGHTLY UNDER TOTAL PROTECTION BUT INCREASED UNDER OTHER TREATMENTS. GRAZING MANAGEMENT WAS SHOWN TO BE ECONOMICALLY UNFEASIBLE AS A CONTROL METHOD. THE INCREASE OF ALL SHRUBS EXCEPT BURROWEED THROUGH 18 YEARS OF TOTAL PROTECTION INDICATES THAT THE DESERT GRASSLAND IS PROBABLY NOT A CLIMAX, BUT WAS MAINTAINED BY SOME FACTOR THAT WAS UNFAVORABLE TO SHRUBS.

OALS/WGM/NPS-ONS/SWERVE/GRASSLAND BIOME/SHRUBS/PLANT INVADERS/ PROSOPIS/PROSOPIS JULIFLORA/FORAGE PRODUCTION/FORAGE LEGUMES/CARRYING CAPACITY/APLOPAPPUS TENUISECTUS/CLIMAX/RANGE MANAGEMENT/ARIZONA/DESERT GRASSLAND/CONTROLLED BURNING/PERTURBATION/SUCCESSION/VEGETATION CHANGE

13

BRYAN, K.

1925

THE PAPAGO COUNTRY, ARIZONA: A GEOGRAPHIC, GEOLOGIC AND HYDROLOGIC RECONNAISSANCE WITH A GUIDE TO DESERT WATERING PLACES.

U.S. GEOLOGICAL SURVEY, WATER SUPPLY PAPER 499. 436 P.

THREE RELIEF MAPS ACCOMPANY THE BOOK AND DEPICT THE EASTERN, CENTRAL AND WESTERN PORTIONS OF THE PAPAGO COUNTRY, ARIZONA, WITH WATERING PLACES (SCALE 1:250,000). A FOURTH MAP, ENTITLED RECONNASISSANCE GEOLOGIC MAP, INDICATES PARENT ROCK MATERIALS. THE MAPS PROVIDE COVERAGE FROM 112 TO 113 DEGREES LONGITUDE AND FROM THE MEXICO BORDER NORTH TO THE LATITUDE OF PHOENIX. (OALS)

OALS/WGM/NPS-ONS/PAPAGO INDIAN RESERVATION/GUIDEBOOKS/ARIZONA/WATER HOLES/GEOLOGY/SWERVE/GEOMORPHOLOGY/REGIONAL GEOGRAPHY/SONORAN DESERT/ HYDROLOGY/VEGETATION/ROCKS/DESERT BIOME/SOUTHERN DESERT SHRUB

14

BRYAN, K.

1928

CHANGES IN PLANT ASSOCIATIONS BY CHANGE IN GROUND-WATER LEVEL.

ECOLOGY 9(4):474-478.

CITES EVIDENCE FOR THE EXISTENCE OF PHREATOPHYTES, AND NOTES CHANGES IN PLANT ASSOCIATIONS ACCOMPANYING CHANNEL-CUTTING AND LOWERED GROUND WATER TABLES. HISTORICAL REPORTS ARE CITED THAT INDICATE THE SANTA CRUZ AND SAN PEDRO RIVERS ONCE CONTAINED MANY CIENEGAS. PROGRESSIVE CHANGES IN THE VEGETATION LED FROM BULRUSH, USING SURFACE WATER, THROUGH THE GRASSES (SACATON) AND COTTONWOODS, USING SHALLOW GROUNDWATER, TO THE DEEP ROOTED MESQUITE (PROSOPIS), USING DEEP GROUNDWATER, FOLLOWING A LOWERING OF THE WATER TABLE. THE FUNDAMENTAL CAUSE OF ARROYO CUTTING MAY HAVE BEEN DUE TO CHANGE TO A DRIER CLIMATE. IF THIS IS TRUE, OVERGRAZING IS AN ACCESSORY WHICH SET THE DATE AT WHICH CUTTING MIGHT BEGIN. (OALS)

OALS/WGM/NPS-ONS/SWERVE/PHREATOPHYTES/PLANT COMMUNITIES/WATER TABLE/GROUNDWATER/SANTA CRUZ RIVER BASIN/SAN PEDRO VALLEY/RANGE MANAGEMENT/GRAZING/SUCCESSION/PLANT ECOLOGY/RIPARIAN VEGETATION/CHANNEL MORPHOLOGY/PROSOPIS/GRASSES/AQUATIC COMMUNITIES/POPULUS/GULLY EROSION/ARROYOS/EPHEMERAL STREAMS/CLIMATIC CHANGE/ARIZONA/VEGETATION CHANGE

15

BRYAN, K.

1941

PRE-COLUMBIAN AGRICULTURE IN THE SOUTHWEST AS CONDITIONED BY PERIODS OF ALLUVIATION.

ASSOCIATION OF AMERICAN GEOGRAPHERS, ANNALS 31(4):219-242.

SOUTHWEST U.S./AGRICULTURE/DEPOSITION(SEDIMENTS)/ALLUVIUM/ARCHAEOLOGY/INDIANS OF NORTH AMERICA

16

BRYAN, K./ALBRITTON, C.C., JR.

1943

SOIL PHENOMENA AS EVIDENCE OF CLIMATIC CHANGES.

AMERICAN JOURNAL OF SCIENCE 241(8):469-490.

DISCUSSES CHARACTERISTICS OF SOILS AND SOIL CONDITIONS THAT CAN BE USED TO PROVIDE PALEOCLIMATOLOGICAL DATA. PARTICULAR SOIL IN DAVIS MOUNTAINS, AUTHORS BELIEVE, RECORDS 3 STAGES OF RELATIVE ARIDITY DURING WHICH CALICHE WAS DEPOSITED IN SUBSOIL, AND TWO INTERVENING STAGES OF MOISTER CLIMATES DURING WHICH CALICHE WAS PARTIALLY OR COMPLETELY DISSOLVED. ADJACENT VALLEYS ARE UNDERLAIN BY 3 BODIES OF ALLUVIUM SEPARATED BY EROSIONAL DISCONFORMITIES. DISPOSITION TOOK PLACE IN HUMID TIMES WHEREAS EROSION TOOK PLACE IN ARID TIMES.

OALS/WGM/SWERVE/CLIMATIC CHANGE/PALEOCLIMATOLOGY/CALICHE/TEXAS/ SOUTHWEST U.S./SOIL EROSION/SOIL FORMATION/WEATHERING/SOIL HORIZONS/ SOIL PROFILES

17

BUSCH, C.D./MATLOCK, W.G./FOGEL, M.M.

1966

UTILIZATION OF WATER RESOURCES IN A COASTAL GROUNDWATER BASIN. I: EVALUATION OF IRRIGATION EFFICIENCY.

JOURNAL OF SOIL AND WATER CONSERVATION 21(5):163-169.

GROUNDWATER IS THE SOLE SOURCE OF WATER IN THE COASTAL PLAIN OF HERMOSILLO IN NORTHWESTERN MEXICO. PUMPING OF GROUNDWATER FOR IRRIGATION PURPOSES HAS DRASTICALLY LOWERED THE GROUNDWATER LEVEL IN THE HERMOSILLO DRAINAGE BASIN. THE OVERDRAFT HAS ALSO ENABLED SALTWATER TO INTRUDE INTO THE FRESHWATER AQUIFER. IN AN EFFORT TO SOLVE THESE PROBLEMS, ANALYSES AND EVALUATIONS WERE MADE OF THE PHYSICAL ASPECTS OF IRRIGATION EFFICIENCY, GROUNDWATER SUPPLY, AND SALTWATER INTRUSION. THE RESULTS OF THESE INVESTIGATIONS WHICH CONSTITUTE A BASE FOR FUTURE ANALYSES OF ECONOMIC ASPECTS ARE REPORTED. SEVERAL TECHNIQUES FOR APPROXIMATING HYDROLOGIC UNKNOWNS ARE ALSO PRESENTED.

OALS/WATER RESOURCES/GROUNDWATER/AQUIFERS/GROUNDWATER BASINS/SALINE WATER INTRUSION/WATER LEVEL FLUCTUATIONS/IRRIGATION WATER/SONORA/ IRRIGATION EFFECTS/ECONOMICS/MEXICO/COASTAL PLAINS/KWIC W 27

18

CABLE, D.R./MARTIN, S.C.

1975

VEGETATION RESPONSE TO GRAZING, RAINFALL, SITE CONDITION, AND MESQUITE CONTROL ON SEMIDESERT RANGE.

U.S. FOREST SERVICE, RESEARCH PAPER RM-149. 25 P. SWRA W76-0266

A DISCUSSION IS PRESENTED OF CHANGES IN VEGETATION DURING A 10-YEAR PERIOD (1957-1966) ON SEMIDESERT RANGELANDS ON THE SANTA RITA EXPERIMENTAL RANGE NEAR TUCSON, ARIZONA, AS AFFECTED BY CLIMATIC FACTORS, CATTLE GRAZING, AND THE CONTROL OF VELVET MESQUITE. WITH AN ANNUAL AVERAGE RAINFALL OF 17 INCHES, AVERAGE PERENNIAL GRASS PRODUCTION FOR THE STUDY PERIOD VARIED FROM 352 TO 524 POUNDS/ACRE. ANNUAL GRASS PRODUCTION FLUCTUATED MUCH MORE THAN PERENNIAL GRASS PRODUCTION, VARYING FROM ESSENTIALLY NONE IN 1962, THE DRIEST YEAR, TO 425 POUNDS/ACRE IN 1959. THE 3 MAJOR FACTORS AFFECTING ANNUAL GRASS PRODUCTION INCLUDED RAINFALL, MESQUITE COMPETITION, AND PERENNIAL GRASS COMPETITION. DATA INDICATE LITTLE CHANGE IN MESQUITE COVER DURING THE STUDY PERIOD. MESQUITE COMPRISED 32 AND 38 PERCENT OF TOTAL THREE-SHRUB CROWN INTERCEPT ON MESQUITE-ALIVE PASTURES, BUT LESS THAN 2 PERCENT ON THE MESQUITE-KILLED PASTURES. MESQUITE CONTROL WAS BENEFICIAL IN INCREASING PERENNIAL GRASS COVER, THUS REDUCING RUNOFF AND SHEET EROSION. (OALS)

PROSOPIS/VEGETAL RELATIONSHIPS

19

CAMPBELL, I.A.

1970

CLIMATE AND OVERGRAZING ON THE SHONTO PLATEAU, ARIZONA.

PROFESSIONAL GEOGRAPHER 22(3):132-141. MGA 21.11-446. SWRA W71-04064.

ANALYSIS OF LONG-TERM CLIMATIC TRENDS FOR THE SHONTO PLATEAU REGION, DERIVED FROM DENDROCHRONOLOGIC AND OTHER RECORDS, SHOWS THAT EXTREMELY FAVORABLE VEGETATION GROWTH PERIODS PREVAILED DURING THE FIRST TWO DECADES OF THE 20TH CENTURY, FOLLOWING DRY CONDITIONS OF THE MIDDLE AND LATE 19TH CENTURY. THROUGHOUT THE 1930'S AND MOST OF THE 1940'S, DRY CONDITIONS PREVAILED AGAIN. UPON THIS AREA OF FLUCTUATING ECOSYSTEMS AN ADDITIONAL ECOLOGICAL IMBALANCE WAS IMPOSED FOR OVER A CENTURY THROUGH THE INTRODUCTION OF SHEEP RAISING AND CONSEQUENT HEAVY GRAZING. ON THE BASIS OF AVAILABLE DATA ON STOCK-CARRYING CAPACITIES OF THE PLATEAU, AND THE EXTENT OF OVERGRAZING, CHANGES IN THE VEGETATION COVER (E.G., INTRODUCTION OF THE RUSSIAN THISTLE; GULLYING, BEGINNING IN THE EARLY 1900'S; AND CLIMATIC VARIATIONS, ESPECIALLY MAJOR PRECIPITATION FLUCTUATIONS) HAVE ACCOUNTED FOR DETERIORATION OF THE VEGETATION MORE THAN OVERGRAZING PER SE.

VEGETATION CHANGE/OALS/WGM/ARIZONA/DENDROCHRONOLOGY/WEATHER PATTERNS/ SEMIARID CLIMATE/ECOSYSTEMS/GRAZING/DEGENERATION/UNDESIRABLE PLANTS/ SALSOLA/GULLY EROSION/CARRYING CAPACITY/CLIMATIC CHANGE/PLANT COVER/ CLIMATIC-VEGETAL RELATIONSHIPS

20

CASEY, H.E.

1972

SALINITY PROBLEMS IN ARID LANDS IRRIGATION: A LITERATURE REVIEW AND SELECTED BIBLIOGRAPHY.

U.S. OFFICE OF WATER RESOURCES RESEARCH, WASHINGTON, D.C., WATER RESOURCES SCIENTIFIC INFORMATION CENTER, OWRR 14-01-0001-1616, WRSIC 73-300. 300 P. AVAILABLE NTIS AS PB-214 172. SWRA W73-03910.

A BIBLIOGRAPHY OF 986 REFERENCES WITH ACCOMPANYING TEXT THAT REVIEWS BROADLY SUCH TOPICS AS WATER QUALITY AND THE TOTAL DRAINAGE BASIN, SALINITY PREVENTION AND SOIL RECLAMATION, SALINITY AND DROUGHT EFFECTS ON PLANTS, SOIL AND WATER SALTS, BASIC WATER BALANCE PROBLEMS IN RELATION TO IRRIGATION, PLUS A PERSPECTIVE ON HISTORIC SALINITY PROBLEMS AND AN OVERVIEW. SOCIOECONOMIC ASPECTS ARE CONSIDERED, WITH REFERENCE TO THE COLORADO RIVER BASIN AS AN EXAMPLE IN MICROCOSM. THERE IS DISCUSSION OF CURRENTLY USED AND POTENTIAL AMELIORATIVE TECHNIQUES THAT WOULD RENDER CURRENT METHODS MORE EFFICIENT, RAISE PRODUCTIVITY ENOUGH TO CONSTITUTE A BREAKTHROUGH AND HIGH-HUMIDITY LOW WATER-USE GREENHOUSE STRUCTURE THAT WOULD RADICALLY ALTER CURRENT ARID LANDS IRRIGATION METHODS. RECOMMENDATIONS INCLUDE: 1) STANDARD RECLAMATION PRACTICES SHOULD BE USED WHEREVER POSSIBLE; 2) INTENSIVE RESEARCH AND DEVELOPMENT EFFORTS SHOULD BE ENCOURAGED ON CROP GROWING METHODS CONSTITUTING MAJOR DEPARTURES FROM STANDARD IRRIGATION PRACTICES, OR THOSE THAT INCREASE CROP TOLERANCE TO SALINE WATERS AND SOILS; 3) NATIONAL GOVERNMENTS SHOULD RECOGNIZE THE SERIOUSNESS OF SALINITY PROBLEMS AND ACCORD THEM HIGH SCIENTIFIC PRIORITY; 4) INDEPENDENT INSTITUTES FOR INFORMATION-GATHERING AND RESEARCH DIRECTION SHOULD BE ESTABLISHED AND SUPPORTED; AND 5) PLANNING CONSTRUCTION AND LARGE-SCALE RECLAMATION PROJECTS SHOULD BE SUSPENDED OR SLOWED UNTIL A MORE BALANCED ASSESSMENT OF THEIR VIABILITY CAN BE DETERMINED.

OALS/BIBLIOGRAPHIES/SALINITY/SALTS/IRRIGATION WATER/WATER QUALITY/ ARID LANDS

21

CHALMERS, J.R.

1974

SOUTHWESTERN GROUNDWATER LAW: A TEXTUAL AND BIBLIOGRAPHIC INTERPRETATION.

UINVERSITY OF ARIZONA, TUCSON, OFFICE OF ARID LANDS STUDIES, ARID LANDS RESOURCES INFORMATION PAPER 4. 229 P. AVAILABLE NTIS AS PB-228 130. SWRA W74-04460.

THIS PAPER ATTEMPTS TO BRING TOGETHER UP-TO-DATE INFORMATION ON THE INTERPRETATION OF GROUNDWATER LAW DOCTRINES AND APPLIED WATER MANAGEMENT POLICIES IN THE SOUTHWESTERN STATES OF ARIZONA, CALIFORNIA, COLORADO, NEVADA, NEW MEXICO, TEXAS, AND UTAH, WHERE NONE IS ABLE TO MEET PRESENT WATER DEMAND FROM SURFACE SUPPLIES. THE RESULTING MINING OF GROUNDWATER, LARGELY TO MEET IRRIGATION NEEDS, IS CREATING A CRITICAL SITUATION THAT EACH OF THE STATES COVERED SEEKS TO MEET IN A VARIETY OF WAYS. THE DOCTRINES OF CORRELATIVE RIGHTS, THE ENGLISH COMMON LAW, PRIOR APPROPRIATION AND ITS CONTEMPORARY MODIFICATIONS, ARE ALL DISCUSSED, STATE BY STATE. WHILE ARIZONA HAS BEEN SELECTED TO SERVE AS A CASE STUDY TO PUT THE PROBLEM OF A DIMINISHING GROUNDWATER SUPPLY IN PERSPECTIVE, THERE IS ALSO A CHRONOLOGICAL SURVEY OF THE DEVELOPMENT OF GROUNDWATER RIGHTS LAW FOR EACH OF THE STATES. A FINAL CHAPTER DEALS WITH THE AUTHOR'S CONCEPT OF A STATUTORY REVISION OF ARIZONA'S CODE, WITH A MODIFIED PRIOR APPROPRIATION DOCTRINE RECOMMENDED. APPENDED IS A 180-ITEM COMPUTERIZED ANNOTATED BIBLIOGRAPHY.

OALS/GROUNDWATER/LEGAL ASPECTS/SOUTHWEST U.S./ARIZONA/CALIFORNIA/COLORADO/ NEVADA/NEW MEXICO/TEXAS/UTAH/BIBLIOGRAPHIES/CONJUNCTIVE USE/GROUNDWATER MINING/ WATER LAW/IRRIGATION WATER/PUMPING/PRIOR APPROPRIATION/REASONABLE USE/WATER RIGHTS/SURFACE-GROUNDWATER RELATIONSHIPS/WATER MANAGEMENT/COMPETING USES/WATER RESOURCES DEVELOPMENT

22

CHRISTENSEN, E.M./HUTCHINSON, M.A.

1965

HISTORICAL OBSERVATION ON THE ECOLOGY OF RUSH AND TOOELE VALLEYS, UTAH.

UTAH ACADEMY OF SCIENCES ARTS AND LETTERS, PROCEEDINGS 42(1):90-105.

RUSH AND TOOELE VALLEYS WERE OCCUPIED ORIGINALLY LARGELY BY PRAIRIE AND MEADOW VEGETATION, ON BOTH UPLANDS AND MOIST LOWLANDS. NORTHERN DESERT SHRUBS WERE PRESENT, BUT WERE DOMINANT ONLY IN LOCAL AREAS. UTAH JUNIPER COMMUNITIES WERE PRESENT IN PARTS OF THE VALLEYS, AND SALT DESERT SHRUBS OCCURRED ON SALTY SOILS. MARSH VEGETATION OCCURRED NEAR THE SOUTHERN SHORE OF GREAT SALT LAKE IN TOOELE VALLEY, AROUND RUSH LAKE IN RUSH VALLEY, AND OTHER LOWLAND AREAS. DISTRIBUTION OF THE PLANT COMMUNITIES OF THE SALINE AND WET SOILS OF THE TOOELE VALLEY AS MAPPED BY KEARNEY AND HIS ASSOCIATES (1914) REPRESENTS THE DISTRIBUTION OF PRE-SETTLEMENT VEGETATION. AFTER THE FIRST, SECOND OR THIRD DECADES FOLLOWING SETTLEMENT, EVIDENT CHANGES TOOK PLACE IN THE VEGETATION OF THE BENCH LANDS AND UPLANDS OF THESE VALLEYS. THE GRASSES BECAME LESS ABUNDANT AND THE WOODY SPECIES, PARTICULARLY SAGEBRUSH AND SHADSCALE BECAME MORE ABUNDANT. ORIGINAL VEGETATION HAD BEEN SO GREATLY MODIFIED BY 1929 THAT DUST STORMS OCCURRED COMMONLY DURING THE 1930'S. IN LOCAL AREAS PERENNIAL GRASSES BECAME MORE ABUNDANT RECENTLY AND DUST STORMS ARE NO LONGER FREQUENT, BUT THE CONTINUED INVASION OF JUNIPER IS EVIDENT, PARTICULARLY IN RUSH VALLEY. MOST OF THE BENCHLANDS AND FOOTHILLS ARE DOMINATED PRESENTLY BY SAGEBRUSH, SHADSCALE, AND OTHER DESERT SHRUBS, AND THE MOST ABUNDANT GRASS IS THE EXOTIC ANNUAL CHEATGRASS. TOOELE VALLEY WAS THE HABITAT FOR A VARIETY OF MAMMALS AT THE TIME OF SETTLEMENT. SEVERAL BIRDS, FISH, AND INSECTS WERE ALSO REPORTED.

OALS/WGM/HISTORY/UTAH/VEGETATION/TOOELE VALLEY/GRASSES/DESERT PLANTS/SHRUBS/ PLANT COMMUNITIES/SOIL TYPES/PLANT DISTRIBUTION/ARTEMISIA/ATRIPLEX/JUNIPERUS/ FLOODS/DUST STORMS/PLANT INVADERS/BROMUS/WILDLIFE HABITATS

23

CHRISTENSEN, E.M./JOHNSON, H.B.

