UNIVERSITY OF UTAH

Department of Anthropology

ANTHROPOLOGICAL PAPERS

NUMBER 56 JUNE 1962

(Upper Colorado Series, Number 6)

A Survey of Vegetation in the Curecanti Reservoir Basins

By ANGUS M. WOODBURY, STEPHEN D. DURRANT and SEVILLE FLOWERS

DAVID M. PENDERGAST, *Editor*

CAROL C. STOUT, *Associate Editor*

UNIVERSITY OF UTAH PRESS

SALT LAKE CITY

UNIVERSITY OF UTAH

ANTHROPOLOGICAL PAPERS

The University of Utah Anthropological Papers are a medium for reporting to interested scholars and to the people of Utah research in anthropology and allied sciences bearing upon the peoples and cultures of the Great Basin and the West. They include, first, specialized and technical record reports on Great Basin archeology, ethnology, linguistics, and physical anthropology, and second, more general articles on anthropological discoveries, problems and interpretations bearing upon the western regions, from the High Plains to the Pacific Coast, insofar as they are relevant to human and cultural relations in the Great Basin and surrounding areas.

For the duration of the archeological salvage project for the Upper Colorado River Basin which the University has undertaken by contract agreement with the National Park Service, reports relating to that research program are being published as series within a series, bearing numbers in the general sequence of the Papers as well as their own identifying numbers.

The Upper Colorado and Glen Canyon subseries will represent a wider range of the sciences and humanities than the parent series itself. The project provides for studies of the natural history of the Glen Canyon area and its inhabitants so that the relationships of the prehistoric cultures and their settings will be understood in depth. As contact with Western peoples and cultures has had a varying effect upon the native Americans and the land, some papers will be concerned with the Colorado in the more recent past.

UNIVERSITY OF UTAH

DIVISION OF BIOLOGICAL SCIENCES

A SURVEY OF VEGETATION

IN THE CURECANTI RESERVOIR BASINS

Angus M. Woodbury, Stephen D. Durrant

and Seville Flowers

ANGUS M. WOODBURY, Biological Editor

Number 56 (Upper Colorado Series No. 6) June, 1962

A N T H R O P O L O G I C A L P A P E R S

Department of Anthropology

A C K N O W L E D G M E N T

The courtesy of the Division of Biological Sciences, University of Utah, in releasing this paper for publication in the Anthropological Papers, instead of the Divisional Biology Series, is acknowledged with appreciation.

UPPER COLORADO RIVER BASIN

A SURVEY OF VEGETATION IN THE CURECANTI RESERVOIR BASINS

as a part of the

Upper Colorado River Basin Project

in accordance with the agreement

dated April 28, 1961

Contract 14-06-400-1663

between the

U. S. Bureau of Reclamation and the University of Utah

by

Angus M. Woodbury, Stephen D. Durrant, Seville Flowers

Division of Biological Sciences

University of Utah

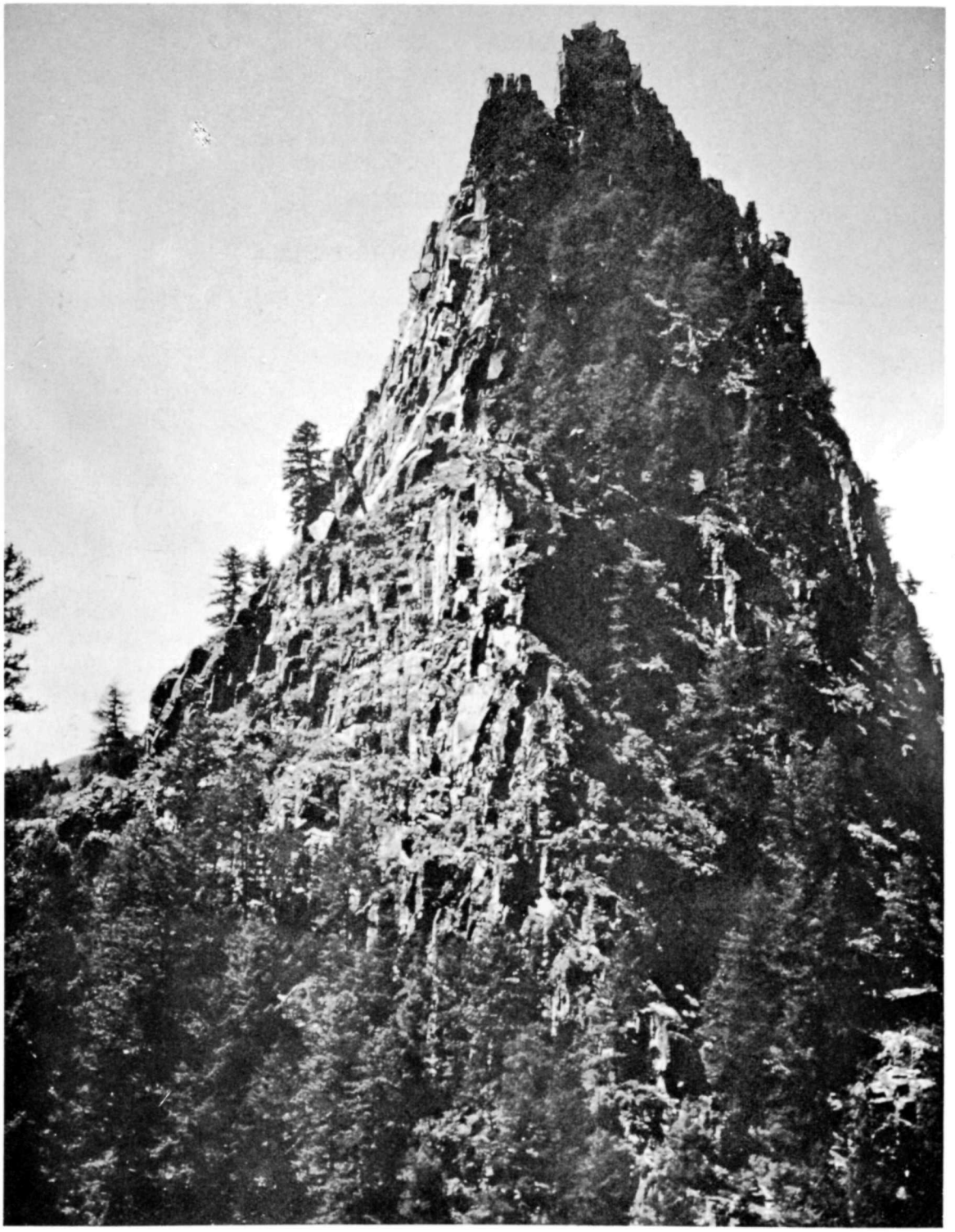

Fig. 1. The Curecanti Needle, from which the project was named. Photo by Robert F. Wilson.

FOREWORD

This report is one of a series of papers that deal with investigations of the Colorado River System arising out of the water storage program provided by Congress for development of the Upper Colorado River Basin to conserve water and regulate stream flow (Act of 11 April 1956, 70 Stat. 105). This paper deals with the vegetation of the area that will be inundated by the three Curecanti reservoirs, Blue Mesa, Morrow Point, and Crystal, located successively downstream along the Gunnison River between Gunnison, Colorado and the Black Canyon National Monument. A separate publication will deal with ecological studies of the flora and fauna.

Reports of previous biological investigations in the Upper Basin by University of Utah personnel were published in University of Utah Anthropological Papers, numbers 31, 36, 40, 45, 48, 51, and 55. The first three dealt with Glen Canyon in Arizona and Utah; the next two with Flaming Gorge along Green River in Wyoming and Utah; the last two with the Navajo on San Juan River in Colorado and New Mexico.

The present report is made primarily for the Bureau of Reclamation's Upper Colorado River Office at Salt Lake City, Cecil B. Jacobson, Chief. It has been a pleasure to deal with Mr. Jacobson; the liaison officer, Robert Wilson; and representatives of the field office at Gunnison, Colorado.

Angus M. Woodbury

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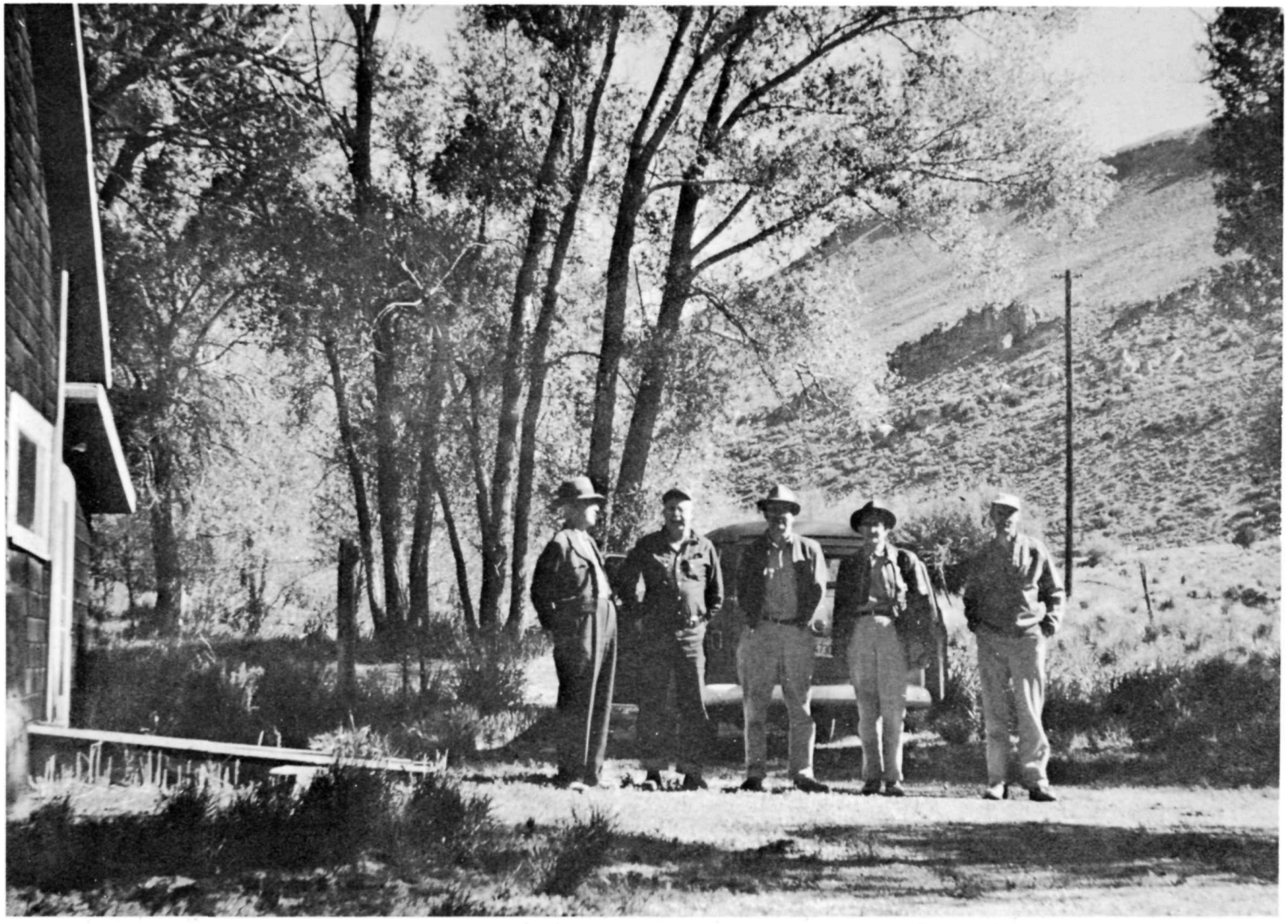


Fig. 2. Personnel of the preliminary reconnaissance expedition at the Ellgen place, from left, Angus M. Woodbury, Stephen D. Durrant, Arden R. Gaufin, Seville Flowers, Robert F. Wilson. Photo by Robert F. Wilson.

INTRODUCTION

During the development of the three Curecanti Unit (Blue Mesa, Morrow Point and Crystal) reservoirs (Fig. 1) on the Gunnison River in western Colorado, the U. S. Bureau of Reclamation, Region 4, with headquarters at Salt Lake City, had need for a quantitative survey of the vegetation of the reservoirs prior to inundation of an estimated 15,000 acres of land. By agreement (Contract No. 14-06-400-1663) dated April 28, 1961, the University of Utah through its specialized personnel in the Division of Biological Sciences, undertook this survey under the leadership of Angus M. Woodbury, Stephen D. Durrant and Seville Flowers.

Through assistance from the University Research Fund and the Division of Biological Sciences, the work was expanded to include ecological surveys of vertebrate and invertebrate faunas. In addition, support was given by the National Science Foundation to four undergraduate students to permit them to join the expedition in order to work in close association with scientists actively engaged in ecological research. This paper is a report of the quantitative survey of vegetation made during June and July, 1961. Other floral and faunal studies will be treated separately.

PRELIMINARIES

Prior to final negotiations for the agreement, Durrant reconnoitered the area on a trip over U. S. Highway 50. After agreement was reached for the University to undertake the work, the three authors, accompanied by limnologist Arden R. Gaufin and Bureau of Reclamation liaison officer Robert F. Wilson, visited the area June 6 to 9, 1961 (Fig. 2) to make detailed arrangements for the expedition planned to begin on June 26. After studying the physiography of the three reservoir basins, we made final arrangement with the Colorado Game and Fish Department representative on the ground, Marion C. Coghill, to use the vacant "Ellgen Place" ranch home for headquarters under authorization previously received from the department headquarters at Denver, Colorado, by Laurence E. Riordan's letter of March 7. We appreciated the courtesy.

We also visited the local office of the Bureau of Reclamation in Gunnison, Colorado and received from that office assurance of assistance if needed in getting permission from landowners within the Blue Mesa Basin to enter their private holdings to make our surveys. This was a problem of little or no significance in the previous surveys of three reservoir basins but here, with so many resorts and ranches posted against trespass, there was potential difficulty. However, with tactful preliminary negotiations, assisted by Marion Coghill, trouble was largely avoided.

While there, we also arranged for camp supplies to be obtained through a Safeway Store in Gunnison, about 20 mi. distant from the place selected for headquarters. Beyond this, we examined the mouths of the tributary canyons as well as the main basins to study the logistic problem of access by the work crews of the expedition. Because of the difficult access to Crystal

Fig. 3. Looking downstream from RM 26.5 into Crystal Reservoir site. Photo by Calvin Lamborn.

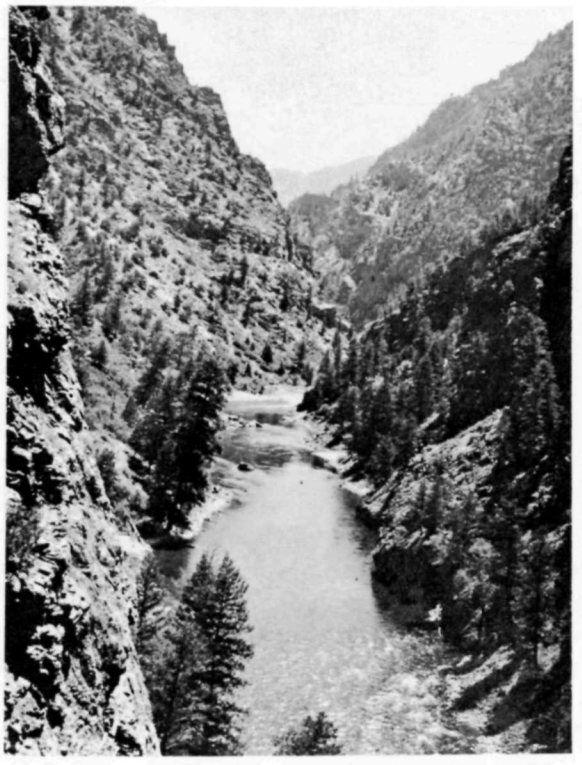


Fig. 4. Looking upstream from RM 26.5 into Crystal Reservoir site. Photo by Calvin Lamborn.

Reservoir Basin, we decided that much of the estimate of vegetation would have to be made by extrapolation from the Morrow Point Basin.

The expedition was planned and organized mainly during May and early June and was in the field from June 26 to July 23. In preparation for the expedition, the Bureau of Reclamation furnished maps and certain supplies and equipment for use by the University. The maps included USGS topographic quadrangle sheets covering the area, aerial photographic maps of the GS-LP and GS-VJV series covering the three basins enlarged to a scale of 1000 ft. per inch, and photo index sheets showing location of the photomaps. A transparent plastic sheet of stabeline film roughened on one side to take ink was firmly stapled in place over each photomap to be used.

On each such photomap, members of the Bureau had drawn the approximate limits of the reservoir within an area restricted as nearly as possible to the central portion because of the radial distortion in such photomaps. The areas thus delimited were so selected as to fit successively downstream along the Gunnison River and upstream on tributaries. The maps and overlay sheets were numbered from one, successively downstream along the Gunnison River to 23 and up the tributaries by adding capital letters to the map number at the mouth of the tributaries, thus 14A, 14B, 14C up Lake Fork. The numbers 1 to 14 are in Blue Mesa Reservoir, those from 15 to 21 in Morrow Point, and 22-23 in Crystal.

The area on each map is delimited by crosslines at each end of the section of reservoir selected for use. These crosslines are indicated by capital letters, A-A, B-B, C-C and so on up the Gunnison River to H-H, and by small letters up each tributary. In addition, certain prominent physiographic and cultural features were entered on the maps including the mileage or river mile (abbreviated RM herein) on the Gunnison River upstream from an arbitary point selected as Mile 20 at the east portal mouth of the proposed Gunnison Tunnel. The three reservoir sites are almost continuous, one above another from RM 20.8 to 62.7, a distance of 42 mi.

These entries provided by the Bureau were copied onto the transparent overlay sheets for use in the field. In addition, we prepared special mimeographed forms that were kept in looseleaf ring binders for use in recording data obtained in the field. These forms will be described later and illustrated in Appendix A.

THE RESERVOIRS

The dams that will impound the water of these three reservoirs are located in the Black Canyon of the Gunnison River in western Colorado. This canyon is cut through an uplift of Precambrian rocks of gneiss, schist and granite, above which the sedimentary rocks of later ages encountered in surrounding areas are here largely missing.

The Crystal damsite is located at RM 20.8 at an altitude of about 6530 ft. The dam (230 ft. high, 660 ft. crest) to be constructed at this point is designed to back water upstream 7.5 mi. to RM 28.3 and to contour level of

Fig. 5. Looking upstream in Black Canyon from RM 36.4 into Morrow Point Reservoir basin. Photo by Calvin Lamborn.

Fig. 6. Looking across Black Canyon from bridge just below Morrow Point Dam. From left, Heber Hall, Seville Flowers, Dean Stock, Robert N. Reynolds, Delbert Argyle, Gary Ranck. Photo by Calvin Lamborn.

6750 ft. (Figs. 3 and 4). When first filled, it will hold over 38,000 acre ft. of which nearly 16,500 will be available for active use. The Morrow Point Dam (405 ft. high, 650 ft. crest) at RM 28.8 is designed to back water upstream more than 11 mi., nearly to RM 40 and contour level of 7160 ft. It is designed to hold 117,000 acre ft., of which 15,000 will be available for active use and 102,000 for inactive storage (lake), (Figs. 5 and 6). These two reservoirs lie entirely within the narrow Black Canyon, which has no significant branches within the reservoir limits. The Blue Mesa Dam (350 ft. high, 1200 ft. crest) at RM 40.5 at the upper end of Black Canyon will back water up through several tributary side canyons and open valleys to RM 62.7 and contour level of 7520 ft. It is designed to hold 940,800 acre ft., of which 742,800 acre ft. will be available for active use and 198,000 ft. for inactive storage.

An abandoned railroad grade, now used for a road, runs from Sapinero downstream through Black Canyon past the Blue Mesa and Morrow Point damsites and emerges from the canyon upstream along Cimarron Creek. Black Canyon below the mouth of the Cimarron is exceedingly narrow. A fisherman trail goes downstream alongside the river in the Crystal Basin. About 2 mi. downstream, the cliffs close in against the river and prevent further foot passage without climbing over the cliff. The Blue Mesa Reservoir is the important one in this series. It will inundate much farm and ranch land and will require relocation of U. S. Highway 50, which now traverses the valley.

Four important tributaries and several of lesser significance enter the Blue Mesa Basin. Lake Fork, entering from the southeast (left bank) will produce an embayment about 8 mi. in length. Next on that side is Cebolla Creek with an embayment of 4.5 mi. and Willow Creek with a small indentation in the shoreline. On the right bank are Soap Creek, West and East Elk creeks with embayments of 4, 2.5 and 1 mi., respectively, as well as several side canyons with smaller indentations. The Black Canyon scenery, although magificent and spectacular, does not have the lavish coloring found in Flaming Gorge and, especially, in Glen Canyon.

SUMMER EXPEDITION OF 1961

The summer expedition, in the field from June 26 to July 23, contained 16 men. Experience gained on three previous expeditions, Glen Canyon in 1957-1958, Flaming Gorge in 1959, and Navajo in 1960, greatly facilitated preparations and field operations. The field crew included the following: Dr. Stephen D. Durrant, field director; Dr. Seville Flowers, field chief of the vegetation survey; Gerald T. Groves, assistant to Flowers; Delbert W. Argyle, Heber H. Hall, Calvin R. Lamborn, Gary L. Ranck, R. Newell Reynolds and A. Dean Stock, members of the vegetation survey crew; Allen W. Knight and Elroy B. Robinson, faunal study team; Paul C. Mountford, camp manager; Ronald W. Olson, Jay W. Richardson, Ernest R. Riley, and R. Bruce Walker, National Science Foundation students, assigned to participate in research with scientists of the expedition.

Part of the crew, with the heavy truck, left the University at Salt Lake City on the afternoon of June 26. The balance of the crew left next morning in a pickup and a carryall. They all reached camp in the afternoon of Tuesday, June 27, 1961 and had the routine of the camp established by evening. In-service

Fig. 7. Personnel of Expedition; front, stooping: Heber H. Hall, Elroy B. Robinson, R. Bruce Walker, Gerald R. Groves, Robert Newell Reynolds. Middle: Stephen D. Durrant, Paul C. Mountford, Ronald W. Olson, Seville Flowers, A. Dean Stock, Ernest R. Riley, Delbert Argyle, Allen W. Knight. Rear: Calvin R. Lamborn, Gary L. Ranck, Jay W. Richardson, Jr. Photo by Gerald R. Groves.

special training for new members of the vegetation survey teams began next morning. For consultation with the crews, camp was visited on July 9 by Angus M. Woodbury, on July 10 by Don M. Rees and on July 11 by Arden R. Gaufin.

LOG OF THE EXPEDITION, 1961

Stephen D. Durrant

June 26, Monday. All members of the expedition met at the Biology Building of the University of Utah at 8:30 a.m. The trucks arrived shortly after and all gear that was on the lower campus was loaded. We then had a short meeting of the crew. Drs. A. M. Woodbury, Seville Flowers and S. D. Durrant explained the nature of the work and gave instructions on procedure. Following this meeting, we went to the upper campus, Building 428, where the remainder of the equipment was loaded. The entire crew consisted of the following persons: Delbert Argyle, S. D. Durrant, S. Flowers, Gerald R. Groves, Heber H. Hall, Allen W. Knight, Calvin R. Lamborn, Paul C. Mountford, Ronald W. Olsen, Gary L. Ranck, Robert Newell Reynolds, Jay W. Richardson Jr., Ernest R. Riley, Elroy B. Robinson, A. Dean Stock, Ronald Bruce Walker. The large truck left around noon for camp and the pickup and carryall were to leave with the remainder of the crew at 4:00 a.m. the next day. Paul Mountford and I left with the large truck, and, after stopping at Petty Motor Company for equipment, we picked up Dean Stock at 1:30 p.m. at 7000 South State Street. We proceeded south through Provo and on to the mouth of Spanish Fork Canyon where we were stopped by the Utah State Highway Patrol and informed that Spanish Fork Canyon was blocked and we would be obliged to detour through Salina to go to Price. We left Highway 50 at Thistle and went south through Indianola, Fairview, Mt. Pleasant, Ephraim, Manti and Gunnison to Salina; thence up Salina Canyon and proceeded to Price through Ferron, Emery and Huntington. We arrived in Price at 7:30 p.m. after a detour of 150 mi. We then continued to Grand Junction, Colorado, arriving at 11:30 p.m.

June 27, Tuesday. We left Grand Junction after breakfast, went to Delta and Montrose and proceeded to our campsite at the "Ellgen Place" of the Colorado State Department of Fish and Game. This is on their game management area, located 17 mi. west of Gunnison, Colorado. We unloaded and set up camp in a vacant ranch house on this property. We arrived at 11:30 a.m. and the pickup arrived with three additional men at 5:30 p.m., followed by the land-rover carryall at 6:30 p.m. Mountford had gone to town for supplies, but we had supper and finished setting up the camp.

June 28, Wednesday. The morning was spent in the final arrangements of the house and camp. The mammalogists obtained Peromyscus maniculatus and Eutamias minimus from traps set last evening. I observed beaver dams along the river and saw several Citellus lateralis. After lunch Dr. Flowers began training the botanical crews in plant identification, the first step in their training to evaluate the plants of the respective reservoir basins. The invertebrate students were busy with their activities.

June 29, Thursday. The mammalogists left at 4:30 a.m. to collect their traps. After breakfast, the botanical crews left for their first study of transects. This was additional training to enable them to more correctly measure the vegetation. After lunch they again set up, this time to do their initial study of quadrats. All the other crews are busy with their specialities and everything appears to be going satisfactorily. We had planned to go with Clifford Coghill of the Colorado Department of Fish and Game to meet the persons who own land within the confines of the reservoir sites, but he came in this evening to tell us that he would be unable to go tomorrow but would do so before the end of the week.

June 30, Friday. This morning the crews were out early on their transect studies in Dry Gulch. This is the last of the in-training schooling, because we plan to begin the actual vegetation survey tomorrow. At 9:00 a.m., Coghill came to camp and took Dr. Flowers and myself to visit the landowners upon whose land we would be working in our surveys. We went first to the top of the reservoir site and worked downstream visiting all persons as far downstream as East Elk Creek. This will provide us with sufficient contacts for the time being and we will continue these visits lower downstream at a later date. In general, we found the owners to be cooperative although there was considerable bitterness concerning the Bureau of Reclamation. We contacted the following persons: Mr. Steinberger, owner of the camp at Beaver Creek, the camp at South Beaver Creek, Steuben Creek and considerable acreage along the river; Mr. Steckel, owner of the Rippling Water Ranch and Resort; Mrs. Dickerson, owner of the Jointed Rod Club; Mrs. Hermann, private home; Mr. Burris, owner of the Elkhorn Ranch and Resort; Mr. Phil Reiss; Mrs. Blackstock, owner of the largest ranch within the reservoir site; Robert Sunderland, owner of Tex Lodge; Mr. Oswald, owner of the Rainbow Ranch and owner of the Trout Haven Resort. After lunch, we discussed plans for the morrow and the crews finished their transect studies. The mammalogists have been extra busy and with help from other members of the crews have already made fine collections. Allen Knight has taken over the aquatic studies and this phase of the study is moving ahead in fine style. Everyone is congenial and busy and morale is high. The weather continues cool with afternoon showers. Mosquitoes are really bad, especially along the river and in the hay fields.

July 1, Saturday. Today we began the official survey of the plants within the confines of the reservoir basin. I feel that the crews are now adequately trained. They left camp for the upper end of the Blue Mesa Reservoir where they covered the upper 4 mi. They returned to camp at 3:30, being pretty well spent because of the terrific number of mosquitoes. Because this was the first day of the formal study, there were some discrepancies in their data and the remainder of the day was spent in ironing out these details and getting ready for the morrow.

July 2, Sunday. This being Sunday, I gave the crews the day off. Some read and studied, while others went with the aquatic crew to shock fish. Groves had a long day preparing the final draft of the first day's work, and in preparing a corrected list of the plants and the correct spelling of the scientific names. The aquatic crew worked Soap Creek and the mammalogists trapped upper Dry Gulch where they had hauled two dead deer for bait for carnivores. Some of the men did some fishing and there appears to be quite a sizable fish

population. They caught several. Yesterday, Dr. R. M. Hansen of the Experiment Station of Colorado State University and three of his students visited us in camp and remained for supper. They have a camp on Cochetopa Pass. This evening Dr. Hansen and one of his students returned on their way to Black Mesa to establish another camp.

July 3, Monday. The vegetation crews left at 7:00 a.m. after breakfast to continue the survey. They returned at noon and spent the afternoon preparing the records and completing the overlays on the aerial photographs. One team, Ranck and Reynolds, had met a Mr. Robbins at the region of the Iola Bridge and he accused them of trespass. Explanations were useless and he became unreasonable and abusive.

July 4, Tuesday. I had thought to give the crews a day off, this being a national holiday. They preferred to work. They returned at noon and finished the records and the overlay maps. This morning another team, Hall and Argyle, ran afoul of this same Mr. Robbins, only this time he really became abusive and threatening. This is interesting in view of the fact that he did not own the land upon which we had been working with permission from the owner, Mr. Burris. This is the only case of any resistance to our efforts.

July 5, Wednesday. The crews continued their surveys downstream from the Iola Bridge. They then returned and prepared the records and maps. The landrover has not been running well and we discovered that the left front spring was broken which perhaps accounted for its poor handling. Both master leaves were broken away from the front spring shackle. I took the machine into Gunnison to the Ford Garage and left it. I called Mr. Petty who informed me that he would send out the necessary parts.

July 6, Thursday. This morning the crews surveyed downstream to the mouth of East Elk Creek at the Miller Ranch. Four weeks ago when we were here, he ordered us off his property. This time he was cooperative, having learned better the nature of our endeavors. The mammalogists are really working hard and have a fine collection in the making. The aquatic crew has about finished the survey of this basin. At noon, to my great surprise, a former student, Dr. M. Raymond Lee, appeared in camp while on his way back from an 18-month collection trip in Mexico for the Museum of Natural History of the University of Kansas. We had a fine visit and he spent the night in camp with us.

July 7, Friday. This morning we sent the crews to work in Cebolla Creek and the area between East Elk Fork, at Miller's Ranch and the Moncrief Ranch. They also spent part of the time in making quadrat studies. In making our vegetation surveys, we usually put one crew on the study of the river banks and one crew on each side to do the terraces and hillsides. They usually finish the surveys around noon, having left camp at 7:00 a.m. The afternoons are spent in recording data, preparing the overlay maps with Dr. Flowers and brining all their work up to date for final compilation by Gerald Groves. This afternoon, Paul Mountford and I went to Gunnison to check on the status of the landrover and to visit personnel of the Bureau of Reclamation. We ran into a terrific cloudburst in the lower canyon and were barely able to proceed. This evening, after somewhat despairing of obtaining bats and commenting upon their apparent scarcity, the men found them to be abundant along the river. They collected four specimens which proved to belong to four different species.

July 8, Saturday. I had the crews up early and they worked the section of the river between the Moncrief Ranch and the new bridge at the construction site of the new highway. This put us a day ahead of schedule. There is quite a similarity in the vegetation and the crews are now well experienced, which enables them to accomplish much more in a day. I went to Gunnison to get supplies for the camp. We are having troubles with transportation. The landrover is still in the shop in Gunnison. The large truck has no license plates and the permit expires today. The pickup is not functioning up to par. This evening Dr. A. M. Woodbury and his two grandsons, Nelson Woodbury and Sandy Gold, arrived in camp. Dr. Woodbury had driven over from Salt Lake City to check upon the work and to learn if everything was in order. It was, and he was pleased both with the progress of the survey and the type of work that was being done in the other studies. After supper, he desired to meet with the first year men and talk over their problems. Morale is high and the men are anxious and interested in their work.

July 9, Sunday. This is Sunday and after breakfast Dr. Woodbury continued his discussions with the men. Dr. Flowers, Gerald Groves, Elroy Robinson, Allen Knight and I left to explore an ingress into the upper end of the reservoir arm that will extend 8 mi. up Lake Fork of the Gunnison River. It was formerly possible to drive the entire length of this canyon on the old railroad grade that had been converted into a county road. This is now blocked by the new road construction about 1 mi. above the mouth of the canyon. This required us to go to Powderhorn and Gateview to enter the canyon from above, a round trip of 100 mi. We made the trip up and down this beautiful canyon and made plans to carry out the survey by starting one crew at the bottom and one at the top and picking them up in the middle. It will be necessary for the aquatic crew and the mammalogists to make an overnight camp here. We returned to camp about 3:00 p.m.

July 10, Monday. Dr. Woodbury left before breakfast. The crews went to Cebolla Creek where they spent the day in transect and quadrat studies. After lunch, Dr. Arden Gaufin and Mrs. Gaufin arrived in camp. They had a camper on a pickup truck. Dr. Gaufin was in camp to consult with the aquatic crew and to further instruct them in the conduct of their studies. After supper, Dr. Don M. Rees, Head of the Department of Zoology, University of Utah, and Glen Collett, Supervisor of the Salt Lake City Mosquito Abatement District, arrived in camp. They were returning from meetings at Greeley, Colorado and are here to inspect the work. They plan to spend two nights with us.

July 11, Tuesday. The crews were up early and left to do the section of the river at West Elk Creek and to study the embayment of the reservoir up this stream. This will leave us but two overlay maps to finish to complete the vegetation survey of the Blue Mesa Reservoir project. We are a little ahead of schedule. I accompanied Dr. Rees and Glen Collett to Tomichi Creek and the Gunnison River above the town of Gunnison, where they searched for and found mosquitoes and I fished for a little while. In the afternoon, we walked a couple of miles up Dry Gulch above camp to the beaver dams. Here they searched for mosquito larvae. Dr. and Mrs. Gaufin left this afternoon.

July 12, Wednesday. Dr. Rees and Glen Collett left this morning at 5:00 a.m. for Grand Junction, Colorado. I went to Gunnison and found the spring had been repaired in the landrover and returned it to camp. The crews worked Soap Creek and the adjacent area on the river. This was a large section and they did not return to camp until midafternoon. They all praised the beauties of Soap Creek and the immensity of the conifers in its upper reaches.

July 13, Thursday. This morning the crews finished the survey of the Blue Mesa Reservoir except for the 8 mi. up Lake Fork. The landrover was found to have a broken rear axle. This upset our plans for tomorrow because it could not be repaired in time to do us any good. By the end of the afternoon all records and maps were finished up to date.

July 14, Friday. I went to Coghill's house and called Mr. Neuman Petty of Petty Ford Company in Salt Lake City about the landrover. He decided to send a G. M. C. Carryall to replace the landrover. The pickup needed minor repairs so we took it over to Delta because we could not get it done in Gunnison. Because of this lack of transportation, the crews spent the day in secondary duties.

July 15, Saturday. The vegetation crews in the pickup truck left this morning to finish the upper 7 mi. in Lake Fork. They went to Powderhorn and entered the canyon at Gateview, returning around 3:00 p.m. after finishing the work. This terminates the survey of the Blue Mesa Reservoir. After supper the man from Petty Ford Motors arrived with the G. M. C. Carryall from Salt Lake City. He had supper and started back in the landrover (We learned later that shortly after leaving camp he rolled the landrover over in the canyon and demolished it. He and his passenger were in the hospital at Montrose for three days.). This has been a good group of men and the crews have had high morale. We are on schedule and plan to finish both the Morrow Point and Crystal Reservoir sites by next Friday night, strike camp and leave for home Saturday, arriving Sunday.

July 16, Sunday. This was Sunday and I gave the men the day off. Some went hiking, while others spent the day fishing, washing, writing letters and studying.

July 17, Monday. The crews left this morning to begin the survey of the Morrow Point Reservoir. This evening Elroy Robinson, Ronald Olsen, Allen Knight, Jay Richardson and Ernest Riley went in the pickup to Lake Fork to stay overnight, some to make aquatic studies including chemical analyses of the water, others to study the diurnal mammals and put in a nocturnal trapline. All were to return to camp for breakfast the next morning.

July 18, Tuesday. The vegetation crews left for Black Canyon in the carryall to complete the section between the mouths of Curecanti and Cimarron creeks today. The vegetation in this canyon is quite uniform within the confines of the reservoir site and the estimation is rather easy. At midmorning, the two crews arrived from their overnight camp on Lake Fork. They were somewhat exhausted. The mammalogists had a rich catch containing six species and numerous specimens. I helped prepare the specimens, putting up 13 skins. This is by far the largest catch and the largest number prepared

for the entire trip. This evening Dr. Hyde, zoologist of Western Colorado College of Gunnison, Colorado, visited us. We explained our activities and he was impressed both with our activities and results.

July 19, Wednesday. This morning the vegetation crews left to enter Black Canyon by way of Cimarron Creek. They finished the survey of the lower reaches of Morrow Point Reservoir and the upper 2 mi. of the Crystal Site. We will have to extrapolate the plants in the balance of the latter basin, based upon our studies of the Morrow Point Reservoir. They found considerable juniper in the first 2 mi. of this basin, lacking in the other two sites. After supper the mammalogists went to trap this same area.

July 20, Thursday. This is the beginning of the final two days to complete all records and to finish all secondary duties. This morning the mammalogists did not return from Black Canyon for several hours so I went down the gorge looking for them. Again, this evening, they were several hours overdue and again I went looking for them. We traversed the entire gorge without finding them, but they were in camp upon our return.

July 21, Friday. This is the last day and everyone was busy. Cliff Coghill brought us a freshly caught beaver from East Elk Creek. Gary Ranck, Heber Hall and I all had a hand in its preparation. It was quite a chore, but we succeeded. We then packed up all the mammalian and bird skins and skulls and all plant specimens for transportation home to the museum on the morrow. Everything was put in readiness to depart. The studies are completed and in many ways I feel that this is the best of the four surveys that we have done. The crews have been busy throughout and everyone was diligent and ambitious.

July 22, Saturday. The crews were up early and after breakfast camp was struck and the trucks were loaded. After packing, the crews scrubbed the house and policed the grounds. Cliff Coghill came over and said goodbye. He was loathe to see us go and gave us a warm invitation to return. He has proved to be a great help in bringing the work to a successful conclusion. We departed about 10:00 a.m. We had lunch at Montrose and had tire trouble with the carryall between Delta and Grand Junction. We changed tires, but the spare tire was not much better. We bought another tire in Grand Junction. All this cost us time and it was 5:00 p.m. before we departed Grand Junction. We proceeded through Fruita and Thompson to Greenriver, Utah where we stopped for dinner at 7:00 p.m. It was dark when we left Greenriver. We proceeded on toward Price but stopped a few miles north of Woodside and made camp. The moon was out and it was a lovely, cool night so pleasant after a hot day.

July 23, Sunday. The men were anxious to get home and this was the first morning of the entire expedition that I was not up first. Bedrolls were quickly put up and all gear was loaded. We were under way by 5:30 a.m. We had breakfast in Price and arrived in Salt Lake City at 10:30 a.m. The trucks were unloaded at the University and the crews dispersed. This is the fourth expedition in which we have made surveys of the vegetation in reservoir sites in the Upper Colorado Basin. We have finished the survey of the Blue Mesa, Morrow Point and Crystal reservoirs on the Gunnison River in Colorado. We have made a detailed survey of the plants and made splendid collections of the fauna and flora. I am certain we have acquitted ourselves with distinction and can be proud of the job we have done.

THE SURVEY OF VEGETATION

The agreement with the Bureau of Reclamation under which the survey of vegetation was made provided that "the University generally will follow the procedures and standards used by it in making the recent surveys on the Glen Canyon and Flaming Gorge reservoirs as reported in the University Anthropological Papers in Publication No. 36 (Glen Canyon Series No. 5) and Publication No. 45 (Upper Colorado Series No. 2), respecitively." This agreement was followed in general but additional experience on the Navajo Reservoir enabled us to improve our procedures and raise our standards in certain particulars.

METHODS OF STUDY

For making the survey of vegetation in the field, the method consisted primarily in having the survey crews walk through the vegetation on the ground, divide it into visually determined units, ocularly estimate the total percentage of plant cover on each such unit, estimate the percentage composition of the dominant plant species in this cover, record these estimates on special forms prepared for that purpose, and take these records into camp.

At camp, Dr. Flowers plotted the units on the transparent overlays above the aerial photographic maps and assigned them key numbers that were then used to designate the units in the field records. The key numbers were usually assigned consecutively downstream, often divided, first on the right bank, then on the left bank. Groves then arranged the ocular estimates made by different crews into a single composite series in consecutive sequence indicated by the numbers on the map.

These methods were supplemented by quantitative studies of sample areas selected in different types of vegetation determined by the ocular surveys. The sample areas were studied quantitatively by means of transects, quadrats or tree-spacing measurements. These studies were intended primarily to sharpen the judgment of the estimators but were so designed that they can also serve as quantitative samples.

INITIAL TRAINING

During the three days of initial training of new members of the survey crew, with assistance of Hall of Glen Canyon, Flaming Gorge and Navajo experience, Groves and Ranck of Flaming Gorge and Navajo experience, and Stock of Navajo experience, Dr. Flowers gave emphasis to: 1) recognition of the local dominant plants that would be encountered on the survey, 2) ocularly estimating the cover density of vegetation on the ground, 3) analyzing the percentage composition of important species of plants in the vegetation cover, 4) estimating the height, diameter, and foliage volume of a) individual plants and b) the average in stands of vegetation, 5) estimating the width of fringe strips of vegetation along streamsides too narrow for realistic planimeter measurement on the aerial photomaps, and 6) experience in making quantitative measurements of a) strip transects, b) quadrats and c) tree spacing.

FIELD PROCEDURES

In the field, each two-man crew was usually asigned to study a specific area shown on the photomap. After the crews were transported in the carryall or pickup by Groves and Flowers to the areas assigned, they studied the map carefully and noted anything necessary for orientation. While the crews were busy, Flowers and Groves made special over-all studies of the vegetation and collected specimens for future reference.

At appointed times and places, the crews were gathered and re-distributed or returned to camp at the close of day. When convenient, either in the field or at camp, the crews reported their survey results to Flowers, who plotted the units of vegetation, as agreed with the teams, upon the transparent overlay sheet above the photomaps. These units were then numbered on the overlay maps and the numbers recorded on the corresponding field tabulation records. When the numbering was completed, Groves assembled the crew records into the comprehensive consecutive master compilation.

As judgment dictated, Flowers selected typical areas of different types of vegetation for the purpose of making strip transect, quadrat, or tree spacing studies. Each of the three crews was given an area to study quantitatively and the teams were distributed to these areas in the manner indicated for the ocular estimate surveys. The results were recorded on special forms prepared for the purpose and kept in looseleaf binders for later study in the laboratory.

Ocular Estimates

The entire area of the Blue Mesa and Morrow Point and the upper 2 mi. of the Crystal reservoir basins were covered by the ocular estimate survey. The balance of Crystal was estimated by extrapolation from the upper parts of Black Canyon by comparison of the areas on photomaps. The two members of each team usually walked through the vegetation of each area determined to be a unit and made a composite judgment of: 1) the percentage of vegetation cover over the ground, 2) the average height of the vegetation, 3) the percentage composition of each major species component in the total cover, and 4) the average height of each component species. These items were recorded on special mimeographed forms that also provided space for giving general information about the location of the area. These records were used by Groves in preparing the master compilation. They were then assembled in looseleaf binders and kept for future reference. The form used is illustrated in Appendix A-1.

The vegetation cover always appeared more dense at a distance than at close range; hence, the team usually walked through some portions of each unit to get close-up observations of the vegetation density. The strip transects and quadrat studies also helped the crews in this problem. Density was estimated as the percentage of ground covered within the perimeters of the plants when projected downward. The balance of the ground surface not so covered was considered to be bare soil exposed to sunshine.

In analyzing the composition of the cover, the observers estimated the area occupied by each component as a percentage of the total vegetation, not

as a percentage of the total area of the unit. Plants included in the composition were usually listed in descending order of dominance. Ordinarily, the estimates were made to the nearest five percent, but in exceptional cases, important plants occupying smaller percentages were ordinarily estimated as three, two or one percent, or as trace quantities.

The vegetation units established by the crews were segregated on each overlay map according to habitat and were designated by numerals as follows: 1) streamside vegetation, which includes those plants at the edge of riverbanks or alongside streams that usually have percolating soil water at their roots, 2) terrace vegetation, which usually includes those plants on old stream or river terraces now a few feet above high water level that usually have available at their roots capillary water drawn upward from percolating water below, 3) hillside vegetation, which includes those plants that usually depend directly upon precipitation for their water supply; and 4) farm or ranch land vegetation, which includes farm and meadow crops and associated weeds that usually depend upon irrigation water.

This system of segregating vegetation types by habitat was established in Glen Canyon where the habitat types were usually conspicuously different and sharply distinguishable from each other. In Flaming Gorge and Navajo reservoir basins, these distinctions were more difficult to recognize in the field because of greater intergradation from one type into another and lesser contrast between the first three types. It is even more difficult to apply here in the Blue Mesa Reservoir because there is much less contrast in the amount of water available at roots of plants in the streamside, terrace, and hillside types. The plants of hillside often extend down over the terraces with little or no difference in vigor that can be ascribed to capillary water. In some cases, they even reach the stream bank. In some places, streamside plants extend backward onto the terraces, often lingering there after the stream bed has been lowered or moved.

In order to distinguish the different vegetation units in each habitat type, the units on each overlay map were designated by adding lower case letters to the habitat number, usually beginning at the upper end and running downstream, first on the right bank, then on the left if feasible, thus: 1a, 1b, 1c on the right, 1d, 1e, 1f on the left; 2a, 2b, 2c on the right and so on. Exceptions had to be made in some cases at the mouths of tributaries.

Overlay Maps

In camp, after consultation with the crews, Flowers drew the outlines of the vegetation units on the overlay maps and gave each unit a number. The units were usually established on single pieces of land but where the vegetation on separate pieces such as islands or isolated terraces were essentially alike, two, three, or more such areas were lumped together under one unit designation. Areas too small to be of quantitative significance were usually merged with adjacent units.

When an overlay map was completed, it usually contained, in addition to the map titles, outline of the reservoir, and crosslines indicating the area to be used, outlines of all units and their respective designations. Sometimes physical features such as creeks, banks, islands, ranches, and other features were added.

Strip Transects

During the course of the expedition, 15 transects consisting of five strips each were made in sagebrush and associated vegetation in unit areas selected for sampling by Flowers. Upon reaching an area to be sampled quantitatively by this method, each crew ocularly estimated and recorded the cover density of the vegetation and its average height over the area. Each one then selected a point from which to begin the strip transects. From that point, a tape 100 ft. long was stretched at random and fastened at each end with steel surveying pins.

The vegetation on a strip along the tape was then estimated and recorded on a special form illustrated in Appendix A-2. The strips used were 4 ft. wide, usually two on each side of the tape. The width was measured with a 6 ft. folding pocket rule, which also served for measuring height and diameter of individual plants on the strip. From measurements of the diameter of plant crowns, the area occupied by each plant on the strip was calculated and recorded. The total cover area of each significant plant species was computed by adding the cover areas of individual plants. The total cover on the strip was obtained by adding the totals for each species. The result was then compared with the preliminary estimate made for the strip.

After completing one strip, a second was made, usually at a cross angle with the first. Three additional strips were also made, usually at random and at differing distances from the first two to sample different portions of the unit area. When the process was completed, data from the five strips were added to produce totals that could be compared with the original estimate for the whole area, which had been made before the transects were run. The field records of these transects are not published but are listed in the Appendix Contents as C-1-a. Summaries of these transects compiled in the laboratory are given as Appendix C-1-b. A tabulation comparing the preliminary ocular estimates and the measured results is given in Appendix C-1-c.

Quadrats

Quadrats were used to supplement the strip transects. They were plotted, data tabulated, and photos taken primarily for the purpose of assisting the vegetation crews to get better ideas about spacing of plants, but they also serve to give the reader a better visual representation of plant distribution and may serve as another type of check on the ocular estimates. All quadrats were 5 by 8 ft. in size and laid out in cardinal directions with the long axis east and west. They were usually selected in the neighborhood of the strip transects and were outlined by stretching a flexible tape around the four sides and anchoring the corners with surveying pins. Folding pocket rules were used to determine spacing arrangements and plant measurements within the quadrats.

Each plant was plotted on the quadrat map and measurements of each, including dimensions of the crown foliage, were tabulated on a form illustrated in Appendix A-3. For comparison of crown density, the foliage of each plant was

compacted when practicable to get 100 percent shade and measurements recorded. Unusual litter in bare spaces between plants was usually indicated. Photographs were taken to illustrate details and were later used to check accuracy of the quadrat maps.

Tree Spacing

Very little forested land was found in the Curecanti reservoirs. Only three tree-spacing samples were taken, one in cottonwoods and associated trees along stream terraces in Dry Gulch, one among spruce-fir forest in a narrow canyon along Soap Creek, and one in Douglas firs in South Red Creek. In each case, nine points were selected, more or less at random, from which the distance to the nearest sapling and to the nearest tree over 4 in. in dia. in each quadrant around the point was measured by use of field range finders or tape.

FIELD RECORDS

Records made in the field included the following:

1. A log of the expedition kept by the field director, S. D. Durrant.

2. A series of 29 overlay maps (Appendix D), upon which the vegetation units were plotted by Seville Flowers. The maps were numbered from 1 to 23 along the main stream of the Gunnison River, running from the upper end of Blue Mesa Reservoir to the damsite of Crystal Reservoir. Adjoining maps running up the branches were numbered 9A and 9B up Cebolla Creek, 12A up West Elk Creek, 13A up Soap Creek, and 14A, 14B, and 14C up Lake Fork.

3. A series of original field records of ocular estimates of the vegetation made by each of the two-man crews of estimators, Hall and Argyle, Ranck and Reynolds, and Stock and Lamborn. These were kept in looseleaf binders; the form is shown in Appendix A-1.

4. A master set of typewritten ocular estimates compiled by Groves from the original field crew estimates; also kept in looseleaf binders.

5. Tabulated records of 15 transects consisting of five strips each, made by the three two-man crews. The form used in recording the data is shown in Appendix A-2 and summaries of the data are given in Appendix C-1-b.

6. A series of 15 quadrat plots with photographs and tabulated data, each quadrat associated with one of the 15 transects. The form used in recording the data is shown in Appendix A-3 and summaries of the data are given in Appendix C-2.

7. Tabulated data from three tree spacing studies, each containing data of distances to nearest trees around nine selected points. The form used is shown in Appendix A-4 and the data are given in Appendix C-3.

8. A series of 752 plant specimens collected and tentatively identified in the field and brought to the University Herbarium for checking and future reference.

9. Individual notes kept by some members of the expedition.

LABORATORY STUDIES

Laboratory studies of the field data were undertaken under the direction of Angus M. Woodbury with advice from S. D. Durrant and Seville Flowers, assistance from crew members Gerald T. Groves, Heber H. Hall, Calvin R. Lamborn, R. Newell Reynolds, and A. Dean Stock; and further assistance from the secretary, Edla Hammond. In order to assure accuracy before using the data, procedures were established to check all records and attempt to bring into harmony any discrepancies found. Major concordances had been checked in the field.

In the laboratory, maps were scrutinized for completion of all units plotted on the overlay maps and were checked against the field records of ocular estimates to see that they agreed in identification of units. Plant specimens collected and identified in the field were checked in the University Herbarium. Most of the specimens were already known and were easily checked but some required careful study and a few specimens had to be sent to specialists for determination.

While this work was in progress, checks were made to assure accuracy in transferring the team ocular estimates made in the field to the master lists compiled by Groves in the field. For further checking of the maps and master lists, the areas of the units on the maps were calculated in acres and these figures were entered on the master lists. Tabulations made in strip transects, quadrats, and tree spacing studies were checked by use of an electric calculator.

Two methods of calculating areas of units were used. The usual method consisted in measuring each unit with a planimeter and converting the measurements into acres. To make this conversion easy, the planimeter arm was set (arm reading 11.10) so that a square mile on the usual scale of the overlay maps (1000 ft. per. in.) measured 320 planimeter units or one-half the acreage of a square mile with sides of 5.28 ins. The planimeter units were then doubled to obtain the area of the vegetation units. The second method was used only where the units could not be planimetered realistically on the map, especially where they consisted of long narrow strips along the edges of streams. In this case, the width of the units was estimated in the field. This width and the length of the unit measured on the overlay map by means of a lineameter or map measuring device and converted into feet (1 in. = 1000 ft.) were used to calculate the area on an electric calculator.

OCULAR ESTIMATE ANALYSIS

After checking the ocular estimate tabulations and computing the areas of the units, the data were prepared for statistical computation and analysis. For each of the four types of habitats, 1) streamside, 2) terrace, 3) hillside and 4) farmland, lists of species found by the survey teams were prepared and brought into harmony with the checklist of identified plants. Each list contained more than 30 plants. To prepare the data for computation on the University Datatron, an electronic computing machine, each list was divided into two parts. The first part included 30 plants that were considered as major components of the vegetation units of that habitat. The balance of the species included in the second group were considered as minor components.

Special mimeographed forms, illustrated in Appendix A-5, were prepared for use in arranging the ocular estimate data for computation by the Datatron. The forms were designed for correlation with the standard punch cards used in the machine on which the 80-space area is broken into 10 unit intervals. The first 20 spaces on all mimeographed sheets are alike; they are the keys that identify the individual units designated on the overlay maps of the survey. The other 60 spaces are used to analyze the plant composition of the units, two spaces being allocated to each of the 30 plants. The arrangement of data on these sheets is explained in Appendix A-5.

STRIP TRANSECT STUDIES

After field computations were checked in the laboratory, the strip transects (Appendix C-1-a) were tabulated to provide summaries (Appendix C-1-b) for comparison and further study. A sketch showing the typical plan of field study for each of the sampled vegetation units is shown in Fig. 7a and views of the men at work making transects in the field are given in Figs. 8 and 9. In each of the 15 areas in sagebrush and associated vegetation so sampled, five strips selected at random approximately as shown in the sketch were used as samples of vegetation on the unit. The strips were 100 x 4 ft. with a total area on five strips of 2000 sq. ft.

To make the strip transects comparable with the ocular estimates, a table was prepared to show the total measured cover of vegetation on each strip and totals of the five strips on each sampled unit. The area covered by each species on each strip was calculated and translated into percent. The total coverage of all plants on each strip was also converted into percent for comparison with the percentage of cover estimated before the measurements were made. This comparison for each strip and the total of the five strips on each unit sampled is given in the last two columns of the first tabular summary (A) for each transect study given in Appendix C-1-b.

For further comparison of the ocular estimates and transects, a second tabulation was prepared to show the percentage of area covered by each major species in the vegetation cover. In this second table (B), the area covered by each species in each strip was converted into percentage of the total cover of the strip and compared with the preliminary estimate of each. The totals of the five strips were then compared with the preliminary estimate of the whole transect area.

TYPICAL TRANSECT STUDY

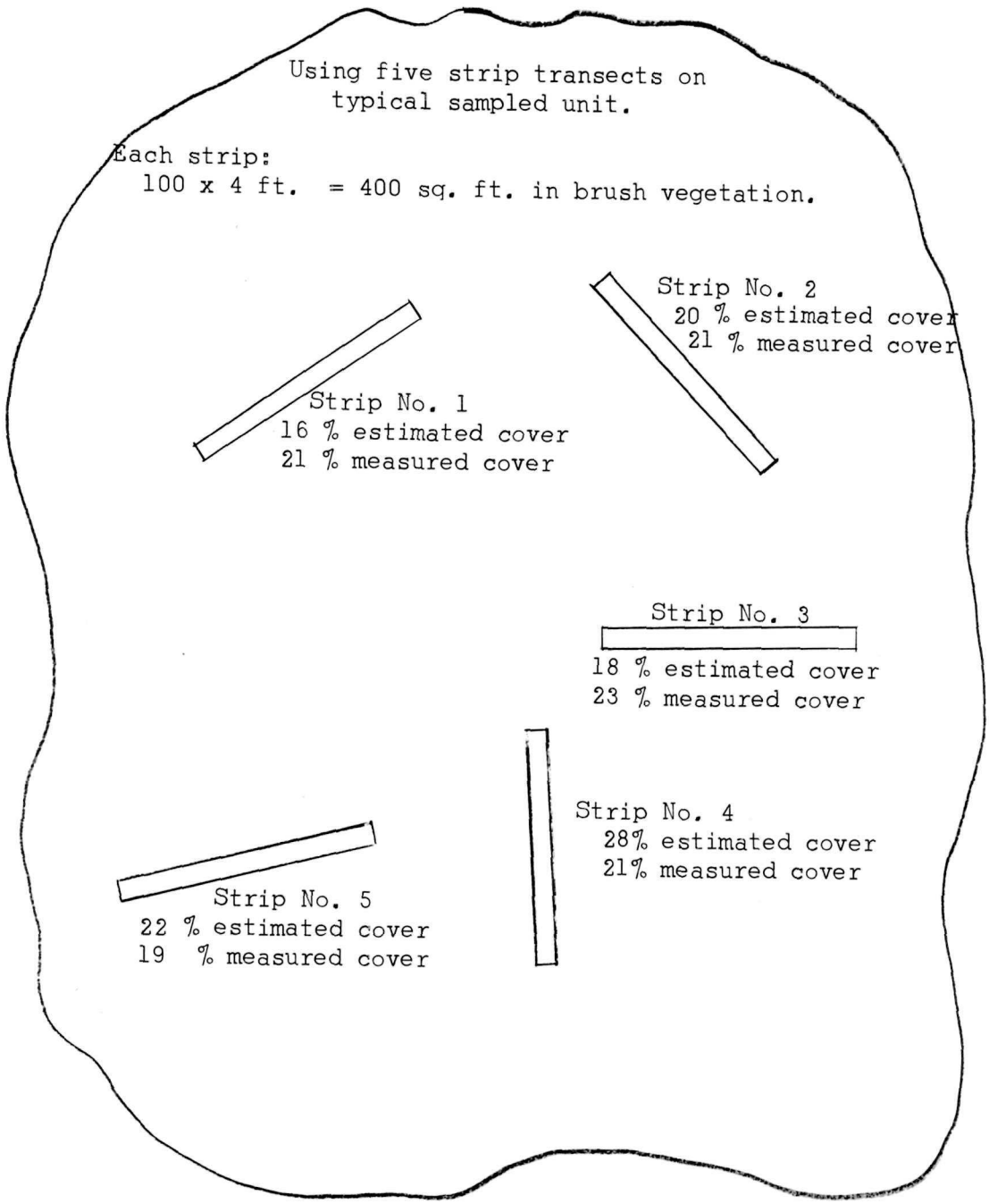


Fig. 7a. A sketch illustrating the way in which strip transects were arranged in a sampling area.

A third table (C) was prepared to show the foliage heights as calculated from the measurements made on the transects. The table gives for each species, the number of plants measured and their average height on each strip as well as the total number and average height for the five strips.

Data from these tables were assembled for each of the 21 most important or significant plants measured in the transects. This is not a complete list of plants. These significant species are assembled in Table 1, which gives the number of transects on which the plant occurs, its average height, the area and percentage that the plant covered in all of the transects on which it was found, together with a comparison of the estimated and measured percent of cover. Measurements are given in feet and fractions of feet.

SUMMARY OF TRANSECTS

Table 1. Arranged to show the areas occupied by each of the 21 significant species and proportion of each in the total cover of the strip transects where it occurs. Fractions in estimate colum arise from averaging individual estimates.

Species	Transects		Ht.	Area covered		% of cover	
	Nos.	Total	ft.	Sq.ft.	%	Meas.	Est.
Tortula ruralis (moss)	2	1	.2	43	2.2	12	7
Agropyron smithii	4, 14	2	.7	72	3.6	6	6
Hilaria jamesii	10,11,12	3	.4	141	7.1	9	8
Oryzopsis hymenoides	1, 3-7, 9-14	12	.6	560	2.8	9	6
Sitanion hystrix	1,11,15	3	.3	20	1.0	3	3
Stipa lettermani	2,4,5,8,11-15	8	.5	346	19.5	8	6
Amelanchier alnifolia	4	1	1.3	4	.2	2	3
Purshia tridentata	11	1	1.3	114	5.7	16	10
Astragulus spp.	11	1	.6	3	.2	--	--
Opuntia hystricina	6, 11	2	.4	9	.5	1	--
Phlox caespitosa	2,3,7,8,9,11	6	.3	297	14.9	11	7
Artemisia tridentata	1-15	15	1.3	4720	15.7	68	74
Aster lucelene	3	1	.3	10	.5	3	2
Chrysothamnus depressus	1-5,7-11,13-15	11	.4	543	2.5	10	8
Chrysothamnus nauseosus	5	1	1.0	73	3.7	13	10
Chrysothamnus viscidiflorus	2,11	2	.6	28	1.4	3	2
Erigeron	2	1	.4	43	2.2	12	5
Gutierrezia sarothrae	6, 11	2	.6	73	3.7	6	5
Ptiloria tenuifolia	11	1	.8	9	.5	2	2
Tetradymia canescens	3,11	2	.9	17	.9	1	1
Small herbs	1,3-7,10-14	10	.4	108	5.4	2	3

Fig. 8. Heber Hall and Gerald Argyle making a transect in sagebrush cover. Photo by Groves.

Fig. 9. Dean Stock and Calvin Lamborn making transect in sagebrush cover. Photo by Groves.

QUADRAT STUDIES

In the laboratory, the quadrat photographs were compared with the quadrat maps to check conformity. The tabulated data (Appendix C-2-a) were checked for accuracy and compared with the quadrat maps (Appendix C-2-c). The maps and accompanying data were then transferred to new sheets (Appendix C-2-b). The plants appearing on the quadrat tabulation were listed in the sequence used in the checklist of plants found in the area and were given numbers used to collate the tabular lists with the quadrat maps.

For each of the 18 quadrats studied, each major plant of significant size had been plotted on the quadrat map and measurements recorded in the table. These measurements included height of plant and height of foliage (often there was a difference), diameter of the crown, area covered by the foliage and area of the foliage compacted to produce 100 percent shade.

The major dominant plants of these quadrats have been assembled in Table 2 together with a summary of the tabulated data. This table shows the relative importance of the plants found on the quadrats.

SUMMARY OF QUADRATS

Table 2. Arranged to show the area and percentage of area occupied by each of seven important species found in quadrats. Measurements given in square feet and tenths.

Species	No.of quads.	Area Sq.ft.	No. of plants	Ave. ht.	Foliage			Compacted	
					Ht.	Area	%	Area	%
Oryzopsis hymenoides	11	440	56	.7	.4	16.8	3.8	7.8	1.8
Stipa lettermani	5	200	27	.6	.6	4.6	2.3	3.1	1.6
Cercocarpus montanus	1	40	5	2.0	2.0	10.1	25.3	5.1	12.8
Phlox caespitosa	10	400	44	.2	.2	15.2	3.8	10.8	2.4
Artemisia tridentata	18	720	95	1.2	.8	202.5	28.1	119.1	16.5
Chrysothamnus depressus	12	480	54	.4	.4	23.8	5.0	13.5	2.8
Chrysothamnus viscidiflorus	3	120	12	1.0	.8	8.3	6.9	4.2	3.5

TREE SPACING STUDY

In the laboratory, the tree spacing tabulation made in the field around nine selected points in each of three sampling areas were checked for accuracy of calculations and prepared for reproduction. These tabulations are given in Appendix C-3.