1964

PRESETTLEMENT VEGETATION AND VEGETATIONAL CHANGE IN THREE VALLEYS IN CENTRAL UTAH.

BRIGHAM YOUNG UNIVERSITY, PROVO, UTAH, SCIENCE BULLETIN, BIOLOGICAL SERIES 4(4). 16 P.

HISTORICAL INFORMATION, SURVEY RECORDS, AND RELICT VEGETATION WERE USED AS SOURCES OF DATA FOR DETERMINING THE NATURE OF THE PRESETTLEMENT VEGETATION OF PAVANT, ROUND AND JUAB VALLEYS IN UTAH. SIGNIFICANT CHANGES IN PRESETTLEMENT VEGETATION HAD OCCURRED BY 1900. IN GENERAL, THERE WAS A TRANSITION FROM A PREDOMINANCE OF PERENNIAL GRASSES TO ONE OF SAGEBRUSH THROUGHOUT THE FOOTHILLS AND BENCHLANDS, AND GRASSES BECAME LESS ABUNDANT IN THE SHRUB COMMUNITIES. AFTER 1870 JUNIPER INCREASED IN DENSITY AND INVADED AREAS THAT WERE FORMERLY DOMINATED BY GRASSES. THESE CHANGES ACCOMPANIED THE USE OF THESE AREAS AS RANGELANDS FOR LIVESTOCK. IN THIS CENTURY SEVERAL EXOTIC SPECIES HAVE BECOME IMPORTANT. THE RATES OF MIGRATION SINCE 1870 OF TWO GROUPS OF UNSTABLE SAND DUNES IN PAVANT VALLEY WERE DETERMINED TO BE 53.5 AND 60.9 FEET PER YEAR.

OALS/UTAH/GREAT BASIN/VEGETATION/GRAZING/GRASSES/DUNES/WIND EROSION/ SHRUBS/JUNIPERUS/HISTORY /SEMIARID CLIMATE/GRASSLAND BIOME/NORTHERN DESERT SHRUB/VEGETATION CHANGE/PERTURBATION

24

CLAUSEN, G.S.

1970

OPTIMAL OPERATION OF WATER-SUPPLY SYSTEMS.

UNIVERSITY OF ARIZONA (PH.D. DISSERTATION). 153 P. DISS ABSTR (30)B: ORDER NO. 70-10,570. ALSO CITED AS OWRR PROJECTS A-010-ARIZ(19) AND B-007-ARIZ(5), TECHNICAL REPORT 1. 142 P. SWRA W71-04042.

THE TRADITIONAL WATER-SUPPLY PLANNING PROBLEM IS CHARACTERIZED BY TWO MAIN STEPS: 1) PROJECT FUTURE WATER REQUIREMENTS BASED ON PRESENT RATES OF ECONOMIC GROWTH, AND 2) SCHEDULE WATER DEVELOPMENT PROJECTS TO BE INTRODUCED INTO THE SYSTEM ON TIME TO MEET THESE PREDICTED REQUIREMENTS. IF ALTERNATIVE PROJECTS ARE THOUGHT TO EXIST, THE ONE THOUGHT TO COST THE LEAST AMOUNT IS SELECTED. AS PROJECT COSTS RISE AND ACTUAL NEW WATER AVAILABILITIES BECOME LESS, THERE IS A GROWING AWARENESS THAT MORE NEW WATER IS NOT NECESSARILY THE ONLY ANSWER. INCREASED EFFICIENCY IN WATER USE THROUGH CONSERVATION, REUSE TRANSFER TO LESS CONSUMPTIVE AND HIGHER VALUED APPLICATIONS, AND IMPROVED MANAGEMENT TECHNIQUES ARE BECOMING PRACTICAL ALTERNATIVES. THESE ALTERNATIVES LEAD TO A NEED FOR A RESTATEMENT OF WATER-SUPPLY PLANNING OBJECTIVES IN MORE PRECISE FORMS THAN HAVE HERETOFORE BEEN PUT FORTH. AN OBJECTIVE FUNCTION USED TO EXPRESS THE WATER-SUPPLY PROBLEM IN THE TUCSON BASIN, ARIZONA, CONSIDERS GAINS AS CASH REVENUE TO A HYPOTHETICAL CENTRAL WATER-CONTROL AGENCY WHICH SELLS WATER TO THE USERS WITHIN THE BASIN. LOSSES ARE CONSIDERED AS MARGINAL COSTS TO THE AGENCY FOR PRODUCING, TREATING, AND DISTRIBUTING WATER. THE CONCEPT OF ECONOMIC DEMAND IS USED TO ESTIMATE THE AMOUNT OF WATER THAT MUNICIPAL, AGRICULTURAL, AND INDUSTRIAL USERS WILL PURCHASE AT DIFFERENT PRICES. THE POSSIBLE SOURCES OF SUPPLY CONSIDERED ARE GROUNDWATER FROM WITHIN THE BASIN, GROUNDWATER FROM THE NEIGHBORING AVRA VALLEY BASIN, RECLAIMED WASTE WATER, AND CENTRAL ARIZONA PROJECT WATER FROM THE COLORADO RIVER. CONSTRAINTS ARE FORMULATED IN ORDER TO DETERMINE OPTIMAL ALLOCATIONS OF WATER UNDER DIFFERENT CONDITIONS. (AUTHOR)

OALS/WATER SUPPLY/ARIZONA/WATER COSTS/TUCSON BASIN/AVRA VALLEY/WATER RESOURCES DEVELOPMENT/MATHEMATICAL MODELS

25

CLYMA, W./YOUNG, R.A.

1968

ENVIRONMENTAL EFFECTS OF IRRIGATION IN THE CENTRAL VALLEY OF ARIZONA.

AMERICAN SOCIETY OF CIVIL ENGINEERS, NATIONAL MEETING ON ENVIRONMENTAL ENGINEERING, CHATTANOOGA, TENNESSEE, MAY 13-17, PREPRINT. 28 P. SWRA W70-07053.

IRRIGATION HAS MODIFIED THE ENVIRONMENT OF THE CENTRAL VALLEY OF ARIZONA FOR THE PAST 2500 YEARS, BEGINNING WITH THE IRRIGATION SYSTEMS OF THE HOHOKAM INDIANS. MODIFICATION OF THE PHYSICAL ENVIRONMENT HAS INCLUDED CHANGES IN CLIMATE, GROUNDWATER, SURFACE WATER AND VEGETATION. THE SOCIAL ENVIRONMENT HAS BEEN CHANGED FROM A RURAL ECONOMY TO AN URBAN INDUSTRIAL ECONOMIC SYSTEM. PRESENT AND FUTURE PROBLEMS RELATED TO IRRIGATION IN THE AREA ARE DISCUSSED. SOME OF THE PROBLEMS ARE WATER DEMAND, LAND SUBSIDENCE, SALINITY, GROUND-WATER MANAGEMENT, AND ALLOCATION OF COLORADO RIVER WATER. SOLUTIONS TO SOME OF THESE PROBLEMS ARE SUGGESTED. (OALS)

ARIZONA/ENVIRONMENTAL EFFECTS/IRRIGATION EFFECTS/WATER SUPPLY/WATER RESOURCES DEVELOPMENT/IRRIGATION/IRRIGATION WATER/CLIMATE/VEGETATION/ GROUNDWATER/GROUNDWATER MINING/SALINITY/SURFACE WATERS/WATER UTILIZATION/WATER RESOURCES/WATER TRANSFER/WATER QUALITY/SOCIAL ASPECTS/SALT RIVER VALLEY/OALS

26

CONSELMAN, F.B.

1970

THE SIGNIFICANCE OF THE OGALLALA FORMATION IN TEXAS. IN THE OGALLALA AQUIFER, A SYMPOSIUM.

TEXAS TECH UNIVERSITY, LUBBOCK, INTERNATIONAL CENTER FOR ARID AND SEMI-ARID LAND STUDIES, SPECIAL REPORT 39:2-4. SWRA W71-08349.

THE OGALLALA AQUIFER OF TEXAS UNDERLIES 35,000 SQUARE MILES, AND HAS AN AVERAGE SATURATED RESERVOIR THICKNESS OF 140 FEET. POROSITY AVERAGES 30 PERCENT, AND SPECIFIC YIELD IS 15 PERCENT. TRANSMISSIBILITY IS ABOUT 30,000 GALLONS PER DAY PER FOOT. IN 1968 THE TEXAS OGALLALA PROVIDED 9.8 MILLION ACRE-FEET OF WATER, EQUAL TO 73 PERCENT OF ALL THE GROUNDWATER WITHDRAWALS IN TEXAS. MOREOVER, WATER WITHDRAWN AS GROUNDWATER FROM THE OGALLALA WAS ALMOST TWICE AS MUCH AS THE TOTAL WATER USAGE FROM ALL SURFACE STORAGE IN THE STATE. IRRIGATION GETS MOST OF THE PRESENT WITHDRAWALS; MUNICIPAL AND INDUSTRIAL USE GETS ABOUT 22 PERCENT, AND A SMALL PERCENTAGE IS USED IN WATER-FLOODING OF OIL FIELDS FOR SECONDARY RECOVERY. THESE WITHDRAWALS FAR EXCEED RECHARGE RATES. (USGS)

OGALLALA FORMATION/TEXAS/AQUIFERS/WITHDRAWAL/GROUNDWATER/GROUNDWATER RECHARGE/ WATER UTILIZATION

27

COOPERRIDER, C.K./HENDRICKS, B.A.

1937

SOIL EROSION AND STREAM FLOW ON RANGE AND FOREST LANDS OF THE UPPER RIO GRANDE WATERSHED IN RELATION TO LAND RESOURCES AND HUMAN WELFARE.

U.S. DEPARTMENT OF AGRICULTURE, TECHNICAL BULLETIN 567. 88 P.

THEORIES THAT CLIMATIC AND GEOLOGIC CHANGES HAVE CAUSED ACCELERATED RUNOFF AND EROSION DO NOT SEEM TENABLE. HISTORICAL EVIDENCE SHOWS THAT THE RECENT GENERAL DECLINE OF WATERSHED LANDS AND RESOURCES BEGAN DURING THE 1880'S FOLLOWING THE IMPAIRMENT OF THE NATURAL VEGETATION COVER PRINCIPALLY THROUGH OVER-GRAZING AND ALSO THROUGH WANTON TIMBER CUTTING, MAN CAUSED FIRES, PROMISCUOUS WAGON TRAILING, AND UNJUDICIOUS DRY FARMING. A COMPARISON OF VEGETATION, SOILS, AND EROSION UNDER GOOD AND POOR LAND MANAGEMENT.

OALS/WGM/SOIL EROSION/STREAMFLOW/RANGES/RIO GRANDE VALLEY/WATERSHED MANAGEMENT/HISTORY/GRAZING/BURNING/VEGETATION/SOIL TYPES/EROSION/ NATURAL RESOURCES/LAND USE/LAND MANAGEMENT/DEGENERATION

28

COSTELLO, D.F./TURNER, G.T.

1941

VEGETATION CHANGES FOLLOWING EXCLUSION OF LIVESTOCK FROM GRAZED RANGES.

JOURNAL OF FORESTRY 39(3):310-315.

THE STUDY WAS BASED ON EXAMINATION OF PROTECTED AREAS, CEMETERIES, MUNICIPAL WATERSHEDS AND PERMANENT ENCLOSURES INCLUDING 29 TWO-ACRE FENCED ENCLOSURES ON THE CENTRAL PLAINS EXPERIMENTAL RANGE. THE MOST EVIDENT DIFFERENCE BETWEEN GRAZED AND UNGRAZED AREAS WAS IN THE DENSITY OF VEGETATION, WITH GRASSES GENERALLY DENSER UNDER NO GRAZING. WEEDS HAD GREATER DENSITIES UNDER PROTECTION IN MOST INSTANCES, BECAUSE PLANTS WERE ABOUT THE SAME INSIDE AND OUT. THE DIFFERENCES BETWEEN OUTSIDE AND INSIDE OF PROTECTED AREAS, ARE INFLUENCED BY CONDITIONS AT TIME OF ENCLOSURE, SIZE OF PROTECTED AREA, TIME, RODENTS AND OTHER WILDLIFE, CLASS OF LIVESTOCK, TYPE OF VEGETATION, DISTURBANCES, LOCATION ON GRAZING UNIT, CLIMATIC CYCLES, AND OTHER FACTORS.

OALS/WGM/SWERVE/UNGRAZED/VEGETATION CHANGE/DENSITY/VEGETATION/ PERTURBATION/GRAZING/FORAGE GRASSES/GRASSES/WEEDS/COLORADO/WYOMING

29

COTTAM, W.P.

1929

MAN AS A BIOTIC FACTOR ILLUSTRATED BY RECENT FLORISTIC AND PHYSIOGRAPHIC CHANGES AT THE MOUNTAIN MEADOWS, WASHINGTON COUNTY, UTAH.

ECOLOGY 10:361-363.

THE MOUNTAIN MEADOWS ABOUT 10 MILES LONG BY A MILE WIDE, WERE FORMERLY CLOTHED WITH A VARIETY OF LUXURIANT GRASSES, AND FRESH WITH NUMEROUS SPRINGS AND CLEAR WATER. OVERGRAZING, WHICH STARTED DEEP WASHES IN THE LOWER MARGIN, WAS FOLLOWED IN 1880, AFTER 10 YEARS OF DROUGHT, BY AN UNUSUAL FLOOD RESULTING FROM A RAIN ON TOP OF 3 FEET OF SNOW. A WASH 30 FEET DEEP WAS CUT THROUGH THE ENTIRE LENGTH OF THE MEADOW. THE DRY CONDITIONS RESULTING FROM THIS DRAINAGE TRANSFORMED THE AREA INTO A DRY SAGEBRUSH ASSOCIATION.

OALS/WGM/SWERVE/UTAH/GRAZING/GULLY EROSION/RANGE MANAGEMENT/ PERTURBATION/ARTEMISIA/VEGETATION CHANGE/DESERTIFICATION

30

COTTAM, W.P./EVANS, F.R.

1945

A COMPARATIVE STUDY OF THE VEGETATION OF GRAZED AND UNGRAZED CANYONS OF THE WASATCH RANGE, UTAH.

ECOLOGY 26(2):171-181.

TWO CANYONS IN THE WASATCH MOUNTAINS NEAR SALT LAKE CITY WERE COMPARED; RED BUTTE CANYON HAD BEEN PROTECTED FROM GRAZING FOR 40 YEARS, WHILE EMIGRATION CANYON HAD BEEN GRAZED HEAVILY SINCE SETTLEMENT IN 1847. EVIDENCE POINTS TO THE COMPLETE SUBSTITUTION OF THE ORIGINAL GRASS TYPE IN EMIGRATION CANYON TO ONE WITH UNPALATABLE SHRUBS AND BROMUS TECTORUM WHILE RED BUTTE CANYON HAS MAINTAINED A RICH PLANT COVER INCLUDING TEN NATIVE GRASSES NOT FOUND IN EMIGRATION CANYON. SHEET AND GULLY EROSION ARE PROMINENT IN EMIGRATION CANYON.

VEGETATION/OALS/WGM/SWERVE/UTAH/GRAZING/UNGRAZED/SHEET EROSION/GULLY EROSION/VEGETATION CHANGE/PERTURBATION/LAND MANAGEMENT/VEGETATION/ RANGE MANAGEMENT

31

COTTAM, W.P./STEWART, G.

1940

PLANT SUCCESSION AS A RESULT OF GRAZING AND MEADOW DESICCATION BY EROSION SINCE SETTLEMENT IN 1862.

JOURNAL OF FORESTRY 38(8):613-626.

RECORD OF VEGETATION CHANGE SINCE 1862 IN MOUNTAIN MEADOWS VALLEY, WASHINGTON COUNTY, UTAH. DEPLETION OF COVER ALLOWED TORRENTIAL RAINS TO CUT A DEEP WASH IN 1884. WET AND DRY MEADOWS ONCE DOMINATED BY JUNCUS, SEDGES AND GRASSES ARE NOW SAGEBRUSH, RABBITBRUSH AND JUNIPER.

OALS/WGM/SWERVE/SUCCESSION/UTAH/GRAZING/HISTORY/EROSION/SOIL EROSION/ DESICCATION/MOISTURE DEFICIT/PERTURBATION/VEGETATION CHANGE/ARTEMISIA/ CHRYSOTHAMNUS/JUNIPERUS

32

COUPLAND, R.T.

1958

THE EFFECTS OF FLUCTUATIONS IN WEATHER UPON THE GRASSLANDS OF THE GREAT PLAINS.

BOTANICAL REVIEW 24(5):273-317.

WHEN DROUGHT IS OF SUFFICIENT DURATION TO CAUSE THE DEATH OF NATIVE SPECIES BY DESICCATION, A CONSIDERABLE MODIFICATION IN THE FLORISTIC COMPOSITION OF THE VEGETATION RESULTS. SOME SPECIES ARE ABLE TO SURVIVE BY GOING INTO DROUGHT DORMANCY. REDUCTION IN BASAL COVER, HEIGHT, FORAGE YIELD AND SEED PRODUCTION ARE CHARACTERISTIC OF SPECIES UNDERGOING DROUGHT CONDITIONS, EVEN OF SHORT DURATION, WHILE DEPTH OF ROOTING IS REDUCED DURING DRY PERIODS OF LONGER DURATION. EFFECTS OF DROUGHT ARE NOT LIMITED TO THOSE OF DESICCATION. WHERE LAYERS OF DUST ARE DEPOSITED, MOISTURE PENETRATION MAY BE SO AFFECTED THAT THE HABITAT IS TRANSFORMED AND OCCUPIED BY OTHER SPECIES; VEGETATION CHANGES IN THE GREAT PLAINS RESULTING FROM THE DROUGHT OF THE 1930'S ARE DISCUSSED AND RELATED TO THE RECOVERY PERIOD AND THE DROUGHT OF THE EARLY 1950'S. A COMPLETE DESCRIPTION OF A VEGETATION TYPE SHOULD INCLUDE AN INDICATION OF THE EXTENT TO WHICH IT MAY PROGRESS IN THE DIRECTION OF FAVORING THE MID GRASSES DURING MOIST PERIODS AND THE SHORT GRASSES DURING XERIC ONES. OTHERWISE THE SAME COMMUNITY MAY BE VARIOUSLY CHARACTERIZED BY DIFFERENT WORKERS AT DIFFERENT TIMES.

OALS/WGM/SWERVE/CLIMATIC CHANGE/DROUGHTS/DROUGHT TOLERANCE/SEMIARID CLIMATE/SHORTGRASS/SHORT GRASSES/GRASSLAND BIOME/MID GRASSES/ VEGETATION TYPES/PLAINS/GREAT PLAINS/ENVIRONMENT/VEGETATION CHANGE

33

DAUBENMIRE, R.F.

1951

AFFORESTATION PROBLEMS IN ARID NORTH AMERICA.

INTERNATIONAL UNION OF BIOLOGICAL SCIENCES, SER. B(9):81-83.

DROUGHT HAS PROVEN THE KEY FACTOR IN AFFORESTATION OF ARID LANDS. SUCCESS DEPENDS UPON THE DEGREE TO WHICH ADVANTAGE IS TAKEN OF 1) COARSE SOILS WHICH FAVOR DEEP ROOTED TREES, 2) DEPRESSIONS IN TOPOGRAPHY WHICH SLIGHTLY INCREASE AVAILABLE MOISTURE AND DECREASE TRANSPIRATION, 3) SLOPES DIRECTED AWAY FROM SUN AND WIND, AND 4) AVOIDANCE OF SOILS WITH HIGH SALINITY, CALCIUM CARBONATE, ETC.

ARID CLIMATE/OALS/WGM/REFORESTATION/AFFORESTATION/LAND RECLAMATION/ SOUTHWEST U.S./GREAT BASIN/SOIL TYPES/SLOPE EXPOSURE/MICROENVIRONMENT/ DROUGHTS/TREES/WOODY PLANTS/SWERVE

34

DENEVAN, W.M.

1967

LIVESTOCK NUMBERS IN NINETEENTH-CENTURY NEW MEXICO AND PROBLEMS OF GULLY IN THE SOUTHWEST.

ASSOCIATION OF AMERICAN GEOGRAPHERS, ANNALS 57(4):691-703. GA 69A-990.

SOUTHWEST U.S./LIVESTOCK/GULLY EROSION/SOIL EROSION

35

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 REVIEWED. 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.

OALS/WGM/SWERVE/VEGETATION/SOUTHWEST U.S./HISTORY/GRASSLAND BIOME/ DESERT GRASSLAND/VEGETATION CHANGE/RANGE MANAGEMENT/ARIZONA/NEW MEXICO/ TEXAS/LAND USE/PERTURBATION

36

DORTIGNAC, E.J.

1963

RIO PUERCO: ABUSED BASIN. IN C. HODGE AND P.C. DUISBERG, EDS., ARIDITY AND MAN.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, PUBLICATION 74:507-515.