The results of these studies as summarized for the major species found in the spacing studies are shown in Table 3. The single sample area in each of the three types of forest stands that are so sparse in this project, give only a meager idea of the forest cover.

SUMMARY OF TREE SPACING STUDIES

Table 3. Arranged to show averages of data taken concerning each species on each of the units studied. Measurements given in feet and tenths.

Kind of tree	Study No.	No. of trees	Trunk diam.	Tree ht.	Crown		Distance	
					Diam.	Ht.	Tree	sap.
Picea pungens Blue spruce	3	24	1.4	68.9	21.0	59.1	23.9	23.3
Pseudotsuga menziesii Douglas fir	2	32	1.3	43.0	18.9	31.7	18.8	20.0
Juniperus scopulorum Mountain red juniper	2	4	.7	17.0	12.0	14.8	11.0	13.5
Populus angustifolia	1	36	1.3	56.4	26.3	29.3	12.8	20.3
Narrow-leaf cottonwood	3	12	2.0	61.0	27.9	45.5	16.1	21.8
Total or average		48	1.5	57.6	26.7	33.4	13.6	20.7

WATER SURFACES AND TOTAL AREAS

Those areas on each map representing non-vegetated areas of streams covered by high water were calculated in the same manner as the vegetation units. The water surface areas were added to the vegetation unit areas to get the total area within the reservoir on each map. The total area within the perimeter of the reservoir on each overlay, delimited by the guide lines, was then planimetered and the resulting acreage was compared with the total derived from addition of the vegetated areas and water surfaces. The average between these two figures was used in computing the total areas of the reservoirs included in the survey.

STATISTICAL COMPUTATIONS OF OCULAR ESTIMATES

The special mimeographed forms (Appendix A-5) prepared for use in statistical calculations, after being filled with appropriate data from the final compilation of the ocular estimates, were sent to the Computer Center for electronic calculation. The data on these sheets were then transferred to punch cards. Data on the punch cards were printed in a tabular series and returned to our laboratory for us to check the accuracy of the punched cards. When accuracy of the cards was assured, a final tabulation (Appendix F-1, not published) was printed at the Center.

Data on the cards were then analyzed in the Datatron to determine for each of the four habitat types (streamside, terrace, hillside and farmland) the area (acreage) covered by vegetation, the area of bare ground, and that covered by each species listed on the cards. The results were tabulated to show the data for each unit and each type of vegetation and each overlay map, with totals for major and minor species in each habitat type (Appendix F-2, not published.)

From the tabulations made by the Datatron, species of plants deemed to be most significant in quantitative studies were selected for compilation in Table 4. This table shows the total acreage covered by each of the listed species in each of the four major habitat types. The acreages covered by species of little quantitative significance and differences due to rounding off fractions are lumped together under the heading of "Other" at the bottom of the list.

The total acreages, thus computed as the cover of the listed species, were used to calculate the volume of foliage of each species. To do this, the acreage for each was multiplied by the average heights (determined from the ocular estimates and transect measurements) to compute the foliage volume in acre feet. These computations are shown in Table 5. For convenience in comparing the average height of plants, a column is included to give estimated climax heights based upon our knowledge of the plants under normal or average conditions in this region when they have attained the equivalent of a climax stand. In many cases, the average and climax heights are identical but in stands that contain young plants, the climax is usually greater than the average.

Fig. 9a. View in the basin of the Blue Mesa Reservoir. Photo by R. Bruce Walker.

AREA COVERED BY DOMINANT PLANTS

Table 4. Cover acreage of dominant species in four habitat types.

Species	Streamside	Terrace	Hillside	Farmland	Total
Equisetum arvense	6	--	--	6	12
Equisetum kansanum	1	--	--	8	9
Juniperus scopulorum	6	--	38	--	44
Picea pungens	18	--	48	5	71
Pinus edulis	--	--	22	--	22
Pinus ponderosa	--	--	6	--	6
Pseudotsuga menziesii	2	1	55	--	58
Typha angustifolia	1	--	--	13	14
Agropyron desertorum	--	--	--	14	14
Agropyron smithii	6	8	18	22	54
Agropyron trachycaulum	--	--	1	7	8
Agrostis alba*	8	1	--	48	57
Aristida fendleriana	--	--	8	--	8
Bromus inermis	13	4	2	389	408
Bromus tectorum	3	2	16	5	26
Dactylis glomerata	--	--	--	20	20
Elymus condensatus	19	15	8	8	50
Hilaria jamesii	--	--	23	--	23
Hordeum jubatum	--	--	--	23	23
Oryzopsis hymenoides	1	--	88	--	89
Phleum pratense	2	--	--	97	99
Poa pratensis	32	1	--	130	163
Sitanion hystrix	1	1	43	2	47
Sporobolus cryptandrus	1	2	--	3	6
Stipa comata	--	--	19	13	32
Stipa lettermani	--	1	61	--	62
Carex nebraskensis*	32	1	--	258	291
Scirpus microcarpus	1	--	--	15	16
Juncus balticus*	29	5	--	180	214
Smilacina stellata	4	1	1	--	6
Yucca angustissima	--	--	4	--	4
Iris missouriensis	1	--	--	9	10
Populus angustifolia	209	13	7	15	244
Populus tremuloides	1	--	11	--	12
Salix caudata	69	2	1	10	82
Salix exigua	139	--	2	1	142
Alnus tenuifolia	70	--	2	--	72
Betula occidentalis	10	--	--	--	10
Quercus gambelii	2	--	190	3	195
Urtica gracilenta	3	--	--	--	3
Eriogonum umbellatum	--	--	10	1	11
Rumex mexicanus	--	--	--	6	6
Chenopodium glaucum	1	--	2	5	8
Eurotia lanata	--	--	6	--	6
Salsola kali	--	--	9	4	13
Berberis repens	--	--	8	--	8
Sisymbrium altissimum	--	--	2	2	4

* and related species

AREA COVERED BY DOMINANT PLANTS (continued)

Species	Streamside	Terrace	Hillside	Farmland	Total
Philadelphus m. microphyllus	--	--	7	--	7
Philadelphus m. occidentalis	--	--	10	--	10
Amelanchier alnifolia	3	--	33	--	36
Cercocarpus montanus	--	--	43	--	43
Crataegus saligna	27	--	--	1	28
Holodiscus dumosus	2	1	65	--	68
Potentilla fruticosa*	5	1	3	7	16
Prunus virginiana	12	--	24	--	36
Purshia tridentata	--	--	34	--	34
Ribes aureum	5	--	10	--	15
Ribes inerme	--	--	4	--	4
Rosa woodsii	43	1	11	6	61
Rubus strigosus	1	--	3	--	4
Lupinus greenei	--	--	4	1	5
Medicago sativa	--	--	--	104	104
Melilotus officinalis	5	--	1	64	70
Thermopsis montana	--	--	--	3	3
Trifolium hybridum	13	--	--	147	160
Trifolium pratense	--	--	--	50	50
Trifolium repens	6	--	--	34	40
Vicia americana	4	--	--	1	5
Rhus trilobata	15	--	32	--	47
Acer glabrum	1	--	22	--	23
Acer negundo interius	1	--	4	--	5
Opuntia hystricina	--	--	3	--	3
Elaeagnus commutata	5	--	--	--	5
Cornus stolonifera	25	--	9	--	34
Phlox caespitosa	--	--	40	--	40
Cryptantha jamesii	--	--	3	--	3
Lappula floribunda	--	--	2	2	4
Plantago major	--	--	--	5	5
Sambucus pubens	--	--	4	--	4
Symphoricarpos oreophilus	--	--	10	--	10
Achillea lanulosa	2	--	1	25	28
Aplopappus acaulis	--	--	8	--	8
Artemisia dracunculus glauca	2	--	1	--	3
Artemisia frigida	--	1	7	2	10
Artemisia nova	--	--	12	--	12
Artemisia tridentata	3	20	825	4	852
Aster adscendens*	--	--	5	--	5
Centaurea picris	--	--	2	1	3
Chrysothamnus depressus	--	--	62	1	63
Chrysothamnus viscidiflorus	13	31	37	21	102
Cirsium undulatum	1	1	1	6	9
Taraxacum officinale	6	--	--	73	79
Tragopogon dubius	--	--	--	3	3
Others and lost fractions	14	4	15	25	58
DATATRON TOTALS	905	118	2068	1908	5000

* and related species

VOLUME OF FOLIAGE

Table 5. Volume of foliage of dominant species calculated by multiplying cover acreage by average foliage height and comparing it with height in climax stand.

Scientific name	Common name	Cover acres	Height Ave.	Height Climax	Foliage Acre ft.
Equisetum arvense	Meadow horsetail	12	.9	1.1	10
Equisetum kansanum	Kansas horsetail	9	.9	1.4	8
Juniperus scopulorum	Mt. red juniper	44	15.0	15.0	666
Picea pungens	Blue spruce	71	60.0	65.0	4260
Pinus edulis	Doubleleaf pinyon pine	22	14.0	13.2	308
Pinus ponderosa	Ponderosa pine	6	50.0	60.0	300
Pseudotsuga menziesii	Douglas fir	58	40.0	65.0	2340
Typha angustifolia	Narrowleaf cattail	14	4.5	5.0	65
Agropyron desertorum	Desert wheatgrass	14	1.5	1.5	21
Agropyron smithii	Western bluestem wheatgrass	54	1.0	2.0	54
Agropyron trachycaulum	Slender wheatgrass	8	2.0	1.8	17
Agrostis alba*	Redtop	57	1.6	1.9	91
Aristida fendleriana	Fendler three-awn grass	8	.6	.8	5
Bromus inermis	Smooth brome	408	1.7	2.3	694
Bromus tectorum	Cheat grass	26	.8	.9	21
Dactylis glomerata	Orchard grass	20	3.0	2.8	60
Elymus condensatus	Giant ryegrass	50	2.7	3.3	135
Hilaria jamesii	Galleta grass	23	.6	.8	14
Hordeum jubatum	Foxtail barley	23	1.1	1.2	25
Oryzopsis hymenoides	Indian ricegrass	89	1.0	1.8	89
Phleum pratense	Timothy	99	1.7	2.0	168
Poa pratensis	Kentucky bluegrass	163	1.2	1.8	196
Sitanion hystrix	Squirreltail	47	.7	.8	33
Sporobolus cryptandrus	Sand dropseed	6	1.3	1.8	8
Stipa comata	Needle and thread grass	32	1.0	1.8	32
Stipa lettermani	Letterman needle grass	62	1.0	1.4	62
Carex nebraskensis*	Sedge	291	1.0	1.3	291
Scirpus microcarpus	Torrey rush	16	1.5	2.0	24
Juncus balticus montanus*	Wiregrass	214	.9	1.6	193
Smilacina stellata	False Solomon seal	6	.8	1.6	5
Yucca angustissima	Narrowleaf yucca	4	.9	1.6	4
Iris missouriensis	Blue iris	10	1.6	1.6	16
Populus angustifolia	Narrowleaf cottonwood	244	50.0	50.0	12180
Populus tremuloides	Quaking aspen	12	30.0	35.0	360
Salix caudata	Whiplash willow	82	12.0	12.0	982
Salix exigua	Sandbar willow	142	8.0	8.0	1140
Alnus tenuifolia	Thinleaf alder	72	16.0	17.0	115
Betula occidentalis	Western riverbirch	10	14.0	17.0	140
Quercus gambelii	Gambel oak	195	8.0	8.0	1560
Urtica gracilenta	Stinging nettle	3	2.3	2.5	7
Eriogonum umbellatum	Sulphur eriogonum	11	.6	.7	7
Rumex mexicanus	Mexican dock	6	1.2	1.5	7
Chenopodium glaucum	Pigweed	8	.8	1.5	6
Eurotia lanata	Winterfat	6	.9	1.2	5
Salsola kali	Russian thistle	1	.7	1.2	7
Berberis repens	Oregon grape	8	.6	.8	5
Sisymbrium altissimum	Tumbling mustard	4	1.3	1.7	5

VOLUME OF FOLIAGE (continued)

Scientific name	Common name	Cover acres	Height Ave.	Height Climax	Foliage Acre ft.
Philadelphus m. microphyllus	Mockorange	7	4.6	5.2	31
Philadelphus m. occidentalis	Western mockorange	10	4.0	5.2	40
Amelanchier alnifolia	Service berry	36	4.0	8.2	144
Cercocarpus montanus	Mt. mahogany	43	3.5	3.6	150
Crataegus saligna	Hawthorn	28	9.0	9.0	252
Holodiscus dumosus	Ocean spray	68	4.6	4.6	313
Potentilla fruticosa*	Shrubby cinquefoil	16	2.8	2.8	46
Prunus virginiana	Chokecherry	36	7.4	8.0	266
Purshia tridentata	Bitterbrush	34	2.0	3.2	68
Ribes aureum	Golden currant	15	3.6	4.8	54
Ribes inerne	Wine gooseberry	4	3.5	3.5	14
Rosa woodsii	Wild rose	61	3.5	4.8	214
Rubus strigosus	Red raspberry	4	3.0	3.0	12
Lupinus greenei	Lupine	5	1.6	1.8	8
Medicago sativa	Alfalfa	104	1.9	2.0	198
Melilotus officinalis	Yellow sweetclover	70	2.3	2.4	161
Thermopsis montana	Yellow Mt. thermopsis	3	1.3	1.5	4
Trifolium hybridum	Alsike clover	160	.8	.8	128
Trifolium pratense	Red clover	50	.9	.8	45
Trifolium repens	White clover	40	.5	.5	20
Vicia americana	American vetch	5	1.8	1.8	9
Rhus trilobata	Squaw bush	47	5.6	7.5	263
Acer glabrum	Mt. red maple	23	10.7	12.0	246
Acer negundo interius	Boxelder	5	17.4	25.0	87
Opuntia hystricina	Yellow prickly pear	3	.3	.3	1
Elaeagnus commutata	Bull berry	5	9.0	9.0	45
Cornus stolonifera	Red osier dogwood	34	5.0	5.0	170
Phlox caespitosa	Caespitose phlox	40	.3	.4	12
Cryptantha jamesii	Cryptantha	3	.6	.4	2
Lappula floribunda	Stickseed	4	.9	1.2	4
Plantago major	Big plantain	5	.9	.9	4
Sambucus pubens	Red elderberry	4	3.5	4.4	14
Symphoricarpos oreophilus	Snowberry	10	2.7	3.0	27
Achillea lanulosa	Purple yarrow	28	1.0	1.0	28
Aplopappus acaulis	Aplopappus	8	.5	.5	4
Artemisia dracunculus glauca	Aromatic sagebrush	3	2.1	2.8	6
Artemisia frigida	Silver sagebrush	10	1.4	1.6	14
Artemisia nova	Black sagebrush	12	1.0	1.3	12
Artemisia tridentata	Big sagebrush	852	2.0	2.5	1704
Aster adscendens*	Aster	5	.7	1.2	4
Centaurea picris	Russian knapweed	3	1.6	1.8	4
Chrysothamnus depressus	Dwarf rabbitbrush	63	1.0	1.0	63
Chrysothamnus viscid.tort.	Varnishleaf rabbitbrush	102	1.5	2.0	153
Cirsium undulatum	Western thistle	9	2.2	2.6	20
Taraxacum officinale	Common dandelion	79	.6	.6	47
Tragopogon dubius.	Goatsbeard	3	1.2	1.2	4
Others	Others	58	1.0	1.0	58
	TOTALS	5000			31914

* and related species

COVERAGE AND DENSITY OF VEGETATION

For further study, the vegetation units were classified in density groups. These were arranged to show, for each primary group, the total acreage calculated by the Datatron to occur in units showing densities classified as follows: 1-10%, 11-25%, 26-50%, 51-75%, and 76% or more. These are shown in Table 6.

DENSITY OF VEGETATION

Table 6. Acreage in each primary vegetation group classified according to density of cover. Cover percentage indicates percentage of area covered in each density group; those indicating totals give percentage of habit area included in each density group.

	Density of cover										Total acres	
	1-10%		11-25%		26-50%		51-75%		76+%			
Habitat	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
STREAMSIDE												
Cover	.2	3	.5	14	13.7	40	24.6	69	829.8*	96	868.8	92
Bare	6.1		3.0		20.3		10.8		38.1		78.3	
Total	6.3	1	3.5	--	34.0	4	35.4	4	867.9	91	947.1	100
TERRACE												
Cover	--		.4	14	24.2	42	31.8	56	61.5	87	117.9	63
Bare	--		2.5		33.0		24.8		9.1		69.4	
Total	--		2.9	2	57.2	31	56.6	30	70.6	37	187.3	100
HILLSIDE												
Cover	.3	10	737.7	19	991.4	36	234.0	62	104.5	92	2067.9	29
Bare	2.6		3119.8		1728.0		146.3		9.5		5006.2	
Total	2.9	--	3857.5	55	2719.4	38	380.3	5	114.0	2	7074.1	100
FARMLAND												
Cover	--		15.0	21	--		43.4	60	1849.4	97	1907.8	93
Bare	--		55.4		--		29.0		63.3		147.7	
Total	--		70.4	3	--		72.4	4	1912.7	93	2055.5	100
TOTALS												
Cover	.5	5	753.6	19	1029.3	37	333.8	61	2845.2	96	4962.4	48
Bare	8.7		3180.7		1781.3		210.9		120.0		5301.6	
Total	9.2	--	3934.3	38	2810.6	28	544.7	5	2965.2	29	10264.0	100
WATER SURFACE											628.5	
									TOTAL		10892.5	

* Areas with more than 100% represent an additional coverage of 36.5 acres.

This table shows very little land supporting less than 25% vegetation coverage in streamside areas. The great bulk has more than 75% and the total streamside habitat averages 92%. The terrace is less dense with a total average of 63% with practically no land having less than 25%. The hillside presents a strong contrast with so much of its coverage less than 50% and averages only 29%. The farmland shows very little land with less than 50% vegetation coverage since most of this area is under cultivation and has a total average of 93%. The average density for the whole basin is calculated at 48%.

DISCUSSION

The principal objective of this study has been to estimate the kinds and quantities of vegetation that will be lost when the area is inundated by waters of the Curecanti Reservoir basins now being constructed on the Gunnison River. Specifically, it is designed to calculate the amount of foliage transpiring water from the basins before the reservoirs are filled. Precipitation in the basins, usually in the neighborhood of 10 ins., is the principal source of water for the vegetation except along the streamsides and springs where water from distant mountains provides additional water. The Gunnison River, draining the west slopes of the Rocky Mountains of central Colorado, is one of the main tributaries to the Colorado River.

In the open basin of the Blue Mesa Reservoir, the landscape is covered principally with big sagebrush and associated plants except where this extra supply of water is available along streamsides or ponds. Here plants adapted to using water more freely than the sagebrush usually take possession. Along the streamside, plants depending upon this extra water usually dominate the banks that are low enough to permit roots to reach soil water derived from the stream. The secondary phreatophytes, using capillary water drawn from percolating water of the streamside, are usually located farther back from the streamside on terraces. In the Blue Mesa Reservoir, most of the terraces and part of the mesa bearing hillside vegetation have been transformed into farming land where irrigated crops have been grown.

In Black Canyon, where the canyon effect upsets the orderly arrangement of vegetation, the big sagebrush is almost entirely replaced by other forms of plants, particularly shrubs and trees that grow on steep talus slopes.

For comparison of the relation between vegetation coverage on the ground and foliage volume of the dominant plants, a list of plants has been selected from Table 5 to show in descending order the acreage covered, and a second list has been selected to show in descending order the quantity of foliage in the basins. These are listed in Table 7 and are plotted in Fig. 10 to show graphically the relationship between the vegetation coverage and volume of these plants.

VEGETATION GROUPS

As already indicated the vegetation was divided into four primary groups: 1) streamside, 2) terrace, 3) hillside, and 4) farmland in conformity with previous studies of Glen Canyon, Flaming Gorge and Navajo reservoirs. These are largely divisions of the habitat but each primary group maybe subdivided into different vegetation types. These are used as the units of the ocular estimates and are plotted on the overlay maps. For comparison of these four groups, the total vegetation coverage and the bare areas in each have been plotted on the bar graph in Fig. 11. This shows that the great bulk of the reservoir basins bears hillside vegetation of relatively low density and that the other three habitat types occupy small areas with greater coverage density. It also shows how the terraces have been transformed into farmland. For still further comparison, data given in Table 6 have been plotted to show graphically in Fig. 12 the density of vegetation on the four primary habitat groups.

COMPARISON OF COVERAGE AND VOLUME OF VEGETATION

Table 7. Lists of plants showing order of coverage and volume.

Order of coverage		Area	Volume A. ft.
Artemisia tridentata	Big sagebrush	852	1,704
Bromus inermis	Smooth brome	408	694
Carex nebraskensis*	Sedge	291	291
Populus angustifolia	Narrowleaf cottonwood	243	12,180
Juncus balticus*	Wiregrass	215	193
Quercus gambelii	Gambel oak	195	1,557
Poa pratensis	Kentucky bluegrass	163	196
Salix exigua	Sandbar willow	142	1,140
Chrysothamnus viscidiflorus	Varnishleaf rabbitbrush	102	153
Phleum pratense	Timothy	99	168
Oryzopsis hymenoides	Indian ricegrass	89	89
Salix caudata	Whiplash willow	82	982
Order of Volume			
Populus angustifolia	Narrowleaf cottonwood	243	12,180
Picea pungens	Blue spruce	71	4,248
Pseudotsuga menziesii	Douglas fir	58	2,340
Artemisia tridentata	Big sagebrush	852	1,704
Quercus gambelii	Gambel oak	195	1,557
Salix exigua	Sandbar willow	142	1,140
Salix caudata	Whiplash willow	82	982
Bromus inermis	Smooth brome	408	694
Juniperus scopulorum	Mt. red juniper	44	666
Populus tremuloides	Quaking aspen	12	360
Pinus ponderosa	Ponderosa pine	6	320
Pinus edulis	Doubleleaf pinyon pine	22	315

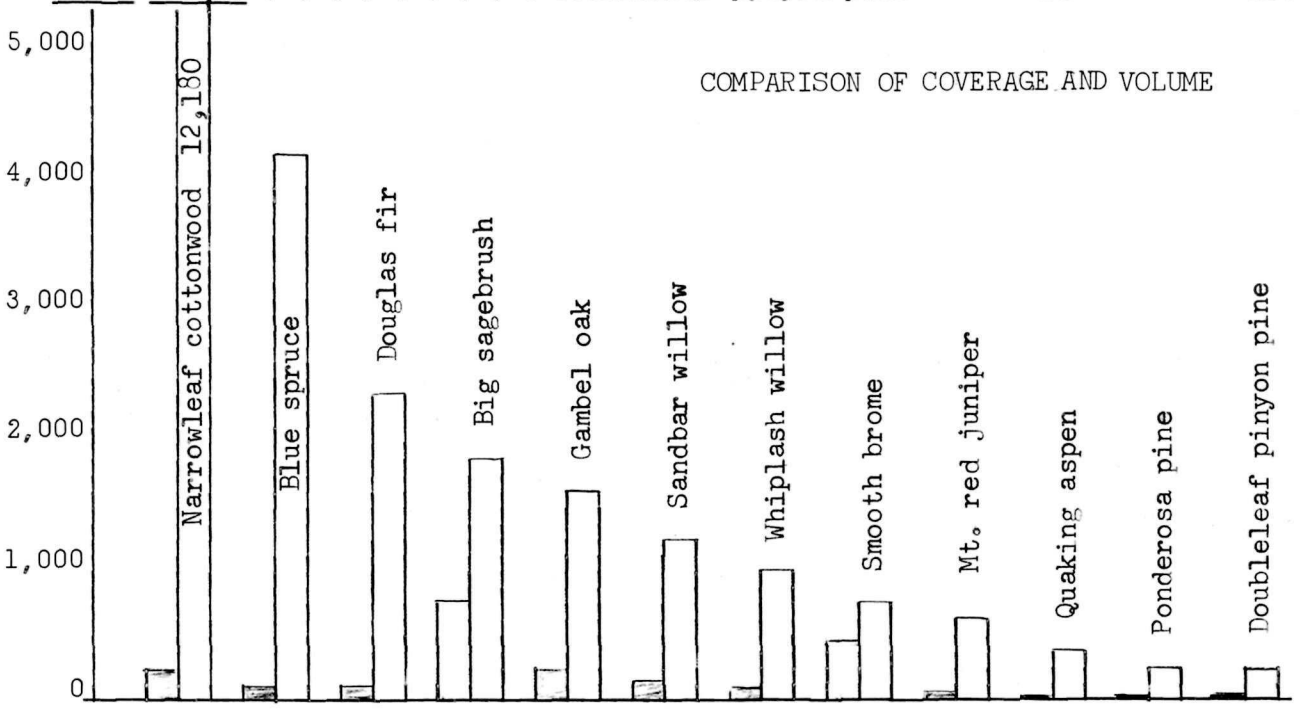


Fig. 10. Bar graph showing coverage in acres and volume in acre-feet of 12 species of plants having greatest volume.

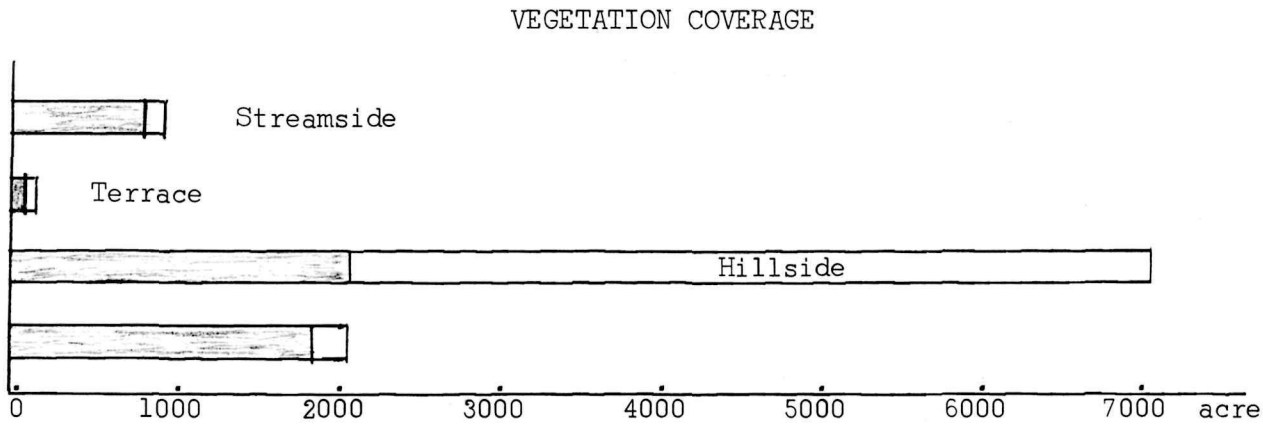


Fig. 11. Bar graph showing proportional areas of bare ground (open portion, and land covered with vegetation (black).

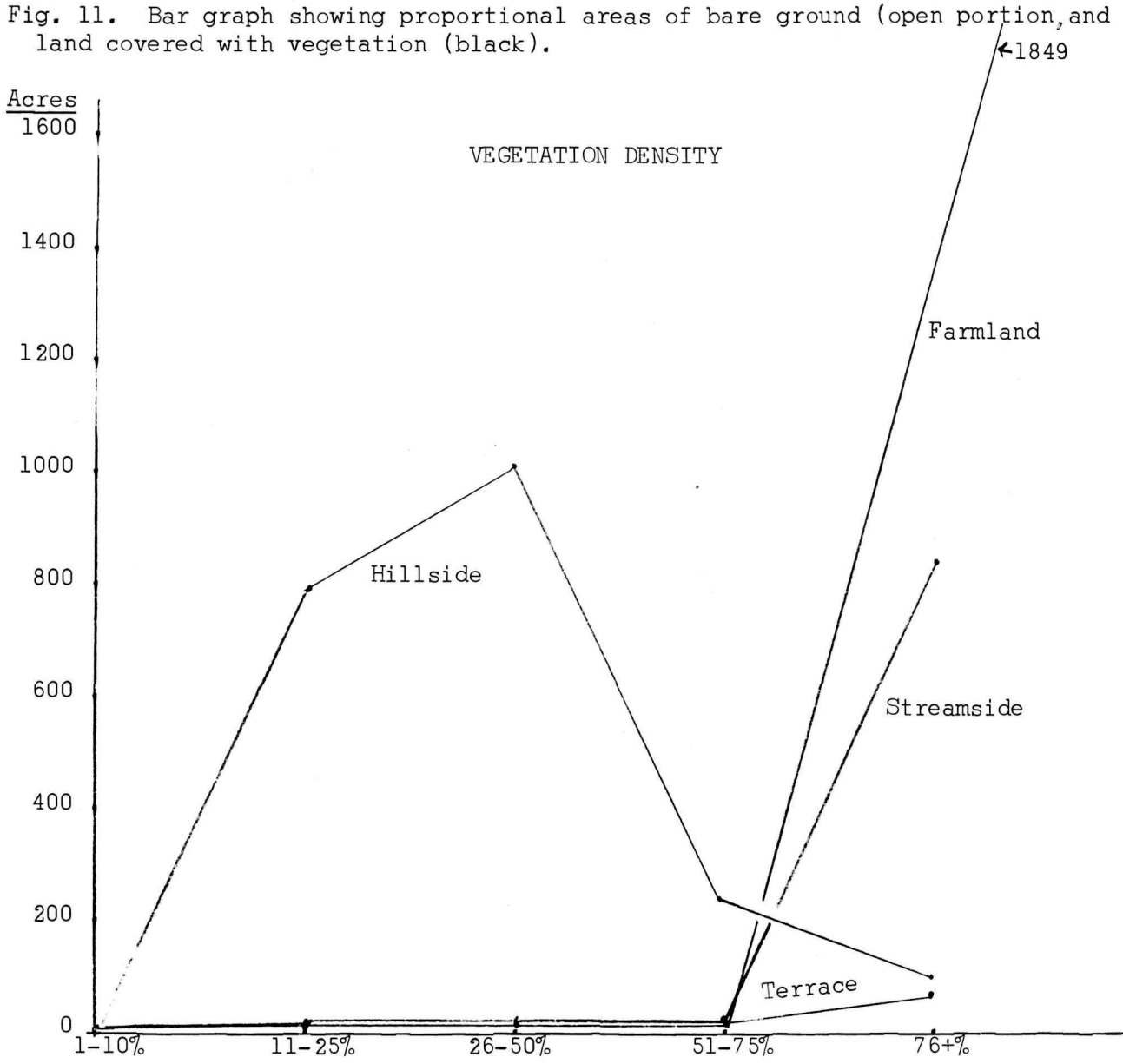


Fig. 12. Graph showing the relative density of vegetation coverage in each of the four primary groups.

Streamside Vegetation

In sharp contrast with the hillside, the vegetation along streams usually consists of dense fringes strung along the banks where plants have free access to the water of the stream. The fringing vegetation is usually broken at intervals into discontinuous narrow strips but in certain favorable locations on shallow flood plains, they may spread to widths of 100 to 200 yds.

Many of these fringes have a tree storey consisting mainly of narrowleaf cottonwood or sandbar willow, occasionally interspersed with the whiplash willow. Beneath the cottonwoods a shrub layer is often found. This layer includes such shrubs as alder, dogwood, wild rose, river birch and several others of lesser significance. The shrub layer is often intermixed with smaller plants of grasses, sedges, herbs, or small shrubs. Tamarix is negligible and almost entirely missing in most of the area.

In some favorable places, especially around irrigated farmlands, shallow water accumulations permit semi-aquatic plants to flourish. These include cattails, rushes, sedges and grasses that sometimes produce small meadows or marshes. A great variety of other shrubs and herbs are associated in such moist habitats.

Terrace Vegetation

Terraces are not such distinct areas as those found in Glen Canyon. Often they merge with benches, mesas or flats at such elevation above the river that no streamside water is available for their use. In a few cases, flood plains of the river have been gradually deprived of water as the river bed has been lowered. These form terraces too high for the floods to reach. With this progressive decline in water supply, some of the streamside vegetation has been transformed to terrace or hillside types. In many cases, large cottonwood trees or groves of trees survive the transition because of their large and deep root systems which have enabled them to keep the foliage well supplied by water as the water table is lowered. Secondary phreatophytes usually invade such areas, but in the Blue Mesa Reservoir most of these terrace areas have been transformed into farmland. The few small terraces that are left are usually dominated by rabbitbrush intermixed with many other plants.

Farmland Vegetation

Farmlands occupy nearly all of the flatter parts of Iola and Sapinero valleys and extend to some of the gentler foothills where canals furnish water. Hay is practically the only crop except for small vegetable gardens and a few fruit trees. Smooth brome grass and alsike clover are the dominant hay plants; timothy, redtop, red clover and alfalfa are grown in lesser quantities. In natural communities weeds are usually of minor importance but when the soil is disturbed and the native vegetation removed, they may become the first pioneers to invade the bare soil. They compete with farm crops and flourish along ditch banks, fence rows, roadsides, and dwellings. The weeds include a great variety of common types such as the fireball, lambsquarter, mapleleaf goosefoot, Russian thistle, dandelion, pigweed, redroot and many grasses. A few of these weeds have escaped cultivation and are invading the native vegetation of terraces and hillsides.

Hillside Vegetation

The ubiquitous big sagebrush is universally present except where special environmental conditions make possible its domination by other plants. It usually occupies areas with fine soils, especially the mesas and valleys but also extends down over some of the terraces and up over many of the foothills. Rocky outcrops and ledges in the canyons interrupt its distribution in many places.

Junipers and pinyon pines are practically missing in these reservoir basins except in the lower end of Black Canyon. The sagebrush is interrupted mainly along the terraces and streamsides where extra water is available and around cliffs and steep hillsides where the orderly arrangement of vegetation is interrupted by the physiographic conditions.

In protected places on the hillside, the gray of the sagebrush may be interrupted by brighter green patches of Gambel oak, chokecherries, service berry, or mountain red juniper. In other places, near outcropping of rocks or ledges, wax currant, bitterbrush, ocean spray and silver sagebrush may occur, occasionally including snowberry or horsebrush. Scattered among this dominant vegetation are many kinds of herbs and grasses many of which are seasonal in character. Many minor species of plants occurring among this dominant vegetation are listed in Appendix A-5.

COMPARISON WITH GLEN CANYON, FLAMING GORGE AND NAVAJO BASINS

Glen Canyon was rough, rugged and much of it inaccessible to the surveying party and only about 27,700 acres or 17 per cent of the area was actually covered in the survey. The balance was extrapolated. Flaming Gorge was much more accessible but available photographic maps covered less than 40,000 acres, or 95 per cent of its reservoir basin, and something more than 2000 acres had to be extrapolated. The Navajo Basin was even more accessible and practically all of the 16,000 acres in the area was surveyed and mapped. Some vegetation immediately above the dam was inundated by water backed up to the level of the outlet tunnel. This required a small amount of extrapolation on good aerial photomaps of the area. The Curecanti basins have both open areas and rough, rugged areas. The upper Blue Mesa Basin is mainly open valleys while the lower Morrow Point Basin occupies the narrow gorge of the upper part of Black Canyon, making it necessary to extrapolate the narrow gorge area.

For comparison of the most conspicuous plants that are important in giving character to the landscape, the 12 most important species and the areas of coverage in each of the four basins are given in Table 8. The first list compares those plants having the greatest coverage, and the second, those having the greatest volume. Much of the difference can be explained on the basis of differences in ecological conditions at the reservoir sites.

Glen Canyon Reservoir is much lower in altitude than the other three. Its water surface is planned for 3700 ft. and the other three at levels between 6000 and 7300 feet. Flaming Gorge is located in a partial rain shadow on the northeast side of the high Uinta Mountains; the Navajo on the southwest foot of the high

Table 8. Lists of plants showing order of coverage and volume of vegetation in Glen Canyon, Flaming Gorge, Navajo Reservoir and Curecanti reservoir basins.

Glen Canyon		Flaming Gorge		Navajo Reservoir		Curecanti reservoirs	
Order of Coverage							
Shadscale	1077	Big sagebrush	1925	Big sagebrush	771	Big sagebrush	852
Sandbar willow	1031	Greasewood	1492	Utah juniper	476	Smooth brome	408
Gambel oak	599	Shadscale	915	Narrowleaf ctwd.	361	Sedge	291
4-winged saltbrush	564	Utah juniper	615	Downy chess	267	Narrowleaf cottonwood	244
Big rabbitbrush	434	Salt grass	495	2-leaf pinyon pine	196	Wiregrass	215
Ephedra	423	Sandbar willow	444	Fremont cottonwood	175	Gambel oak	195
Tamarix	422	Narrowleaf cottonwd.	398	Sandbar willow	158	Kentucky bluegrass	163
Arrowweed	263	Rabbitbrush	367	Yellow sweetclover	140	Sandbar willow	143
Indian rice grass	258	W. blue-stem grass	300	Squawbush	139	Varnish rabbitbrush	102
Seepweed	217	Hop sage	255	White sweetclover	112	Timothy	99
Baccharis	211	Ponderosa pine	249	Mt. mahogany	108	Indian ricegrass	89
Black brush	207	Squawbush	249	Service berry	106	Whiplash willow	82
Order of Volume							
Sandbar willow	7216	Ponderosa pine	11081	Narrowleaf ctwd.	10541	Narrowleaf ctwd.	12180
Gambel oak	4794	Narrowleaf ctwd.	9828	Fremont cottonwood	6878	Blue spruce	4248
Tamarix	3377	Utah juniper	7011	Utah juniper	5188	Douglas fir	2340
Hackberry	1598	Douglas fir	5225	2-leaf pinyon pine	1509	Big sagebrush	1704
4-winged saltbush	1522	Big sagebrush	5006	Big sagebrush	1311	Gambel oak	1157
Gooding tree willow	1344	Red juniper	2704	Red juniper	1170	Sandbar willow	1140
Big rabbitbrush	1301	Sandbar willow	2574	Gambel oak	1088	Whiplash willow	982
Fremont cottonwood	1212	Pinyon pine	2362	Squawbush	945	Mt. red juniper	666
Baccharis	1158	Greasewood	2239	Sandbar willow	901	Smooth brome	694
Shadscale	861	Squawbush	1393	New Mexican adelia	632	Quaking aspen	360
Arrowweed	656	Shadscale	915	Service berry	456	Ponderosa pine	320
Ephedra	593	Rabbitbrush	661	Varnishleaf rabbit.	432	Doubleleaf pinyon pine	315

Rocky Mountains and about 300 mi. farther south; and the Curecanti Blue Mesa Reservoir in western central Colorado lies in the rain shadow of Blue Mesa and stands at elevations about 6700 to 7600.

The lists at Glen Canyon include such plants as ephedra, arrowweed, baccharis and blackbrush, which are missing or very sparse at the higher altitudes of the other three reservoir areas. The sandbar willow and tamarix that are so extensive in Glen Canyon are much less in evidence above. Of the cottonwood trees, the Fremont is present in Glen Canyon and Navajo, the narrowleaf in Flaming Gorge, Navajo and Curecanti.

For comparison of the vegetation coverage in the four primary habitats in the four reservoir basins, Table 9 has been prepared. This shows a significant increase in the ratio of volume of foliage to area covered by the vegetation in the four basins, 3.4, 5.1, 6.1 and 6.4. This probably reflects an increased precipitation, which enables the plants at Navajo and Curecanti to maintain larger volumes of foliage on a given area of land.

COMPARISON OF COVERAGE AND VOLUME

Table 9. Vegetation coverage and foliage volume on surveyed areas of Glen Canyon, Flaming Gorge, Navajo and Curecanti reservoir basins. The ratio given is that of foliage volume to cover acres.

Habitat	Glen Canyon Cover	%	Flaming Gorge Cover	%	Navajo Res.Basin Cover	%	Curecanti Res. Cover	%
Vegetation Cover								
Streamside	2,116	82	1,396	86	975	80	905	96
Terrace	3,337	51	4,083	51	1,324	72	118	63
Hillside	3,307	18	5,390	21	2,369	22	2,068	29
Farmland	32	38	462	73	1,655	68	1,908	93
TOTAL	8,782	32	11,510	32	6,323	39	4,999	49
Area surveyed	27,570		36,280		16,022		10,893	
Foliage Volume								
Acre-ft.	29,830		58,825		38,310		31,914	
Ratio		3.4		5.1		6.1		6.4

SUMMARY

During the summer of 1961 the University of Utah, Division of Biological Sciences, Curecanti Project, made a survey of vegetation in the Curecanti Reservoir Basin on the Gunnison River in Colorado, for the U. S. Bureau of Reclamation, Upper Colorado River Office at Salt Lake City. The principal objective of the survey was to determine the kinds and quantities of vegetation in the area that would be inundated by the anticipated reservoir. Cooperation from the University of Utah Research Fund made it possible to include an auxiliary faunal survey at the same time.

The expedition was conducted in the field by a crew of 16 scientists, led by Stephen D. Durrant, head of the expedition, and Seville Flowers, chief of the vegetation survey. This report covers the vegetation survey only. The vegetation survey crews made ocular estimates of 209 unit areas of vegetation, of which 82 were classified as streamside vegetation usually having roots immersed in percolating water, 12 as terrace vegetation having capillary water available, 28 as farmland or abandoned farmland depending mainly upon irrigation, and 87 as hillside vegetation depending upon precipitation for its water supply.

By traversing each unit area in the field, two-man crews estimated the density and average height of vegetation on each one and estimated the density and average height of vegetation on each one and estimated the percentage composition of the dominant species occupying an estimated five per cent of the cover, occasionally including important species with even less coverage. These data were recorded on special field records and plotted on transparent overlay sheets above aerial photomaps having a map scale ratio of one in. to 1000 ft. (USGS series GS-LP, 1950).

The ocular estimates were supplemented and checked by means of strip transects, quadrats and tree spacing studies. Fifteen strip transects in sagebrush, 100 by 4 ft., were made. Eighteen quadrats, 5 by 8 ft., were made in sagebrush, and three tree spacing studies were made in quaking aspen, spruce and fir by measuring distances between trees at nine different points in each. Plants on quadrats were measured, plotted and photographed.

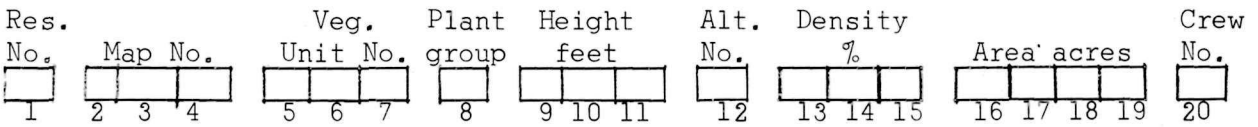
The expedition extended from June 26 to July 23, 1961. The field data were studied in the laboratory by Angus M. Woodbury, with advice and assistance from the field leaders and some crew members. After they were checked for accuracy, the field data were compiled for use in this report. Data from the ocular estimates, analyzed on an electronic computer, showed that 947 acres of streamside vegetation had 96 per cent cover, 187 acres of terrace land had 63 per cent cover, 2055 acres of farmland had 93 per cent cover, but 7074 acres of hillside had only 29 per cent cover. The total of 10,264 acres of land had an average cover of 49 per cent. An area of 629 acres of water surface makes a total of 10,892 acres covered by the survey. When translated into volume, the 4,999 acres of vegetation cover contains 31,914 acre feet of foliage, a ratio of 6.4 of volume to one of cover. A similar ratio in Glen Canyon was 3.4, in Flaming Gorge was 5.1 and in Navajo was 6.1.

APPENDICES

APPENDIX A-5

CURECANTI RESERVOIRS BASINS, GUNNISON RIVER

KEY FOR MAJOR STREAMSIDE VEGETATION



Equisetum arvense 21 22	Juniperus scopulorum 23 24	Agropyron smithii 25 26	Agrostis alba* 27 28	Bromus inermis 29 30	Elymus condensatus 31 32
Poa pratensis 33 34	Carex nebraskensis* 35 36	Juncus balticus montanus* 37 38	Smilacina stellata 39 40	Populus angustifolia 41 42	Salix caudata 43 44
Salix exigua 45 46	Alnus tenuifolia 47 48	Betula occidentalis 49 50	Urtica gracilenta 51 52	Amelanchier alnifolia 53 54	Crataegus saligna 55 56
Holodiscus dumosus 57 58	Prunus virginiana 59 60	Ribes aureum 61 62	Rosa woodsii 63 64	Rubus strigosus 65 66	Trifolium hybridum 67 68
Trifolium repens 69 70	Acer glabrum 71 72	Rhus trilobata 73 74	Cornus stolonifera 75 76	Artemisia tridentata 77 78	Chrysothamnus viscidiflorus tortifolius 79 80

* and related species

KEY FOR MINOR STREAMSIDE VEGETATION

21-22	Equisetum kansanum	51-52	Allium macropetalum
23-24	Picea pungens	53-54	Iris missouriensis
25-26	Pinus ponderosa	55-56	Populus tremuloides
27-28	Pseudotsuga menziesii	57-58	Salix bebbiana
29-30	Typha angustifolia	59-60	Salix geyeriana
31-32	Agropyron desertorum	61-62	Salix lutea
33-34	Beckmannia syzigachne	63-64	Quercus gambelii
35-36	Bromus tectorum	65-66	Rumex mexicanus
37-38	Glyceria grandis	67-68	Chenopodium glaucum
39-40	Oryzopsis hymenoides	69-70	Kochia scoparia
41-42	Phleum pratense	71-72	Clematis ligusticifolia
43-44	Phragmites communis	73-74	Cleome serrulata
45-46	Sitanion hystrix	75-76	Camelina microcarpa
47-48	Sporobolus cryptandrus	77-78	Sisymbrium altissimum
49-50	Scirpus microcarpus*	79-80	Crataegus rivularis

* and related species

APPENDIX A-5 (continued 2)

KEY FOR MINOR STREAMSIDE VEGETATION (continued)

21-22	Potentilla fruticosa*	51-52	Lappula floribunda
23-24	Purshia tridentata	53-54	Mentha penardi
25-26	Ribes inerme	55-56	Pentstemon comarrhenus
27-28	Glycyrrhiza lepidota	57-58	Sambucus pubens
29-30	Lupinus greenei	59-60	Symphoricarpos oreophilus
31-32	Melilotus officinalis	61-62	Campanula rotundifolia
33-34	Trifolium pratense	63-64	Achillea lanulosa
35-36	Vicia americana	65-66	Artemisia dracunculus glauca
37-38	Rhus radicans	67-68	Artemisia frigida
39-40	Acer negundo interius	69-70	Artemisia ludoviciana
41-42	Elaeagnus commutata	71-72	Aster adscendens*
43-44	Cicuta douglasii	73-74	Cirsium undulatum
45-46	Heracleum lanatum	75-76	Solidago sparsiflora*
47-48	Apocynum cannabinum	77-78	Taraxacum officinale
49-50	Gilia aggregata	79-80	Others

KEY FOR MAJOR TERRACE VEGETATION

21-22	Pseudotsuga menziesii	51-52	Salix caudata
23-24	Agropyron smithii	53-54	Alnus tenuifolia
25-26	Agropyron trachycaulum	55-56	Chenopodium glaucum
27-28	Aristida fendleriana	57-58	Kochia scoparia
29-30	Bromus inermis	59-60	Salsola kali
31-32	Bromus tectorum	61-62	Holodiscus dumosus
33-34	Elymus condensatus	63-64	Potentilla fruticosa*
35-36	Poa pratensis	65-66	Rosa woodsii
37-38	Sitanion hystrix	67-68	Rhus trilobata
39-40	Sporobolus cryptandrus	69-70	Symphoricarpos oreophilus
41-42	Stipa columbiana	71-72	Achillea lanulosa
43-44	Stipa lettermani	73-74	Artemisia frigida
45-46	Carex nebraskensis*	75-76	Artemisia tridentata
47-48	Juncus balticus montanus*	77-78	Chrysothamnus viscidiflorus
49-50	Populus angustifolia	79-80	Cirsium undulatum

KEY FOR MINOR TERRACE VEGETATION

21-22	Juniperus scopulorum	39-40	Trifolium repens
23-24	Agrostis alba	41-42	Cicuta douglasii
25-26	Hilaria jamesii	43-44	Scutellaria galericultata
27-28	Oryzopsis hymenoides	45-46	Pentstemon comarrhenus
29-30	Smilacina stellata	47-48	Artemisia dranunculus glauca
31-32	Iris missouriensis	49-50	Artemisia ludoviciana
33-34	Lepidium perfoliatum	51-52	Chrysopsis villosa
35-36	Prunus virginiana	53-54	Senecio ambrosioides*
37-38	Lupinus greenei	55-56	Others

* and related species

APPENDIX A-5 (continued 3)

KEY FOR MAJOR HILLSIDE VEGETATION

21-22	Juniperus scopulorum	51-52	Amelanchier alnifolia
23-24	Picea pungens	53-54	Cercocarpus montanus
25-26	Pinus edulis	55-56	Holodiscus dumosus
27-28	Pseudotsuga menziesii	57-58	Prunus virginiana
29-30	Agropyron smithii	59-60	Purshia tridentata
31-32	Bromus tectorum	61-62	Ribes aureum
33-34	Elymus condensatus	63-64	Rhus trilobata
35-36	Hilaria jamesii	65-66	Acer glabrum
37-38	Oryzopsis hymenoides	67-68	Opuntia hystricina
39-40	Sitanion hystrix	69-70	Phlox caespitosa
41-42	Stipa comata	71-72	Cryptantha jamesii
43-44	Stipa lettermani	73-74	Artemisia frigida
45-46	Quercus gambelii	75-76	Artemisia tridentata
47-48	Eriogonum umbellatum	77-78	Chrysothamnus depressus
49-50	Salsola kali	79-80	Chrysothamnus viscidiflorus

KEY FOR MINOR SHILLSIDE VEGETATION

21-22	Pinus ponderosa	51-52	Eriogonum racemosum
23-24	Agropyron trachycaulum	53-54	Atriplex canescens
25-26	Aristida fendleriana	55-56	Chenopodium glaucum
27-28	Bouteloua gracilis	57-58	Eurotia lanata
29-30	Bromus inermis	59-60	Kochia scoparia
31-32	Stipa columbiana	61-62	Berberis repens
33-34	Smilacina racemosa	63-64	Cleome serrulata
35-36	Smilacina stellata	65-66	Camelina microcarpa
37-38	Yucca angustissima	67-68	Lepidium draba
39-40	Populus angustifolia	69-70	Sisymbrium altissimum
41-42	Populus tremuloides	71-72	Philadelphus m. microphyllus
43-44	Salix caudata	73-74	Philadelphus m. occidentalis
45-46	Salix exigua	75-76	Crataegus saligna
47-48	Alnus tenuifolia	77-78	Potentilla fruticosa*
49-50	Urtica gracilenta	79-80	Ribes inerme

KEY FOR MINOR HILLSIDE VEGETATION (continued)

21-22	Rosa woodsii	49-50	Symphoricarpos oreophilus
23-24	Rubus strigosus	51-52	Achillea lanulosa
25-26	Lupinus greenei	53-54	Aplopappus acaulis
27-28	Lupinus kingii	55-56	Artemisia dracunculus glauca
29-30	Melilotus officinalis	57-58	Artemisia ludoviciana
31-32	Acer negundo interius	59-60	Artemisia nova
33-34	Sphaeralcea coccinea	61-62	Aster adscendens*
35-36	Cornus stolonifera	63-64	Centaurea picris
37-38	Apocynum cannabinum	65-66	Chrysothamnus nauseosus
39-40	Gilia aggregata	67-68	Cirsium undulatum
41-42	Lappula floribunda	69-70	Erigeron speciosus speciosus
43-44	Pentstemon barbatus	71-72	Solidago sparsiflora*
45-46	Pentstemon comarrhenus	73-74	Tetradymia canescens
47-48	Sambucus pubens	75-76	Others

* and related species

APPENDIX A-5 (continued 4)

KEY FOR MAJOR FARMLAND VEGETATION

21-22	Typha angustifolia	51-52	Populus angustifolia
23-24	Agropyron desertorum	53-54	Salix caudata
25-26	Agropyron smithii	55-56	Salix exigua
27-28	Agrostis alba	57-58	Rumex mexicanus
29-30	Bromus inermis	59-60	Salsola kali
31-32	Bromus tectorum	61-62	Malcolmia africana
33-34	Dactylis glomerata	63-64	Medicago sativa
35-36	Elymus condensatus	65-66	Melilotus officinalis
37-38	Hordeum jubatum	67-68	Trifolium hybridum
39-40	Phleum pratense	69-70	Trifolium pratense
41-42	Poa pratensis	71-72	Trifolium repens
43-44	Sporobolus cryptandrus	73-74	Achillea lanulosa
45-46	Carex nebraskensis*	75-76	Artemisia tridentata
47-48	Scirpus microcarpus*	77-78	Chrysothamnus viscidiflorus
49-50	Juncus balticus montanus*	79-80	Taraxacum officinale

KEY FOR MINOR FARMLAND VEGETATION

21-22	Equisetum arvense	51-52	Kochia scoparia
23-24	Equisetum kansanum	53-54	Camelina microcarpa
25-26	Picea pungens	55-56	Descurainia pinnata
27-28	Agropyron trachycaulum	57-58	Lepidium perfoliatum
29-30	Glyceria grandis	59-60	Sisymbrium altissimum
31-32	Sitanion hystrix	61-62	Thlaspi arvense
33-34	Stipa columbiana	63-64	Crataegus saligna
35-36	Stipa comata	65-66	Potentilla fruticosa*
37-38	Iris missouriensis	67-68	Rosa woodsii
39-40	Salix geyeriana	69-70	Lupinus greenei
41-42	Alnus tenuifolia	71-72	Thermopsis montana
43-44	Quercus gambelii	73-74	Vicia americana
45-46	Eriogonum umbellatum	75-76	Elaeagnus commutata
47-48	Rumex crispus	77-78	Cornus stolonifera
49-50	Chenopodium glaucum	79-80	Convolvulus arvense

KEY FOR MINOR FARMLAND VEGETATION (continued)

21-22	Lappula floribunda	31-32	Chrysothamnus depressus
23-24	Plantago major	33-34	Cirsium undulatum
25-26	Artemisia frigida	35-36	Tragopogon dubius
27-28	Artemisia ludoviciana	37-38	Xanthium pennsylvanicum
29-30	Centaurea picris	39-40	Others

* and related species

APPENDIX C-1-b

TRANSECT STUDY

CURECANTI RESERVOIRS BASINS
Gunnison River

T 49 N, R 2 W
Sec. 32
Size: 100 x 4 ft. = 400 ft.
Team: Stock & Lamborn, Unit: 3d, July 5, 1961
Locality: North Willow Creek, RM 56.6L, Veg. type: Sagebrush

TRANSECT NO. 1
Overlay No. 6
Map No. 1-48
Alt. 7,480 ft.

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Chrysotham. depressus		Oryzopsis hymenoides		Sitanion hystrix		Small herbs		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	52	13.0	1	.3	1	.2	1	.2	--	--	55	14	13
2	52	13.0	2	.5	1	.2	1	.2	--	--	56	14	13
3	59	14.8	3	.8	1	.2	1	.2	1	.2	65	16	13
4	60	15.0	7	1.8	1	.2	1	.2	1	.2	70	18	12
5	64	16.0	3	.8	--	--	--	--	--	--	67	17	14
TOTALS	287	14.4	16	.8	4	.2	4	.2	2	.1	313	16	15

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Chrysotham. depressus		Oryzopsis hymenoides		Sitanion hystrix		Small herbs		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	96	98	2	1	1	.5	1	.5	--	--	100	100
2	95	98	3	1	1	.5	1	.5	--	--	100	100
3	92	97	5	1	1	.5	1	.5	1	1	100	100
4	87	93	10	5	1	.5	1	.5	1	1	100	100
5	95	99	5	11	--	--	--	--	--	--	100	100
Average	92	94	5	2	1	1.5	1	1.5	1	1	100	100

C. FOLIAGE HEIGHTS OF VEGETATION

Strip	Artemisia tridentata		Chrysotham. depressus		Oryzopsis hymenoides		Sitanion hystrix		Small herbs	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	21	1.4	4	.6	5	.3	5	.3	--	--
2	33	1.6	7	.4	1	.3	1	.3	--	--
3	30	1.5	7	.5	7	.3	7	.3	7	.2
4	22	1.4	4	.3	1	.3	1	.3	1	.2
5	35	1.2	7	.3	1	.3	1	.3	1	.2
Tot/Aver.	141	1.4	29	.4	15	.3	15	.3	9	.2

APPENDIX C-1-b (continued 2)

TRANSECT STUDY

CURECANTI RESERVOIRS BASINS
Gunnison River

T 49 N, R 2 W
Sec. 31
Size: 100 x 4 ft. = 400 ft.
Team: Ranck & Reynolds, Unit: 3d, July 5, 1961
Locality: Near North Willow Creek, RM 56.4L, Veg. type: Sagebrush

TRANSECT NO. 2
Overlay No. 6
Map No. 1-48
Alt. 7460 ft.

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Phlox caespitosa		Stipa lettermani*		Erigeron sp.		Others		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	41	10.2	3	.8	6	1.5	8	2.0	18	4.5	78	19	18
2	46	11.5	6	1.5	11	2.8	10	2.5	11	2.7	84	21	18
3	41	10.2	4	1.0	6	1.5	7	1.8	14	3.5	72	18	18
4	34	8.5	4	1.0	8	2.0	6	1.5	14	3.5	66	16	18
5	38	9.5	3	.8	10	2.5	12	3.0	9	2.2	72	18	18
TOTALS	200	10.0	20	1.0	41	2.0	43	2.2	66	3.3	370	18	18

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Phlox caespitosa		Stipa lettermani*		Erigeron sp.		Others		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	54	80	4	2	7	3	11	5	24	10	100	100
2	55	70	8	4	13	5	11	7	13	14	100	100
3	57	80	5	2	8	3	11	5	19	10	100	100
4	52	70	5	4	13	5	9	7	21	14	100	100
5	52	65	4	4	15	5	17	9	12	17	100	100
Average	54	80	5	2	11	3	12	5	18	10	100	100

C. FOLIAGE HEIGHTS OF VEGETATION

Strip	Artemisia tridentata		Phlox caespitosa		Stipa lettermani*		Erigeron sp.	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	16	1.8	5	.3	7	.4	11	.4
2	19	1.7	8	.3	10	.4	12	.4
3	16	1.5	6	.3	5	.3	11	.4
4	16	1.4	6	.2	11	.4	9	.3
5	16	1.5	5	.2	10	.4	12	.3
Total/Aver.	83	1.6	30	.3	43	.4	55	.4

* and related species

APPENDIX C-1-b (continued 3)

TRANSECT STUDY

CURECANTI RESERVOIRS BASINS

Gunnison River

T 49 N, R 2 W — TRANSECT NO. 3
Sec. 32 — Overlay No. 6
Size: 100 x 4 ft. = 400 ft. — Map No. 1-48
Team: Hall & Argyle, Unit: 3d, July 5, 1961 — Alt. 7480 ft.
Locality: Near North Willow Creek, RM 56.2L, Veg. type: Sagebrush

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Chrysotham. depressus		Oryzopsis hymenoides		Phlox caespitosa		Others		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	73	18.3	4	1.0	5	1.3	4	1.0	5	1.2	91	23	30
2	73	18.3	8	2.0	6	1.5	7	1.8	5	1.2	99	25	25
3	66	16.5	11	2.8	7	1.8	3	.8	3	.8	90	23	20
4	66	16.5	6	2.5	4	1.0	1	.3	3	.8	80	20	21
5	70	17.5	2	.5	6	1.5	3	.8	--	--	81	20	19
TOTALS	348	17.4	31	1.6	28	1.4	18	.9	16	.8	441	22	27

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Chrysotham. depressus		Oryzopsis hymenoides		Phlox caespitosa		Others		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	80	90	4	3	6	3	4	2	6	2	100	100
2	74	85	8	4	6	3	7	3	5	5	100	100
3	74	90	12	5	8	2	3	2	3	1	100	100
4	83	80	7	10	5	3	1	3	4	4	100	100
5	86	90	2	2	8	5	4	3	--	--	100	100
Average	79	85	7	5	6	4	4	3	4	3	100	100

C. FOLIAGE HEIGHTS OF VEGETATION

Strip	Artemisia tridentata		Chrysothamnus depressus		Oryzopsis hymenoides		Phlox caespitosa	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	19	1.6	4	.3	4	.4	4	.2
2	19	1.6	6	.4	5	.5	5	.2
3	14	1.8	8	.4	4	.4	2	.2
4	17	1.9	5	.4	3	.2	1	.2
5	17	1.5	2	.4	5	.4	2	.2
Total/aver.	86	1.7	25	.4	21	.4	14	.2

APPENDIX C-1-b (continued 4)

TRANSECT STUDY

CURECANTI RESERVOIRS BASINS
Gunnison River

T 49 N, R 3 W
Sec. 28
Size: 100 x 4 ft. = 400 ft.
Team: Stock & Lamborn, Unit: 2a, June 30, 1961
Locality: Dry Gulch, west slope, RM 50.2R, Veg. type: Sagebrush

TRANSECT NO. 4
Overlay No. 9
Map No. 3-10
Alt. 7520 ft.

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Chrysotham. depressus		Agropyron smithii		Small herbs		Others		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	43	10.8	4	1.0	2	.5	1	.3	1	.3	51	13	15
2	47	11.8	8	2.0	2	.5	6	1.5	1	.3	64	16	10
3	57	14.3	7	1.8	2	.5	--	--	--	--	66	17	13
4	62	15.5	4	1.0	4	1.0	1	.3	4	1.0	75	19	14
5	47	11.8	5	1.3	2	.5	4	1.0	--	--	58	15	11
TOTALS	256	12.8	28	1.4	12	.6	12	.6	6	.3	314	16	16

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Chrysotham. depressus		Agropyron smithii		Small herbs		Others		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	85	75	8	10	4	8	2	5	1	2	100	100
2	73	80	12	5	4	4	10	10	1	1	100	100
3	86	85	11	10	3	4	--	--	--	1	100	100
4	83	88	5	3	5	5	2	1	5	3	100	100
5	81	82	9	5	4	3	6	10	--	--	100	100
Average	81	75	9	10	4	8	4	3	2	4	100	100

C. FOLIAGE HEIGHTS OF VEGETATIONS

Strip	Artemisia tridentata		Chrysothamnus depressus		Agropyron smithii		Small herbs	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	26	1.0	13	.3	1	.4	8	.4
2	28	.9	11	.4	14	.5	11	.3
3	24	1.0	10	.5	9	.4	--	--
4	25	1.0	5	.5	12	.5	7	.3
5	26	.9	11	.3	12	.4	10	.3
Total/aver.	129	1.0	50	.4	48	.5	36	.3

APPENDIX C-1-b (continued 5)

TRANSECT STUDY

CURECANTI RESERVOIRS BASINS
Gunnison River

T 49 N, R 3 W
Sec. 28
Size: 100 x 4 ft. = 400 ft.
Team: Ranck & Reynolds, Unit 2a, June 30, 1961
Locality: Dry Gulch, RM 50.2R, Veg. type: Sagebrush

TRANSECT NO. 5
Overlay No. 9
Map No. 1-10
Alt. 7520 ft.