THE HISTORY OF THIS BASIN IS AN EXAMPLE OF MAN'S FAILURE TO LIVE IN HARMONY WITH SOIL, TOPOGRAPHY, VEGETATION AND CLIMATE. THE HISTORY OF DROUGHTS, SETTLEMENT AND GRAZING ARE VIEWED IN RELATION TO A SEQUENCE OF EVENTS THAT LED TO THE BREAKDOWN IN THE CLIMATE-SOIL-VEGETATION EQUILIBRIUM. THIS IN TURN RESULTED IN AN EROSION CYCLE WITH RESULTANT GULLY-DISSECTED ALLUVIUM AND SEDIMENTATION OF THE RIO GRANDE. MUCH OF THE IRRIGATED LAND WAS DESTROYED AND ABANDONED. COST OF RECLAMATION MAY BE PROHIBITIVE, BUT SOME REVEGETATION IS IN PROGRESS. THE AUTHOR LEAVES US WITH THE QUESTION, COULD THIS DETERIORATION HAVE BEEN PREVENTED.

RIO GRANDE VALLEY/SOIL-WATER-PLANT RELATIONSHIPS/WATERSHEDS(BASINS)/ OALS/SOUTHWEST U.S./ARID LANDS/RANGE MANAGEMENT/NEW MEXICO/RIVER BASINS/EROSION/GULLY EROSION/SOIL EROSION/SEDIMENTATION/HISTORY/ DEGENERATION/DROUGHTS/SETTLEMENTS/GRAZING/PERTURBATION

37

DOUGLASS, A.E.

1914

A METHOD OF ESTIMATING RAINFALL BY THE GROWTH OF TREES.

AMERICAN GEOGRAPHICAL SOCIETY, BULLETIN 46(5):321-335.

THIS CLASSIC STUDY INTRODUCED THE TECHNIQUE OF RELATING TREE RING GROWTH TO PAST CLIMATIC PHENOMENA. STUDIES CENTERED IN FLAGSTAFF AND PRESCOTT, ARIZONA ON THE YELLOW PINE (PINUS PONDEROSA). RING GROWTH IS CORRELATED WITH YEARLY MEANS OF EFFECTIVE PRECIPITATION, AND PROBLEMS OF INTERPRETATION AND ERROR ARE DISCUSSED. 500 YEAR CURVES WERE DRAWN FOR FLAGSTAFF IN ORDER TO SEARCH FOR CLIMATIC CYCLES. CYCLIC OCCURRENCES OF 33, 21, AND 11 YEAR PERIODS ARE DISCUSSED. THE 11-YEAR CYCLE CORRESPONDS TO SUN SPOT CYCLES AND SEVERAL METEOROLOGICAL PHENOMENA IN COASTAL CALIFORNIA.

KWIC WC 32/OALS/ARIZONA/CLIMATOLOGY/PINUS PONDEROSA/ANALYTICAL TECHNIQUES/PALEOCLIMATOLOGY/DENDROCHRONOLOGY/CLIMATIC CHANGE

38

DRESCH, J.

1970

A PROPOS DU DESERT DE CHIHUAHUA (MEXIQUE).

ANNALES DE GEOGRAPHIE 79(431):51-57.

LE DESERT DE CHIHUAHUA AU MEXIQUE SEPTENTRIONAL N'EST QU'UN SEMI-DESERT TEMPERE PAR L'ALTITUDE, DE HAUTES PLAINES D'ACCUMULATION EN PLUSIEURS NIVEAUX, ENNOYANT UN RELIEF DIFFERENCIE. LES FORMATIONS SONT RAPIDEMENT DECRITES.

MEXICO/CHIHUAHUAN DESERT/TOPOGRAPHIC FEATURES

39

FIREMAN, B.

1971

USE AND ABUSE OF SOUTHWESTERN RIVERS. HYSTORIC MAN--THE ANGLO. IN HYDROLOGY AND WATER RESOURCES IN ARIZONA AND THE SOUTHWEST, 1:397-403.

AMERICAN WATER RESOURCES ASSOCIATION, ARIZONA SECTION/ARIZONA ACADEMY OF SCIENCE, HYDROLOGY SECTION, PROCEEDINGS OF THE 1971 MEETINGS, TEMPE, ARIZONA. SWRA W72-02238.

THE EXPLOITATION OF SOUTHWESTERN RIVERS IS DISCUSSED IN THE CONTEXT OF AMERICAN INTRUSION, ACQUISITION AND DEVELOPMENT OF ARIZONA. THE FIRST AMERICANS IN THE REGION WERE BEAVER TRAPPERS WHO QUICKLY DECIMATED THE SONORAN BEAVER BUT OTHERWISE WROUGHT LITTLE ENVIRONMENTAL IMPACT. IMMEDIATELY FOLLOWING THE ACQUISITION OF THE REGION BY THE U.S. AFTER THE MEXICAN WAR, GOLD MINERS DESCENDED UPON IT FROM CALIFORNIA. THEY QUICKLY SCARRED HILLS AND STREAMS, DIVERTING WATER FOR PLACERS, BUILDING PILES OF RUBBLE AND LOGGING OFF ENTIRE FORESTS. THE LARGE NUMBERS OF PEOPLE AND TOWNS THAT FOLLOWED CREATED A NEED FOR MORE HOME GROWN FOOD PRODUCTS AND LARGE STORAGE DAMS WERE SOON BUILT. WHEN THESE WASHED OUT THE STORED FLOODWATERS DID MORE SHARP, TRAGIC DAMAGE DOWNSTREAM THAN EVEN THE SEASONAL FLOODS OF THE PAST. THE COMMON MUNICIPAL PRACTICE OF DUMPING RAW SEWAGE INTO WATERWAYS SOON BROUGHT WATER POLLUTION. FOLLOWING THE NATIONAL RECLAMATION ACT OF 1902, LARGE DAMS WERE SOON BUILT ON MAJOR WATERWAYS AND THE MULTIPLE USE PROJECTS CAME INTO EXISTENCE. TODAY, EVEN THE INDIANS HAVE LEARNED A MAJOR LESSON FROM THE WHITES--THE RIVERS THEY USED ONLY FOR BASIC NEEDS A CENTURY AGO, MAY BE MORE PROFITABLE IF OVERUSED WITHOUT REGARD FOR TOMORROW. (OALS)

OALS/RIVER BASINS/WATER RESOURCES DEVELOPMENT/DAMS/ARID LANDS/ARIZONA/ WATER CONSERVATION/HISTORY/SOUTHWEST U.S./WATER RESOURCES/WATER POLLUTION

40

FISHER, R.G.

1934

SOME GEOGRAPHIC FACTORS THAT INFLUENCED THE ANCIENT POPULATIONS OF THE CHACO CANYON, NEW MEXICO.

UNIVERSITY OF NEW MEXICO BULLETIN, ARCHAEOLOGY, SER. 3(1):3-24.

SOUTHWEST U.S./REGIONAL GEOGRAPHY/HUMANS/PREHISTORY/ARCHAEOLOGY/NEW MEXICO/ INDIANS OF NORTH AMERICA

41

FRASIER, G.W. ED.

1975

WATER HARVESTING SYMPOSIUM, MARCH 26-28, 1974, PHOENIX, ARIZONA, PROCEEDINGS.

U.S. AGRICULTURAL RESEARCH SERVICE, W-22. 329 P.

VARIOUS WATER HARVESTING AND STORAGE TECHNIQUES ALONG WITH APPLICATIONS TO FARMING ARE DESCRIBED IN 30 TECHNICAL REPORTS PRESENTED HEREIN. THE MAJORITY OF PAPERS DISCUSS RESULTS OF LARGE-SCALE FIELD EXPERIMENTS DESCRIBING DIFFERENT APPLICATIONS TO RENDER THE RUNOFF AREA AND/OR THE STORAGE POND IMPERMEABLE, INCLUDING ECONOMIC ASPECTS AND PRACTICABILITY OF THE TREATEMENT. (OALS)

OALS/WATER HARVESTING/RUNOFF/RAINFALL-RUNOFF RELATIONSHIPS/WATER STORAGE/WATER QUALITY/WATER YIELD IMPROVEMENT/SOIL SEALANTS/SOIL TREATMENT/SEALANTS/SOIL COMPACTION/SEEPAGE/CATCHMENTS/RUNOFF FARMING/ PRECIPITATION(ATMOSPHERIC)/ARIZONA/WATER-REPELLENT SOILS/RESERVOIRS/ MODELS/EVAPORATION/SURFACE WATERS/PLANT GROWTH

42

FRITTS, H.C.

1965

TREE-RING EVIDENCE FOR CLIMATIC CHANGES IN WESTERN NORTH AMERICA.

MONTHLY WEATHER REVIEW 93(7):421-443.

THE RELATIONSHIPS BETWEEN CLIMATIC FACTORS AND FLUCTUATIONS IN DATED TREE-RING WIDTHS ARE STATISTICALLY EVALUATED. A WIDE RING INDICATES THAT THE YEAR'S CLIMATE WAS MOIST AND COOL, AND A NARROW RING DRY AND WARM. IN GENERAL, RING WIDTH RELATED TO A 14-MONTH PERIOD FROM JUNE THROUGH JULY BUT MOST TREE-RING CHRONOLOGIES EXHIBIT A CLOSER RELATIONSHIP WITH AUTUMN, WINTER, AND SPRING MOISTURE THAN WITH SUMMER MOISTURE. THE CLIMATIC RELATIONSHIPS FOR EVERGREEN TREES ARE ATTRIBUTED LARGELY TO THE INFLUENCE OF ENVIRONMENTAL FACTORS ON PHOTOSYNTHESIS AND THE ACCUMULATION OF FOOD RESERVES. UNDER ABNORMALLY DRY AND WARM CONDITIONS, ESPECIALLY DURING THE AUTUMN, WINTER, AND SPRING, LITTLE FOOD IS ACCUMULATED, NEW CELLS ARE FORMED MORE SLOWLY DURING THE GROWING PERIOD, AND THE RESULTING RING IS NARROW. RELATIVE 10-YEAR DEPARTURES ARE CALCULATED FOR THE ENTIRE LENGTH OF 26 TREE-RING CHRONOLOGIES FROM WESTERN NORTH AMERICA. THOSE PORTIONS AFTER 1500 ARE USED TO MAP AREAS OF HIGH AND LOW MOISTURE. PERIODS OF WIDESPREAD DROUGHT ARE NOTED IN 1576-1590, 1626-1635, 1776-1785, 1841-1850, 1871-1880, 1931-1970. PERIODS OF WIDESPREAD AND ABOVE AVERAGE MOISTURE OCCURRED DURING 1611-1625, 1641-16250, 1741-1755, 1626-1840, 1906-1920. THE MOIST PERIODS OF 1911-1925, AND 1906-1920 WERE MOST WIDESPREAD AND MARKEDLY ABOVE AVERAGE. (AUTHOR)

OALS/SOUTHWEST U.S./DENDROCHRONOLOGY/CLIMATOLOGY/DROUGHTS/WEST U.S./ ANALYTICAL TECHNIQUES/CLIMATIC CHANGE

43

FRITTS, H.C. ET AL

1971

MULTIVARIATE TECHNIQUES FOR SPECIFYING TREE-GROWTH AND CLIMATE RELATIONSHIPS AND FOR RECONSTRUCTING ANOMALIES IN PALEOCLIMATE.

JOURNAL OF APPLIED METEOROLOGY 10(5):845-864. SWRA W71-07055.

FEW LONG-TERM CLIMATIC RECORDS ARE AVAILABLE FOR WESTERN NORTH AMERICA BECAUSE OF LOW POPULATION DENSITIES AND RECENT SETTLEMENT. ALTHOUGH TREE RINGS CAN BE PRECISELY DATED AND THEIR WIDTHS CAN BE USED TO EXTEND THE CLIMATIC RECORD BACKWARDS IN TIME, THE USEFULNESS OF THIS METHOD HAS BEEN LIMITED. TREE-RING DATA REPRESENT A GREAT VARIETY OF RESPONSES TO THE ENVIRONMENT WHICH GENERATES AN AWKWARD NUMBER OF VARIABLES FOR DATA PROCESSING. UNTIL RECENTLY, IT WAS NECESSARY TO SELECT HIGHLY STRATIFIED SAMPLES WHOSE GROWTH HAS BEEN SIMILARLY LIMITED BY A SMALL NUMBER OF ENVIRONMENTAL VARIABLES. ADVANCES IN COMPUTER PROCESSING TECHNIQUES AND MULTIVARIATE STATISTICAL ANALYSIS HAVE ALLEVIATED SOME OF THE DATA GATHERING RESTRICTIONS. ENVIRONMENTAL VARIABLES ARE DIAGRAMMED AND RESPONSE FUNCTIONS DERIVED WHICH RELATE RING-WIDTH CHRONOLOGIES TO SEASONAL CLIMATIC CHRONOLOGIES. A LARGE NUMBER OF CLIMATIC VARIABLES WERE CALIBRATED USING MULTIVARIATE ANALYSES. A SERIES OF TRANSFER FUNCTIONS ALLOWED ESTIMATES OF ANOMALOUS CLIMATIC VARIATIONS FROM THE TREE-RING RECORDS AND FOR PERIODS WITHOUT WHICH CLIMATIC RECORDS ARE AVAILABLE. RECONSTRUCTION OF THE ANOMALOUS VARIATIONS WERE OBTAINED BACK TO 1700 A.D. THE RESULTS INDICATE THAT MULTIVARIATE ANALYSIS COULD WELL REVOLUTIONIZE DENDROCHRONOLOGY BY LIBERATING IT FROM THE RESTRICTIONS OF ARID FOREST BORDERS AND ARCTIC TREELINES.

OALS/PRECIPITATION(ATMOSPHERIC)/ANALYTICAL TECHNIQUES/ DENDROCHRONOLOGY/CLIMATIC DATA/HISTORY/PLANT GROWTH/ENVIRONMENTAL EFFECTS/NORTH AMERICA/TIME MEASUREMENT /PALEOCLIMATOLOGY

44

FRITTS, H.C. ET AL

1976

RECONSTRUCTION OF PAST CLIMATIC VARIABILITY. FINAL TECHNICAL REPORT, JUNE 30, 1972-SEPTEMBER 30, 1975, CONTRACT AFOSR 72-2406, ADVANCED RESEARCH PROJECTS AGENCY/IPT, ARLINGTON, VIRGINIA.

UNIVERSITY OF ARIZONA, TUCSON, LABORATORY OF TREE-RING RESEARCH. 148 P.

RESULTS FROM THE FIRST 3 YEARS OF A 5-YEAR PROJECT TO RECONSTRUCT PAST CLIMATIC FLUCTUATIONS IN THE NORTHERN HEMISPHERE FROM VARIATIONS IN THE GROWTH RINGS OF TREES. THE MOST SIGNIFICANT RESULTS INCLUDE A GROWING INTERNATIONAL COLLABORATION STIMULATED BY THIS RESEARCH EFFORT, AND THE DEVELOPMENT OF 127 HIGH QUALITY TREE-RING CHRONOLOGIES FROM NORTH AMERICA AND EUROPE. RINGS OF TREES PROVIDE A VALUABLE RECORD OF ANNUAL VARIATIONS IN PAST CLIMATE SINCE THEY CAN BE DATED TO THE EXACT YEAR IN WHICH THEY WERE FORMED. RECONSTRUCTIONS OF SPATIAL ANOMALY PATTERNS OF SURFACE PRESSURE MAY BE ESTIMATED FROM SPATIAL VARIATIONS IN TREE GROWTH FOR SITES THROUGHOUT WESTERN NORTH AMERICA.

CLIMATIC CHANGE/PALEOCLIMATOLOGY/DENDROCHRONOLOGY/TREE RINGS/SITES/ VARIABILITY(ENVIRONMENTAL)

45

GARDNER, J.L.

1950

EFFECTS OF THIRTY YEARS OF PROTECTION FROM GRAZING IN DESERT GRASSLAND.

ECOLOGY 31(1):44-50.

MEASUREMENTS AND OBSERVATIONS OF VEGETATION IN A 320-ACRE TRACT OF DESERT GRASSLAND, PROTECTED FROM DOMESTIC ANIMALS SINCE 1918, SITUATED NEAR SILVER CITY, NEW MEXICO, AT AN ELEVATION OF 5600 FEET, WERE MADE IN 1946 AND 1948. IN 1946, GRASS DENSITY ON PROTECTED UPLAND SITES AVERAGED 9.64 PERCENT; THAT ON COMPARABLE SITES IMMEDIATELY OUTSIDE THE TRACT 4.58 PERCENT. IN 1948, AFTER 2 YEARS OF SEVERE DROUGHT, GRASS DENSITY ON THE SAME SITES AVERAGED 2.34 PERCENT INSIDE AND 1.02 PERCENT OUTSIDE. PART OF A LOWLAND TOBOSA GRASS FLAT HAD BEEN PLOWED AND CROPPED FROM 1914 TO 1918, BUT UNDISTURBED SINCE. IN 1948, THE PLOWED AREA SUPPORTED AN AVERAGE GRASS DENSITY OF 1.33 PERCENT; THE ADJACENT UNPLOWED AREA, 2.34 PERCENT. ON THE FORMER AREA, VERY LITTLE TOBOSA GRASS WAS OBSERVED; ON THE LATTER, IT WAS THE ONLY DOMINANT GRASS. THE DIVIDING LINE BETWEEN PLOWED AND UNPLOWED WAS STILL SHARP. UNDER PROTECTION, ARROYOS WERE HEALING; OUTSIDE THEY WERE RAW AND ERODING.

KWIC LM 12/OALS/WGM/SWERVE/DESERT GRASSLAND/GRASSLAND BIOME/UNGRAZED/ NEW MEXICO/EROSION CONTROL/ARROYOS/PLANT COVER/DROUGHTS/ENVIRONMENTAL EFFECTS/VEGETATION CHANGE/HILARIA MUTICA/PERTURBATION

46

GLADWIN, H.S.

1947

TREE-RING ANALYSIS; TREE-RINGS AND DROUGHTS.

GILA PUEBLO, GLOBE, ARIZONA, MEDALLION PAPERS 37. 36 P.

SOUTHWEST U.S./DROUGHTS/TREE RINGS/DENDROCHRONOLOGY

47

GOODYEAR, A.C., III.

1975

HECLA II AND III - AN INTERPRETIVE STUDY OF ARCHEOLOGICAL REMAINS FROM THE LAKESHORE PROJECT, PAPAGO RESERVATION, SOUTH CENTRAL ARIZONA.

ARIZONA STATE UNIVERSITY, TEMPE, ANTHROPOLOGICAL RESEARCH PAPER 9. 401 P.

PLANT DISTRIBUTION PATTERNS ARE CORRELATED WITH ARTIFACTS TO TEST HYPOTHESES BASED ON INFORMATION ABOUT RECENT PAST USES OF VEGETATION, ABOUT FOOD-GATHERING PRACTICES OF PREHISTORIC INHABITANTS. ALL SITES ON THE SOUTH-FACING SLOPES OF THE SLATE MOUNTAINS ARE ASSOCIATED WITH VILLAGES IN THE ADJACENT SANTA ROSA WASH. APPENDICES PROVIDE DATA ON POLLEN ANALYSES, HISTORIC PAPAGO ARCHEOLOGY, VEGETATIONAL COVER DATA, NUTRITIONAL VALUES OF FOODS, AND SOIL CHEMISTRY. (OALS)

OALS/SANTA ROSA WASH/PINAL COUNTY/ARIZONA/ARCHAEOLOGY/PLANT COVER/VEGETATION MAPS/PAPAGO INDIAN RESERVATION/CARNEGIEA GIGANTEA/OPUNTIA/SONORAN DESERT/OLNEYA TESOTA/LEMAIREOCEREUS THURBERI/BIBLIOGRAPHIES

48

GRAY, J.H.

1967

MEN AGAINST THE DESERT.

WESTERN PRODUCER BOOK SERVICE, SASKATOON. 250 P.

A DETAILED HISTORY OF CANADA'S DUST BOWL, THE PALLISER TRIANGLE (SOUTHEASTERN ALBERTA, SOUTHERN SASKATCHEWAN, SOUTHWESTERN MANITOBA). AUTHOR BEGINS WITH A BRIEF HISTORY OF THE AGRICULTURAL SETTLEMENT OF THIS AREA, THEN CONCENTRATES ON THE EVENTS OF THE 1920'S AND 1930'S, AS DERIVED FROM PERSONAL INTERVIEWS, NEWSPAPER ACCOUNTS, AND GOVERNMENT FILES. STRESS IS PLACED ON SUCCESSFUL EXPERIMENTS BY EMPLOYEES OF THE DOMINION EXPERIMENTAL FARMS: TO STOP SOIL DRIFTING, CONSERVE SOIL MOISTURE, IMPROVE PEST CONTROL, REMOVE MARGINAL LANDS FROM CULTIVATION, REGRASS DENUDED AREAS WITH IMPROVED SPECIES, AND DEVELOP LARGE COMMUNITY PASTURE AREAS. IN GENERAL, AUTHOR ARGUES IN FAVOR OF LARGE ACREAGES AND MECHANIZED GRAIN FARMING. EXCELLENT AS AN INTRODUCTION TO THE PROBLEMS OF THE AREA, ALTHOUGH AUTHOR'S STATEMENTS ARE FREQUENTLY UNDOCUMENTED. ALSO, THE AUTHOR'S ARGUMENTS SUFFER FROM HIS CONFESSED IGNORANCE OF CLIMATE, AS EVIDENCED IN HIS MANY UNQUALIFIED REFERENCES TO 'NORMAL RAINFALL' OR 'NORMAL' CLIMATE.

CANADA/AGRICULTURE/SOIL STABILIZATION/SOIL MOISTURE/PESTS(INSECTS)/ALBERTA/REVEGETATION/LAND RECLAMATION/SASKATCHEWAN

49

GREEN, D.E.

1973

LAND OF THE UNDERGROUND RAIN: IRRIGATION ON THE TEXAS HIGH PLAINS, 1910-1970.

UNIVERSITY OF TEXAS PRESS, AUSTIN. 295 P.

ONE COULD WRITE THE HISTORY OF THE U.S. SOUTHWEST IN TERMS OF WATER AND ITS LACK. THIS ECONOMIC STUDY DESTROYS TWO MAJOR MYTHS: THE MYTH OF THE GARDEN - THAT THE GREAT AMERICAN DESERT COULD BE MADE TO BLOOM BY IRRIGATION - AND THAT GROUNDWATER IS INEXHAUSTIBLE. THE DEVELOPMENT OF HIGH-POWER PUMPS MADE THE PLAINS A GARDEN BUT EXHAUSTED THE GROUNDWATER.

SOUTHWEST U.S./WATER RESOURCES/GROUNDWATER/IRRIGATION/PUMPING/WATER SHORTAGE/ WATER UTILIZATION

50

HACK, J.T.

1942

THE CHANGING PHYSICAL ENVIRONMENT OF THE HOPI INDIANS OF ARIZONA.

HARVARD UNIVERSITY, PEABODY MUSEUM OF AMERICAN ARCHAEOLOGY AND ETHNOLOGY, PAPERS 35(1). 85 P.

SOUTHWEST U.S./REGIONAL GEOGRAPHY/PHYSICAL GEOGRAPHY/ETHNOLOGY/INDIANS OF NORTH AMERICA/ARIZONA

51

HAFER, G.

1970

FOSSIL FALLS.

DESERT 33(6):26-27. GA 71A-2276 (ANAG).

DURING THE WISCONSIN STAGE OF THE GLACIAL PERIOD, WATER WAS ABUNDANT IN THE NORTHERN MOJAVE DESERT, CALIFORNIA, WITH LAKES AND STREAMS FED FROM MELTING GLACIERS IN THE SIERRA NEVADA. OWENS LAKE WAS 220 FEET DEEP, AND THE OVERFLOW WENT SOUTH TO FILL CHINA LAKE, AND FROM THERE TO SEARLES BASIN FORMING ANOTHER LAKE, THE OVERFLOW OF WHICH WENT EAST AND NORTH TO FILL PANAMINT LAKE, 60 MILES LONG AND 900 FEET DEEP. THE GLACIAL WATERS FINALLY CAME TO REST IN A TROUGH TO FORM LAKE MANLEY ESTIMATED TO HAVE BEEN 90 MILES LONG AND 600 FEET DEEP. THE LAKE IS GONE, BUT THE TROUGH REMAINS, AND IS CALLED DEATH VALLEY. THE CONNECTING STREAMS ARE NOT AS WELL KNOWN AS THE EXTINCT LAKES. FOSSIL FALLS MARKS THE SITE WHERE THE OVERFLOW FROM OWENS LAKE PLUNGED OVER BASALTIC CLIFFS.

MOJAVE DESERT/DEATH VALLEY/CALIFORNIA/GLACIERS/FLOW/TOPOGRAPHIC FEATURES/ PALEOCLIMATOLOGY/RUNOFF

52

HANSEN, H.P.

1947

POST GLACIAL VEGETATION OF THE NORTHERN GREAT BASIN.

AMERICAN JOURNAL OF BOTANY 34(3):164-171.

THIS STUDY IS CONCERNED WITH THE POLLEN ANALYSIS OF THREE SEDIMENTARY COLUMNS IN THE NORTHERN GREAT BASIN OF SOUTH CENTRAL OREGON, AND THE INTERPRETATION OF THE POLLEN PROFILES IN TERMS OF FOREST SUCCESSION AND CLIMATIC TRENDS. THE DATA IN THIS STUDY PROVIDE STRONG SUPPORT FOR THE OCCURRENCE OF THE XEROTHERMIC STAGE BETWEEN 8,000 AND 4,000 YEARS AGO. AT THAT TIME FORESTS WERE MAXIMALLY CONTRACTED; SINCE THEN THEY HAVE SLIGHTLY EXPANDED BUT HAVE NEVER REGAINED THEIR EARLY POST-GLACIAL ABUNDANCE.

KWIC DE 15/OALS/PALEOCLIMATOLOGY/PALYNOLOGY/GREAT BASIN/ARID LANDS/OREGON/FORESTS/VEGETATION/SHRUBS /GRASSES/PINUS CONTORTA/PINUS MONTICOLA/PINUS PONDEROSA/CLIMATIC-VEGETAL RELATIONSHIPS/NORTHERN DESERT SHRUB /CLIMATIC CHANGE/DESERTIFICATION/ARTEMISIA/SARCOBATUS/ATRIPLEX

53

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. GA 68B-596.

SEVERAL PLANT COMMUNITIES IN THE SOUTHWEST HAVE BEEN DRASTICALLY ALTERED WITHIN A CENTURY BY THE RAPID SPREAD OF A SMALL NUMBER OF WOODY SPECIES. THE HABITATS PRINCIPALLY AFFECTED HAVE BEEN THE PLATEAUS AND PLAINS AT INTERMEDIATE ELEVATIONS, THAT FORMERLY SUPPORTED GRASSLAND AND HAVE NOW BEEN INVADED ON A MASSIVE SCALE BY MESQUITE AND OTHER NATIVE SHRUBS; AND THE STREAM COURSES, THAT HAVE BEEN 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 FAVOURED 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. (AUTHOR)

OALS/WGM/SOUTHWEST U.S./SEMIARID CLIMATE/SUCCESSION/PROSOPIS/SHRUBS/PLANT INVADERS/LAND USE/DESERT GRASSLAND/TAMARIX/GRAZING/PLAINS/PLATEAUS/WOODY PLANTS

54

HASTINGS, J.R.

1959

VEGETATION CHANGE AND ARROYO CUTTING IN SOUTHEASTERN ARIZONA.

ARIZONA ACADEMY OF SCIENCE, JOURNAL 1:60-67.

HISTORICAL RECORDS REVEAL THAT IN 1882, WITH 50,000 CATTLE, 7.08 INCHES OF SUMMER RAINFALL PRODUCED NO UNUSUAL FLOOD CONDITIONS, WHEREAS IN 1886, WITH 156,000 CATTLE, 4.63 INCHES DID CAUSE FLOODING, AS DID 253,000 CATTLE IN 1890 WITH 7.92 INCHES. THE IDEA THAT OVERGRAZING PLAYED AN IMPORTANT PART IN CHANGING THE FACE OF SOUTHEASTERN ARIZONA IS HARDLY OPEN TO QUESTION. NEVERTHELESS THERE IS A DISTINCT POSSIBILITY THAT SECULAR TRENDS IN CLIMATE WERE OPERATING IN SUCH A WAY AS TO CONTRIBUTE TO THE OTHER FACTORS THAT CREATED THE VEGETATION CHANGE AND ARROYO CUTTING UNDER OBSERVATION. WEATHER RECORDS ARE BEING COMPILED AT THE UNIVERSITY OF ARIZONA INSTITUTE OF ATMOSPHERIC PHYSICS THAT MAY GIVE SUPPORT TO THIS LATTER THEORY.

OALS/WGM/NPS-ONS/SWERVE/GRAZING/ARIZONA/DESERT GRASSLAND/GRASSLAND BIOME/CLIMATIC-VEGETAL RELATIONSHIPS/CLIMATIC CHANGE/GULLY EROSION/ SOIL EROSION/HISTORY/VEGETATION CHANGE/RANGE MANAGEMENT/CARRYING CAPACITY/CLIMATIC DATA

55

HASTINGS, J.R.

1963

HISTORICAL CHANGES IN THE VEGETATION OF A DESERT REGION.

UNIVERSITY OF ARIZONA (PH.D. DISSERTATION). 499 P.

BY REPEAT PHOTOGRAPHY THE AUTHOR ESTABLISHES THE PRINCIPAL FACTS ABOUT VEGETATIVE CHANGE. THE LOWER EDGE OF THE RANGE OF OAKS HAS MIGRATED UPWARD, THAT OF PALOVERDES HAS UNDERGONE SIMILAR DISPLACEMENT. DESERT GRASSLANDS HAVE DETERIORATED AND IN SOME CASES VANISHED, BEING REPLACED BY DESERT SCRUB. PROSOPIS JULIFLORA AND ACACIA VERNICOSA HAVE BEEN THE PRINCIPAL WOODY INVADERS. HISTORICAL DATA SUPPLEMENT VARIOUS HYPOTHESES RELATING CHANGES TO CULTURAL FACTORS SUCH AS MAN'S INFLUENCE ON THE ECOLOGY THROUGH INTRODUCTION OF CATTLE, SUPPRESSION OF FIRE, AND PREDATOR CONTROL, BUT THE CONCLUSION DRAWN IS THAT THE REGION HAS PARTICIPATED IN A WORLDWIDE RECENT CLIMATIC FLUCTUATION, DECREASED RAINFALL, AND INCREASED TEMPERATURE, WITH CULTURAL FACTORS MERELY REINFORCING OR SUPPLEMENTING THE EFFECT OF CLIMATE.

OALS/WGM/NPS-ONS/SWERVE/ARIZONA/DESERT GRASSLAND/TIME LAPSE PHOTOGRAPHY/VEGETATION CHANGE/CLIMATIC-VEGETAL RELATIONSHIPS/CLIMATIC CHANGE/PERTURBATION/BURNING/GRAZING/ELEVATION/PLANT DISTRIBUTION/PLANT INVADERS/UNDESIRABLE PLANTS/PROSOPIS/CERCIDIUM/QUERCUS/GRASSLAND BIOME

56

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 REGION'S 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.

TIME LAPSE PHOTOGRAPHY/KWIC V 49B/OALS/SOUTHWEST U.S./ARIZONA/NEW MEXICO/MEXICO/ARID LANDS/ARID CLIMATE/SEMIARID CLIMATE/EROSION/VEGETATION CHANGE/HISTORY/GRAZING/BURNING/ANIMAL DAMAGE/SHRUBS/GULLY EROSION/DESICCATION/BIOGEOGRAPHY/DESERT GRASSLAND/CLIMATIC-VEGETAL RELATIONSHIPS/WOODLAND/DESERTS/ENVIRONMENTAL EFFECTS/PROSOPIS/DESERTIFICATION/CLIMATIC CHANGE

57

HAURY, E.W.

1958

POST-PLEISTOCENE HUMAN OCCUPATION OF THE SOUTHWEST. IN T.L. SMILEY, ED., CLIMATE AND MAN IN THE SOUTHWEST, A SYMPOSIUM HELD BEFORE THE THIRTY-THIRD ANNUAL MEETING OF THE SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, APRIL 30, 1957, TUCSON, ARIZONA, P. 69-75.

UNIVERSITY OF ARIZONA PRESS, TUCSON.

MAN REACHED THE SOUTHWEST DURING A RETREAT PHASE OF THE LAST GLACIATION, PERHAPS JUST PRIOR TO THE MANKATO STAGE (DATING ABOUT 12 MILLENIA AGO). THIS WAS A PERIOD CHARACTERIZED BY CLIMATIC INSTABILITY. THE DEGREE OF MOBILITY WAS DIRECTLY RELATED TO THE ADVANCES MADE IN FOOD STORAGE AND PRESERVATION. THE CLIMATE WAS COOLER AND MOISTER, WITH SURFACE WATER MORE PLENTIFUL AND GROUND COVER DENSER. WITH ONSET OF THE THERMAL MAXIMUM ABOUT 5000 B.C. THE TEMPERATURE INCREASED. THE CHAIN REACTION OF REDUCED VEGETATION COVER, SHRINKAGE OF SURFACE WATER, LOSS OF LARGER GAME ANIMALS CAUSED MAN TO DEPEND UPON PLANTS AND NEW SKILLS. THE INCREASED ARIDITY AND CONSEQUENT REDUCTION OF SURFACE WATER TENDED TO HOLD MAN TO RELATIVELY SMALL AREAS WHERE WATER WAS AVAILABLE. THE MODIFICATION OF THE LANDSCAPE WAS LITTLE AFFECTED UNTIL PLANTING BECAME DOMINANT IN THE SUBSISTENCE PATTERN. 15 REFERENCES. (OALS)

SONORAN DESERT/OALS/SETTLEMENTS /SOUTHWEST U.S./ARIZONA/NEW MEXICO/NEVADA/ANIMAL POPULATIONS/PALEOCLIMATOLOGY/DISTRIBUTION PATTERNS/FOOD SUPPLY/CLIMATIC CHANGE/DESICCATION/DESERTIFICATION/SURFACE WATERS/WATER LOSS/SOIL-WATER-PLANT RELATIONSHIPS/SUCCESSION/ARID CLIMATE

58

HECHT, M.E.

1975

THE DECLINE OF THE GRASS LAWN TRADITION IN TUCSON.

LANDSCAPE 19(3):3-10.

DISCUSSES CHANGING CONCEPTS OF LANDSCAPING IN AN ARID COMMUNITY WHERE VEGETATION USE CHARACTERIZES NEIGHBORHOOD DIFFERENCES. EMPHASIS IS ON A GROWING AWARENESS OF THE SUITABILITY OF MORE DROUGHT-TOLERANT NATIVE SPECIES AND FEWER WATER-INTENSIVE SPECIES.

LANDSCAPING/ENVIRONMENTAL ENGINEERING/SOCIAL ASPECTS/VEGETATION EFFECTS

59

HUMPHREY, R.R.

1953

THE DESERT GRASSLAND, PAST AND PRESENT.

JOURNAL OF RANGE MANAGEMENT 6(3):159-164.

A STUDY OF HISTORICAL AND VEGETATIONAL DATA SHOWS THAT THE DESERT GRASSLAND OF SOUTHWESTERN UNITED STATES AND NORTHERN MEXICO IS NOT TRUE CLIMAX. RATHER, IT IS A SUBCLIMAX MAINTAINED BY FIRE. TODAY, WITH FIRES LARGELY A THING OF THE PAST, THE TRUE CLIMAX OF LOW TREES, BRUSH, AND CACTI, WITH AN UNDERSTORY OF GRASSES AND LOW-GROWING SHRUBS IS DEVELOPING EXTENSIVELY ON AREAS THAT WERE ONCE GRASSES. (AUTHOR)

OALS/WGM/NPS-ONS/SWERVE/DESERT GRASSLAND/HISTORY/SOUTHWEST U.S./ MEXICO/CLIMAX/BURNING/VEGETATION CHANGE/PERTURBATION/GRASSLAND BIOME/ SUCCESSION/SONORAN DESERT/PROSOPIS/RANGE MANAGEMENT

60

HUMPHREY, R.R.

1958

THE DESERT GRASSLAND. A HISTORY OF VEGETATIONAL CHANGE AND AN ANAYLSIS OF CAUSES.

BOTANICAL REVIEW 24(4):193-252. (REPRINTED AS ARIZONA AGRICULTURAL EXPERIMENT STATION, BULLETIN 299).

EXTENSIVE PORTIONS OF THE DESERT GRASSLAND OF SOUTHERN ARIZONA, NEW MEXICO, AND SOUTHWESTERN TEXAS HAVE BEEN INVADED BY WOODY SPECIES. MESQUITE, CREOSOTE BUSH, CACTI OF THE GENUS OPUNTIA, BURROWEED, AND SNAKEWEED ARE AMONG THE PRINCIPAL INVADERS. THE PRINCIPAL FACTORS COMMONLY BELIEVED TO HAVE CAUSED THIS CHANGE ARE CHANGE OF CLIMATE, GRAZING BY DOMESTIC LIVESTOCK, PLANT COMPETITION, RODENTS AND FIRE. OF THESE VARIOUS FACTORS, CHANGE OF CLIMATE SEEMS TO HAVE HAD THE LEAST EFFECT. FIRES THAT WERE FORMERLY FREQUENT AND WIDESPREAD WERE THE CHIEF AGENCY RESTRICTING SHRUB INVASION. SINCE FIRES HAVE BEEN CONTROLLED, THE INTRODUCTION OF DOMESTIC LIVESTOCK, PLANT COMPETITION, AND RODENTS HAVE BEEN EFFECTIVE AGENTS FAVORING WOODY PLANTS AT THE EXPENSE OF GRASSES.

APLOPAPPUS TENUISECTUS/VEGETATION CHANGE/OALS/WGM/NPS-ONS/DESERTS/ GRASSLAND BIOME/HISTORY/SUCCESSION/VEGETATION/ENVIRONMENTAL EFFECTS/ ARIZONA/NEW MEXICO/TEXAS/WOODY PLANTS/PROSOPIS/LARREA TRIDENTATA/ OPUNTIA/APLOPAPPUS/GUTIERREZIA/PLANT INVADERS/CLIMATIC CHANGE/ CLIMATE/GRAZING/LIVESTOCK/COMPETITION/PLANTS/RODENTS/BURNING/MEIGS SB

61

HUMPHREY, R.R./MEHRHOFF, L.A., JR.

1958

VEGETATION CHANGES ON A SOUTHERN ARIZONA GRASSLAND RANGE.

ECOLOGY 39(4):720-726.

VEGETATION SURVEYS OF THE SANTA RITA EXPERIMENTAL RANGE WERE MADE IN 1904, 1934 AND 1954, AND ANALYZED TO DETERMINE CHANGES IN AREA AND ABUNDANCE OF CREOSOTEBUSH, BURROWEED, CHOLLA, AND MESQUITE. ALL INCREASED IN AREA AND ABUNDANCE FROM 1904 TO 1954. MAXIMUM INCREASE HAD OCCURRED BY 1934, BUT EXCEPT FOR BURROWEED, CONTINUED AT A SLOWER RATE FROM 1934 TO 1954. CLIMATE, GRAZING, RODENTS AND FIRE WERE FACTORS THAT MAY HAVE CONTRIBUTED TO THE VEGETATIONAL CHANGES NOTED. NO APPARENT CHANGE IN CLIMATE COULD BE DETECTED. GRAZING BY DOMESTIC LIVESTOCK AFFECTED THE COMPOSITION OF THE VEGETATION (BY SEED DISSEMINATION, SELECTIVE GRAZING AND REMOVAL OF GRASS THAT FORMERLY SERVED AS FUEL FOR RANGE FIRES). RODENTS BURY MESQUITE SEEDS AND TRANSPORT CHOLLA JOINTS, THUS SERVING TO PROPAGATE THOSE PLANTS. FIRES MAINTAINED DESERT GRASSLAND PRIOR TO THE INTRODUCTION OF LIVESTOCK. SHRUB INVASION OF SOUTHERN ARIZONA GRASSLANDS IS DUE TO REDUCTION OF RANGE FIRES. (OALS)

OALS/WGM/NPS-ONS/SWERVE/ARIZONA/DESERT GRASSLAND/GRASSLAND BIOME/ SANTA RITA EXPERIMENTAL RANGE/VEGETATION CHANGE/APLOPAPPUS TENUISECTUS/ GRAZING/RODENTS/PROSOPIS/BURNING/RANGE MANAGEMENT/BRUSH CONTROL

62

HUNTINGTON, E. ET AL

1914

THE CLIMATIC FACTOR AS ILLUSTRATED IN ARID AMERICA.

CARNEGIE INSTITUTION OF WASHINGTON, PUBLICATION 192. 341 P.

EVIDENCE REGARDING THE CHARACTER AND SEQUENCE OF CHANGES IN CLIMATE DURING THE LAST TWO OR THREE THOUSAND YEARS, THE PERIOD COVERED BY HISTORY AND MAN'S LATER DEVELOPMENT, IN THE DRIER PORTIONS OF AMERICA FROM GUATEMALA TO IDAHO IS ASSEMBLED AND DISCUSSED. EVIDENCE WAS DERIVED FROM STUDIES OF THE INFLUENCE OF THE PRESENT CLIMATIC CONDITIONS UPON PHYSIOGRAPHY AND THE HABITS AND DISTRIBUTION OF PLANTS AND ANIMALS THROUGH TRACES OF ANCIENT HUMAN OCCUPATION OF THE AREA. DATA ON CLIMATIC CHANGE WAS DERIVED FROM DOUGLASS DEVELOPMENT OF TREE-RING MEASUREMENT. CONCLUSIONS ARE THAT NORTH AMERICA HAS BEEN SUBJECT TO CLIMATIC PULSATIONS SIMILAR TO THOSE IN THE OLD WORLD, RATHER THAN GRADUAL AND REGULAR CHANGE.

OALS/CLIMATIC CHANGE/ARID CLIMATE/NORTH AMERICA/DENDROCHRONOLOGY

63

JORDAN, G.L./MAYNARD, M.L.

1970

THE SAN SIMON WATERSHED: REVEGETATION.

PROGRESSIVE AGRICULTURE IN ARIZONA 22(6):4-7. SWRA W71-06223.