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Chrysotham. nauseosus		Stipa lettermani		Oryzopsis hymenoides		Others		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	52	12.8	2	.4	17	4.1	2	.5	7	1.8	80	20	30
2	72	18.0	6	1.5	24	6.0	10	2.5	5	1.3	117	29	20
3	61	15.2	31	7.8	16	4.0	2	.5	8	2.0	118	29	35
4	94	23.5	30	7.5	6	1.5	5	1.3	6	1.5	141	35	35
5	66	16.5	4	1.0	16	4.0	6	1.5	7	1.8	99	25	17
TOTALS	345	17.2	73	3.7	79	4.0	25	1.3	33	1.7	555	28	25

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Chrysotham. nauseosus		Stipa lettermani		Oryzopsis hymenoides		Others		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	65	75	2	2	21	10	3	10	9	3	100	100
2	62	80	5	2	21	10	8	5	4	3	100	100
3	52	50	26	25	13	10	2	2	7	13	100	100
4	67	75	21	15	4	5	4	2	4	3	100	100
5	67	80	4	2	16	10	6	5	7	3	100	100
Average	62	65	13	10	14	10	5	7	6	8	100	100

C. FOLIAGE HEIGHTS OF VEGETATION

Strip	Artemisia tridentata		Chrysothamnus nauseosus		Stipa lettermani		Oryzopsis hymenoides	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	22	1.3	2	1.2	11	.5	2	.7
2	19	1.3	6	.9	11	.6	6	.6
3	22	1.4	20	1.1	10	.6	2	.5
4	23	1.6	20	1.0	7	.5	2	.6
5	19	1.1	5	.9	11	.4	5	.4
Total/average	105	1.3	53	1.0	50	.5	17	.5

APPENDIX C-1-b (continued 6)

TRANSECT STUDY

CURECANTI RESERVOIRS BASINS
Gunnison River

T 49 N, R 3 W
Sec. 28
Size: 100 x 4 ft. = 400 ft.
Team: Hall & Argyle, Unit 3a, June 30, 1961
Locality: Dry Gulch, RM 50.2R, Veg. type: Sagebrush

TRANSECT NO. 6
Overlay No. 9
Map No. 1-10
Alt. 7485 ft.

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Gutierrezia sarothrae		Oryzopsis hymenoides		Opuntia hystricina		Small herbs		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	87	21.8	11	2.8	11	2.8	1	.3	2	.5	112	28	18
2	77	19.3	28	7.0	10	2.5	--	--	1	.3	116	29	20
3	96	24.0	12	3.0	11	2.8	1	.3	1	.3	121	30	27
4	118	29.5	9	2.3	10	2.5	--	--	3	.8	140	5	30
5	126	1.5	9	2.3	14	3.5	1	.3	--	--	150	8	35
TOTALS	504	25.2	69	3.5	56	2.8	3	.2	7	.4	639	32	27

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Gutierrezia sarothrae		Oryzopsis hymenoides		Opuntia hystricina		Small Herbs		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	77	80	10	10	10	5	1	--	2	5	100	100
2	66	60	24	30	9	5	--	--	1	5	100	100
3	79	90	10	5	9	5	1	--	1	--	100	100
4	85	90	6	5	7	5	--	--	2	--	100	100
5	84	90	6	5	9	5	1	--	--	--	100	100
Average	78	80	11	10	9	5	1	--	1	5	100	100

C. FOLIAGE HEIGHTS OF VEGETATION

Strip	Artemisia tridentata		Gutierrezia sarothrae		Oryzopsis hymenoides		Opuntia hystricina		Small herbs	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	16	1.3	6	.4	7	.7	1	.2	2	.3
2	16	1.3	9	.6	8	.7	--	--	1	.2
3	19	1.4	5	.7	5	.8	1	.3	1	.1
4	23	1.6	8	.6	5	.9	--	--	3	.3
5	19	1.7	6	.7	7	.7	1	.3	--	--
Tot./aver.	93	1.5	34	.6	32	.8	3	.3	7	.3

APPENDIX C-1-b (continued 7)

TRANSECT STUDY

CURECANTI RESERVOIRS BASINS
Gunnison River

T 49 N, R 3 W
Sec. 33
Size: 100 x 4 ft. = 400 ft.
Team: Hall & Argyle, Unit: 3c, July 10, 1961
Locality: Moncrief Ranch, RM 49L, Veg. type: Sagebrush

TRANSECT NO. 7
Overlay No. 9
Map No. 3-10
Alt. 7460 ft.

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Chrysotham. depressus		Oryzopsis hymenoides		Phlox caespitosa		Small herbs		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	80	20.0	3	.8	3	.8	14	3.5	--	--	100	25	30
2	85	21.3	3	.8	4	1.0	9	2.3	1	.3	102	26	28
3	113	28.3	7	1.8	24	6.0	7	1.8	1	.3	152	38	35
4	91	22.8	5	1.3	13	3.3	8	2.0	--	--	117	29	27
5	60	15.0	11	2.8	18	4.5	7	1.8	1	.3	97	24	24
TOTALS	429	21.4	29	1.5	62	3.1	45	2.3	3	.1	568	28	28

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Chrysotham. depressus		Oryzopsis hymenoides		Phlox caespitosa		Small herbs		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	80	90	3	2	3	3	14	5	--	--	100	100
2	83	85	3	2	4	3	9	10	1	--	100	100
3	75	80	4	5	16	10	4	5	1	--	100	100
4	78	85	4	5	11	5	7	5	--	--	100	100
5	62	85	11	5	19	5	7	5	1	--	100	100
Average	75	80	5	5	11	5	8	10	1	--	100	100

C. FOLIAGE HEIGHTS OF VEGETATION

Strip	Artemisia tridentata		Chrysotham. depressus		Oryzopsis hymenoides		Phlox caespitosa		Small herbs	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	16	1.7	3	.5	3	.8	10	.3	--	--
2	20	1.7	3	.5	4	.8	8	.3	1	.4
3	23	2.0	7	.7	17	.8	5	.3	1	.2
4	18	1.7	4	.5	10	.8	8	.3	--	--
5	19	1.5	9	.5	14	.6	7	.2	1	.4
Tot/Aver.	96	1.7	26	.5	48	.8	38	.3	3	.3

APPENDIX C-1-b (continued 8)

TRANSECT STUDY

CURECANTI RESERVOIRS BASINS
Gunnison River

T 49 N, R 3 W
Sec. 29
Size: 100 x 4 ft. = 400 ft.
Team: Stock & Lamborn, Unit: 3c, July 10, 1961
Locality: Moncrief Ranch, RM 49L, Veg. type: Sagebrush

TRANSECT NO. 8
Overlay No. 9
Map No. 3-10
Alt. 7430 ft.

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Chrysothamnus depressus		Phlox caespitosa		Stipa lettermani		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	49	12.3	8	2.0	12	3.0	3	.8	72	18	15
2	44	11.0	10	2.5	13	3.3	4	1.0	71	18	15
3	45	11.3	10	2.5	14	3.5	4	1.0	73	18	16
4	60	15.0	2	.5	14	3.5	4	1.0	80	20	17
5	43	10.8	2	.5	12	3.0	4	1.0	61	15	16
TOTALS	241	12.1	32	1.6	65	3.3	19	1.0	357	18	16

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Chrysotham. depressus		Phlox caespitosa		Stipa lettermani		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	68	80	11	8	17	8	4	4	100	100
2	62	70	14	10	18	15	6	5	100	100
3	62	70	14	13	19	11	5	6	100	100
4	75	70	2	8	18	15	5	7	100	100
5	71	65	3	5	20	20	6	10	100	100
Average	68	75	9	10	18	10	5	5	100	100

C. FOLIAGE HEIGHTS OF VEGETATION

Strip	Artemisia tridentata		Chrysothamnus depressus		Phlox caespitosa		Stipa lettermani	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	23	.9	9	.2	9	.2	7	.4
2	33	.8	12	.3	11	.2	11	.4
3	30	1.0	8	.3	8	.2	20	.4
4	29	1.0	7	.3	1	.2	2	.4
5	38	.7	7	.3	1	.2	1	.5
Total/aver.	153	.9	43	.3	30	.2	41	.4

APPENDIX C-1-b (continued 8)

TRANSECT STUDY

CURECANTI RESERVOIRS BASINS
Gunnison River

T 49 N, R 3 W
Sec. 29
Size: 100 x 4 ft. = 400 ft.
Team: Ranck & Reynolds, Unit: 3c, July 10, 1961
Locality: Moncrief Ranch, RM 48.9L, Veg. type: Sagebrush

TRANSECT NO. 9
Overlay No. 9
Map No. 3-10
Alt. 7420 ft.

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Chrysotham. depressus		Oryzopsis hymenoides		Phlox caespitosa		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	41	10.3	9	2.3	9	2.3	26	6.5	85	21	16
2	45	11.3	6	1.5	13	3.3	19	4.8	83	21	20
3	39	9.8	8	2.0	12	3.0	31	7.8	90	23	18
4	45	11.3	7	1.8	15	3.8	43	10.8	110	28	21
5	32	8.0	6	1.5	11	2.8	27	6.8	76	19	22
TOTALS	202	10.1	36	1.8	60	3.0	146	7.3	444	22	16

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Chrysothamnus depressus		Oryzopsis hymenoides		Phlox caespitosa		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	48	60	11	10	11	12	30	18	100	100
2	54	50	7	10	16	15	23	25	100	100
3	44	50	9	10	13	15	34	25	100	100
4	41	45	6	5	14	15	39	35	100	100
5	42	45	8	5	15	15	35	35	100	100
Average	46	60	8	10	13	12	33	18	100	100

C. FOLIAGE HEIGHTS OF VEGETATION

Strip	Artemisia tridentata		Chrysothamnus depressus		Oryzopsis hymenoides		Phlox caespitosa	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	17	1.2	9	.5	10	.7	17	.3
2	15	1.2	7	.5	9	.7	12	.3
3	15	1.0	8	.5	7	.7	11	.3
4	20	1.0	10	.4	10	.4	22	.3
5	22	1.1	9	.4	11	.5	18	.3
Total/aver.	89	1.1	43	.5	47	.6	80	.3

APPENDIX C-1-b (continued 10)

TRANSECT STUDY

CURECANTI RESERVOIRS BASINS
Gunnison River

T 49 N, R 4 W
Sec. 25
Size: 100 x 4 ft. = 400 ft.
Team: Stock & Lamborn, Unit: 3d, June 29, 1961
Locality: Near mouth Red Creek, RM 46.8R, Veg. type: Sagebrush

TRANSECT NO. 10
Overlay No. 10
Map No. 3-9
Alt. 7400

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Oryzopsis hymenoides		Hilaria jamesii		Small herbs		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	44	11.0	10	2.5	2	.5	--	--	56	14	25
2	62	15.5	9	2.3	2	.5	--	--	73	18	25
3	82	20.5	7	1.8	2	.5	--	--	91	23	15
4	63	15.8	4	1.0	1	.3	--	--	68	17	13
5	69	17.3	1	.3	1	.3	2	.5	73	18	15
TOTALS	320	16.0	31	1.6	8	.4	2	.1	361	18	27

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Oryzopsis hymenoides		Hilaria jamesii		Small herbs		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	79	95	18	4	3	1	--	--	100	100
2	85	90	12	8	3	2	--	--	100	100
3	90	75	8	20	2	5	--	--	100	100
4	93	90	6	8	1	2	--	--	100	100
5	95	94	1	4	1	1	3	1	100	100
Average	89	85	9	8	2	2	--	5	100	100

C. FOLIAGE HEIGHTS OF VEGETATION

Strip	Artemisia tridentata		Oryzopsis hymenoides		Hilaria jamesii		Small herbs	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	22	1.7	1	.4	1	.4	--	--
2	1	1.7	1	.4	1	.4	--	--
3	17	1.9	1	.4	1	.3	--	--
4	31	1.4	1	.4	1	.4	--	--
5	25	1.6	1	.4	1	.4	2	.5
Total/aver.	96	1.6	5	.4	5	.4	2	.5

APPENDIX C-1-b (continued 11)

TRANSECT STUDY

CURECANTI RESERVOIRS BASINS
Gunnison River

T 49 N, R 4 W
Sec. 25
Size: 100 x 4 ft. = 400 ft.
Team: Hall & Argyle, Unit: 3d, June 29, 1961
Locality: Near mouth Red Creek, RM 46.8R, Veg. type: Sagebrush

TRANSECT NO. 11
Overlay No. 10
Map No. 3-9
Alt. 7356 ft.

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Oryzopsis hymenoides		Purshia tridentata		Hilaria jamesii		Others		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	62	15.5	--	--	--	--	4	1.0	48	6.8	114	29	34
2	31	7.8	--	--	62	15.5	30	7.5	30	7.5	153	38	33
3	71	17.8	33	8.3	41	10.3	--	--	14	3.5	159	40	35
4	50	12.5	69	17.3	11	2.8	9	2.3	9	2.3	148	37	33
5	51	12.8	66	16.5	--	--	34	8.5	7	1.8	158	40	37
TOTALS	265	13.3	168	8.4	114	5.7	77	3.9	108	5.4	732	37	28

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Oryzopsis hymenoides		Purshia tridentata		Hilaria jamesii		Others		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	54	55	--	--	--	--	4	--	42	45	100	100
2	20	20	--	--	40	40	20	20	20	20	100	100
3	45	55	21	20	26	20	--	--	8	5	100	100
4	34	30	47	55	7	5	6	3	6	7	100	100
5	32	40	42	40	--	--	22	15	4	5	100	100
Average	36	50	23	15	16	10	10	10	15	15	100	100

C. FOLIAGE HEIGHTS OF VEGETATION

Strip	Artemisia tridentata		Oryzopsis hymenoides		Purshia tridentata		Hilaria jamesii	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	12	1.8	--	--	--	--	3	.8
2	6	2.0	--	--	5	1.3	7	.7
3	14	1.7	3	.6	3	1.2	--	--
4	13	.9	12	.8	1	2.0	2	.5
5	10	1.3	5	.7	--	--	3	.5
Total/aver.	55	1.5	20	.7	9	1.3	15	.6

APPENDIX C-1-b (continued 12)

TRANSECT STUDY

CURECANTI RESERVOIRS BASINS
Gunnison River

T 49 N, R 4 W
Sec. 25
Size: 100 x 4 ft. = 400 ft.
Team: Ranck & Reynolds, Unit: 3d, June 29, 1961
Locality: Near mouth Red Creek, RM 46.8R, Veg. type: Sagebrush

TRANSECT NO. 12
Overlay No. 10
Map No. 3-9
Alt. 7445 ft.

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Oryzopsis hymenoides		Hilaria jamesii		Small herbs		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	44	11.0	16	4.0	28	7.0	5	1.3	93	23	17
2	42	10.5	21	5.3	10	2.5	6	1.5	79	20	16
3	48	12.0	14	3.3	12	3.0	4	1.0	78	20	18
4	47	11.8	15	3.8	6	1.5	4	1.0	72	18	15
5	43	10.8	32	8.0	--	--	11	2.8	86	21	17
TOTALS	224	11.2	98	4.9	56	2.8	30	1.5	408	20	17

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Oryzopsis hymenoides		Hilaria jamesii		Small herbs		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	47	70	17	12	30	15	6	3	100	100
2	53	72	27	20	13	6	7	2	100	100
3	62	70	18	13	15	15	5	2	100	100
4	65	80	21	10	8	8	6	2	100	100
5	50	65	37	20	--	10	13	5	100	100
Average	55	70	24	8	14	20	7	2	100	100

C. FOLIAGE HEIGHTS OF VEGETATION

Strip	Artemisia tridentata		Oryzopsis hymenoides		Hilaria jamesii		Small herbs	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	17	1.3	10	.6	15	.4	3	.3
2	14	1.0	12	.7	4	.4	5	.3
3	17	1.1	10	.5	8	.4	3	.3
4	21	.9	11	.6	8	.3	4	.4
5	14	1.4	11	.6	--	--	7	.4
Total/average	83	1.1	54	.6	35	.4	22	.4

APPENDIX C-1-b (continued 13)

TRANSECT STUDY

CURECANTI RESERVOIRS BASINS
Gunnison River

T 49 N, R 4 W
Sec. 35
Size: 100 x 4 ft. = 400 ft.
Team: Ranck & Reynolds, Unit: 3a, July 14, 1961
Locality: West of Red Creek, RM 45.2L, Veg. type: Sagebrush

TRANSECT NO. 13
Overlay No. 11
Map No. 3-8
Alt. 7500 ft.

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Chrysotham. depressus		Oryzopsis hymenoides		Stipa lettermani		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	58	14.5	22	5.5	1	.3	18	4.5	99	25	21
2	70	17.5	28	7.0	--	--	28	7.0	126	32	26
3	80	20.0	34	8.5	--	--	24	6.0	138	34	30
4	44	11.0	21	5.3	4	1.0	14	3.5	83	20	20
5	41	10.3	19	4.8	2	.5	12	3.0	74	19	20
TOTALS	293	14.7	124	6.2	7	.4	96	4.8	520	26	23

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Chrysotham. depressus		Oryzopsis hymenoides		Stipa lettermani		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	59	65	22	23	1	2	18	10	100	100
2	56	58	22	23	--	2	22	17	100	100
3	58	58	25	23	--	2	17	17	100	100
4	53	60	25	23	5	2	17	15	100	100
5	55	60	26	22	3	3	16	15	100	100
Average	56	65	24	23	1	2	19	10	100	100

C. FOLIAGE HEIGHTS OF VEGETATION

Strip	Artemisia tridentata		Chrysothamnus depressus		Oryzopsis hymenoides		Stipa lettermani	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	17	1.2	15	.5	1	.8	11	.6
2	18	1.3	16	.5	--	--	11	.6
3	19	1.2	12	.5	--	--	9	.6
4	18	1.0	13	.4	5	.7	11	.6
5	18	1.0	13	.4	2	.7	11	.6
Total/average	90	1.1	69	.5	8	.7	53	.6

APPENDIX C-1-b (continued 14)

TRANSECT STUDY

CURECANTI RESERVOIR BASINS
Gunnison River

T 49 N, R 4 W
Sec. 35
Size: 100 x 4 ft.= 400 ft.
Team: Hall & Argyle, Unit: 3d, July 14, 1961
Locality: West of Red Creek, RM 45.2L, Veg. type: Sagebrush

TRANSECT NO. 14
Overlay No. 12
Map No. 3-8
Alt. 7500 ft.

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Chrysotham. depressus		Stipa lettermani*		Agropyron smithii		Others		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	109	27.3	19	4.8	6	1.5	--	--	17	4.3	151	38	40
2	124	31.0	27	6.8	21	5.3	18	4.5	--	--	190	48	45
3	149	37.3	21	5.3	17	4.3	5	1.3	2	.5	194	49	45
4	87	21.8	57	14.3	17	4.3	28	7.0	3	.8	192	48	50
5	73	18.3	49	12.3	14	3.5	9	2.3	1	.3	146	37	35
TOTALS	542	27.1	173	8.7	75	3.8	60	3.0	23	1.2	873	44	38

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Chrysotham. depressus		Stipa lettermani*		Agropyron smithii		Others		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	72	80	13	10	4	5	--	--	11	5	100	100
2	66	70	14	10	11	10	9	10	--	--	100	100
3	77	80	11	8	9	8	2	4	1	--	100	100
4	45	60	30	20	9	10	15	10	1	--	100	100
5	50	50	33	40	10	5	6	5	1	--	100	100
Average	62	70	20	10	9	10	7	5	2	5	100	100

C. FOLIAGE HEIGHTS OF VEGETATION

Strip	Artemisia tridentata		Chrysothamnus depressus		Stipa lettermani*		Agropyron smithii	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	27	1.8	13	.5	5	1.0	--	--
2	27	1.6	16	.5	14	.9	14	.9
3	24	1.5	10	.4	11	.8	4	.9
4	18	2.5	14	.5	8	.7	5	1.0
5	19	1.7	17	.5	5	.8	4	1.5
Total/average	115	1.8	70	.5	43	.8	27	1.0

* and related species

APPENDIX C-1-b (continued 15)

TRANSECT STUDY

CURECANTI RESERVOIRS BASINS
Gunnison River

T 49 N, R 4 W
Sec. 35
Size: 100 x 4 ft. = 400 ft.
Team: Stock & Lamborn, Unit: 3d, July 14, 1961
Locality: West of Red Creek, RM 45.1L, Veg. type: Sagebrush

TRANSECT NO. 15
Overlay No. 12
Map No. 3-8
Alt. 7500 ft.

A. AREA COVERED BY VEGETATION

Strip	Artemisia tridentata		Chrysotham. depressus		Stipa lettermani		Sitanion hystrix		Totals		
No.	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Sq.ft.	%	Est.
1	49	12.3	8	2.0	3	.8	3	.8	63	16	16
2	44	11.0	7	1.8	3	.8	3	.8	57	14	13
3	58	14.5	9	2.3	3	.8	3	.8	73	18	16
4	53	13.3	7	1.8	3	.8	3	.8	66	17	17
5	60	15.0	14	3.5	3	.8	3	.8	80	20	19
	264	13.2	45	2.3	15	.8	15	.8	339	17	17

B. SPECIES PERCENTAGE OF VEGETATION COVER

Strip	Artemisia tridentata		Chrysotham. depressus		Stipa lettermani		Sitanion hystrix		Totals	
No.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.	Meas.	Est.
1	78	75	12	15	5	5	5	5	100	100
2	77	80	13	11	5	4	5	5	100	100
3	80	76	12	15	4	5	4	4	100	100
4	80	80	10	12	5	4	5	4	100	100
5	75	75	17	15	4	5	4	5	100	100
Average	78	75	14	15	4	5	4	5	100	100

C. FOLIAGE HEIGHTS OF VEGETATION

Strip	Artemisia tridentata		Chrysothamnus depressus		Stipa lettermani		Sitanion hystrix	
No.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.	Nos.	Ave.ht.
1	34	.9	1	.3	1	.4	1	.4
2	34	.8	1	.3	1	.3	1	.3
3	36	1.1	1	.3	1	.4	1	.4
4	28	1.2	1	.3	1	.4	1	.4
5	31	1.3	1	.3	1	.4	1	.4
Total/aver.	163	1.1	5	.3	5	.4	5	.4

APPENDIX C-1-c

COMPARISON OF ESTIMATES AND TRANSECTS

Summary comparison of vegetation covereage made by Ocular Estimates (E) and measured strip Transects (T).

Trans. No.	Map No.	General locality Sec.	T	R	River mile	Vegetation type	No. of species	Average E %	Average T %	Average Differ.	Team
1	1-48	32	49	2	56.6	Sagebrush	5	15	16	- 1	3
2	1-48	31	49	2	56.4	Sagebrush	6	18	18	0	2
3	1-48	32	49	2	56.2	Sagebrush	7	22	27	- 5	1
4	3-10	28	49	3	50.2	Sagebrush	7	16	16	0	3
5	1-10	28	49	3	50.2	Sagebrush	6	25	28	- 3	2
6	1-10	28	49	3	50.2	Sagebrush	5	27	32	- 5	1
7	3-10	33	49	3	49.0	Sagebrush	5	28	28	0	1
8	3-10	29	49	3	49.0	Sagebrush	4	16	18	- 2	3
9	3-10	29	49	3	48.9	Sagebrush	4	16	22	- 6	2
10	3-10	25	49	4	46.8	Sagebrush	4	27	18	+ 9	3
11	3-9	25	49	4	46.8	Sagebrush	15	28	37	- 9	1
12	3-9	25	49	4	46.8	Sagebrush	4	17	20	- 3	2
13	3-8	35	49	4	45.2	Sagebrush	4	23	26	- 6	2
14	3-8	35	49	4	45.2	Sagebrush	6	38	44	- 6	1
15	3-8	35	49	4	45.1	Sagebrush	4	17	17	0	3
						TOTAL AVERAGE		22	24	- 2	

APPENDIX C-2

QUADRAT TABULATIONS

The following is a list of plants that appear in the quadrats. Each is given a number to be used as a code number. If more than one plant of one species appears on a quadrat, they are given letters following their number to designate each individual, thus 6a, 6b, 6c, etc. generally in sequence.

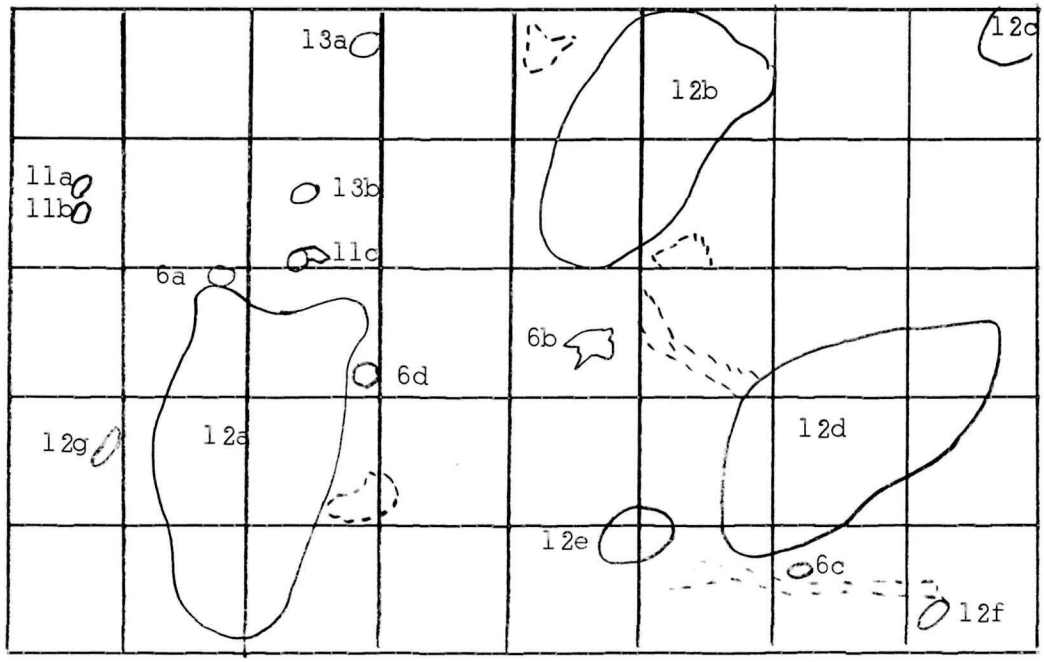
1. Tortula ruralis
2. Agropyron smithii
3. Aristida fendleriana
4. Hilaria jamesii
5. Oryzopsis hymenoides
6. Sitanion hystrix
7. Stipa comata
8. Stipa lettermani
9. Cercocarpus montanus
10. Opuntia hystriciana
11. Phlox caespitosa
12. Artemisia tridentata
13. Chrysothamnus depressus
14. Chrysothamnus viscidiflorus
15. Erigeron
16. Gutierrezia sarothrae
17. Small herbs

Quadrat No. 1

APPENDIX C-2-b

QUADRAT STUDY

T 49 N, R 2 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 1
Sec. 32 — Gunnison River — Overlay No. 6
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 1-48
Team: Stock & Lamborn, Unit: 3d, June 5, 1961 — Alt. 7480 ft.
Locality: North Willow Creek, RM 56.6L, Veg. type: Sagebrush

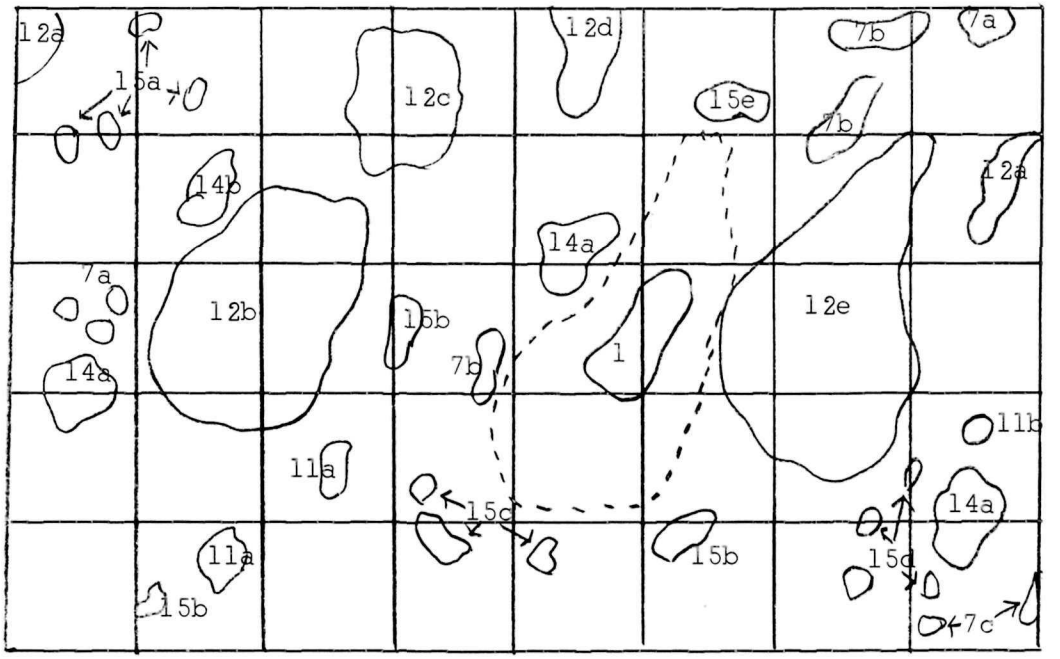


No. Species	Ht.	Mat-urity	Foliage Ht.	Diam.	Area	%	Compacted Diam.	Area	%
6a Sitanion hystrix	.3	60	.3	.2	.04		.2	.04	
6b	.4	60	.4	.2	.04		.2	.04	
6c	.1	60	.1	.3	.09		.3	.09	
6d	.3	60	.3	.2	.04		.2	.04	
Total or average	.3	60	.3	.2	.21	.5	.2	.21	.5
11a Phlox caespitosa	.1	90	.1	.2	.04		.2	.04	
11b	.1	90	.1	.1	.01		.1	.01	
11c	.1	90	.1	.3	.09		.3	.09	
Total or average	.1	90	.1	.2	.14	.4	.2	.14	.4
12a Artemisia tridentata	1.8	90	.9	2.4	3.68		2.0	4.0	
12b	1.8	90	1.1	1.6	2.76		1.3	1.8	
12c	.8	20	.7	.5	.25		.4	.16	
12d	1.8	80	.9	1.7	2.85		1.4	1.96	
12e	.8	30	.6	.7	.49		.5	.25	
12f	.5	20	.3	.6	.36		.4	.16	
12g	.7	20	.6	.4	.16		.4	.16	
Total or average	1.2	50	.7	1.1	10.55	26.4	.9	8.49	21.2
13a Chrysothamnus depressus	.4	45	.4	.3	.09		.3	.09	
13b	.3	45	.3	.1	.01		.1	.01	
Total or average	.4	45	.4	.2	.10	.3	.2	.10	.3
TOTAL OR AVERAGE	.6	59	.5	.6	11.00	27.5	.5	8.94	22.4

APPENDIX C-2-b (continued 2)

QUADRAT STUDY

T 49 N, R 2 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 2
Sec. 31 — Gunnison River — Overlay No. 6
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 1-48
Team: Ranck & Reynolds, Unit: 3d, July 5, 1961 — Alt. 7460 ft.
Locality: Near North Willow, RM 56.4L, Veg. type: Sagebrush



No.	Species	Ht.	Maturity	Foliage Ht.	Foliage Diam.	Foliage Area	Foliage %	Compacted Diam.	Compacted Area	Compacted %
1	Tortula ruralis	.2	100	.2	.6	.47	1.2	.5	.3	.8
7a	Stipa comata	.5	100	.5	.4	.2		.3	.2	
7b		.5	100	.5	.5	.6		.4	.2	
7c		.5	100	.5	.6	.5		.5	.3	
	Total or average	.5	100	.5	.5	1.3	3.3	.4	.7	1.2
11a	Phlox caespitosa	.2	100	.2	.5	.4		.4	.2	
11b		.2	100	.2	.3	.1		.2	--	
	Total or average	.2	100	.2	.4	.5	1.3	.3	.2	.5
12a	Artemisia tridentata	.5	15	.4	.3	.2		.2	.1	
12b		1.8	100	1.7	.9	.7		.7	.5	
12c		1.4	50	1.0	.8	.5		.7	.5	
12d		.9	25	.6	.5	.3		.4	.1	
12e		1.8	90	1.5	1.4	2.0		1.2	1.5	
	Total or average	1.1	49	.9	.7	3.7	9.3	.6	2.7	6.8
14a	Chrysothamnus viscidiflorus	.7	65	.7	.6	1.4		.5	.9	
14b		.5	65	.5	.5	.3		.4	.1	
	Total or average	.6	65	.6	.6	1.7	4.3	.5	1.0	2.5
15a	Erigeron	.3	100	.3	.5	.3		.4	.1	
15b		.3	100	.3	.4	.3		.3	.3	
15c		.3	100	.3	.6	.3		.5	.3	
15d		.3	100	.3	.6	.5		.5	.3	
15e		.3	100	.3	.7	.5		.6	.5	
	Total or average	.3	100	.3	.5	1.9	4.8	.4	1.5	3.8
	TOTAL OR AVERAGE	.6	82	.5	.5	9.6	24.0	.4	6.5	16.3

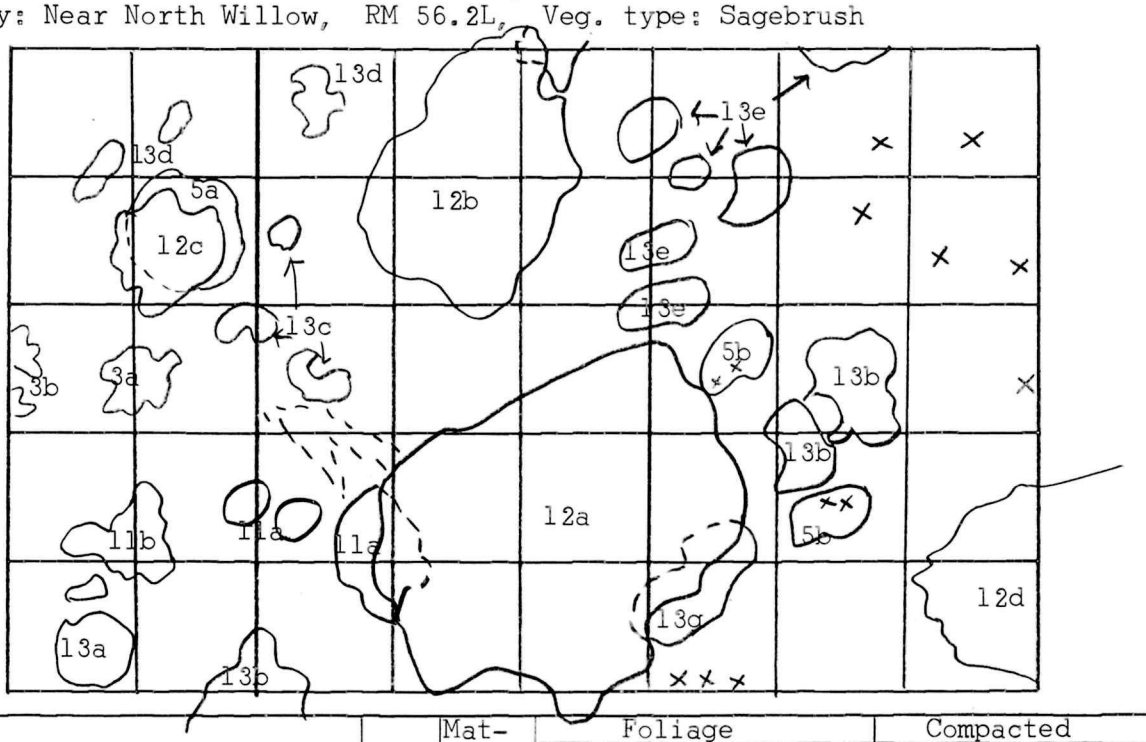
Quadrat No. 2

Quadrat No. 3

APPENDIX C-2-b (continued 3)

QUADRAT STUDY

T 49 N, R 2 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 3
Sec. 32 — Gunnison River — Overlay No. 6
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 1-48
Team: Hall & Argyle, Unit: 3d, July 5, 1961 — Alt. 7480 ft.
Locality: Near North Willow, RM 56.2L, Veg. type: Sagebrush

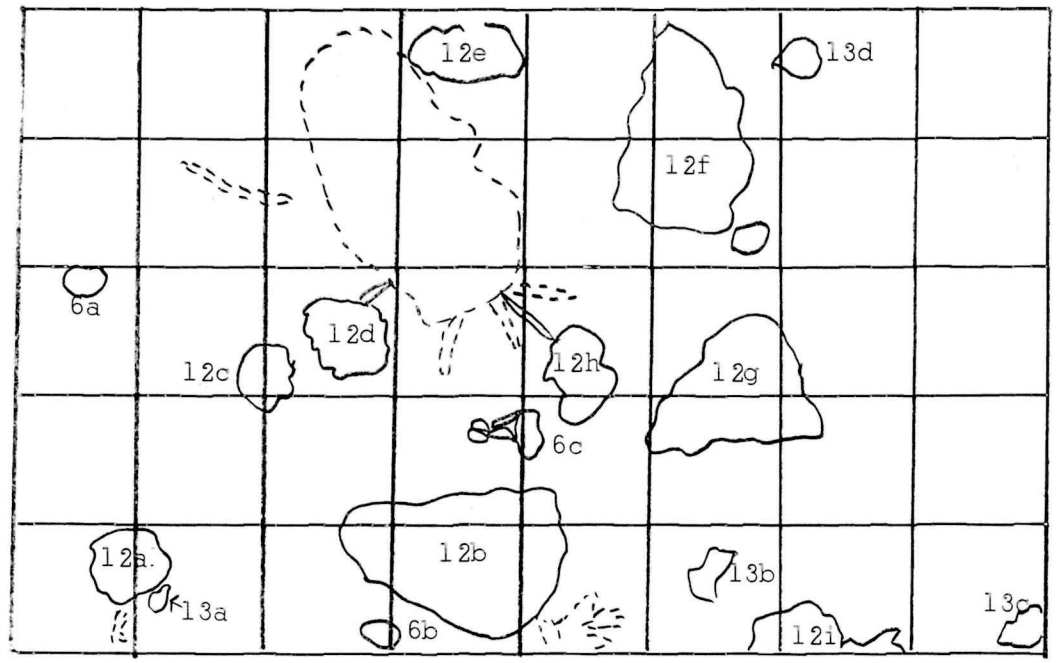


Nos. Species	Ht.	Mat-urity	Foliage Ht.	Foliage Diam.	Foliage Area	Foliage %	Compacted Diam.	Compacted Area	Compacted %
3a Aristida fendleriana	.2	90	.2	.5	.2		.5	.2	
3b	.2	90	.2	.2	.03		.2	.03	
Total or average	.2	90	.2	.4	.23	.6	.4	.23	.6
5a Oryzopsis hymenoides	1.4	90	1.4	.8	.5		.2	.03	
5b	.6	90	.6	.6	.29		.2	.03	
Total or average	1.0	90	1.0	.7	.79	2.0	.2	.06	.1
11a Phlox caespitosa	.2	90	.2	.6	.29		.6	.29	
11b	.2	90	.2	.3	.07		.3	.07	
Total or average	.2	90	.2	.5	.36	.9	.5	.36	.9
12a Artemisia tridentata	1.7	90	1.4	2.5	4.9		1.7	2.26	
12b	1.6	90	1.2	1.5	1.76		1.0	.79	
12c	1.2	90	.9	.8	.5		.6	.29	
12d	1.9	90	1.9	.9	.65		.6	.29	
Total or average	1.6	90	1.4	1.4	7.8	19.5	1.0	3.63	9.1
13a Chrysothamnus depressus	.4	90	.3	.5	.2		.3	.05	
13b	.4	80	.3	.2	.03		.1	.01	
13c	.5	70	.4	.4	.16		.2	.03	
13d	.4	80	.3	.3	.07		.2	.02	
13e	.3	80	.2	.9	.65		.5	.16	
13f	.5	90	.4	.4	.16		.2	.03	
13g	.4	90	.3	.6	.29		.3	.07	
Total or average	.4	83	.3	.5	1.56	3.9	.3	.37	.9
x Some grass sprigs									
TOTAL OR AVERAGE	.7	87	.6	.7	10.74	26.9	.5	4.65	11.6

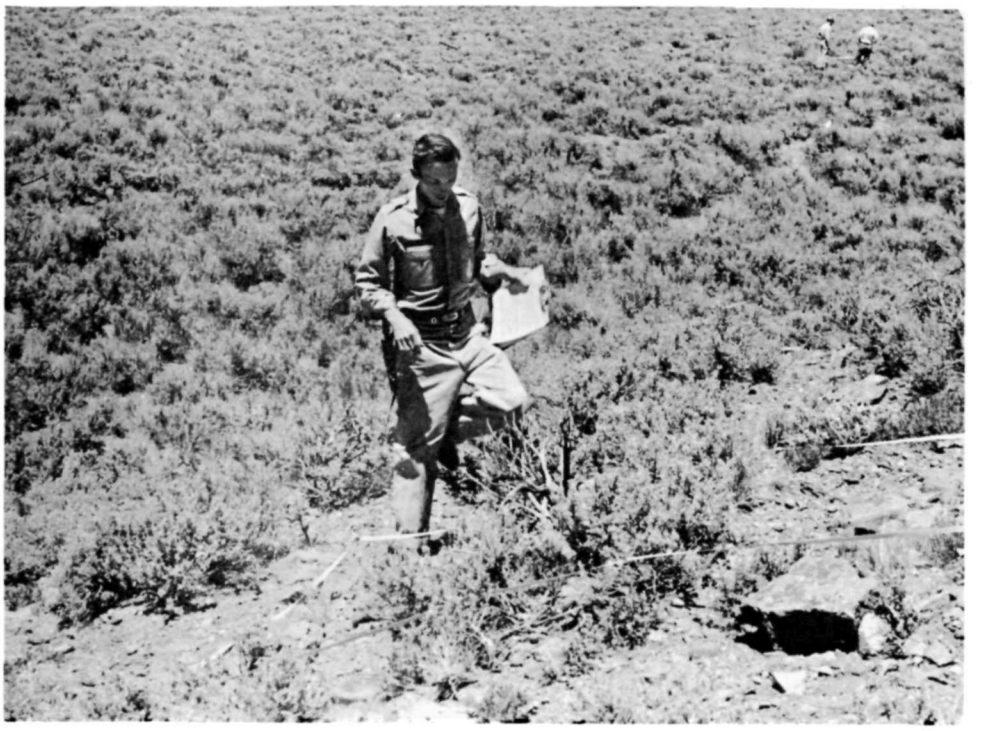
APPENDIX C-2-b (continued 4)

QUADRAT STUDY

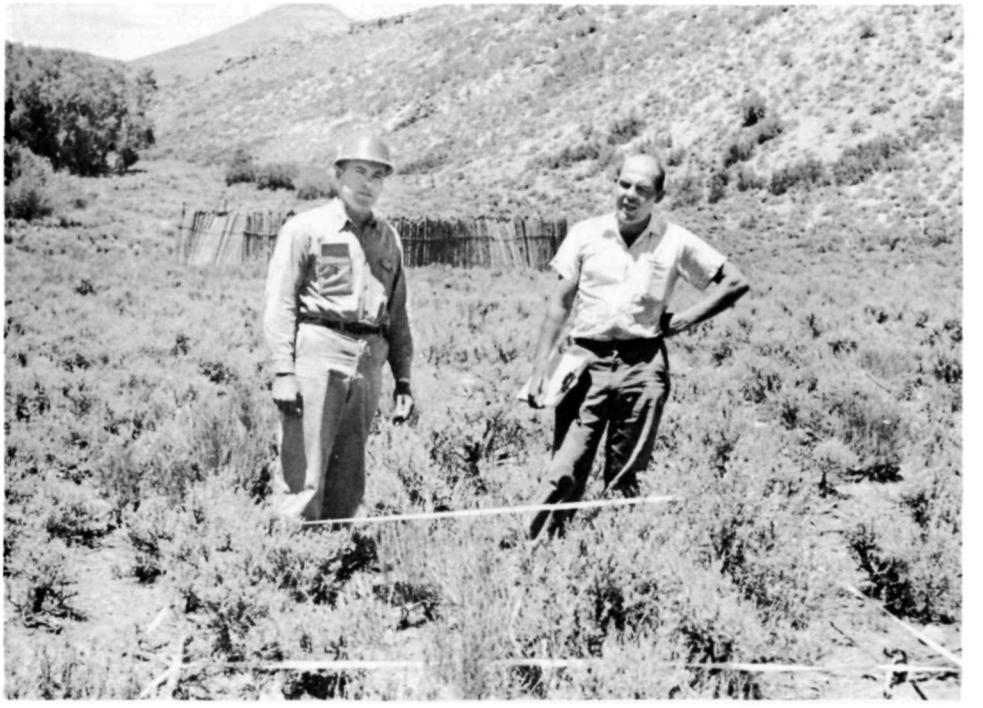
T 49 N, R 3 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 4
Sec. 28 — Gunnison River — Overlay No. 9
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 1-10
Team: Stock & Lamborn, Unit: 2a, July 5, 1961 — Alt. 7515 ft.
Locality: Dry Gulch, west slope, RM 50.2R, Veg. type: Sagebrush



No.	Species	Ht.	Maturity	Foliage Ht.	Foliage Diam.	Foliage Area	Foliage %	Compacted Diam.	Compacted Area	Compacted %
6a	Sitanion hystrix	.6	100	.6	.4	.16		.4	.16	
6b		.3	80	.3	.2	.04		.2	.04	
6c		.3	75	.3	.3	.09		.2	.04	
6d		.5	75	.5	.4	.16		.4	.16	
	Total or average	.4	83	.4	.3	.45	1.1	.3	.40	1.0
12a	Artemisia tridentata	1.0	60	.5	.5	.25		.5	.25	
12b		1.1	75	.6	1.2	1.44		1.0	1.0	
12c		.8	40	.6	.7	.49		.5	.25	
12d		.8	100	.6	.7	.49		.6	.36	
12e		1.1	100	.6	.5	.25		.5	.25	
12f		.9	75	.6	1.3	1.69		1.0	1.0	
12g		1.1	80	.9	1.3	1.69		1.0	1.0	
12h		.9	100	.5	.6	.36		.5	.25	
12i		.6	30	.4	.8	.64		.7	.49	
	Total or average	.9	73	.6	.8	7.30	18.3	.7	4.85	12.1
13a	Chrysothamnus depressus	.5	75	.4	.4	.16		.3	.09	
13b		.6	75	.5	.6	.36		.5	.25	
13c		.4	77	.4	.7	.49		.6	.36	
13d		.4	75	.4	.5	.25		.4	.16	
	Total or average	.5	75	.4	.6	1.26	3.1	.5	.86	2.2
	TOTAL OR AVERAGE	.7	76	.5	.7	9.01	22.5	.5	6.11	15.3



Quadrat No. 4

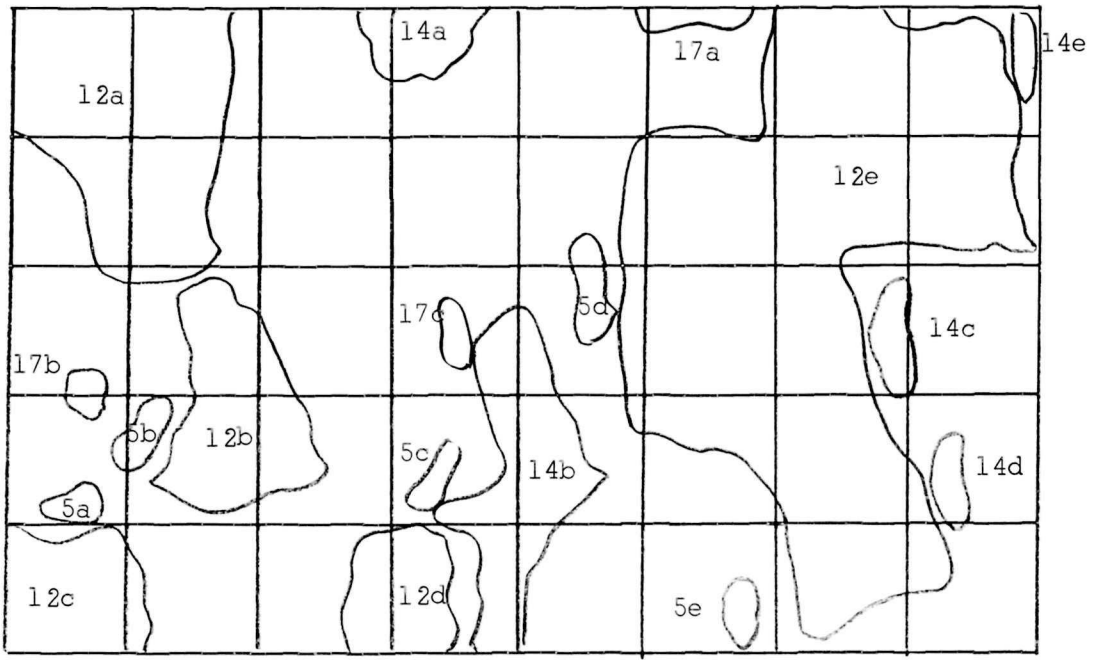


Quadrat No. 5

APPENDIX C-2-b (continued 5)

QUADRAT STUDY

T 49 N, R 3 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 5
Sec. 28 — Gunnison River — Overlay No. 9
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 1-10
Team: Ranck & Reynolds, Unit: 2a, July 5, 1961 — Alt. 7510 ft.
Locality: Dry Gulch, RM 50.2R, Veg. type: Sagebrush

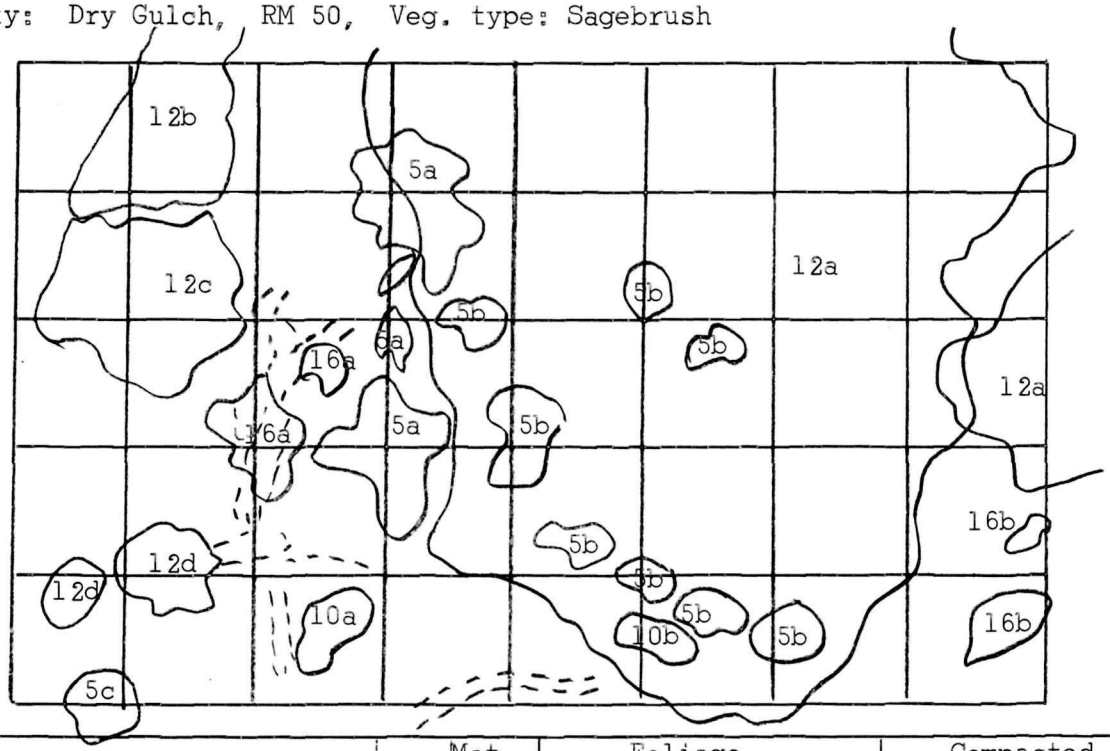


No. Species	Ht.	Mat-urity	Foliage Ht.	Diam.	Area	%	Compacted Diam.	Area	%
5a Oryzopsis hymenoides	.4	100	.4	.3	.06		.2	.03	
5b	.3	100	.3	.4	.12		.3	.06	
5c	.4	100	.4	.3	.06		.2	.03	
5d	.5	100	.4	.5	.2		.4	.12	
5e	.4	100	.4	.3	.06		.2	.03	
Total or average	.4	100	.4	.4	.50	1.3	.3	.27	.7
12a Artemisia tridentata	1.1	90	.8	2.0	3.1		1.5	1.9	
12b	.9	90	.5	1.0	.8		.6	.3	
12c	1.2	100	.8	.9	.75		.7	.5	
12d	.7	60	.5	1.0	.8		.8	.5	
12e	1.4	100	.9	4.0	12.4		3.0	6.2	
Total or average	1.1	88	.7	1.8	17.85	44.6	1.3	9.4	23.5
14a Chrysothamnus viscidiflorus	1.3	60	1.0	.5	.2		.4	.12	
14b	1.7	100	1.3	2.0	3.1		1.3	1.5	
14c	.6	50	.4	.4	.12		.3	.06	
14d	.6	50	.4	.5	.2		.3	.06	
14e	.4	100	.4	.3	.06		.2	.03	
Total or average	.9	72	.7	.7	3.68	9.2	.5	1.77	4.4
17a Small herbs	.9	100	.8	.4	.12		.3	.06	
17b	.3	100	.3	.3	.06		.2	.03	
17c	.3	100	.3	.2	.03		.1	.1	
Total or average	.5	100	.5	.3	.21	.5	.2	.19	.5
TOTAL OR AVERAGE	.7	89	.6	.9	22.24	55.6	.6	11.63	29.1

APPENDIX C-2-b (continued 5)

QUADRAT STUDY

T 49 N, R 3 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 6
Sec. 28 — Gunnison River — Overlay No. 9
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 1-10
Team: Hall & Argyle, Unit: 3a, July 5, 1961 — Alt. 7515 ft.
Locality: Dry Gulch, RM 50, Veg. type: Sagebrush



No.	Species	Ht.	Maturity	Foliage Ht.	Foliage Diam.	Foliage Area	Foliage %	Compacted Diam.	Compacted Area	Compacted %
5a	Oryzopsis hymenoides	.9	90	.9	.8	.5		.4	.16	
5b		.7	90	.7	1.0	.79		.3	.07	
5c		.4	90	.4	.4	.16		.2	.03	
	Total or average	.7	90	.7	.7	1.45	3.6	.3	.26	.7
10a	Opuntia hystricina	.2	80	.2	.4	.16		.3	.03	
10b		.2	80	.2	.3	.07		.3	.07	
	Total or average	.2	80	.2	.4	.23	.6	.3	.10	.3
12a	Artemisia tridentata	2.0	90	1.6	4.6	15.8		3.5	9.6	
12b		.9	90	.9	1.0	.79		.7	.39	
12c		1.1	90	1.0	1.5	1.76		1.0	.8	
12d		.5	95	.3	.6	.29		.3	.07	
	Total or average	1.1	91	1.0	1.0	18.64	46.6	1.4	10.86	27.2
16a	Gutierrezia sarothrae	.5	90	.4	.4	.16		.2	.03	
16b		.3	60	.2	.4	.16		.2	.03	
	Total or average	.4	75	.3	.4	.32	.8	.2	.06	--
	TOTAL OR AVERAGE	.8	86	.6	1.0	20.64	51.6	.7	11.28	28.2

Some dead branches of Artemisia and much leaves and dead grass.

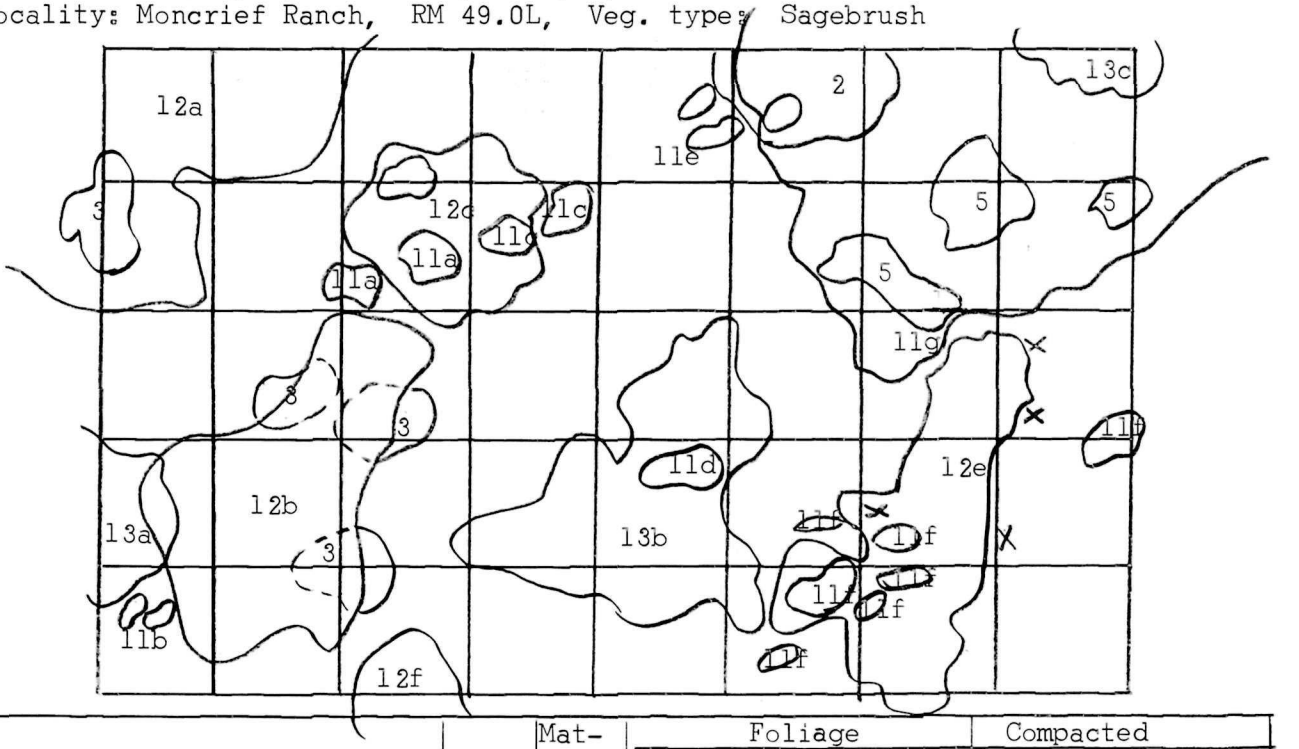
Quadrat No. 6

Quadrat No. 7

APPENDIX C-2-b (continued 6)

QUADRAT STUDY

49 N, R 3 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 7
Sec. 29 — Gunnison River — Overlay No. 9
Size: 8 x 5 ft. = 40 sq. ft. — Map No. 3-10
Team: Hall & Argyle, Unit: 3c, July 7, 1961 — Alt. 7400 ft.
Locality: Moncrief Ranch, RM 49.0L, Veg. type: Sagebrush

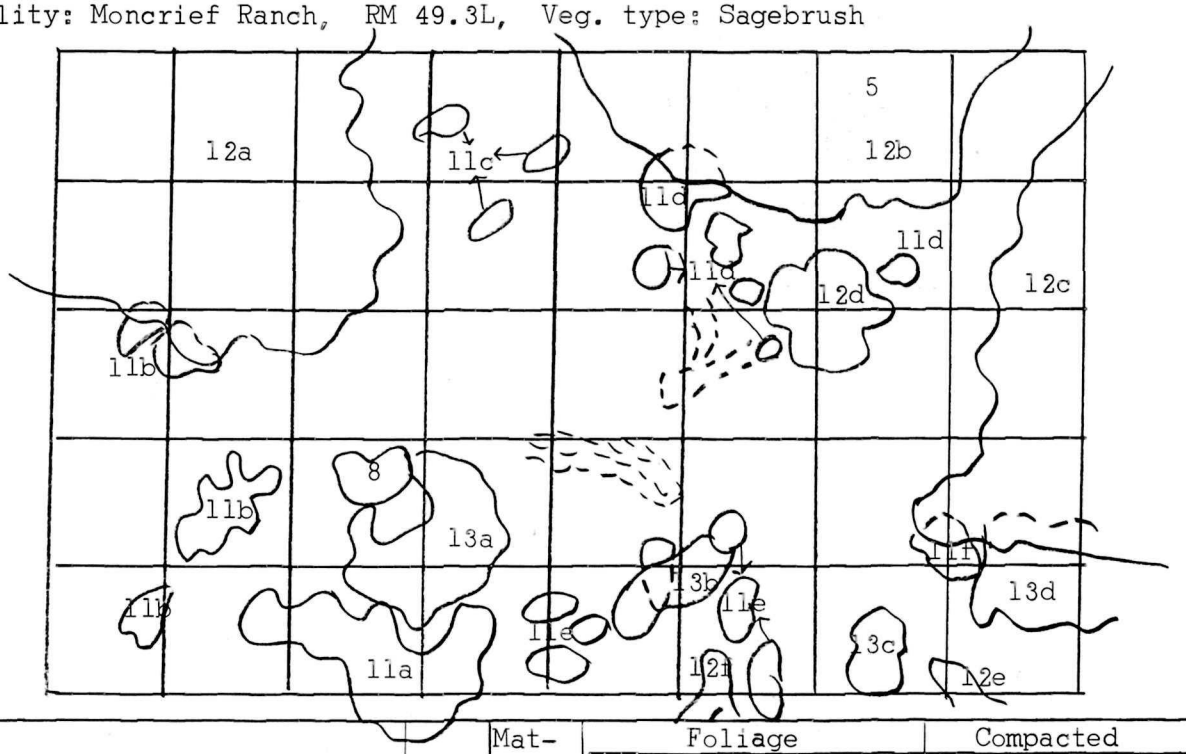


No.	Species	Ht.	Maturity	Foliage Ht.	Foliage Diam.	Foliage Area	Foliage %	Compacted Diam.	Compacted Area	Compacted %
2	Agropyron smithii	.9	80	.9	.8	.5	1.3	.2	.03	.1
3	Aristida fendleriana	1.2	85	1.2	.9	.63	1.6	.3	.07	--
5	Oryzopsis hymenoides	1.1	80	1.1	.8	.5	1.3	.2	.03	.1
11a	Phlox caespitosa	.2	90	.2	.7	.38		.4	.13	
11b		.2	90	.2	.2	.03		.1	.01	
11c		.2	90	.2	.7	.38		.4	.13	
11d		.2	90	.2	1.2	1.13		.7	.38	
11e		.2	90	.2	.9	.63		.5	.2	
11f		.2	90	.2	1.0	.78		.5	.2	
11g		.2	90	.2	1.2	1.13		.6	.28	
	Total or average	.2	90	.2	.8	4.46	11.2	.5	1.33	3.3
12a	Artemisia tridentata	2.4	95	2.1	1.8	2.55		1.2	1.13	
12b		1.5	90	1.0	2.4	4.52		2.0	3.14	
12c		1.9	80	.9	1.3	1.31		.9	.63	
12d		1.7	90	1.1	2.5	4.9		2.0	3.14	
12e		1.3	95	1.0	2.0	3.14		1.5	1.76	
12f		.9	95	.9	.7	.38		.4	.13	
	Total or average	1.6	86	1.2	1.8	16.80	42.0	1.3	9.93	24.8
13a	Chrysothamnus depressus	.8	90	.8	.8	.5		.4	.13	
13b		.6	90	.5	.2	.03		.1	.01	
13c		.4	90	.4	.3	.07		.1	.01	
	Total or average	.6	90	.6	.4	.60	1.5	.2	.15	.4
	TOTAL OR AVERAGE	.8	89	.7	1.1	23.49	58.7	.7	11.54	28.9