IN THE ABSENCE OF COMPETITION FROM GRASS, SHRUBS TEND TO REINVADE AREAS WHERE THEY HAVE BEEN CLEARED. CULTURAL PROCEDURES FOR GRASS ESTABLISHMENT ARE DESCRIBED AND EVALUATED. ROOT PLOWING PROVED TO BE THE MOST EFFECTIVE METHOD, BOTH FOR SHRUB CONTROL AND THE ESTABLISHMENT OF ERAGROSTIS LEHMANNIANA. DEPENDING ON PRECIPITATION, EMERGENCE AND DEVELOPMENT OF E. LEHMANNIANA USUALLY OCCURRED FROM JULY 15 TO SEPTEMBER 15. LACK OF PRECIPITATION AND LOW TEMPERATURES LIMIT GERMINATION DURING THE REMAINDER OF THE YEAR. E. LEHMANNIANA APPEARS TO BE THE MOST DEPENDABLE GRASS TO SEED IN THIS AREA. THE SEASONAL DISTRIBUTION OF RAINFALL IS AN ESPECIALLY CRITICAL FACTOR; 5.5 INCHES OF SUMMER RAINFALL IS CLOSE TO THE MINIMUM REQUIRED BY E. LEHMANNIANA. (OALS)

ERAGROSTIS LEHMANNIANA/OALS/WGM/SAN SIMON WATERSHED/ARIZONA/BRUSH CONTROL/UNDESIRABLE PLANTS /SHRUBS/WOODY PLANTS/SEEDING/PLANT INVADERS/INTRODUCED SPECIES/GRASSES /EROSION CONTROL/EROSION/GULLY EROSION/GROUND COVER/LAND MANAGEMENT/WATERSHED MANAGEMENT/RANGE MANAGEMENT/REVEGETATION/GERMINATION/VIABILITY/SUMMER/SEASONAL/ RAINFALL/TEMPERATURE/FORAGE GRASSES/PRODUCTIVITY/PERTURBATION/ COMPETITION/DESERT GRASSLAND/MECHANICAL CONTROLS/SUMMER PRECIPITATION/ FORAGE PRODUCTION/SWERVE

64

KELLEY, J.C.

1952

FACTORS INVOLVED IN THE ABANDONMENT OF CERTAIN PERIPHERAL SOUTH-WESTERN SETTLEMENTS.

AMERICAN ANTHROPOLOGIST 54(3):356-387.

MARKED CONTRACTION IN THE AREA OCCUPIED BY FARMING PEOPLES IN THE VICINITY OF LA JUNTA, COLORADO, OCCURRED DURING THE FIRST HALF OF THE EIGHTEENTH CENTURY. THIS MOVEMENT RESULTED FROM THE DISTURBANCE OF A DELICATE ECOLOGICAL BALANCE EXISTING BETWEEN THE PRINCIPAL SUBSISTENCE LIFE ZONES AND THE APACHE AND PUEBLOAN PEOPLES OF THE REGION. THE HYPOTHESIS HAS BEEN ADVANCED THAT THIS DISTURBANCE IN ECOLOGICAL BALANCE WAS PRODUCED BY A SLIGHT ADVERSE FLUCTUATION IN ANNUAL OR SEASONAL RAINFALL IN THIS REGION. IT MAY BE INFERRED FROM THIS THAT A PREVIOUS PERIOD OF MORE FAVORABLE CLIMATIC CONDITIONS IN THE PREVIOUS CENTURY HAD ALLOWED THE ORIGINAL DEVELOPMENT OF THE NOMAD-SEDENTATE SYMBIOTIC RELATIONSHIP.

OALS/SOUTHWEST U.S./COLORADO/SOCIAL ASPECTS/INDIANS OF NORTH AMERICA/ PRECIPITATION(ATMOSPHERIC)/DROUGHTS/SEMIARID CLIMATE/SETTLEMENTS/ PERTURBATION/CLIMATIC CHANGE

65

LAMARCHE, V.C., JR./FRITTS, H.C.

1971

ANOMALY PATTERNS OF CLIMATE OVER THE WESTERN UNITED STATES, 1700-1930, DERIVED FROM PRINCIPAL COMPONENT ANALYSIS OF TREE-RING DATA.

MONTHLY WEATHER REVIEW 99(2):138-142. MGA 22.7-441.

MAJOR ANOMALY PATTERNS OF ANNUAL TREE-RING GROWTH IN DROUGHT-SENSITIVE TREES OF THE WESTERN UNITED STATES, 1931-1962, SEEM TO REFLECT CORRESPONDING PATTERNS IN MONTHLY PRECIPITATION AMOUNTS, WHICH, IN TURN, MAY BE RELATED TO CIRCULATION ANOMALIES. THE THREE MOST IMPORTANT ANOMALY PATTERNS THAT DOMINATED THE 1931-1962 PERIOD WERE ALSO PROMINENT IN THE TREE-GROWTH DATA DURING THE PRECEEDING PERIOD 1700-1930. THESE PATTERNS CAN THUS BE EXPECTED TO MAINTAIN THEIR IMPORTANCE DURING AT LEAST THE IMMEDIATE FUTURE.

WEST U.S./CLIMATE/DENDROCHRONOLOGY/CLIMATIC CHANGE/PRECIPITATION(ATMOSPHERIC)/ ATMOSPHERIC CIRCULATION/WEATHER FORECASTING

66

LAW, J.P., JR./WITHEROW, J.L. ED.

1970

WATER QUALITY MANAGEMENT PROBLEMS IN ARID REGIONS.

U.S. FEDERAL WATER QUALITY ADMINISTRATION, WATER POLLUTION CONTROL RESEARCH SERIES 13030. 105 P. AVAILABLE NTIS AS PB-198 125. SWRA W71-06111.

A SELECTION OF PAPERS PRESENTED AT THE AAAS COMMITTEE ON ARID LANDS CONFERENCE, ARID LANDS IN A CHANGING WORLD, HELD IN TUCSON, ARIZONA, IN JUNE 1969. INCLUDED ARE PAPERS COVERING NITRATE REMOVEL FROM AGRICULTURAL WASTEWATER, THE EFFECTS OF SALINITY STANDARDS ON IRRIGATED AGRICULTURE IN THE COLORADO RIVER BASIN, PROBLEMS OF POLLUTION OF IRRIGATION WATER IN ARID REGIONS, SALINITY CONTROL IN RETURN FLOW FROM IRRIGATED AREAS, NATURAL POLLUTION IN ARID LAND WATERS, DISTILLATION OF WASTEWATERS, ANIMAL WASTE RUNOFF, WATER QUALITY REQUIREMENTS AND RE-USE OF WASTEWATER EFFLUENTS, AND WATER QUALITY CONTROL PROBLEMS IN INLAND SINKS.

KWIC W 32/OALS/WATER QUALITY/WATER MANAGEMENT/RETURN FLOW/SALINITY/ COLORADO RIVER/WATER POLLUTION/IRRIGATION WATER/FEED LOTS/WATER REUSE/ SEWAGE EFFLUENTS

67

LEOPOLD, A.

1924

GRASS, BRUSH, TIMBER AND FIRE IN SOUTHERN ARIZONA.

JOURNAL OF FORESTRY 22:1-10.

BRUSH ENCROACHMENT HAS BECOME A SERIOUS PROBLEM IN SOUTHERN ARIZONA. THE PREDOMINANT INVADING BRUSH SPECIES ARE: OAK, MANZANITA, MOUNTAIN MAHOGANY, AND CEANOTHUS. SOME VERY CONSPICUOUS FACTORS ARE: 1) WIDESPREAD ABNORMAL EROSION; 2) UNIVERSAL FIRE SCARS ON ALL OF THE OLDER JUNIPERS, OAKS, AND OTHER TREES; 3) OLD JUNIPER STUMPS LEVELLED TO THE GROUND BY FIRE; 4) MUCH JUNIPER REPRODUCTION MERGING TO PINE REPRODUCTION IN THE UPPER LIMITS OF THIS TYPE; 5) GREAT THRIFT AND SIZE IN THE JUNIPERS AND OTHER SPECIES THAT HAVE SURVIVED FIRE. CLOSER EXAMINATION REVEALS ADDITIONAL FACTS, ALL DATING BACK APPROXIMATELY 40 YEARS, AND POINTING TO CHANGED CONDITIONS SINCE THEN. THIS CORRESPONDS WITH SETTLEMENT BY WHITE MAN, FIRE SUPPRESSION AND OVERGRAZING. THE CLIMAX WAS ORIGINALLY WOODLAND, BUT WAS HELD IN CHECK BY GRASS COMPETITION AND FIRES. GRAZING RESULTED IN THE REMOVAL OF GRASSES, THUS ALTERING THE GRASS-ROOT COMPETITION WITH WOODY SPECIES AND SUPPRESSING FIRES (DUE TO LESS GRASS FUEL). THE SUBSTITUTION OF GRAZING FOR FIRE HAS RESULTED IN A TRANSITION TO THIN GRASS AND THICK BRUSH, CONDITIONS THAT FAVOR SUCCESSION TOWARD A WOODLAND CLIMAX. (OALS)

OALS/WGM/NPS-ONS/ARIZONA/GRASSLAND BIOME/DESERT GRASSLAND/VEGETATION CHANGE/CLIMAX/SUCCESSION/BURNING/GRAZING/PERTURBATION/GRASSES/VEGETAL RELATIONSHIPS/PLANT COMMUNITIES/PLANT ECOLOGY/CEANOTHUS/QUERCUS/ ARCTOSTAPHYLOS/CERCOCARPUS/JUNIPERUS/SWERVE

68

LEOPOLD, L.B.

1951

VEGETATION OF THE SOUTHWESTERN WATERSHEDS IN THE NINETEENTH CENTURY.

GEOGRAPHICAL REVIEW 41:295-316.

ANALYSES OF THE VEGETATION OF THE SOUTHWEST PRIOR TO LIVESTOCK GRAZING ARE BASED ON JOURNALS OF EARLY EXPLORERS AND EARLY PHOTOGRAPHS (1895-1903). ABOUT 30 MANUSCRIPTS (1826-1919) CONTAINING DESCRIPTIONS OF THE GEOGRAPHY AND VEGETATION OF THE SOUTHWEST ARE LISTED INCLUDING 10 MANUSCRIPTS ON THE MIDDLE AND LOWER GILA RIVER AND SAN PEDRO RIVER AREAS. THE AUTHOR THEORIZES THAT GOOD RANGE CONDITIONS DID NOT EXIST EVEN PRIOR TO THE INTRODUCTION OF LIVESTOCK EXCEPT IN SELECTED LOCALITIES. (OALS)

SONORAN DESERT/OALS/WGM/NPS-ONS/VEGETATION/NATURAL AREAS/SOUTHWEST U.S./HISTORY/WATERSHEDS(BASINS)/VEGETATION CHANGE/REGIONAL GEOGRAPHY/ ARIZONA/GILA RIVER/SAN PEDRO VALLEY/GRAZING/RANGES/GRASSLAND BIOME/ DESERT BIOME/RANGE MANAGEMENT/EXPEDITIONS/SWERVE

69

LOGAN, R.F.

1961

POST-COLUMBIAN DEVELOPMENTS IN THE ARID REGIONS OF THE UNITED STATES OF AMERICA.

UNESCO, PARIS. ARID ZONE RESEARCH 17:277-297.

ARID LANDS/HISTORY/PHYSICAL GEOGRAPHY/CATTLE/SHEEP(DOMESTIC)/IRRIGATION/ WATER LAW/WATER RESOURCES/AGRICULTURE/INDIANS OF NORTH AMERICA/URBAN AREAS

70

LONG, C.A.

1971

SIGNIFICANCE OF THE LATE PLEISTOCENE FAUNA FROM THE LITTLE BOX ELDER CAVE, WYOMING, TO STUDIES OF ZOOGEOGRAPHY OF RECENT MAMMALS.

GREAT BASIN NATURALIST 31(2):93-105.

FOSSIL EVIDENCE REVEALS A WARMING TREND DURING THE POST PLEISTOCENE DURING WHICH MANY NORTHERN SPECIES DISAPPEARED IN AREAS AGAIN CHARACTERIZED AS BOREAL. DISTRIBUTION OF SOME MAMMALIAN SPECIES WAS ALSO INFLUENCED BY THE ADVANCE AND RETREAT OF ICE.

WYOMING/PLEISTOCENE EPOCH/FOSSIL FAUNA/CLIMATIC CHANGE/ANIMAL DISTRIBUTION/ ZOOGEOGRAPHY

71

LOVE, R.M.

1970

THE RANGELANDS OF THE WESTERN U.S.

SCIENTIFIC AMERICAN 222(2):88-96. GA 71C-1155. SWRA W70-04907.

CATTLE GRAZING IS THE PRIMARY USE OF THE RANGELANDS IN THE WESTERN UNITED STATES. THE WESTERN RANGES FALL INTO THREE DISTINCT CATEGORIES: NORTHERN ROCKY MOUNTAIN, INTERMOUNTAIN, AND SOUTHWEST. TRUE GRASSLAND IS RARE IN THE SOUTHWEST. INSTEAD, DESERTS AND SEMI-DESERTS PREDOMINATE. VEGETATION MANAGEMENT IS THE MAJOR PROBLEM IN IMPROVING THE RANGELANDS. BRUSH CONVERSION PROGRAMS HAVE SHOWN SUBSTANTIAL INCREASES IN WATER YIELD IN THE TREATED AREAS. THIS IS DUE TO THE FACT THAT AN ACRE OF BRUSH USES SIX MORE ACRE-INCHES OF WATER THAN DOES HERBACEOUS VEGETATION. WITH PROPER MANAGEMENT OF BRUSH IN THE WATERSHEDS OF THE WEST, THE LAND CAN PROVIDE MORE MEAT AND LUMBER, SUFFER LESS FROM EROSION AND FLOOD, AND BE MORE USABLE FOR RECREATION. THE RAPIDLY GROWING NEED FOR MORE RECREATIONAL LAND IS CAUSING CONFLICTS WITH OTHER LAND USES. THE ADVANTAGES OF BRUSH CONTROL AND THE USE OF CONTROLLED FIRES, TRANSHUMANCE, CANOPY ARCHITECTURE, LEAF-AREA INDEX, AND EXOTIC GRASSES ARE OTHER TOPICS DISCUSSED. (OALS)

VEGETATION/DESERTS/OALS/RANGES/SOUTHWEST U.S./ROCKY MOUNTAIN REGION/ WEST U.S./CATTLE/GRAZING/RANGE GRASSES/SEMIARID CLIMATE/RANGE MANAGEMENT/BRUSH CONTROL/CONVERSION(MANAGEMENT) /WATER YIELD IMPROVEMENT/REVEGETATION/DESERT PLANTS/WATER CONSERVATION/LAND USE/ MULTIPLE PURPOSE/RECREATION/CONTROLLED BURNING/WATERSHED MANAGEMENT/ TRANSHUMANCE/CANOPY /INTERCEPTION/LEAVES/INTRODUCED SPECIES/GRASSES

72

MACDOUGAL, D.T.

1908

THE COURSE OF THE VEGETATIVE SEASONS IN SOUTHERN ARIZONA.

PLANT WORLD 11(9, 10, 11, 12):189-201, 217-231, 237-249, 261-270.

A TREATISE ON THE CLIMATE AND VEGETATION OF THE SONORAN DESERT. DATA IS PRESENTED FROM THE DESERT LABORATORY ON TUMAMOC HILL. CITES THE PROGRESSIVE ARIDITY OF THE SONORAN DESERT SINCE PLEISTOCENE TIMES AS RESULTING IN THE RECENT EVOLUTION OF XEROPHILOUS PLANT FORMS. THE MAJOR PORTION OF THE ARTICLE IS A DISCUSSION OF PLANT SPECIES IN RELATION TO, AND MOST CHARACTERISTIC OF, EACH SEASON.

OALS/WGM/NPS-ONS/TUMAMOC HILL/SONORAN DESERT/CLIMATIC-VEGETAL RELATIONSHIPS/CLIMATIC CHANGE/XEROPHYTES/DESERT PLANTS/PLANT ECOLOGY/ SEASONAL/ADAPTATION/WINTER PRECIPITATION/SUMMER PRECIPITATION/ANNUALS/ PERENNIALS/EPHEMERALS/CACTACEAE/PHENOLOGY/FLOWERING/SUMMER EPHEMERALS/ WINTER EPHEMERALS/DESERT BIOME

73

MALDE, H.E.

1964

ENVIRONMENT AND MAN IN ARID AMERICA.

SCIENCE 145:123-129.

THE AUTHOR BELIEVES THAT MODERN MAN MIGHT BRING HIS SURROUNDINGS UNDER BETTER CONTROL IF HE ADOPTED EARLY MAN'S RESPONSE TO HIS ENVIRONMENT AND ATTEMPTED TO IDENTIFY AND UNDERSTAND PAST CHANGES IN THE LANDSCAPE. HE POSES THE FOLLOWING QUESTIONS: DID EARLY HUNTERS EXTERMINATE PLEISTOCENE ANIMALS, OR DID THEY DISAPPEAR BECAUSE OF AN ELUSIVE BIOLOGIC CAUSE. WAS MAN DRIVEN OUT OF SOME AREAS BY DROUGHT DURING ALTITHERMAL TIME, OR ARE THE PREVAILING CONCEPTS OF ALTITHERMAL ARIDITY ERRONEOUS. DO ANOMALOUS DISTRIBUTIONS OF PLANTS AND ANIMALS MAP RECENT CHANGES IN CLIMATIC PATTERNS. IS LIFE MORE TOLERANT OF EXTREMES THAN UNIFORMITARIAN IDEAS ASSUME. FROM GEOLOGIC STUDY OF FORMER EPISODES OF ALLUVIATION, CAN MAN LEARN TO MAKE DESERT STREAMS RUN AGAIN IN GRASSY FLOOD PLAINS, OR IS THE CLIMATE NOW TOO GREAT A HINDRANCE. HIS CONCLUSION IS THAT GEOLOGIC, BIOLOGIC, AND ARCHEOLOGIC CLUES SUGGEST CLIMATIC CHANGES IN THE DRY AMERICAN SOUTHWEST IN THE LAST 15,000 YEARS, AND THAT MODERN MAN HAS MUCH TO LEARN FROM AN EXAMINATION OF THIS EVIDENCE TO HELP HIM CURRENTLY. (OALS)

KWIC WC . OALS/SOUTHWEST U.S./BIOGEOGRAPHY/CLIMATIC CHANGE/ ARCHAEOLOGY/ENVIRONMENT/HISTORY/LIMITING FACTORS/GEOCHRONOLOGY

74

MACGREGOR, M.T.G./VALVERDE, C.V.

1975

EVOLUTION OF THE URBAN POPULATION IN THE ARID ZONES OF MEXICO, 1900-1970.

GEOGRAPHICAL REVIEW 65(2):214-228.

STUDY OF URBANIZATION AND POPULATION GROWTH RELATED TO CONTEMPORARY DISTRIBUTION BASED ON ECONOMIC, DEMOGRAPHIC, POLITICAL, AND PHYSICAL FACTORS, AS WELL AS THE ENVIRONMENTAL IMPACT OF NEW TECHNOLOGIES.

URBAN PLANNING/URBAN AREAS/MEXICO/POPULATIONS/DENSITY/POLITICAL ASPECTS/ DEMOGRAPHY

75

MARTIN, P.S.

1958

PLEISTOCENE ECOLOGY AND BIOGEOGRAPHY OF NORTH AMERICA. IN C.L. HUBBS, ED., ZOOGEOGRAPHY, P. 375-420.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, WASHINGTON, D.C., PUBLICATION 51.

BIOGEOGRAPHY/PLEISTOCENE EPOCH/ECOLOGY/NORTH AMERICA/ZOOGEOGRAPHY

76

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. 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.

OALS/SOUTHWEST U.S./ARIZONA/NEW MEXICO/MEXICO/PALYNOLOGY/ PALEOCLIMATOLOGY/PLEISTOCENE EPOCH/VEGETATION/DROUGHTS/BIOGEOGRAPHY / DENDROCHRONOLOGY/CLIMATOLOGY/ARCHAEOLOGY /ARID LANDS/MAMMALS/SUMMER PRECIPITATION/EXTIRPATED SPECIES/CLIMATIC CHANGE/VEGETATION CHANGE/ INDIANS OF NORTH AMERICA

77

MARTIN, P.S.

1970

PLEISTOCENE NICHES FOR ALIEN ANIMALS.

BIOSCIENCE 20(4):218-221. SWRA W71-01402.

RECENT STUDIES IN A TYPICAL ARIZONA DESERT SHRUB COMMUNITY SHOWED THAT OF A PRODUCTIVITY OF 1400 KG/HA/YR, 900 KG/HA WERE INEDIBLE FOR CATTLE. FIVE TIMES AS MANY CATTLE WERE SUPPORTED ON AN ADJACENT GRASSLAND WITH ABOUT THE SAME PRECIPITATION, EVEN THOUGH THE PRODUCTIVITY OF THE DESERT SHRUB COMMUNITY WAS GREATER. CLEARLY THE COW, A GRASS-PREFERRING, WATER-DEPENDENT HERBIVORE IS ILL-ADAPTED TO WESTERN RANGES WHICH HAVE LITTLE OF EITHER. THE AUTHOR ARGUES FOR SELECTIVE, CAREFUL STUDIES ON THE INTRODUCTION OF AFRICAN HERBIVORES TO THESE ARID AREAS. IN ANSWER TO THE OBJECTION THAT THEY MAY WREAK ECOLOGICAL DESTRUCTION, OWING TO THEIR LACK OF ADAPTATION TO THESE AREAS, SEVERAL POINTS ARE MADE: 1) THE PAST BIOMASS OF THE SOUTHWEST WAS MUCH GREATER THAN IT IS NOW; 2) DURING THE PLEISTOCENE, A WAVE OF EXTINCTIONS OCCURRED; 3) THESE EXTINCTIONS WERE MAINLY LARGE HERBIVORES CLOSELY RELATED OR IDENTICAL TO EXTANT AFRICAN HERBIVORES, 4) THE VACATED NICHES HAVE NEVER BEEN FILLED AND 5) INTRODUCTION OF AT LEAST SOME OF THESE ANIMALS INTO THE SOUTHWESTERN U.S. MAY VERY WELL BE INTO NICHES FOR WHICH THEY ARE PREADAPTED. A PLEA IS MADE FOR CONSERVATION OF POTENTIALLY USEFUL AFRICAN ANIMAL GENE BANKS. (OALS)

SONORAN DESERT/OALS/SOUTHWEST U.S./GRAZING/RANGE MANAGEMENT/ INTRODUCED SPECIES/EXTIRPATED SPECIES/PRODUCTIVITY/ADAPTATION/ARID LANDS/CATTLE/XEROPHILES/DESERT ANIMALS/SHRUBS/ARIZONA/HERBIVORES/ UNGULATA/HABITATS/FORAGE PRODUCTION/BROWSE/PLEISTOCENE EPOCH

78

MARTIN, S.C.