APPENDIX C-2-b (continued 7a)

QUADRAT STUDY

T 49 N, R 3 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 7a
Sec. 33 — Gunnison River — Overlay No. 9
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 3-10
Team: Hall & Argyle, Unit 3c, July 10, 1961 — Alt. 7460 ft.
Locality: Moncrief Ranch, RM 49.3L, Veg. type: Sagebrush



No.	Species	Ht.	Mat-urity	Foliage Ht.	Foliage Diam.	Foliage Area	Foliage %	Compacted Diam.	Compacted Area	Compacted %
5	Oryzopsis hymenoides	.5	80	.5	.1	.01	--	.1	.01	--
8	Stipa lettermani	.7	80	.7	.5	.2	.1	.3	.07	--
11a	Phlox caespitosa	.2	90	.2	.9	.64		.9	.64	
11b		.3	90	.3	.7	.38		.7	.38	
11c		.2	90	.2	.3	.07		.3	.07	
11d		.3	90	.3	.8	.5		.8	.5	
11e		.2	90	.2	1.0	.79		.9	.64	
11f		.2	90	.2	.4	.13		.4	.13	
	Total or average	.2	90	.2	.7	2.51	6.3	.7	2.36	5.9
12a	Artemisia tridentata	2.2	90	1.6	2.1	4.95		1.8	2.54	
12b		1.9	90	1.2	2.0	3.14		1.7	2.26	
12c		1.8	90	.8	1.8	2.54		1.4	1.58	
12d		1.5	80	1.0	.9	.64		.7	.38	
12e		.7	40	.3	.2	.03		.1	.01	
12f		1.0	80	.5	.4	.13		.3	.07	
	Total or average	1.5	78	.9	1.2	11.43	28.6	1.0	6.79	17.0
13a	Chrysothamnus depressus	.4	60	.4	1.0	.79		.8	.5	
13b		.2	50	.2	.4	.13		.3	.07	
13c		.2	50	.2	.4	.13		.3	.07	
13d		.5	70	.4	.8	.5		.6	.28	
	Total or average	.3	58	.3	.7	1.55	3.9	.5	.92	2.3
	TOTAL OR AVERAGE	.7	78	.5	.8	15.70	39.3	.7	10.15	25.4

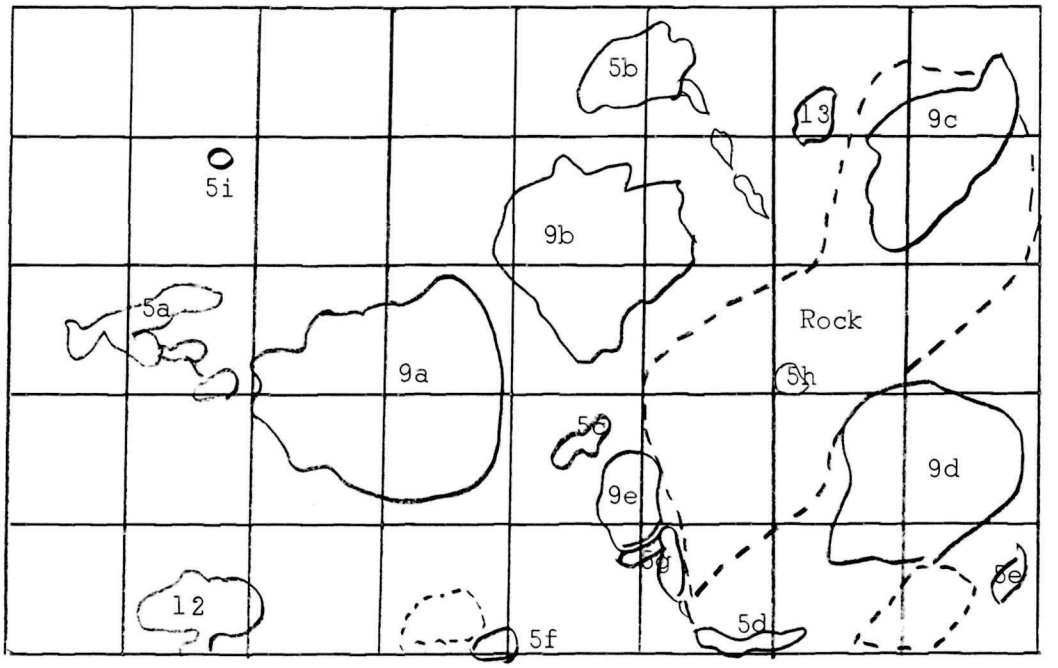
Quadrat No. 7a

Quadrat No. 8

APPENDIX C-2-b (continued 8)

QUADRAT STUDY

T 49 N, R 3 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 8
Sec. 29-28 — Gunnison River — Overlay No. 9
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 3-10
Team: Stock & Lamborn, Unit 3b, July 7, 1961 — Alt. 7500 ft.
Locality: Near Moncrief Ranch, RM 49L, Veg type: Sagebrush

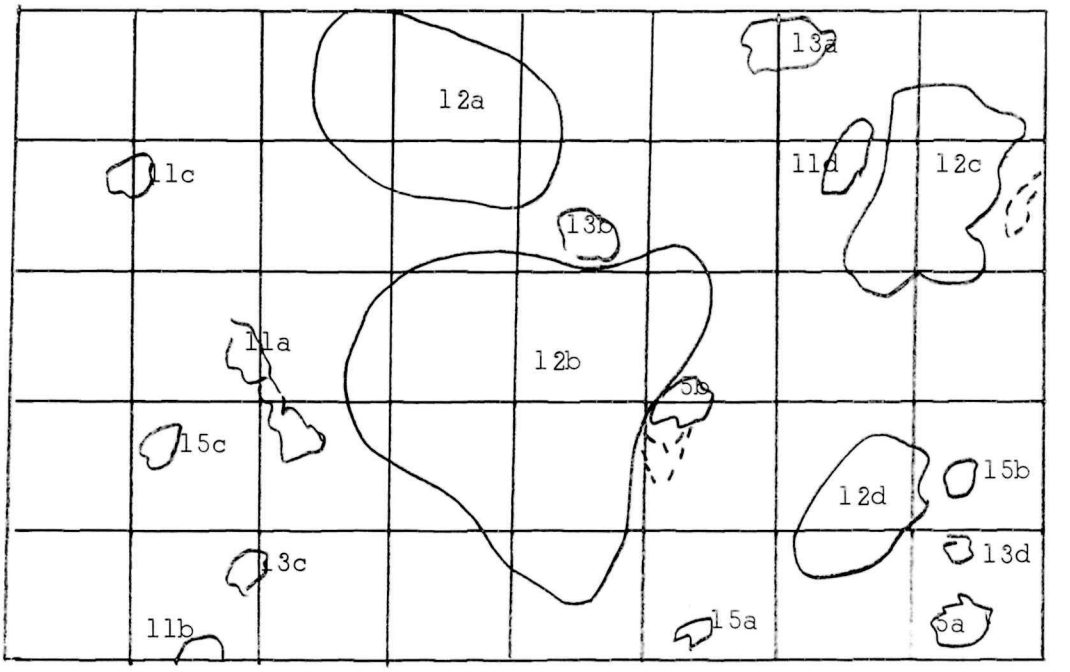


No.	Species	Ht.	Maturity	Foliage Ht.	Foliage Diam.	Foliage Area	Foliage %	Compacted Diam.	Compacted Area	Compacted %
5a	Oryzopsis hymenoides	.6	75	.6	.6	.30		.6	.30	
5b		.8	100	.8	.9	.72		.9	.72	
5c		.6	90	.6	.3	.08		.3	.08	
5d		.5	100	.5	.5	.20		.5	.20	
5e		.7	100	.7	.5	.20		.5	.20	
5f		.5	80	.5	.4	.15		.4	.15	
5g		.4	100	.4	.7	.42		.7	.42	
5h		.3	100	.3	.2	.04		.2	.04	
5i		.4	70	.4	.1	.01		.1	.01	
	Total or average	.5	91	.5	.5	2.12	5.3	.5	2.12	5.3
9a	Cercocarpus montanus	2.2	90	2.2	1.9	3.06		1.3	1.44	
9b		2.0	90	2.0	1.9	3.06		1.3	1.44	
9c		2.4	90	2.4	1.4	1.56		1.0	.72	
9d		1.3	90	1.3	1.5	1.80		1.2	1.21	
9e		2.2	90	2.2	.9	.64		.6	.30	
	Total or average	2.0	90	2.0	1.5	10.12	25.3	1.1	5.11	12.8
12	Artemisia tridentata	.5	75	.5	.9	.72	1.8	.8	.56	1.4
13	Chrysothamnus depressus	.5	40	.5	.5	.20	.5	.4	.12	.3
	TOTAL OR AVERAGE	1.0	86	1.0	.8	13.16	32.9	.7	7.91	19.8

APPENDIX C-2-b (continued 8a)

QUADRAT STUDY

T 49 N, R 3 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 8a
Sec. 29 — Gunnison River — Overlay No. 9
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 3-10
Team: Stock & Lamborn, Unit 3c, July 10, 1961 — Alt. 7430 ft.
Locality: Moncrief Ranch, RM 49.7R, Veg. type: Sagebrush



No.	Species	Ht.	Maturity	Foliage Ht.	Foliage Diam.	Foliage Area	Foliage %	Compacted Diam.	Compacted Area	Compacted %
5a	Oryzopsis hymenoides	.6	90	.6	.3	.08		.3	.08	
5b		.6	90	.6	.3	.08		.3	.08	
	Total or average	.6	90	.6	.3	.16	.4	.3	.16	.4
11a	Phlox caespitosa	.1	100	.1	1.0	1.0		1.0	1.0	
11b		.1	80	.1	.3	.08		.3	.08	
11c		.1	90	.1	.5	.20		.5	.20	
11d		.1	100	.1	1.1	1.0		1.1	1.0	
	Total or average	.1	93	.1	.7	2.28	5.7	.7	2.28	5.7
12a	Artemisia tridentata	1.1	90	1.1	1.4	1.44		1.2	1.21	
12b		1.0	100	.9	2.1	3.80		1.8	1.89	
12c		1.0	80	.9	1.2	1.2		1.0	1.0	
12d		1.0	80	.8	1.1	.9		.9	.81	
	Total or average	1.0	88	.9	1.5	7.34	18.4	1.2	4.91	12.3
13a	Chrysothamnus depressus	.3	100	.3	.7	.43		.6	.30	
13b		.4	90	.4	.6	.43		.6	.36	
13c		.2	70	.2	.3	.09		.3	.09	
13d		.2	50	.2	.2	.04		.2	.04	
	Total or average	.3	78	.3	.5	.99	2.5	.4	.79	2.0
15a	Erigeron	.2	100	.2	.2	.04		.2	.04	
15b		.2	100	.2	.3	.08		.3	.08	
15c		.2	100	.2	.4	.14		.4	.14	
	Total or average	.2	100	.2	.3	.26	.7	.3	.26	.7
	TOTAL OR AVERAGE	.5	88	.4	.7	11.03	27.6	.7	8.40	21.0

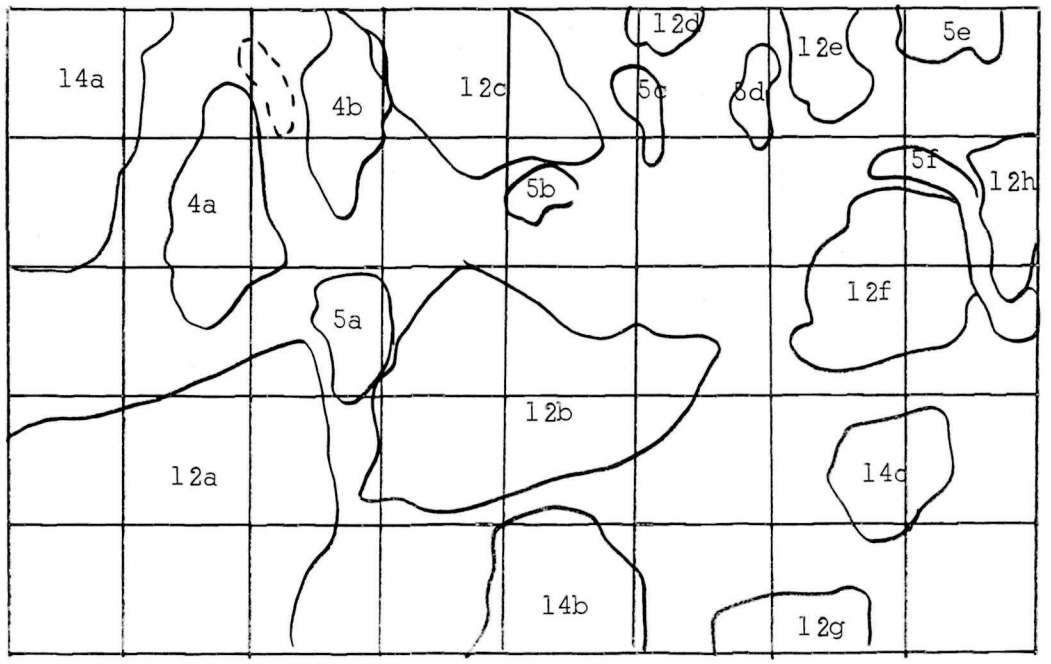
Quadrat No. 8a

Quadrat No. 9

APPENDIX C-2-b (continued 9)

QUADRAT STUDY

T 49 N, R 3 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 9
Sec. 28-29 — Gunnison River — Overlay No. 9
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 3-10
Team: Ranck & Reynolds, Unit 3a, July 7, 1961 — Alt. 7340 ft.
Locality: Near Moncrief Ranch, RM 48.9L, Veg. type: Sagebrush

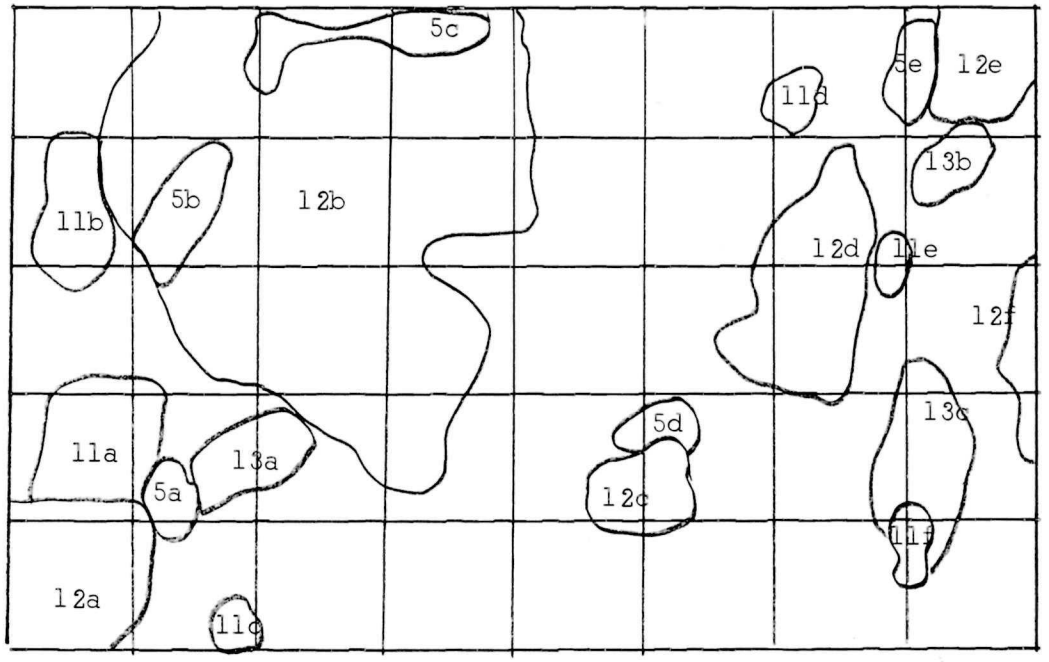


No. Species	Ht.	Mat-urity	Foliage Ht.	Foliage Diam.	Foliage Area	Foliage %	Compacted Diam.	Compacted Area	Compacted %
4a Hilaria jamesii	.5	100	.5	1.5	1.8		1.0	.8	
4b	.5	100	.5	.8	.5		.6	.3	
Total or average	.5	100	.5	1.2	2.3	5.8	.8	1.1	2.8
5a Oryzopsis hymenoides	.4	100	.4	.8	.5		.6	.3	
5b	.5	100	.5	.5	.2		.4	.1	
5c	.5	100	.5	.8	.5		.6	.3	
5d	.6	100	.6	.6	.3		.4	.1	
5e	.8	100	.8	.9	.6		.6	.3	
5f	.7	100	.7	.9	.6		.6	.3	
Total or average	.6	100	.6	.8	2.7	6.8	.5	1.4	3.5
12a Artemisia tridentata	1.0	80	.8	2.0	3.1		1.5	1.8	
12b	.6	70	.4	1.5	1.8		1.0	.8	
12c	.7	75	.5	1.3	1.1		.9	.6	
12d	.7	50	.4	.5	.2		.4	.1	
12e	.9	80	.7	.8	.5		.6	.3	
12f	1.1	80	.9	1.8	2.5		1.5	1.8	
12g	.9	80	.6	.6	.3		.4	.1	
12h	.9	50	.8	.8	.5		.6	.3	
Total or average	.9	71	.6	1.2	10.0	25.0	.9	5.8	14.5
14a Chrysothamnus viscidiflorus	1.5	100	1.2	1.5	1.8		1.0	.8	
14b	1.4	80	1.2	.9	.6		.6	.3	
14c	1.4	80	1.1	.8	.5		.6	.3	
Total or average	1.4	87	1.2	1.1	2.9	7.3	.7	1.4	3.5
TOTAL OR AVERAGE	.8	86	.7	1.0	17.9	44.8	.7	9.7	24.3

APPENDIX C-2-b (continued 9a)

QUADRAT STUDY

T 49 N, R 3 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 9a
Sec. 29 — Gunnison River — Overlay No. 9
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 3-10
Team: Ranck & Reynolds, Unit 3c, July 10, 1961 — Alt. 7420 ft.
Locality: Moncrief Ranch, RM 49.3R, Veg. type: Sagebrush



No.	Species	Ht.	Mat-urity	Foliage Ht.	Diam.	Area	%	Compacted Diam.	Area	%
5a	Oryzopsis hymenoides	.8	100	.8	.4	.1		.3	.07	
5b		.7	100	.7	.6	.3		.4	.1	
5c		.7	100	.7	.7	.4		.5	.2	
5d		.9	100	.9	.4	.1		.3	.07	
5e		1.1	100	1.1	.4	.1		.3	.07	
	Total or average	.8	100	.8	.5	1.0	2.5	.4	.51	1.3
11a	Phlox caespitosa	.3	100	.3	.9	.7		.6	.3	
11b		.3	100	.3	.5	.2		.4	.1	
11c		.3	100	.3	.3	.07		.2	.03	
11d		.3	100	.3	.3	.07		.2	.03	
11e		.3	100	.3	.4	.1		.3	.07	
11f		.3	100	.3	.4	.1		.3	.07	
	Total or average	.3	100	.3	.5	1.24	3.1	.3	.60	1.5
12a	Artemisia tridentata	1.1	90	.7	1.1	1.1		.8	.5	
12b		.9	90	.6	3.0	6.9		2.0	3.1	
12c		.6	60	.4	.6	.3		.4	.1	
12d		1.1	90	.7	1.3	1.2		.9	.7	
12e		1.0	80	.7	.8	.5		.6	.3	
12f		1.0	90	.8	.4	.1		.3	.07	
	Total or average	1.0	83	.7	1.2	10.1	25.3	.8	4.77	11.9
13a	Chrysothamnus depressus	.4	100	.4	.6	.3		.4	.1	
13b		.4	100	.4	.5	.2		.4	.1	
13c		.4	100	.4	1.0	1.0		.8	.5	
	Total or average	.4	100	.4	.7	1.5	3.8	.5	.7	1.8
	TOTAL OR AVERAGE	.6	95	.6	.7	13.84	34.6	.5	6.58	16.5

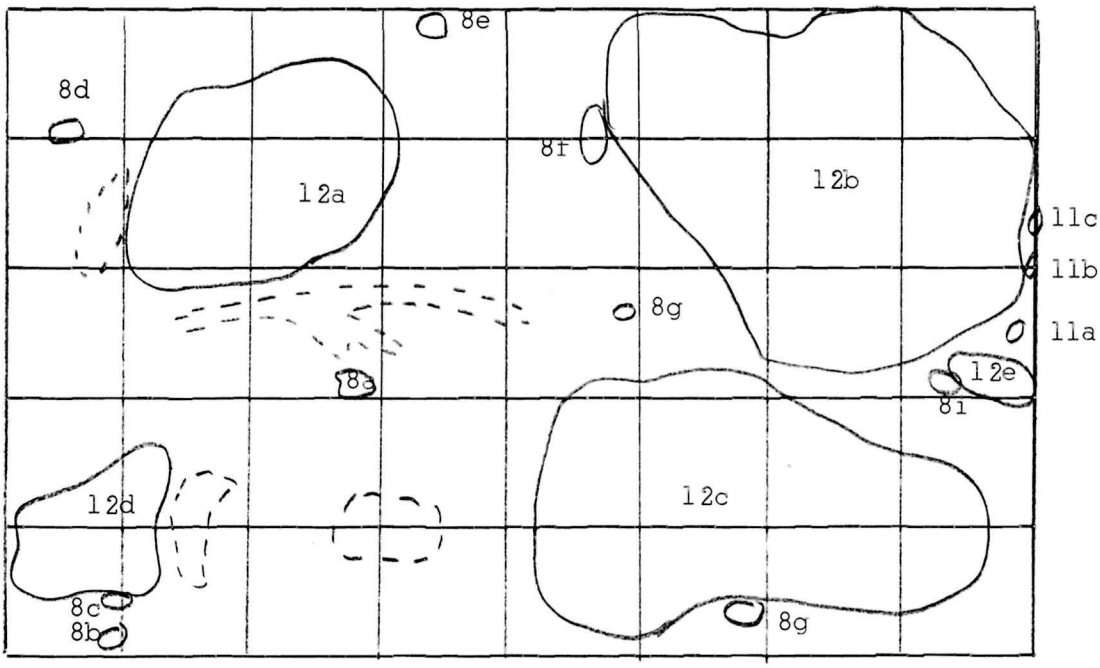
Quadrat No. 9a

Quadrat No. 10

APPENDIX C-2-b (continued 10)

QUADRAT STUDY

T 49 N, R 4 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 10
Sec. 25 — Gunnison River — Overlay No. 10
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 3-9
Team: Stock & Lamborn, Unit 3d, June 29, 1961 — Alt. 7440 ft.
Locality: Near mouth of Red Creek, RM 46.8R, Veg. type: Sagebrush

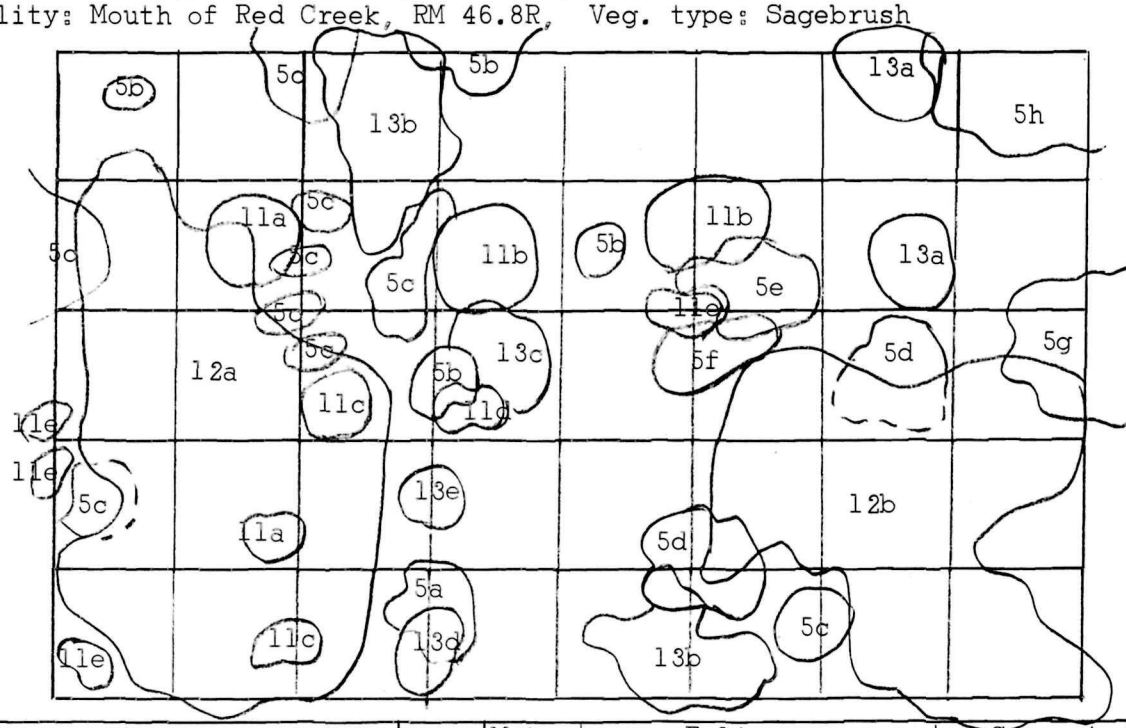


No.	Species	Ht.	Mat-urity	Foliage Ht.	Foliage Diam.	Foliage Area	Foliage %	Compacted Diam.	Compacted Area	Compacted %
8a	Stipa lettermani	.5	90	.5	.3	.09		.2	.04	
8b		.3	80	.3	.2	.04		.2	.04	
8c		.3	80	.3	.1	.01		.1	.01	
8d		.4	80	.4	.1	.01		.1	.01	
8e		.4	80	.4	.3	.09		.2	.04	
8f		.6	90	.6	.4	.15		.3	.09	
8g		.2	70	.2	.1	.01		.1	.01	
8h		.3	70	.3	.3	.09		.3	.09	
8i		.4	80	.4	.2	.04		.2	.04	
	Total or average	.4	80	.4	.2	.53	1.3	.2	.37	.9
11a	Phlox caespitosa	.1	100	.1	.3	.06		.2	.04	
11b		.2	80	.2	.3	.08		.2	.04	
11c		.1	70	.1	.1	.01		.1	.01	
	Total or average	.1	83	.1	.2	.15	.4	.2	.09	.2
12a	Artemisia tridentata	2.1	90	1.0	1.6	2.6		1.4	1.7	
12b		1.9	90	.8	2.4	5.4		1.6	2.56	
12c		1.5	90	.8	2.4	5.6		1.5	2.25	
12d		1.5	90	.8	1.1	1.04		.9	.18	
12e		1.1	70	.5	.5	.25		.3	.09	
	Total or average	1.6	86	.8	1.6	14.89	37.2	1.1	6.78	17.0
	TOTAL OR AVERAGE	.7	82	.5	.6	15.57	38.9	.5	7.24	18.1

APPENDIX C-2-b (continued 11)

QUADRAT STUDY

T 49 N, R 4 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 11
Sec. 25 — Gunnison River — Overlay No. 10
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 3-9
Team: Hall & Argyle, Unit 3d, June 29, 1961 — Alt. 7356 ft.
Locality: Mouth of Red Creek, RM 46.8R, Veg. type: Sagebrush



No. Species	Ht.	Mat-urity	Foliage Ht.	Diam.	Area	%	Compacted Diam.	Area	%
5a Oryzopsis hymenoides	.7	90	.7	.6	.3		.3	.1	
5b	.9	60	.9	.2	.2		.1	.1	
5c	.8	60	.8	.5	1.1		.2	.3	
5d	1.2	85	1.2	.8	1.1		.4	.2	
5e	1.0	90	1.0	.9	.6		.6	.3	
5f	.8	90	.8	.7	.3		.5	.2	
5g	.8	80	.8	1.2	1.1		.8	.3	
5h	.6	80	.6	1.3	1.2		.8	.3	
Total or average	.9	70	.9	.6	5.9	14.7	.3	1.8	4.6
11a Phlox caespitosa	.1	90	.1	.8	1.0		.8	1.0	
11b	.1	90	.1	.9	1.2		.8	1.1	
11c	.1	90	.1	.6	.6		.6	.6	
11d	.1	90	.1	.5	.2		.5	.2	
11e	.1	90	.1	.3	.2		.3	.2	
Total or average	.1	90	.1	.6	3.2	8.0	.6	3.1	7.8
12a Artemisia tridentata	3.0	90	2.4	3.5	9.7		1.8	2.6	
12b	2.1	90	1.3	2.4	5.4		2.0	3.1	
Total or average	2.6	90	1.9	3.0	15.1	37.8	1.9	5.7	14.3
13a Chrysothamnus depressus	.4	90	.4	.6	.7		.4	.3	
13b	.4	90	.4	1.2	2.2		.8	.8	
13c	.3	90	.3	.8	.5		.4	.1	
13d	.6	90	.6	.6	.3		.4	.1	
13e	.7	90	.7	.4	.1		.2	.1	
Total or average	.5	90	.5	.8	3.8	9.6	.5	1.4	3.5
TOTAL OR AVERAGE	.7	80	.6	.8	28.0	70.0	.5	12.0	30.0