1964

SOME FACTORS AFFECTING VEGETATION CHANGES ON A SEMIDESERT GRASS-SHRUB CATTLE RANGE IN ARIZONA.

UNIVERSITY OF ARIZONA (PH.D. DISSERTATION). 122 P.

A 5-YEAR GRAZING STUDY TESTING THE EFFECTS OF WINTER, SUMMER, AND YEAR-LONG GRAZING ON SEMIDESERT CATTLE RANGE WAS MADE IN SOUTHERN ARIZONA FROM 1957 TO 1961. SUPERIMPOSED ON THE GRAZING TREATMENTS WERE MEASUREMENTS OF THE EFFECTS OF DISTANCE FROM WATER, TEXTURE OF SUBSOIL, AND MESQUITE CONTROL. SPECIES OF GRASSES STUDIED WERE TRICHACHNE CALIFORNICA, ARISTIDA TERNIPES, A. HAMULOSA, A. GLABRATA, AND MUHLENBERGIA PORTERI. DATA ARE ALSO COMPILED IN GROUPS FOR ANNUAL GRASSES, ALL PERENNIAL GRASSES, AND TOTAL GRASSES. SHRUB SPECIES WERE PROSOPIS JULIFLORA VELUTINA, APLOPAPPUS TENUISECTUS, AND ALL SHRUBS COMBINED. (OALS)

MUHLENBERGIA PORTERI/OALS/WGM/NPS-ONS/ARIZONA/RANGES/RANGE MANAGEMENT/GRAZING /DESERT GRASSLAND/SHRUBS/SOIL TEXTURE/SUBSOIL/ BRUSH CONTROL/VEGETATION CHANGE/GRASSES/WATER SOURCES/TRICHACHNE CALIFORNICA/ARISTIDA/CATTLE/PROSOPIS JULIFLORA/APLOPAPPUS TENUISECTUS

79

MARTIN, W.E./BOWER, L.G.

1966

PATTERNS OF WATER USE IN THE ARIZONA ECONOMY.

ARIZONA REVIEW 15(12):1-6. SWRA W70-01202.

ALTHOUGH WATER IS SCARCE IN ARIZONA ITS PER CAPITA USE IS OVER THREE TIMES THE NATIONAL AVERAGE. PAST NEEDS WERE MET BY DIVERTING SURFACE FLOW OR TAPPING UNDERGROUND SUPPLIES. SOLUTION OF TODAY'S PROBLEM INVOLVES DEVELOPMENT OF SUPPLIES OUTSIDE THE STATE OR REALLOCATION OF EXISTING SUPPLIES WITHIN THE STATE, OR BOTH. IN 1958 AGRICULTURAL INDUSTRIES USED OVER 90 PERCENT OF THE WATER SUPPLIED FOR ECONOMIC PRODUCTION. RELATIVE USE HAS PROBABLY REMAINED SIMILAR. FOOD AND FEED GRAINS CONSUME ABOUT 50 ACRE-FEET OF WATER PER 1,000 DOLLARS OUTPUT, COMPARED WITH .032 ACRE-FEET FOR THE SAME VALUE OUTPUT IN THE MINING INDUSTRY. ALL USES TOTAL APPROXIMATELY SEVEN MILLION ACRE-FEET PER YEAR COMPARED WITH AVERAGE ANNUAL INCOME OF 3.6 MILLION ACRE-FEET. EVEN WITH THE ADDITION OF 1.2 MILLION ACRE-FEET FROM THE CENTRAL ARIZONA PROJECT THERE WILL BE A LARGE DEFICIT AND SOME REALLOCATION WILL EVENTUALLY BE NECESSARY EVEN WITHOUT GROWTH. FROM THE DATA PRESENTED IT IS EVIDENT THAT CRUCIAL REALLOCATION DECISIONS WILL LIKELY FALL UPON CROP AGRICULTURE IF CONTINUED OVERDRAFT OF GROUNDWATER IS TO BE CHECKED. (OALS)

WATER SUPPLY/ARIZONA/WATER LOSS/WATER RESOURCES/GROUNDWATER/ECONOMIC DEVELOPMENT/OALS

80

MCBRIDE, L.L.

1972

ARIZONA'S COMING DILEMMA: WATER SUPPLY AND POPULATION GROWTH.

ECOLOGY LAW QUARTERLY 2:357-384. SWRA W74-01452.

A COMPREHENSIVE ANALYSIS IS PRESENTED OF THE WATER SUPPLY PROBLEMS FACING THE STATE OF ARIZONA. IT EXPLORES THE SUPPLY AND DEMAND OF WATER RESOURCES IN ORDER TO DETERMINE WHETHER WATER SUPPLY WILL SET AN UPPER LIMIT ON THE POPULATION GROWTH. THE CURRENT LAW GOVERNING WATER RIGHTS IS DISCUSSED IN RELATION TO ITS EFFECT ON WATER CONSUMPTION AND ON GROWTH PATTERNS. PROSPECTS ARE EVALUATED FOR MAINTAINING CONSUMPTION AND THE PRESENT GROWTH RATES BY INCREASING THE WATER SUPPLY, OR, IN THE ALTERNATIVE, BY ALTERING THE CURRENT WATER RIGHTS SYSTEM TO PREVENT THE EXHAUSTION OF WATER RESOURCES. THE COLORADO RIVER IS THE MAJOR SOURCE OF SURFACE WATER FOR ARIZONA AND THE ADJOINING AREAS OF THE LOWER COLORADO BASIN, WHICH ALSO INCLUDES THE LAS VEGAS AREA OF NEVADA, AND THE IMPERIAL AND COACHELLA VALLEYS OF SOUTHEASTERN CALIFORNIA. HOWEVER, AS ACCOMPANYING TABLES INDICATE, ARIZONA HAS COMPLETELY INSUFFICIENT SUPPLIES OF SURFACE WATER TO MEET THE TOTAL DEMAND. POSSIBLE FUTURE SOURCES INCLUDE DESALINIZATION AND INTER-REGIONAL WATER DIVERSION.

OALS/ARIZONA/WATER RESOURCES DEVELOPMENT/SOCIAL ASPECTS/LEGAL ASPECTS/ COLORADO RIVER/COLORADO RIVER BASIN/WATER MANAGEMENT/WATER SUPPLY/WATER UTILIZATION/WATER SHORTAGE

81

MEHRHOFF, L.A., JR.

1955

VEGETATION CHANGES ON A SOUTHERN ARIZONA GRASSLAND RANGE, AN ANALYSIS OF CAUSES.

UNIVERSITY OF ARIZONA (M.S. THESIS). 48 P.

AN ATTEMPT WAS MADE TO EVALUATE AND EXAMINE THE MORE IMPORTANT CAUSES OF SHRUB INVASION ON THE SANTA RITA EXPERIMENTAL RANGE: GRAZING BY DOMESTIC LIVESTOCK AND OTHER ANIMALS, COMPETITION AND SELECTION, CLIMATIC CHANGES, AND FIRE. PRINCIPAL INVADERS WERE BURROWEED, MESQUITE, OPUNTIA SPINOSIOR, O. FULGIDA AND CREOSOTEBUSH. IT WAS CONCLUDED THAT THERE HAVE BEEN NO CHANGES IN CLIMATE THAT WOULD PERMIT INVASION BY SHRUBS; THAT GRAZING ANIMALS HAVE HAD AN ADVERSE EFFECT ON GRASSLAND VEGETATION BECAUSE OF LARGE HERD NUMBERS AND THEIR EFFECTS ON SOIL WITH THE REDUCTION OF LITTER AND DRY GRASSES WHICH FORMERLY CARRIED RANGE FIRES; THAT CATTLE AND RODENTS AFFECT THE RATE OF SHRUB INVASION THROUGH DISSEMINATION OF SEEDS AND VEGETATIVE JOINTS OF INVADING SPECIES; AND THAT SHRUB INVASION ON SOUTHERN ARIZONA SEMIDESERT GRASSLAND RANGE IS DUE PRIMARILY TO THE REDUCTION OF RANGE FIRES. AFTER LIVESTOCK INTRODUCTION, FIRES COULD NO LONGER REPEL THE INVADING SHRUBBY SPECIES BECAUSE OF THE LACK OF NECESSARY FUEL.

LARREA TRIDENTATA/OALS/WGM/NPS-ONS/SWERVE/ARIZONA/DESERT GRASSLAND/ GRASSLAND BIOME/VEGETATION CHANGE/SANTA RITA EXPERIMENTAL RANGE/ SHRUBS/GRAZING/BURNING /COMPETITION/CLIMATIC CHANGE/OPUNTIA/PROSOPIS JULIFLORA/APLOPAPPUS TENUISECTUS/PLANT INVADERS/PERTURBATION/ UNDESIRABLE PLANTS/RANGE MANAGEMENT/DESERT BIOME

82

MEHRINGER, P.J.

1967

LATE QUATERNARY VEGETATION IN THE MOHAVE DESERT (USA).

REVIEW OF PALAEOBOTANY AND PALYNOLOGY 2(1-4):319-320. GA 69B-615.

POLLEN AND C14 DATES IN NEVADA AND CALIFORNIA FROM ALLUVIUM, PLAYA CORES, AND ANCIENT SPRING DEPOSITS SHOW THAT THE PRESENT VEGETATION ZONES WERE REDUCED BY 1,000 M. DURING THE MAXIMUM WISCONSIN GLACIATION. SOUTHWARD VEGETATIONAL SHIFTS OF SEVERAL HUNDRED KILOMETRES ARE SHOWN. OTHER VEGETATIONAL CHANGES OF LESS MAGNITUDE ALSO ARE DISCUSSED. (AUTHOR)

NEVADA/CALIFORNIA/ALLUVIUM/VEGETATION ESTABLISHMENT/MOJAVE DESERT/ QUATERNARY PERIOD/RADIOCARBON DATING/PALEOBOTANY/GLACIAL DRIFT/OALS/ WGM

83

MEHRINGER, P.J.

1967

THE ENVIRONMENT OF EXTINCTION OF THE LATE-PLEISTOCENE MEGAFAUNA IN THE ARID SOUTHWESTERN UNITED STATES.

INQUA CONGRESS, 7TH, PROCEEDINGS 6:247-266. GA 69B-614.

THE SAME TYPES OF HABITAT WIDESPREAD TODAY WERE OCCUPIED BY LATE-PLEISTOCENE MEGAFAUNA. IF CLIMATIC CHANGE IS TO BE CONSIDERED THE PRINCIPAL CAUSE OF EXTINCTION, THE EXTREME GLACIAL CLIMATES OF WISCONSIN AGE SHOULD HAVE EXERTED A DETRIMENTAL EFFECT. EXCLUDING NONCLIMATIC FACTORS, THE PERIOD OF RAPID DEGLACIATION SHOULD HAVE RESULTED IN THE EXPANSION AND NOT THE DEMISE OF THE MEGAFAUNA. AT PRESENT THERE IS A GREATER AREA AND A WIDER VARIETY OF HABITATS FOR HERBIVORES THAN EXISTED DURING THE WISCONSIN ICE ADVANCES. LARGE HERBIVORE BIOMASS SHOULD HAVE INCREASED, NOT DECLINED, AS THE ICE RETREATED. BECAUSE DIFFERENT SPECIES OCCUPIED HABITATS RANGING FROM WARM SEMIARID TO PERIGLACIAL, IT SEEMS UNLIKELY THAT A SINGLE CLIMATIC CAUSE ALONG IS RESPONSIBLE FOR EXTINCTION.

OALS/CLIMATIC CHANGE/SOUTHWEST U.S./PLEISTOCENE EPOCH/GLACIAL GEOLOGY/ QUATERNARY PERIOD/HABITATS/HERBIVORES/EXTIRPATED SPECIES

84

MOORE, C.V./SNYDER, J.H.

1974

MANAGEMENT OF SALINE WATER.

UNIVERSITY OF CALIFORNIA, DAVIS, WATER RESOURCES CENTER, REPORT 29. 19 P.

RECENT RESEARCH ON THE ECONOMICS OF SALINE WATER MANAGEMENT WAS SURVEYED AND PRINCIPAL CONCLUSIONS SUMMARIZED. SALINITY STUDIES IN THE COLORADO BASIN, IMPERIAL VALLEY, ORANGE COUNTY (CALIFORNIA), AND SALTON SEA WERE EXAMINED TO DETERMINE THE EFFECTS OF AGRICULTURE ON QUANTITY AND QUALITY OF SALINE WATER, INCREASING IRRIGATION EFFICIENCY, AND SALINITY IN URBAN AND RECREATIONAL USES, AS WELL AS INTERNATIONAL AND LEGAL ASPECTS OF SALINITY AND COST-SHARING IN SALINITY CONTROL. SALINITY IN A RIVER BASIN TENDS TO INCREASE FROM THE HEAD-WATERS TO THE MOUTH. THE SALINE WATERS OF THE COLORADO RIVER POSE MAJOR MANAGEMENT PROBLEMS IN THE REGIONS STUDIED, AND ARE ALSO IMPORTANT IN RELATIONS WITH MEXICO. TOTAL WATER WITHDRAWALS EXCEED ANNUAL REPLENISHMENTS, AND TOTAL DISSOLVED SALINITY IN THE LOWER REACHES OF THE RIVER ARE NEAR OR BEYOND THRESHOLD USES. ESTIMATED ECONOMIC LOSSES TO DOMESTIC USERS ARE ABOUT 16 MILLION DOLLARS AND ARE PROJECTED TO INCREASE TO A POSSIBLE LEVEL OF ABOUT 28 MILLION DOLLARS BY 1980.

KWIC W 12/OALS/SALINE WATER/COLORADO RIVER BASIN/SALTON SEA/ AGRICULTURE/IRRIGATION EFFECTS/LEGAL ASPECTS/IRRIGATION WATER/WATER QUALITY/ECONOMIC IMPACT/MEXICAN WATER TREATY

85

MORRIS, E.H.

1948

MODERN OVERGRAZING BY LIVESTOCK AS THE DIRECT CAUSE OF RUIN OF SOUTHWESTERN AGRICULTURE, WITH A NOTE BY H.H. CHAPMAN.

JOURNAL OF FORESTRY 46(12):929-931.

REPRINT OF A PORTION (P. 5-8) OF THE AUTHOR'S 1939 CARNEGIE INSTITUTION OF WASHINGTON PUBLICATION, ARCHAEOLOGICAL STUDIES OF THE LA PLATA DISTRICT, SOUTHWESTERN COLORADO AND NORTHWESTERN NEW MEXICO, DEALING WITH CONDITIONS IN THE PUEBLO AREA BEFORE THE ADVENT OF WHITE MAN AND THE GRAZING OF SHEEP AND CATTLE. OVERGRAZING DISTURBED THE EQUILIBRIUM OF A NATURAL BALANCE OF FORCES SUCH AS RAINFALL, EROSION, AND VEGETATION.

COLORADO RIVER BASIN/OALS/WGM/SWERVE/NEW MEXICO/GRAZING/RANGE MANAGEMENT/EROSION/VEGETATION CHANGE/PERTURBATION/SOUTHWEST U.S./ GULLY EROSION/ARCHAEOLOGY/HISTORY/AGRONOMY/GRASSLAND BIOME

86

MUEGGLER, W.F.

1950

EFFECTS OF SPRING AND FALL GRAZING BY SHEEP ON VEGETATION OF THE UPPER SNAKE RIVER PLAINS.

JOURNAL OF RANGE MANAGEMENT 3(4):308-315.

VEGETAL TRENDS ON SAGEBRUSH-GRASS RANGE CAUSED BY A COMBINATION OF HEAVY SPRING AND LIGHT FALL GRAZING, 1924-1949, ARE COMPARED WITH TRENDS CAUSED BY HEAVY FALL GRAZING ALONE. THE TWO 80-ACRE PASTURES WERE ESSENTIALLY ALIKE IN 1924, BUT 25 YEARS LATER THE PASTURE GRAZED IN SPRING AND FALL PRODUCED (ESTIMATED AIR-DRY WEIGHT) 173 PERCENT AS MUCH BRUSH, 72 PERCENT AS MUCH GRASS, AND 20 PERCENT AS MUCH FORBS AS THE PASTURE GRAZED ONLY IN FALL. OVER THREE-FOURTHS OF ITS VEGETATION WAS BRUSH, MOSTLY UNDESIRABLE SAGEBRUSH, BY 1949, WHILE BRUSH COMPOSED LESS THAN HALF THE VEGETATION OF THE PASTURE GRAZED ONLY IN FALL. THIS LATTER PASTURE REMAINED IN GOOD CONDITION WHILE THE PASTURE GRAZED BOTH IN SPRING AND FALL DETERIORATED TO POOR CONDITION WITH AN ESTIMATED GRAZING CAPACITY LESS THAN ONE-THIRD THAT OF THE OTHER.

OALS/WGM/SWERVE/GRAZING/SEASONAL/UTAH/RANGE MANAGEMENT/VEGETATION CHANGE/PERTURBATION/GRASSLAND BIOME/PLANT INVADERS/SHRUBS/FORBS/ CARRYING CAPACITY/RANGE GRASSES/FORAGE PRODUCTION/RANGES/PASTURES

87

MURRAY, A.V.

1959

AN ANALYSIS OF CHANGES IN SONORAN DESERT VEGETATION FOR THE YEARS 1928-1957.

UNIVERSITY OF ARIZONA (M.S. THESIS). 146 P.

CHANGES THAT HAVE TAKEN PLACE IN THE PERENNIAL VEGETATION OF A PERMANENTLY-MARKED AREA OF 800 SQUARE METERS, LOCATED IN THE SONORAN DESERT, TWO MILES WEST OF TUCSON, ARIZONA, WERE ANALYZED BY TWO TYPES OF QUANTITATIVE DATA. DATA WERE COLLECTED FROM VEGETATION MAPS TO SHOW THE LOCATION OF EACH PLANT, AND TO SHOW AN OUTLINE OF THE AREA OF SOIL SURFACE COVERED BY ITS CROWN. THE NUMBER OF INDIVIDUALS PRESENT AT EACH MAPPING WERE COUNTED AS WELL AS THE AMOUNT OF CROWN COVERAGE PRESENT AT EACH MAPPING WAS MEASURED. RAINFALL VARIATION AFFECTED PLANT GROWTH, WITH VIGOROUS VEGETATIVE GROWTH TAKING PLACE WHEN WINTER RAINS WERE HEAVY, WHILE CHANGES IN THE NUMBERS OF SEEDLING ESTABLISHMENTS WERE CONTROLLED BY VARIATIONS IN THE DISTRIBUTION OF FALL RAINFALL. DROUGHT PERIODS BROUGHT ABOUT REDUCTION IN CROWN SIZES AND NUMBER OF INDIVIDUALS ONLY WHEN THEY OCCURRED DURING THE REGULAR SUMMER AND WINTER RAINY SEASONS. THERE WAS NO EVIDENCE THAT ANY SUCCESSIONAL CHANGES HAD TAKEN PLACE IN THE VEGETATION OF THE AREA OVER THE 29-YEAR PERIOD.

OALS/SONORAN DESERT/SOUTHERN DESERT SHRUB/PERENNIALS/ARIZONA/ QUANTITATIVE SAMPLING /RAINFALL/VEGETATION EFFECTS/SOIL SURFACES/ GRAZING/VEGETATION ESTABLISHMENT/ SUCCESSION/TUMAMOC HILL

88

NOWINSON, D.

1972

OUR DIMINISHING DESERT.

ECOLOGY TODAY 2(3):32-33.

SINCE 1968 RECREATIONAL USE OF THE MOJAVE AND COLORADO DESERTS IN CALIFORNIA HAS INCREASED BY 50 PERCENT, TO 7.5 MILLION VISITOR DAYS IN 1971. THIS GROWING INVASION OF OFF-ROAD VEHICLES HAS RESULTED IN PHYSICAL DAMAGE TO PACKED SAND AND DESERT SOIL, AS WELL AS TO PLANTS, ANIMALS, AND ARCHEOLOGICAL REMAINS FROM LITTERING AND VANDALISM. THE U.S. BUREAU OF LAND MANAGEMENT, AS ADMINISTRATOR OF 11 MILLION ACRES OF CALIFORNIA DESERT, IS MAKING RECOMMENDATIONS FOR THE USE, PROTECTION, AND LONG RANGE PLANNING AND DEVELOPMENT OF THIS DESERT RESOURCE.

OFF-ROAD VEHICLES/PLANT INJURY/SOCIAL ASPECTS/OALS/MOJAVE DESERT/ COLORADO DESERT/CALIFORNIA/RECREATION/SANDS/DESERT SOILS/DESERT PAVEMENT/CRUSTS/LAND USE/LAND MANAGEMENT/LAND RESOURCES/CONSERVATION/ WIND EROSION/DESERTIFICATION/VANDALISM/PERTURBATION

89

PAYLORE, P. ED.

1976

THE SONORAN DESERT, A RETROSPECTIVE BIBLIOGRAPHY. HISTORICAL PERSPECTIVE, BY W.G. MCGINNIES.

UNIVERSITY OF ARIZONA, TUCSON, OFFICE OF ARID LANDS STUDIES, ARID LANDS ABSTRACTS 8. 777 REFS.

CITATIONS SELECTED FROM THE COMPUTERIZED ARID LANDS INFORMATION SYSTEM (ALIS) COVER SUCH DIVERSE TOPICS AS ENVIRONMENT, FAUNA, GEOMORPHOLOGY, GEOGRAPHY, SURFACE MATERIALS, VEGETATION, DESERT GRASSLAND, SUCCULENTS, WATER, WEATHER AND CLIMATE. FULL ABSTRACTS FOR EACH, WITH COMPUTERIZED KEYWORD AND AUTHOR INDEXES.

SONORAN DESERT/BIBLIOGRAPHIES/ARIZONA/BAJA CALIFORNIA/SOUTHWEST U.S./ANIMALS/ SOUTHERN DESERT SHRUB/SUCCULENTS/PLANT DISTRIBUTION/RANGE MANAGEMENT/GRASSES/ ENVIRONMENTAL EFFECTS/GRAZING/WATER RESOURCES/VEGETATION/CHIHUAHUAN DESERT/ PRECIPITATION(ATMOSPHERIC)/CLIMATE/GEOMORPHOLOGY

90

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. ED. BY WALLACE STEGNER.

BELKNAP PRESS OF HARVARD UNIVERSITY PRESS, CAMBRIDGE, MASSACHUSETTS. 202 P.

THIS BOOK IS A FIRST-HAND ACCOUNT OF THE ARID REGION OF THE UNITED STATES WRITTEN IN 1878. SUBJECTS COVERED INCLUDE PHYSICAL CHARACTERISTICS OF THE REGION, THE LAND SYSTEM NEEDED, 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 CONSIDERS THE CHARACTER OF THE LANDS BUT ALSO THE ENGINEERING PROBLEMS INVOLVED IN THEIR REDEMPTION AND SUGGESTIONS FOR THE LEGISLATIVE ACTION NECESSARY.

OALS/KWIC EN 35B/ARID LANDS/WEST U.S./SOUTHWEST U.S./LAND RECLAMATION/ PRECIPITATION(ATMOSPHERIC)/ARABLE LAND/WATER SUPPLY/IRRIGATION/UTAH/HISTORY/ GREAT BASIN/COLORADO RIVER BASIN/POLITICAL ASPECTS

91

RODGERS, W.M.

1965

HISTORICAL LAND OCCUPANCE OF THE UPPER SAN PEDRO RIVER VALLEY (ARIZONA) SINCE 1870.

UNIVERSITY OF ARIZONA (M.S. THESIS). 167 P.

FOLLOWING A DESCRIPTION OF THE GEOGRAPHICAL ENVIRONMENT, THIS STUDY DESCRIBES LAND OCCUPATION BEFORE 1870, FROM 1870 TO 1900, AND FROM 1900 TO 1964. SPECIAL EMPHASIS IS GIVEN TO THE GEOGRAPHICAL LANDSCAPE OF THIS SEMIARID REGION IN 1900 AND AGAIN IN 1964. CONCLUSIONS DISCUSS CHANGING OCCUPANCE AND LANDSCAPE, AND RELATE THESE CHANGES TO CURRENT HYPOTHESES AS TO THE CAUSES OF THE CHANGE. EMPHASIS IS GIVEN TO HUMAN AND CULTURAL IMPACTS, AND CLIMATE IS PLAYED DOWN AS A FACTOR IN LANDSCAPE CHANGE. BIBLIOGRAPHY.

ARIZONA/SAN PEDRO VALLEY/REGIONAL GEOGRAPHY/DEMOGRAPHY/LAND USE/ENVIRONMENTAL IMPACT/BIBLIOGRAPHIES

92

SCHULMAN, E.

1938

NINETEEN CENTURIES OF RAINFALL HISTORY IN THE SOUTHWEST.

AMERICAN METEOROLOGICAL SOCIETY, BULLETIN 19:211-215.

THE USE OF TIMBERS BY THE PUEBLO INDIANS OF THE SOUTHWEST FOR BUILDING PURPOSES MADE POSSIBLE THE EXTENSION OF THE COLORADO PLATEAU CHRONOLOGY INTO PRE-HISTORIC TIMES. TREE RING GROWTH PATTERNS FROM VARIOUS RUINS HAVE BEEN CROSS REFERENCED. CENTRAL PUEBLO CHRONOLOGY IS DISCUSSED IN SEVERAL INTERVALS, EACH ENDING OR BEGINNING WITH A SEVERE DROUGHT. IT APPEARS LIKELY THAT NO SUBSTANTIAL SECULAR CHANGE IN CLIMATE HAS TAKEN PLACE DURING THE LAST NINETEEN CENTURIES IN THIS REGION. AN EXTENSIVE FOREST WAS PROBABLY REMOVED FROM THE CHACO CANYON, NEW MEXICO AREA ABOUT THE 10TH CENTURY. REESTABLISHMENT WAS PREVENTED BY LOSS OF SOIL DUE TO EROSION.

PRECIPITATION(ATMOSPHERIC)/OALS/ARCHAEOLOGY/PALEOCLIMATOLOGY/TREES/ DENDROCHRONOLOGY/CLIMATOLOGY/NEW MEXICO/SOUTHWEST U.S./COLORADO PLATEAU/HISTORY/CLIMATIC CHANGE/DESERTIFICATION

93

SEARS, P.B.

1958

ENVIRONMENT AND CULTURE IN RETROSPECT. IN T.L. SMILEY, ED., CLIMATE AND MAN IN THE SOUTHWEST, A SYMPOSIUM HELD BEFORE THE THIRTY-THIRD ANNUAL MEETING OF THE SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, APRIL 30TH, 1957, TUCSON, ARIZONA, P. 77-84.

UNIVERSITY OF ARIZONA PRESS, TUCSON.

THE AUTHOR FEELS THAT ARID REGIONS OF LOW RAINFALL AND HIGH EVAPORATION, COMPRISING AT LEAST 35 PERCENT OF THE EARTH'S SURFACE, ARE UNDER CONSTANTLY INCREASING PRESSURE FROM MAN. EARLIER CULTURES IN ANCIENT TIMES, BY TRIAL AND ERROR, WORKED OUT EMPIRICALLY A MORE RATIONAL AND SUSTAINING PATTERN OF WATER USE THAN IS CURRENTLY BEING DEVELOPED. EVIDENCES OF MAN'S ACTIVITY ARE SCARCE DUE TO EROSION OF THE OLD MARGINS AND SURFACE SLOPES. INCLUDED IS A TABLE DEFINING CHARACTERISTICS OF CULTURE AND CLIMATE, AS WELL AS DATES AND GENERAL GEOLOGIC FEATURES OF DIFFERENT TIME PERIODS. SEVEN REFERENCES. (OALS)

WATER UTILIZATION/OALS/SETTLEMENTS/SOUTHWEST U.S./ARIZONA/CLIMATIC CHANGE/ARID CLIMATE/PERTURBATION/DESICCATION /ENVIRONMENTAL EFFECTS/ ADAPTATION/DESERTIFICATION

94

SHREVE, F./HICKLEY, A.L.

1937

THIRTY YEARS OF CHANGE IN DESERT VEGETATION.

ECOLOGY 18:463-478.

VEGETATION/VEGETATION CHANGE/SONORAN DESERT

95

THOMAS, H.E.

1963

DROUGHT IN THE SOUTHWEST, 1942-1956.

U.S. GEOLOGICAL SURVEY, PROFESSIONAL PAPER 372.

THIS COMPREHENSIVE STUDY IS ISSUED IN 7 PARTS AND A GENERAL SUMMARY (372A-H), COVERING IN DETAIL THE METEOROLOGIC PHENOMENON, AND EFFECTS OF DROUGHT ON WATER RESOURCES (CENTRAL AND SOUTH TEXAS, THE RIO GRANDE BASIN, BASINS OF INTERIOR DRAINAGE, COLORADO RIVER BASIN, AND THE PACIFIC COAST IN CALIFORNIA). THE SUMMARY CLASSIFIES HYDROLOGIC UNITS ACCORDING TO TYPE, WITH EXAMPLES. BASED ON ANALYSIS OF LONGEST RECORDS AVAILABLE CONCERNING ALL ASPECTS OF THE REGION'S WATER RESOURCES, IT PAYS SPECIAL ATTENTION TO THE PERIOD 1942-1956 TO ASCERTAIN SIMILARITIES WITH EARLIER DROUGHT PERIODS AND CONTRASTS WITH PERIODS OF GREATER PRECIPITATION. THE DEFINITION OF DROUGHT USED IS THAT IT IS A METEOROLOGICAL PHENOMENON AND OCCURS DURING A PERIOD WHEN PRECIPITATION IS SIGNIFICANTLY LESS THAN THE LONG-TERM AVERAGE AND WHEN THIS DEFICIENCY IS GREAT ENOUGH AND CONTINUES LONG ENOUGH TO AFFECT MANKIND. WITHIN THIS UNDERSTANDING, EFFECTS OF DROUGHT ARE DISTINGUISHED FROM WATER SHORTAGES DUE TO OTHER CAUSES.

OALS/DROUGHTS/METEOROLOGICAL DATA/ARID LANDS/ARID CLIMATE/SEMIARID CLIMATE/WATER STORAGE/HYDROLOGIC DATA/WATER SOURCES/SOUTHWEST U.S.

96

THOMPSON, K.

1961

RIPARIAN FORESTS OF THE SACRAMENTO VALLEY, CALIFORNIA.

ASSOCIATION OF AMERICAN GEOGRAPHERS, ANNALS 51:294-315.

MOST OF THE VALLEY WILL NOT NOW SUPPORT TREES DUE TO THE EDAPHIC AND BIOTIC CONDITIONS, BUT QUERCUS LOBATA, PLANTANUS RACEMOSA, COTTONWOOD, AND WILLOW USED TO GROW ALONG THE WATER COURSES. THESE TREES GREW HERE DUE TO SUB-IRRIGATION, FERTILE ALLUVIAL LOAM SOILS, AND RELATIVE FREEDOM FROM SURFACE WATERLOGGING AND FIRE. THEY SERVED TO REINFORCE THE RIVER BANKS, PROVIDED STREAM CHANNEL STABILITY, ACTED AS WINDBREAKS, REDUCED EVAPORATION, TRANSPIRATION, AND WIND DAMAGE, AND PROVIDED WILDLIFE HABITAT. THE WOODS WERE DESTROYED BY ANGLO AMERICANS IN ORDER TO USE THE LAND FOR OTHER PURPOSES. (OALS)

OALS/WGM/RIPARIAN VEGETATION/CALIFORNIA/QUERCUS/BURNING/SATURATED SOILS/EROSION CONTROL/BANK EROSION/CHANNEL EROSION/WINDBREAKS/ EVAPORATION/WILDLIFE HABITATS/HISTORY/PHREATOPHYTES/DEGENERATION/MEIGS SC13

97

THORNTHWAITE, C.W. ET AL

1942

CLIMATE AND ACCELERATED EROSION IN THE ARID AND SEMI-ARID SOUTHWEST, WITH SPECIAL REFERENCE TO THE POLACCA WASH DRAINAGE BASIN, ARIZONA.

U.S. DEPARTMENT OF AGRICULTURE, TECHNICAL BULLETIN 808. 134 P.

AN ANALYSIS OF THE CLIMATE IN THE SOUTHWEST AND ITS RELATION TO EROSION AND OVERGRAZING IS MADE. THE REPORT IS IN 3 PARTS: CLIMATE NORMAL AND ACCELERATED EROSION IN A SELECTED DRAINAGE BASIN, AND THE HISTORY OF EROSION. THE PART ON CLIMATE EXAMINES AIR MASSES, VARIATIONS IN TEMPERATURE AND PRECIPITATION, EXCESSIVE PRECIPITATION DROUGHTS AND CLIMATIC PATTERNS. PART 2 EXAMINES THE BASIC CONDITION GOVERNING EROSION: CLIMATE, GEOLOGY,SOIL, VEGETATION, LAND USE AND PRESENT EROSION CONDITIONS IN THE BLACK MESA, TUSAYAN WASHES, AND PAINTED DESERT SECTIONS. RECENT ACCELERATED EROSION IN THIS AREA IS DESCRIBED. IN PART 3 THE CAUSES OF EROSION (DIASTROPHISM, AGRICULTURE, CLIMATE AND GRAZING) ARE EXAMINED. ACCELERATION OF EROSION WAS ACCOMPANIED BY DEPLETION OF VEGETATION. EVIDENCE INDICATES NO CLIMATIC CHANGE IN THE LAST 2,000 YEARS. THIS ACCELERATED EROSION APPEARS TO HAVE BEEN CAUSED BY MAN. MAN CAN CHE EROSION AND RECLAIM THE LAND BY PROPER METHODS: MODIFICATION OF CORRALLING SYSTEM, REDUCTION IN ANIMAL UNITS, ROTATIONAL PASTURAGE I FENCED ENCLOSURES, VEGETATIVE PLANTINGS, DIVERSION DAMS, DISTRIBUTIO DITCHES, AND SPREADER STRUCTURES. (OALS)

OALS/WGM/NPS-ONS/CLIMATE/SOUTHWEST U.S./EROSION/RANGE MANAGEMENT/ CYCLES-OF-EROSION CONCEPT/EROSION CONTROL/LAND MANAGEMENT/PLANT COVE VEGETATION EFFECTS/WATERSHED MANAGEMENT/ARID CLIMATE/REGIONAL ANALYS CLIMATIC GEOMORPHOLOGY/CLIMATIC-VEGETAL RELATIONSHIPS/ARIZONA/DROUGH HISTORY/GEOLOGY/LAND RECLAMATION/VEGETATION ESTABLISHMENT/REVEGETATI DEGENERATION/WEATHER PATTERNS

98

TODD, C.J./JAMES, R.C.

1972

EXPERIMENTS IN DROUGHT ALLEVIATION.

AMERICAN WATER WORKS ASSOCIATION, JOURNAL 64(9):582-584. SWRA W73-07649.

CURRENT ACTIVITIES ARE SUMMARIZED OF PROJECT SKY-WATER, A PROGRAM SPONSORED BY THE BUREAU OF RECLAMATION AND CONCERNED WITH THE INVESTIGATION AND DEVELOPMENT OF THE TECHNOLOGY REQUIRED FOR THE MANAGEMENT OF ATMOSPHERIC WATER, WITH CONSIDERATIONS OF LEGAL, ECONOMIC, ECOLOGICAL, AND SOCIAL IMPLICATIONS. IT DISCUSSES GENERAL MECHANISMS OF PRECIPITATION, CLOUD SEEDING ATTEMPTS IN WINTER MOUNTAIN STORMS AND SUMMER CUMULUS CLOUDS, CURRENT FIELD RESEARCH AT EXPERIMENTAL STATIONS AND PILOT PROJECTS. SOME OF THE STATES INCLUDED IN THE DISCUSSION ARE: NEW MEXICO, ARIZONA, UTAH, COLORADO, CALIFORNIA, WYOMING, MONTANA, NEVADA, AND THE DAKOTAS. RESULTS ARE REPORTED OF DROUGHT ALLEVIATION ATTEMPTS IN THE STATES OF TEXAS, ARIZONA, AND OKLAHOMA, WHERE REACTION TIME WAS 12, 7, AND 19 DAYS AFTER INITIAL REQUEST. ALL SEEDING OPERATIONS WERE BELIEVED TO INCREASE LOCAL PRECIPITATION BUT LACK OF SCIENTIFIC DATA PRECLUDES SOUND EVALUATION.

OALS/WEATHER MODIFICATION/CLOUD SEEDING/DROUGHTS/ARTIFICIAL PRECIPITATION/ SOUTHWEST U.S./LEGAL ASPECTS/PRECIPITATION(ATMOSPHERIC)/SUMMER PRECIPITATION/ WINTER PRECIPITATION

99

TUAN, YI-FU

1966

NEW MEXICAN GULLIES, A CRITICAL REVIEW AND SOME RECENT OBSERVATIONS.

ASSOCIATION OF AMERICAN GEOGRAPHERS, ANNALS 56(4):573-597. GA 69A-989; ANAG(1967)9121.

GULLIES CUT IN ALLUVIAL FILL ARE COMMON FEATURES OF THE NEW MEXICO LANDSCAPE, AND ARE MOST CONSPICUOUS IN A SEMI-ARID UPLAND ENVIRONMENT. THIS PAPER IS CONCERNED WITH TYPES OF GULLIES AND THEIR REGIONAL SETTING, COMPARISON OF MODERN GULLIES, CHANGES IN FORM AND DEPTH SINCE THE LATE 19TH CENTURY, AND PROBLEMS OF ENVIRONMENTAL INTERPRETATION. ALLUVIAL FILL, EROSIONAL CONDITIONS, POLLEN RECORD, AND CLIMATE ARE BRIEFLY CONSIDERED, AND TWO ENVIRONMENTAL MODELS ARE EVALUATED. THE ONE DESIGNATED THE MARTIN-SCHOENWETTER MODEL IS FAVORED IN THAT GULLYING IS REGARDED AS THE RESULT OF AN INCREASE IN THE NUMBER AND ENERGY OF SUMMER RAINS, AND THAT IT IS SUPPORTED TO SOME EXTENT BY RECENT OBSERVATIONS.

DEGRADATION(STREAM)/OALS/NEW MEXICO/GULLY EROSION/CHANNEL EROSION/ EROSION/DEPOSITION(SEDIMENTS)/MODELS/SEMIARID CLIMATE/ALLUVIUM/ CLIMATIC CHANGE /SUMMER PRECIPITATION

100

WALLEN, C.C.

1955

SOME CHARACTERISTICS OF PRECIPITATION IN MEXICO.

GEOGRAFISKA ANNALER 37:51-85.

THE AUTHOR DISCUSSES THE NATURE OF AVAILABLE PRECIPITATION DATA IN MEXICO. HE THEN INVESTIGATES VARIABILITY OF ANNUAL RAINFALL AND THE CAUSES OF THE VARIABILITY. FREQUENCY DISTRIBUTIONS OF RAINFALL AMOUNTS ARE ALSO DESCRIBED.

PRECIPITATION(ATMOSPHERIC)/RAINFALL/CLIMATIC DATA/VARIABILITY(ENVIRONMENTAL)/ MEXICO

101

WILSON, A.W.

1976

THE SONORAN DESERT: THE IMPACT OF URBANIZATION. IN PAST, PRESENT, AND FUTURES OF THE DESERT: THE SONORAN EXAMPLE.

CONSORTIUM OF ARID LANDS INSTITUTIONS (CALI) CONFERENCE, 2D, TUCSON, ARIZONA, [PAPER DELIVERED AT]. 11 P. (PROCESSED)

SONORAN DESERT/URBAN AREAS/ENVIRONMENTAL IMPACT/ARIZONA/VEGETATION CHANGE

102

WOODBURY, R.B.

1963

INDIAN ADAPTATION OF ARID ENVIRONMENTS. IN C. HODGE AND P.C. DUISBERG, EDS., ARIDITY AND MAN.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, PUBLICATION 74:55-85.

BRIEFLY TRACES MAN'S CHANGING ROLES IN THE WESTERN U.S. DISCUSSES FOOD GATHERS, BIG-GAME HUNTERS, VILLAGE-FARMING LIFE, VILLAGES AND WATER SOURCES, WATER-CONTROL TECHNIQUES, DECLINE OF VILLAGE-FARMING LIFE, INTRODUCTION OF ADAPTABLE ATHABASCANS, SHIFT TO WAGEWORK, COLLAPSE OF GREAT BASIN CULTURE, RISE AND FALL OF THE SIOUX, ADJUSTMENT TO RESERVATION LIFE, PAPAGO STRUGGLES IN THE DESERT, INDIAN ADJUSTMENTS AND PROSPECTS. CLIMATIC CHANGE IN THE 13TH CENTURY WAS PROBABLY RESPONSIBLE FOR EARLY DECLINE OF VILLAGE FARMING LIFE. GRAZING ABUSES BY INDIANS AND WHITES HAVE RESULTED IN DETERIORATED RANGELANDS. THE PLIGHT OF THE INDIAN IN THE LAST CENTURY OR SO IS NOT THE RESULT OF ENVIRONMENTAL CAUSES SUCH AS ARIDITY; THE CAUSES ARE SOCIAL. IT CAN BE SEEN AS PART OF THE WORLDWIDE PROBLEM OF THE NONLITERATE, NONINDUSTRIAL WORLD CONFRONTED BY THE TECHNOLOGY, SOCIAL AND ETHICAL SYSTEMS OF THE WESTERN WORLD. INDIAN TECHNIQUES AND THEIR PHYILOSOPHY OF WORKING WITH THE ENVIRONMENT RATHER THAN AGAINST IT MAY BE INDISPENSIBLE INGREDIENTS FOR THE SUCCESSFUL UTILIZATION OF ARID LANDS.

INDIANS OF NORTH AMERICA/OALS/SOCIAL ASPECTS/MIGRATION/SOCIAL ORGANIZATION/HISTORY/ARID LANDS/SEMIARID CLIMATE/DRY FARMING/RANGE MANAGEMENT/SOUTHWEST U.S./WATER SPREADING/DROUGHTS/ADAPTATION/GREAT BASIN/GREAT PLAINS/DEGENERATION

AUTHOR INDEX

ALBRITTON, C.C., JR. 16
ALDON, E.F. 1
ANDERSON, R.Y. 2
AXELROD, D.I. 3
AYRES, J.E. 4

BECKER, R.J. 5
BENNETT, H.H. 6
BENTLEY, H.L. 7
BIROT, P. 8
BOCHERT, J.R. 9
BOWDEN, C. 10
BOWER, L.G. 79
BREED, C.S. 11
BROWN, A.L. 12
BRYAN, K. 13 14 15 16
BUSCH, C.D. 17

CABLE, D.R. 18
CAMPBELL, I.A. 19
CASEY, H.E. 20
CHALMERS, J.R. 21
CHAPLINE, W.R. 6
CHRISTENSEN, E.M. 22 23
CLAUSEN, G.S. 24
CLYMA, W. 25
CONSELMAN, F.B. 26
COOPEPRIDER, C.K. 27
COSTELLO, D.F. 28
COTTAM, W.P. 29 30 31
COUPLAND, R.T. 32

DAUBENMIRE, R.F. 33
DENEVAN, W.M. 34
DITTMER, H.J. 35
DORTIGNAC, E.J. 36
DOUGLASS, A.E. 37
DRESCH, J. 8 38

EVANS, F.R. 30

FIREMAN, B. 39
FISHER, R.G. 40
FOGEL, M.M. 17
FRASIER, G.W. 41
FRITIS, R.C. 42 43 44
65

GARDNER, J.L. 45
GLADWIN, H.S. 46
GOODYEAR, A.C., III. 47
GRAY, J.H. 48
GREEN, D.E. 49

HACK, J.T. 50
HAFER, G. 51
HANSEN, H.P. 52
HARRIS, D.R. 53
HASTINGS, J.R. 54 55 56
HAURY, E.W. 57
HECHT, M.E. 58
HENDRICKS, B.A. 27
HICKLEY, A.L. 94
HUMPHREY, R.R. 59 60 61
HUNTINGTON, E. 62
HUTCHINSON, M.A. 22

JAMES, R.C. 98
JOHNSON, H.B. 23
JORDAN, G.L. 63

KELLEY, J.C. 64
KIRKLAND, D.W. 2

LAMARCHE, V.C., JR. 65
LAW, J.P., JR. 66
LEOPOLD, A. 67
LEOPOLD, L.B. 68
LOGAN, R.F. 69
LONG, C.A. 70
LOVE, R.M. 71

MACDOUGAL, D.T. 72
MACGREGOR, M.T.G. 74
MALDE, H.E. 73
MARTIN, P.S. 75 76 77
MARTIN, S.C. 18 78
MARTIN, W.E. 79
MATLOCK, W.G. 17
MAYNARD, M.L. 63
MCBRIDE, L.L. 80
MEHRHOFF, L.A., JR. 61 81
MEHRINGER, P.J. 82 83
MOORE, C.V. 84
MORRIS, E.H. 85
MUEGGLER, W.F. 86
MURRAY, A.V. 87

NOWINSON, D. 88

PAYLORE, P. 89
POWELL, J.W. 90

RODGERS, W.M. 91

SCHULMAN, E. 92
SEARS, P.B. 93
SHREVE, F. 94
SNYDER, J.H. 84
STEWART, G. 31

THOMAS, H.E. 95
THOMPSON, K. 96
THORNTHWAITE, C.W. 9
TODD, C.J. 98
TUAN, YI-FU 99
TURNER, G.T. 28
TURNER, R.M. 56

VALVERDE, C.V. 74

WALLEN, C.C. 100
WILSON, A.W. 101
WITHEROW, J.L. 66
WOODBURY, R.B. 102

YOUNG, R.A. 25

KEYWORD INDEX

ADAPTATION 72 77 93 102
AFFORESTATION 33
AGRICULTURE 9 15 48 69 84
AGRONOMY 85
AIR POLLUTION 5
ALBERTA 48
ALLUVIUM 15 82 99
ALTERNATIVE FUELS 10
ANALYTICAL TECHNIQUES 37 42 43
ANIMAL DAMAGE 56
ANIMAL DISTRIBUTION 70
ANIMAL POPULATIONS 57
ANIMALS 89
ANNUALS 72
APLOPAPPUS 60
APLOPAPPUS TENUISECTUS 12 60 61 78 81
AQUATIC COMMUNITIES 14
AQUIFERS 17 26
ARABLE LAND 90
ARCHAEOLOGY 15 40 47 73 76 85 92
ARCTOSTAPHYLOS 67
ARID CLIMATE 33 56 57 62 93 95 97
ARID LANDS 10 11 20 36 39 52 56 69 76 77 90 95 102
ARISTIDA 78
ARIZONA 4 5 11 12 13 14 19 21 24 25 35 37 39 41 47 50 54 55 56 57 60 61 63 67 68 76 77 78 79 80 81 87 89 91 93 97 101
ARROYOS 14 45
ARTEMISIA 22 29 31 52
ARTIFICIAL PRECIPITATION 98
ATMOSPHERIC CIRCULATION 65
ATRIPLEX 22 52
AVRA VALLEY 24

BAJA CALIFORNIA 89
BANK EROSION 96
BASINS 8
BIBLIOGRAPHIES 10 20 21 47 89 91
BIOGEOGRAPHY 56 73 75 76
BROMUS 22
BROWSE 77
BRUSH CONTROL 61 63 71 78
BURNING 6 27 55 56 59 60 61 67 81 96

CACTACEAE 72
CALICHE 16
CALIFORNIA 21 51 82 88 96
CANADA 48
CANOPY 71
CARNEGIEA GIGANTEA 47
CARRYING CAPACITY 7 12 19 54 86
CATCHMENTS 41
CATTLE 69 71 77 78
CEANOTHUS 67
CERCIDIUM 55
CERCOCARPUS 67
CHANNEL EROSION 96 99
CHANNEL MORPHOLOGY 14
CHIHUAHUAN DESERT 3 38 89
CHRYSOTHAMNUS 31
CLIMATE 25 60 65 89 97
CLIMATIC CHANGE 2 3 14 16 19 32 37 42 44 52 54 55 56 57 60 62 64 65 70 72 73 76 81 83 92 93 99
CLIMATIC DATA 43 54 100
CLIMATIC GEOMORPHOLOGY 2 8 97
CLIMATIC-VEGETAL RELATIONSHIPS 3 19 52 54 55 56 72 97
CLIMATOLOGY 37 42 76 92
CLIMAX 12 59 67
CLOUD SEEDING 98
COASTAL PLAINS 17
COLORADO 21 28 64
COLORADO DESERT 88
COLORADO PLATEAU 92
COLORADO RIVER 11 66 80
COLORADO RIVER BASIN 10 11 80 84 85 90
COMPETING USES 21
COMPETITION 60 63 81
CONJUNCTIVE USE 21
CONSERVATION 88
CONTROLLED BURNING 12 71
CONVERSION(MANAGEMENT) 71
COSTS 5
CRUSTS 88
CYCLES-OF-EROSION CONCEPT 97

DAMS 11 39
DEATH VALLEY 51
DEGENERATION 5 19 27
36 96 97 102
DEGRADATION (STREAM) 99
DEMOGRAPHY 74 91
DENDROCHRONOLOGY 19 37
42 43 44 46 62 65
76 92
DENSITY 28 74
DEPOSITION (SEDIMENTS) 15
99
DESERT ANIMALS 77
DESERT BIOME 13 68 72
81
DESERT GRASSLAND 12 35
45 53 54 55 56 59
61 63 67 78 81
DESERT PAVEMENT 88
DESERT PLANTS 3 22 71
72
DESERT SOILS 88
DESERTIFICATION 29 52 56
57 88 92 93
DESERTS 3 56 60 71
DESICCATION 31 56 57
93
DISTRIBUTION PATTERNS 57
DROUGHT TOLERANCE 32
DROUGHTS 7 9 32 33
36 42 45 46 64 76
95 97 98 102
DRY FARMING 102
DUNES 23
DUST STORMS 22

ECOLOGY 75
ECONOMIC DEVELOPMENT 79
ECONOMIC IMPACT 84
ECONOMICS 17
ECOSYSTEMS 19
ELEVATION 55
ENERGY 10
ENERGY CONVERSION 10
ENVIRONMENT 32 73
ENVIRONMENTAL EFFECTS 25
43 45 56 60 89 93
ENVIRONMENTAL ENGINEERING 58
ENVIRONMENTAL IMPACT 5 10
91 101
EPHEMERAL STREAMS 14
EPHEMERALS 72
ERAGROSTIS LEHMANNIANA 63
EROSION 6 27 31 36
56 63 85 97 99
EROSION CONTROL 1 6 45
63 96 97
ETHNOLOGY 50
EVAPORATION 41 96
EVOLUTION 3
EXPEDITIONS 68
EXTIRPATED SPECIES 76 77
83

FEED LOTS 66
FLOOD CONTROL 6
FLOODS 6 22
FLOW 51
FLOWERING 72
FOOD SUPPLY 57
FORAGE GRASSES 28 63
FORAGE LEGUMES 12
FORAGE PLANTS 7
FORAGE PRODUCTION 12 63
77 86
FORAGE SUPPLY 7
FORBS 86
FORESTS 52
FOSSIL FAUNA 70
FOSSIL FUELS 10

GEOCHRONOLOGY 8 73
GEOGRAPHICAL ORIGIN 3
GEOLOGY 13 97
GEOMORPHOLOGY 8 11 13
89
GEOTHERMAL POWER 10
GERMINATION 63
GILA RIVER 68
GLACIAL DRIFT 82
GLACIAL GEOLOGY 83
GLACIERS 51
GRASSES 7 14 22 23
28 52 63 67 71 78
89
GRASSLAND BIOME 12 23 32
35 45 54 55 59 60
61 67 68 81 85 86
GRAZING 6 7 14 19
23 27 28 29 30 31
36 53 54 55 56 60
61 67 68 71 77 78
81 85 86 87 89
GREAT BASIN 3 23 33
52 90 102
GREAT PLAINS 9 10 32
102
GROUND COVER 63
GROUNDWATER 14 17 21
25 26 49 79
GROUNDWATER BASINS 17
GROUNDWATER MINING 11 21
25
GROUNDWATER RECHARGE 26
GUIDEBOOKS 13
GULLY EROSION 6 14 19
29 30 34 36 54 56
63 85 99
GUTIERREZIA 60

HABITATS 77 83
HERBIVORES 77 83
HILARIA MUTICA 45
HISTORY 4 7 22 23
27 31 35 36 39 43
54 56 59 60 68 69
73 85 90 92 96 97
102
HUMANS 40
HYDROLOGIC DATA 95
HYDROLOGY 11 13

INDIANS OF NORTH AMERICA 15
40 50 64 69 76 102
INTERCEPTION 71
INTRODUCED SPECIES 63 71
77
IRRIGATION 25 49 69 90
IRRIGATION EFFECTS 17 25
84
IRRIGATION PRACTICES 4
IRRIGATION WATER 17 20
21 25 66 84

JUNIPERUS 22 23 31 67

LAKE BASINS 2
LAND CONSERVATION 1
LAND MANAGEMENT 6 27 30
63 88 97
LAND RECLAMATION 33 48
90 97
LAND RESOURCES 88
LAND USE 5 27 35 53
71 88 91
LANDFORMS 8
LANDSCAPING 58
LARREA TRIDENTATA 60 81
LEAVES 71
LEGAL ASPECTS 21 80 84
98
LEMAIREOCEREUS THURBERI 47
LEPUS 7
LIMITING FACTORS 73
LIVESTOCK 7 34 60

MAMMALS 76
MATHEMATICAL MODELS 24
MECHANICAL CONTROLS 63
MEIGS SB 60
MEIGS SC13 96
METEOROLOGICAL DATA 95
MEXICAN WATER TREATY 84
MEXICO 17 38 56 59
74 76 100

MICROENVIRONMENT 33
MID GRASSES 32
MIGRATION 102
MINING 6
MODELS 41 99
MOISTURE DEFICIT 31
MOJAVE DESERT 51 82 88
MUHLENBERGIA PORTERI 78
MULTIPLE PURPOSE 71

NATURAL AREAS 68
NATURAL RESOURCES 27
NEVADA 21 57 82
NEW MEXICO 21 35 36 40
45 56 57 60 76 85
92 99
NORTH AMERICA 43 62 75
NORTHERN DESERT SHRUB 23
52

OFF-ROAD VEHICLES 88
OGALLALA FORMATION 26
OLNEYA TESOTA 47
OPUNTIA 7 47 60 81
OREGON 52

PALEOBOTANY 82
PALEOCLIMATOLOGY 16 37
43 44 51 52 57 76
92
PALEOECOLOGY 2
PALYNOLOGY 52 76
PAPAGO INDIAN RESERVATION 13
47
PASTURES 86
PEDIMENTS 8
PERENNIALS 72 87
PERTURBATION 6 7 12
23 28 29 30 31 35
36 45 55 59 63 64
67 81 85 86 88 93
PESTS(INSECTS) 48
PHENOLOGY 72
PHREATOPHYTES 14 96
PHYSICAL GEOGRAPHY 50 69
PHYTOGEOGRAPHY 3
PINAL COUNTY 47
PINUS CONTORTA 52
PINUS MONTICOLA 52
PINUS PONDEROSA 37 52
PLAINS 2 32 53
PLANT COMMUNITIES 14 22
67
PLANT COVER 19 45 47
97
PLANT DISTRIBUTION 22 55
89
PLANT ECOLOGY 14 67 72
PLANT GROWTH 41 43

PLANT INJURY 88
PLANT INVADERS 12 22 53 55 60 63 81 86
PLANTS 60
PLATEAUS 53
PLEISTOCENE EPOCH 2 70 75 76 77 83
PLIOCENE EPOCH 8
POLITICAL ASPECTS 11 74 90
POPULATIONS 74
POPULUS 14
PRECIPITATION(ATMOSPHERIC) 41 43 64 65 89 90 92 98 100
PREHISTORY 40
PRIOR APPROPRIATION 21
PRODUCTIVITY 63 77
PROSOPIS 12 14 18 53 55 56 59 60 61
PROSOPIS JULIFLORA 12 78 81
PUMPING 21 49

QUANTITATIVE SAMPLING 87
QUATERNARY PERIOD 8 82 83
QUERCUS 55 67 96

RADIOCARBON DATING 82
RAINFALL 63 87 100
RAINFALL-RUNOFF RELATIONSHIPS 41
RANGE GRASSES 71 86
RANGE MANAGEMENT 6 7 12 14 29 30 35 36 54 59 61 63 68 71 77 78 81 85 86 89 97 102
RANGES 7 27 68 71 78 86
REASONABLE USE 21
RECREATION 71 88
REFORESTATION 33
REGIONAL ANALYSIS 97
REGIONAL GEOGRAPHY 13 40 50 68 91
RESERVOIRS 41
RETURN FLOW 66
REVEGETATION 48 63 71 97
RIO GRANDE VALLEY 27 36
RIPARIAN VEGETATION 14 96
RIVER BASINS 11 36 39
ROCKS 13
ROCKY MOUNTAIN REGION 8 71
RODENTS 60 61
RUNOFF 1 41 51
RUNOFF FARMING 41

SALINE WATER 84
SALINE WATER INTRUSION 17
SALINITY 20 25 66
SALSOLA 19
SALT RIVER VALLEY 25
SALTON SEA 84
SALTS 20
SAN PEDRO VALLEY 14 68 91
SAN SIMON WATERSHED 63
SANDS 88
SANTA CRUZ RIVER BASIN 14
SANTA RITA EXPERIMENTAL RANGE 61 81
SANTA ROSA WASH 47
SARCOBATUS 52
SASKATCHEWAN 48
SATURATED SOILS 96
SEALANTS 41
SEASONAL 63 72 86
SEDIMENTATION 36
SEEDING 7 63
SEEPAGE 41
SEMIARID CLIMATE 19 23 32 53 56 64 71 95 99 102
SETTLEMENTS 36 57 64 93
SEWAGE EFFLUENTS 66
SHEEP(DOMESTIC) 69
SHEET EROSION 30
SHORT GRASSES 32
SHORTGRASS 32
SHRUBS 7 12 22 23 52 53 56 63 77 78 81 86
SITES 44
SLOPE EXPOSURE 33
SOCIAL ASPECTS 9 10 25 58 64 80 88 102
SOCIAL ORGANIZATION 102
SOIL COMPACTION 41
SOIL CONSERVATION 6
SOIL EROSION 5 6 16 27 31 34 36 54
SOIL FORMATION 16
SOIL HORIZONS 16
SOIL MANAGEMENT 6
SOIL MOISTURE 48
SOIL PROFILES 16
SOIL PROPERTIES 4
SOIL SEALANTS 41
SOIL STABILIZATION 6 48
SOIL SURFACES 87
SOIL TEXTURE 78
SOIL TREATMENT 41
SOIL TYPES 22 27 33
SOIL-WATER-PLANT RELATIONSHIPS 36 57
SONORA 17
SONORAN DESERT 3 4 11 13 47 57 59 68 72 77 87 89 94 101
SOUTHERN DESERT SHRUB 13 87 89

SOUTHWEST U.S. 1 3 5
7 10 15 16 21 33
34 35 36 39 40 42
46 49 50 53 56 57
59 64 68 71 73 76
77 83 85 89 90 92
93 95 97 98 102
STRATIGRAPHY 2
STREAMFLOW 27
STRIP MINING 10
SUBSOIL 78
SUCCESSION 12 14 31 53
57 59 60 67 87
SUCCULENTS 89
SUMMER 63
SUMMER EPHEMERALS 72
SUMMER PRECIPITATION 63 72
76 98 99
SURFACE WATERS 25 41 57
SURFACE-GROUNDWATER RELATIONSHIPS
21

TAMARIX 53
TEMPERATURE 63
TEXAS 2 7 16 21 26
35 60
TIME LAPSE PHOTOGRAPHY 55
56
TIME MEASUREMENT 43
TOOELE VALLEY 22
TOPOGRAPHIC FEATURES 38 51
TRANSHUMANCE 71
TREE RINGS 44 46
TREES 33 92
TRICHACHNE CALIFORNICA 78
TUCSON BASIN 24
TUMAMOC HILL 72 87

UNDESIRABLE PLANTS 19 55
63 81
UNGRAZED 28 30 45
UNGULATA 77
UNITED STATES 6
URBAN AREAS 69 74 101
URBAN PLANNING 74
UTAH 21 22 23 29 30
31 86 90

VANDALISM 88
VARIABILITY (ENVIRONMENTAL)
44 100
VEGETAL RELATIONSHIPS 18
67
VEGETATION 13 22 23 25
27 28 30 30 35 52
60 68 71 76 89 94

VEGETATION CHANGE 3 7
12 14 19 23 28 29
30 31 32 35 45 54
55 56 59 60 61 67
68 76 78 81 85 86
94 101
VEGETATION EFFECTS 58 87
97
VEGETATION ESTABLISHMENT 82
87 97
VEGETATION MAPS 47
VEGETATION TYPES 32
VIABILITY 63

WATER ALLOCATION (POLICY) 10
WATER CONSERVATION 39 71
WATER COSTS 24
WATER HARVESTING 41
WATER HOLES 13
WATER LAW 21 69
WATER LEVEL FLUCTUATIONS 17
WATER LOSS 5 11 57 79
WATER MANAGEMENT 11 21
66 80
WATER POLLUTION 39 66
WATER QUALITY 20 25 41
66 84
WATER RESOURCES 17 25 39
49 69 79 89
WATER RESOURCES DEVELOPMENT
11 21 24 25 39 80
WATER REUSE 66
WATER RIGHTS 21
WATER SHORTAGE 10 49 80
WATER SOURCES 78 95
WATER SPREADING 102
WATER STORAGE 41 95
WATER SUPPLY 24 25 79
80 90
WATER TABLE 11 14
WATER TRANSFER 25
WATER UTILIZATION 25 26
49 80 93
WATER YIELD IMPROVEMENT 41
71
WATER-REPELLENT SOILS 41
WATERSHED MANAGEMENT 1 6
27 63 71 97
WATERSHEDS (BASINS) 36 68
WEATHER FORECASTING 65
WEATHER MODIFICATION 98
WEATHER PATTERNS 19 97
WEATHERING 16
WEEDS 28
WEST U.S. 8 42 65 71
90
WILDLIFE HABITATS 22 96
WIND EROSION 23 88
WINDBREAKS 96
WINTER EPHEMERALS 72
WINTER PRECIPITATION 72 98
WITHDRAWAL 26
WOODLAND 56
WOODY PLANTS 33 53 60
63
WYOMING 28 70

XEROPHILES 77
XEROPHYTES 72

ZOOGEOGRAPHY 70 75