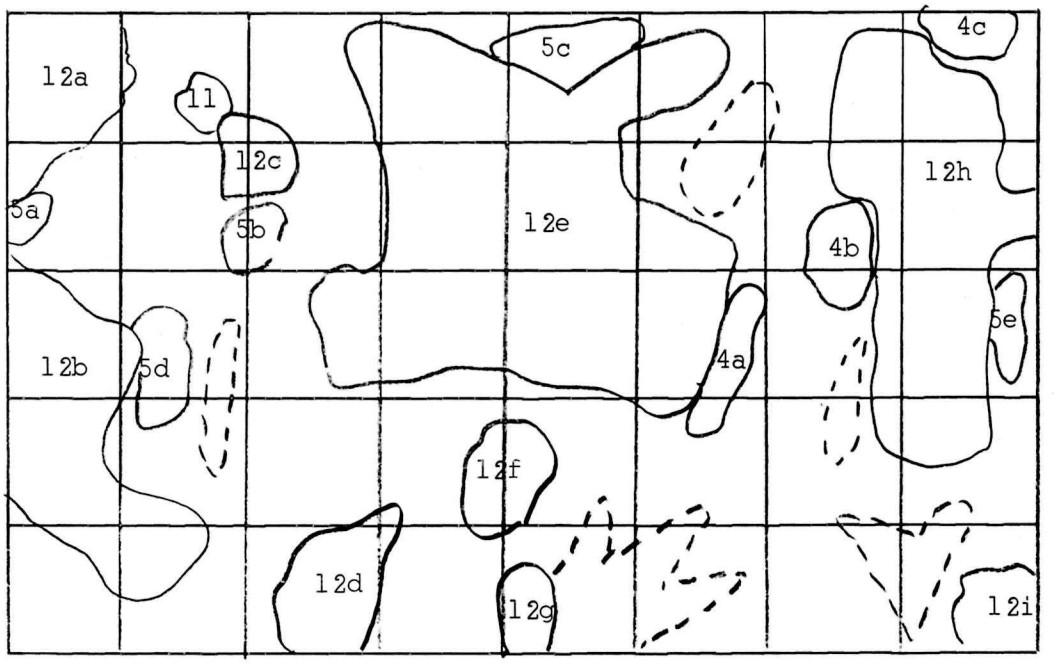
Quadrat No. 11

Quadrat No. 12

APPENDIX C-2-b (continued 12)

QUADRAT STUDY

T 49 N, R 4 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 12
Sec. 25 — Gunnison River — Overlay No. 10
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 3-9
Team: Ranck & Reynolds, Unit 3d, June 29, 1961 — Alt. 7445 ft.
Locality: Near mouth Red Creek, RM 46.8R, Veg.type: Sagebrush

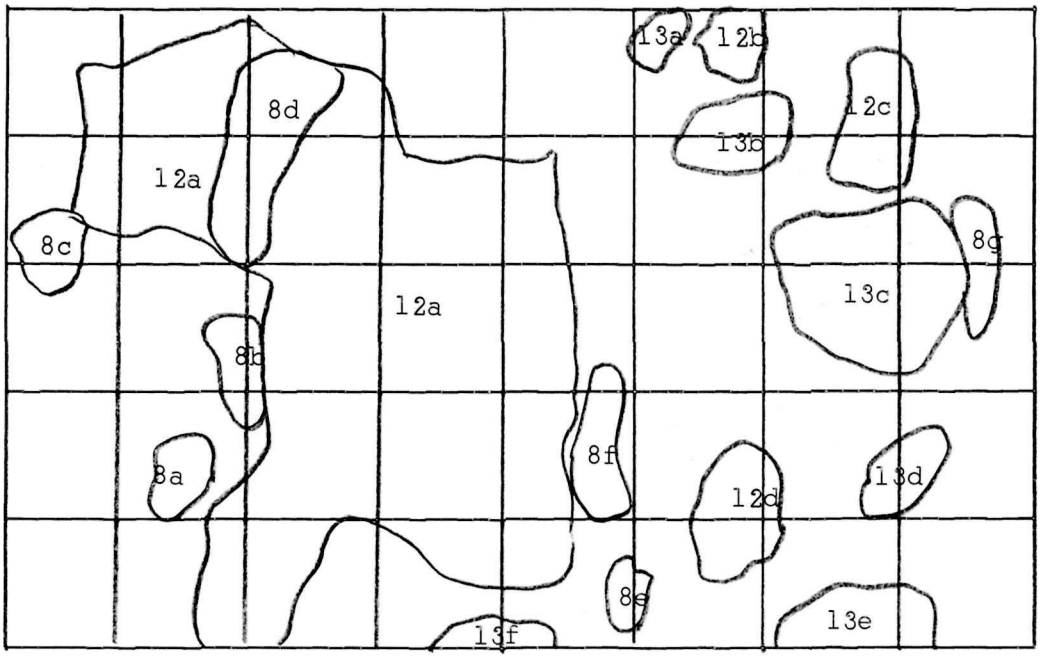


No.	Species	Ht.	Mat-urity	Foliage Ht.	Diam.	Area	%	Compacted Diam.	Area	%
4a	Hilaria jamesii	.3	80	.3	.3	.2		.2	.15	
4b		.3	80	.3	.3	.3		.2	.2	
4c		.2	85	.2	.4	.4		.3	.3	
	Total or average	.3	82	.3	.3	.9	2.3	.2	.65	1.6
5a	Oryzopsis hymenoides	.4	100	.4	.2	.4		.2	.2	
5b		.3	80	.3	.3	.3		.2	.2	
5c		.5	90	.5	.5	.3		.4	.25	
5d		.5	90	.5	.5	.4		.4	.3	
5e		.4	90	.4	.3	.3		.2	.2	
	Total or average	.4	90	.4	.4	1.7	4.3	.3	1.15	2.9
11	Phlox caespitosa	.3	100	.3	.3	.3	.8	.2	.25	.5
12a	Artemisia tridentata	.8	60	.7	1.2	.6		.8	.4	
12b		1.0	80	.7	1.8	2.0		1.0	1.4	
12c		.4	20	.4	.5	.3		.3	.15	
12d		.7	30	.6	.8	.5		.5	.3	
12e		1.0	100	.8	2.5	6.0		2.0	3.5	
12f		.5	20	.4	.4	.3		.3	.25	
12g		.4	15	.3	.3	.2		.2	.15	
12h		.8	80	.7	2.0	3.0		1.5	2.0	
12i		.7	50	.5	.4	.2		.3	.15	
	Total or average	.7	51	.6	1.1	13.1	32.8	.8	8.30	20.8
	TOTAL OR AVERAGE	.5	69	.5	.7	16.0	40.0	.5	10.35	25.9

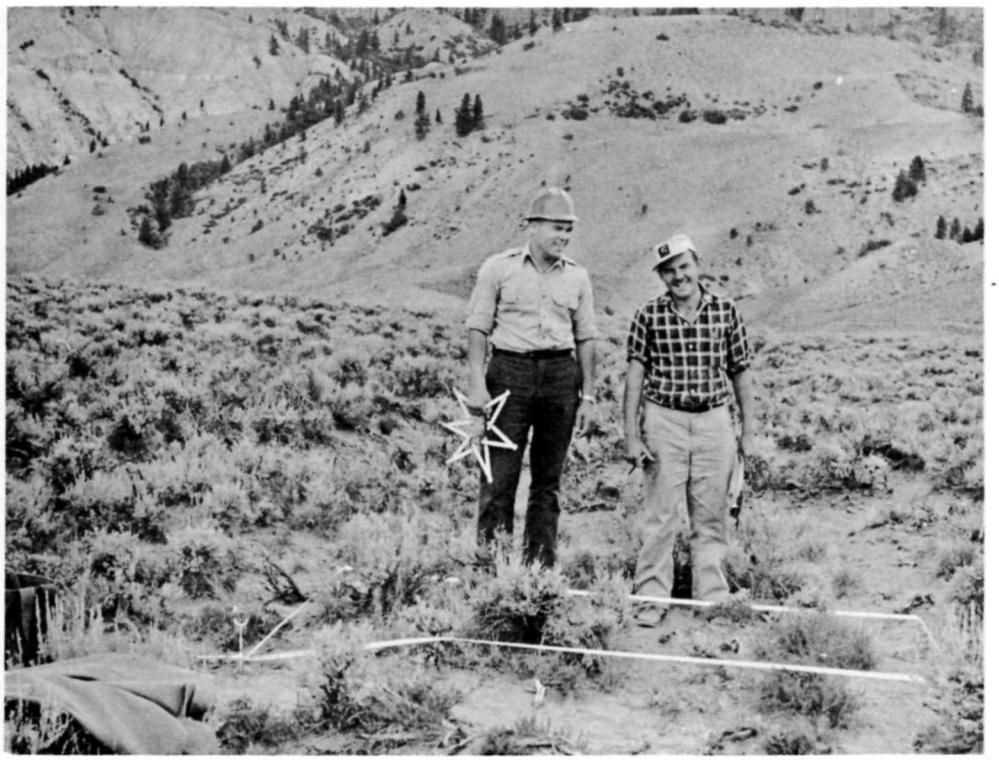
APPENDIX C-2-b (continued 13)

QUADRAT STUDY

T 49 N, R 4 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 13
Sec. 35 — Gunnison River — Overlay No. 11
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 3-8
Team: Ranck & Reynolds, Unit 3a, July 14, 1961 — Alt. 7500 ft.
Locality: West of Red Creek, RM 45.2L, Veg type: Sagebrush



No.	Species	Ht.	Maturity	Foliage Ht.	Foliage Diam.	Foliage Area	Foliage %	Compacted Diam.	Compacted Area	Compacted %
8a	Stipa lettermani	1.0	100	1.0	.4	.13		.3	.07	
8b		.9	100	.9	.4	.13		.3	.07	
8c		.8	100	.8	.4	.13		.3	.07	
8d		.9	100	.9	1.2	1.2		.9	.6	
8e		.7	100	.7	.3	.07		.2	.03	
8f		1.0	100	1.0	.4	.13		.4	.13	
8g		.8	100	.8	.4	.13		.3	.07	
	Total or average	.9	100	.9	.5	1.92	4.8	.4	1.04	2.6
12a	Artemisia tridentata	1.3	100	1.0	4.0	12.4		3.0	7.0	
12b		.5	90	.4	.5	.2		.4	.13	
12c		.8	95	.7	.8	.5		.6	.28	
12d		.8	95	.6	.7	.45		.6	.28	
	Total or average	.9	90	.7	1.5	13.55	33.9	1.2	7.69	19.2
13a	Chrysothamnus depressus	.2	50	.2	.3	.07		.2	.03	
13b		.3	100	.3	.8	.5		.6	.28	
13c		.4	100	.4	1.2	1.2		.9	.6	
13d		.3	100	.3	.5	.2		.4	.13	
13e		.4	100	.4	.8	.5		.6	.28	
13f		.4	100	.4	.3	.07		.2	.03	
	Total or average	.3	92	.3	.7	2.54	6.4	.5	1.35	3.4
	TOTAL OR AVERAGE	.7	96	.6	.8	18.01	45.0	.6	10.08	25.2



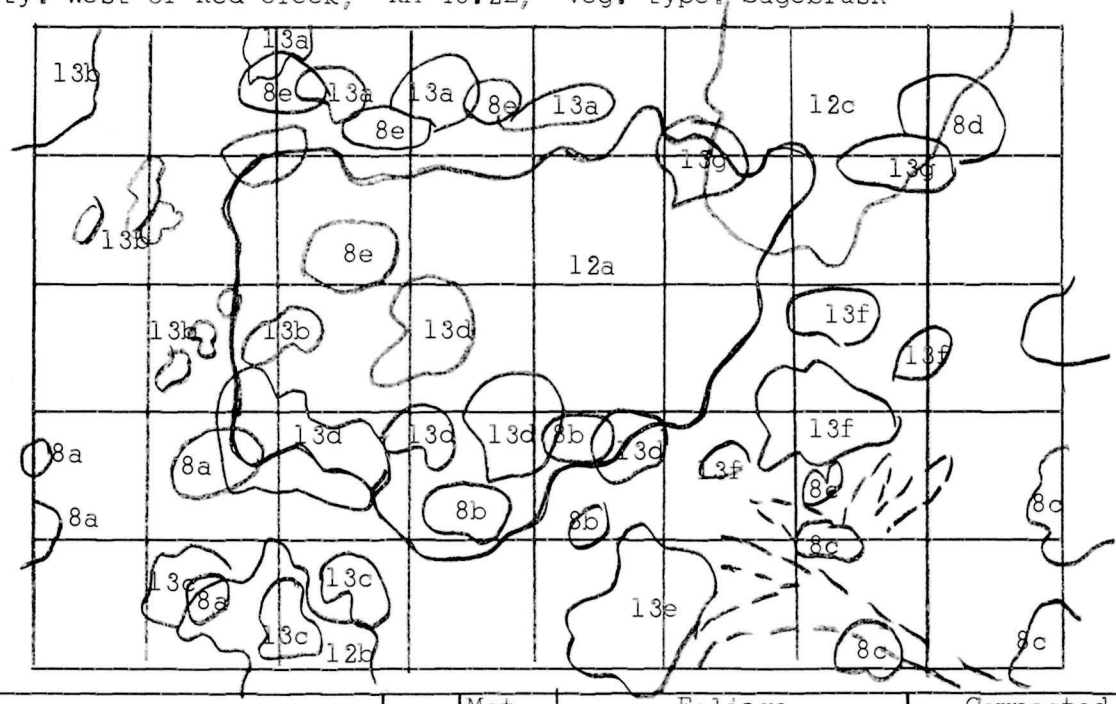
Quadrat No. 13

Quadrat No. 14

APPENDIX C-2-b (continued 14)

QUADRAT STUDY

T 49 N, R 4 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 14
Sec. 35 — Gunnison River — Overlay No. 11
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 3-8
Team: Hall & Argyle, Unit 3a, July 14, 1961 — Alt. 7500 ft.
Locality: West of Red Creek, RM 45.2L, Veg. type: Sagebrush

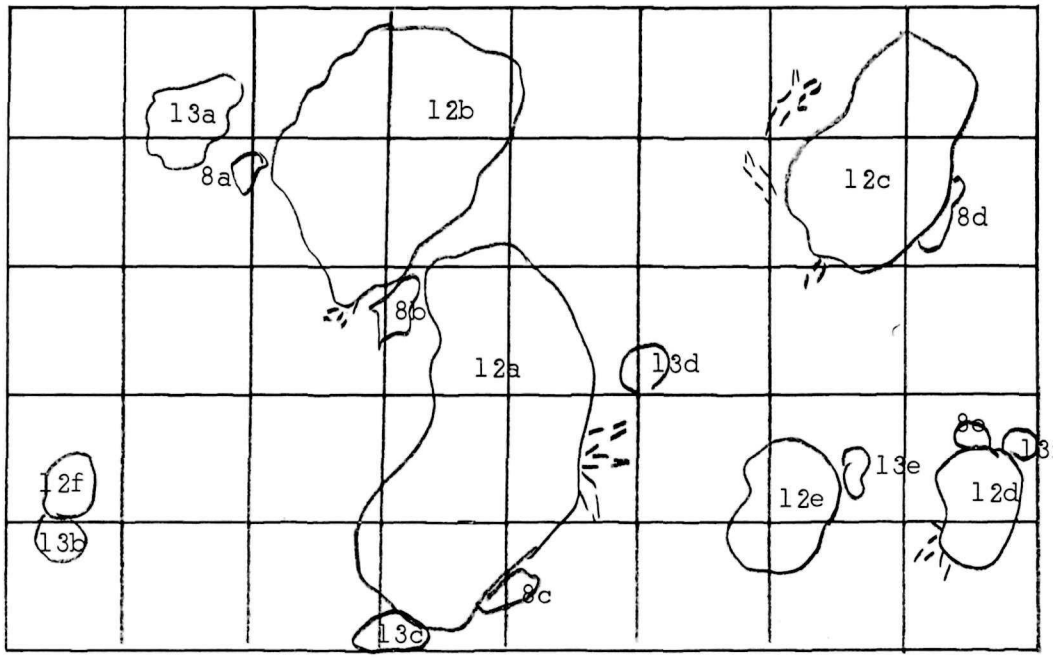


No. Species	Ht.	Maturity	Foliage Ht.	Foliage Diam.	Foliage Area	Foliage %	Compacted Diam.	Compacted Area	Compacted %
7a Stipa lettermani	1.1	70	1.1	.4	.13		.3	.07	
7b	.8	70	.8	.3	.07		.3	.07	
7c	.9	80	.9	.4	.13		.2	.03	
7d	1.0	80	1.0	.5	.2		.4	.13	
7e	.7	80	.7	.4	.13		.3	.07	
Total or average	.9	76	.9	.4	.66	1.7	.3	.37	.9
12a Artemisia tridentata	2.7	90	2.1	3.6	10.1		3.0	8.0	
12b	1.4	80	1.1	.9	.6		.7	.39	
12c	2.3	90	1.3	2.0	3.14		1.6	2.0	
Total or average	2.1	87	1.5	2.2	13.84	34.5	1.8	10.39	26.0
13a Chrysothamnus depressus	.4	80	.4	1.6	2.0		1.2	1.13	
13b	.4	90	.4	1.2	1.13		1.0	.78	
13c	.5	90	.5	1.3	1.3		1.1	.95	
13d	.5	90	.5	1.3	1.3		1.1	.95	
13e	.4	90	.4	.9	.6		.8	.5	
13f	.4	90	.4	1.4	1.53		1.2	1.13	
13g	1.0	80	1.0	.6	.28		.4	.13	
Total or average	.5	87	.5	1.2	8.14	20.4	1.0	5.57	13.9
TOTAL OR AVERAGE	1.0	83	.8	1.1	22.64	56.6	.9	16.33	40.8

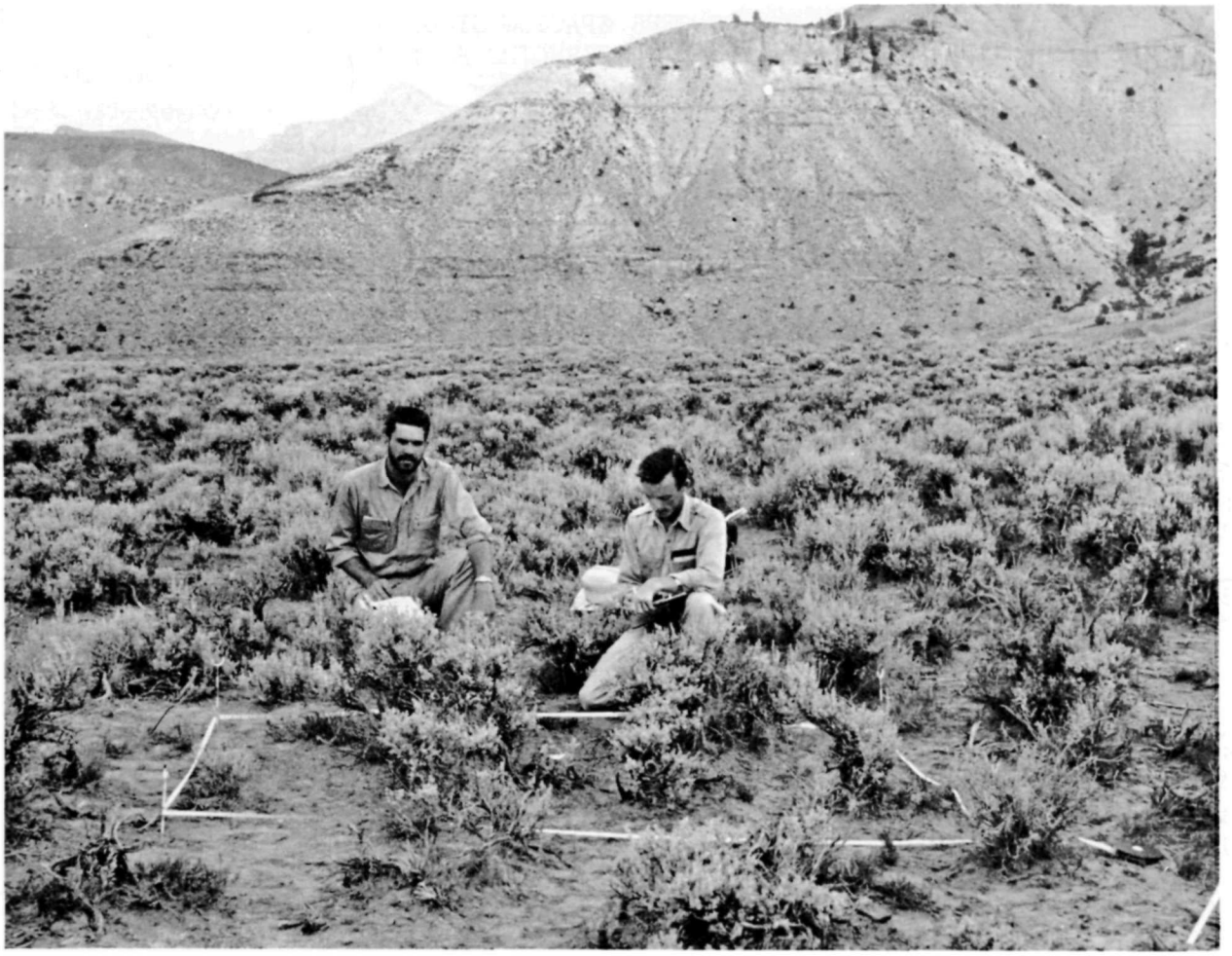
APPENDIX C-2-b (continued 15)

QUADRAT STUDY

T 49 N, R 4 W — CURECANTI RESERVOIRS BASINS — QUADRAT NO. 15
Sec. 35 — Gunnison River — Overlay No. 11
Size: 8 x 5 ft. = 40 sq.ft. — Map No. 3-6
Team: Stock & Lamborn, Unit 3a, July 14, 1961 — Alt. 7500 ft.
Locality: West of Red Creek, RM 45.1L, Veg. type: Sagebrush



No. Species	Ht.	Mat-urity	Foliage Ht.	Diam.	Area	%	Compacted Diam.	Area	%
8a Stipa lettermani	.4	100	.4	.2	.04		.2	.04	
8b	.5	100	.5	.7	.46		.7	.46	
8c	.6	100	.6	.5	.24		.5	.24	
8d	.6	100	.6	.6	.36		.6	.36	
8e	.3	100	.3	.4	.15		.4	.15	
Total or average	.5	100	.5	.5	1.25	3.1	.5	1.25	3.1
12a Artemisia tridentata	1.3	90	1.1	1.9	2.86		1.7	2.40	
12b	1.4	90	1.0	1.8	2.72		1.6	2.10	
12c	1.4	90	1.1	1.6	2.24		1.3	1.44	
12d	1.2	90	.9	1.1	1.0		1.0	.9	
12e	1.1	90	.6	.9	.72		.8	.60	
12f	.6	20	.6	.5	.20		.4	.15	
Total or average	1.2	78	.9	1.3	9.74	24.4	1.1	7.59	19.0
13a Chrysothamnus depressus	.3	80	.3	.7	.45		.6	.35	
13b	.2	100	.2	.4	.15		.3	.08	
13c	.3	75	.3	.5	.20		.4	.15	
13d	.3	60	.3	.4	.16		.4	.14	
13e	.3	90	.3	.5	.20		.4	.16	
13f	.3	80	.3	.6	.34		.5	.25	
Total or average	.3	81	.3	.5	1.50	3.8	.4	1.13	2.8
TOTAL OR AVERAGE	.7	86	.6	.8	12.49	31.2	.7	9.97	24.9



Quadrat No. 15

APPENDIX C-3

FOREST TREE SPACING STUDIES

Since little forested land was found in the Curecanti reservoirs, only three tree-spacing samples were taken, one in cottonwoods and associated trees on stream terraces in Dry Gulch, one among spruce-fir forest in a narrow canyon of Soap Creek, and one in Douglas Firs in South Red Creek. In each case, nine points were selected, more or less at random, from which the distance to the nearest sapling and to the nearest tree over 4 ins. dia. in each quadrant around the point was measured. These data are given in the following tables.

APPENDIX C-3

FOREST TREE SPACING STUDY
CURECANTI RESERVOIRS BASINS
Gunnison River

T 49 N, R 3 W
Sec. 28, Alt. 7520
Team: Hall, Walker, Unit 1a, July 5, 1961
Locality: Dry Gulch, RM 50, Veg. type: Populus angustifolia

TREE SPACING NO. 1
Overlay No. 9
Map No. 3-10

Tree No.	Kind of trees	Trunk Diam.	Ht. feet	Foliage Diam.	Foliage Ht.	Distance feet Trees	Distance feet Saplings
1-1	Populus angustifolia	1.8	57.0	26.0	19.0	26.8	35.4
1-2		1.0	48.0	20.0	45.0	25.7	21.1
1-3		1.6	64.0	30.0	30.0	20.6	None
1-4		1.6	66.0	34.0	44.0	21.3	None
	Average	1.5	58.8	27.5	34.5	23.6	28.3
2-1	Populus angustifolia	1.2	62.0	30.0	28.0	14.3	10.6
2-2		.6	42.0	21.0	33.0	14.3	29.1
2-3		1.6	68.0	46.0	27.0	8.7	6.3
2-4		1.0	53.0	26.0	31.0	6.7	8.3
	Average	1.1	56.3	30.8	29.8	11.0	13.6
3-1	Populus angustifolia	.9	56.0	23.0	41.0	13.9	21.8
3-2		2.8	60.0	42.0	31.0	12.4	24.7
3-3		.8	53.0	44.0	24.0	13.1	31.0
3-4		1.4	61.0	19.4	27.0	9.2	32.0
	Average	1.5	57.5	32.1	30.8	12.2	27.4
4-1	Populus angustifolia	1.5	57.0	26.0	24.0	27.0	9.4
4-2		1.3	58.0	14.0	29.0	17.0	30.0
4-3		.7	44.0	17.0	36.0	18.0	26.0
4-4		1.4	64.0	42.0	29.0	14.4	30.4
	Average	1.2	55.8	24.8	29.5	19.1	24.0
5-1	Populus angustifolia	.8	55.0	23.0	27.0	13.5	13.3
5-2		1.4	58.0	18.0	24.0	6.6	17.9
5-3		1.6	49.0	27.0	23.0	11.8	16.8
5-4		1.3	46.0	34.0	29.0	4.6	18.3
	Average	1.3	52.0	25.5	25.8	9.1	16.6
6-1	Populus angustifolia	.9	57.0	24.0	17.0	14.7	19.0
6-2		1.3	58.0	27.0	23.0	3.3	19.4
6-3		1.7	60.0	23.0	28.0	7.4	16.3
6-4		1.1	60.0	21.0	18.0	8.2	18.3
	Average	1.3	58.8	23.8	21.5	8.4	18.3
7-1	Populus angustifolia	.8	55.0	36.0	20.0	9.7	None
7-2		.9	57.0	38.0	29.0	14.8	None
7-3		1.8	54.0	34.0	37.0	17.4	33.1
7-4		.5	31.0	12.0	22.0	21.5	34.2
	Average	1.0	49.3	30.0	27.0	15.9	33.7
8-1	Populus angustifolia	1.7	57.0	18.0	21.0	2.9	7.0
8-2		1.8	59.0	13.0	23.0	2.6	17.0
8-3	(very old trees	1.7	63.0	17.0	19.0	2.0	43.4
8-4	1/3 dead)	.7	48.0	21.0	21.0	7.5	15.4
	Average	1.5	56.8	17.3	21.0	3.8	20.7
9-1	Populus angustifolia	1.3	63.0	23.0	30.0	10.9	1.4
9-2		1.8	65.0	30.0	38.0	14.2	16.3
9-3		1.1	60.0	26.0	50.0	10.1	17.2
9-4		1.5	64.0	20.0	56.0	14.7	9.2
	Average	1.4	63.0	24.8	43.5	12.5	11.0
	TOTAL AVERAGE	1.3	56.4	26.3	29.3	12.8	20.3

APPENDIX C-3 (continued 2)

FOREST TREE SPACING STUDY
CURECANTI RESERVOIRS BASIN
Gunnison River

T 49 N, R 3 W
Sec. 31, Alt. 7440
Tream: Hall & Argyle, Unit 3b, July 8, 1961
Locality: South Red Creek, RM 47, Veg. type: Fir community

TREE SPACING NO. 2
Overlay No. 10
Map No. 3-9

Tree No.	Kind of trees	Trunk Diam.	Ht. feet	Foliage Diam.	Foliage Ht.	Distance feet Trees	Distance feet Saplings
1-1	Pseudotsuga menziesii	.9	30.0	22.0	25.0	27.0	22.0
1-2		1.7	42.0	Dead		54.0	96.0
1-3		1.8	46.0	30.0	36.0	48.0	26.0
1-4		2.0	47.0	26.0	47.0	17.0	52.0
	Average	1.6	41.3	26.0	36.0	36.5	49.0
2-1	Pseudotsuga menziesii	.8	46.0	20.0	36.0	14.0	20.0
2-2	" "	.7	26.0	16.0	18.0	21.0	80.0
2-3	Juniperus scopolorum	.8	12.0	7.0	7.0	25.0	27.0
2-4	Pseudotsuga menziesii	2.0	45.0	25.0	40.0	12.0	14.0
	Average	1.1	32.3	17.0	25.3	18.0	35.3
3-1	Pseudotsuga menziesii	1.7	50.0	20.0	30.0	80.0	14.0
3-2		1.6	56.0	22.0	40.0	50.0	50.0
3-3		.6	32.0	12.0	22.0	8.0	12.0
3-4		1.5	45.0	26.0	37.0	12.0	8.0
	Average	1.4	45.8	20.0	32.3	37.5	21.0
4-1	Pseudotsuga menziesii	1.3	35.0	12.0	15.0	9.0	7.0
4-2		1.5	50.0	20.0	25.0	25.0	10.0
4-3		1.0	47.0	12.0	27.0	20.0	14.0
4-4		1.1	55.0	22.0	40.0	8.0	15.0
	Average	1.2	46.8	16.5	26.8	15.5	11.5
5-1	Pseudotsuga menziesii	.9	35.0	18.0	27.0	13.0	6.0
5-2		1.1	37.0	18.0	36.0	4.0	11.0
5-3		1.2	40.0	22.0	36.0	7.0	18.0
5-4		1.8	47.0	18.0	27.0	40.0	37.0
	Average	1.3	40.0	19.0	31.5	16.0	18.0
6-1	Pseudotsuga menziesii	.9	48.0	20.0	38.0	5.0	4.0
6-2	" "	1.1	47.0	18.0	30.0	7.0	7.0
6-3	" "	.7	36.0	12.0	26.0	7.0	12.0
6-4	Juniperus scopulorum	.4	14.0	7.0	14.0	3.0	14.0
	Average	.8	36.3	14.3	27.0	5.5	9.3
7-1	Pseudotsuga menziesii	.6	35.0	8.0	25.0	7.0	9.0
7-2		2.4	60.0	32.0	50.0	16.0	8.0
7-3		1.2	38.0	12.0	20.0	13.0	7.0
7-4		1.0	50.0	15.0	45.0	15.0	2.0
	Average	1.3	45.8	16.8	35.0	12.8	6.5
8-1	Pseudotsuga menziesii	2.0	56.0	28.0	50.0	14.0	9.0
8-2		.8	30.0	16.0	20.0	12.0	9.0
8-3		.5	30.0	7.0	15.0	8.0	8.0
8-4		1.9	59.0	25.0	40.0	7.0	22.0
	Average	1.3	43.8	19.0	31.3	10.3	12.0
9-1	Juniperus scopulorum	.8	16.0	12.0	16.0	10.0	6.0
9-2		.8	26.0	22.0	22.0	6.0	7.0
9-3		1.3	48.0	21.0	40.0	9.0	17.0
9-4		.7	28.0	11.0	18.0	12.0	14.0
	Average	.9	29.5	16.5	24.0	9.3	11.0
	TOTAL AVERAGE	1.2	40.2	18.1	29.7	17.9	19.3

APPENDIX C-3 (continued 3)

FOREST TREE SPACING STUDY
CURECANTI RESERVOAIRS BASINS
Gunnison River

T 49 N, R 4 W
Sec. 9, Alt. 7420
Team: Hall & Walker, Unit 1a, July 12, 1961
Locality: Soap Creek, RM 3, Veg. type: Spruce, fir

TREE SPACING NO. 3
Overlay No. 13a
Map No. 1-12

Tree No.	Kind of trees	Trunk Diam.	Ht. feet	Foliage Diam.	Foliage Ht.	Distance feet Trees	Distance feet Saplings
1-1	Populus angustifolia	1.6	44.0	18.0	35.0	35.0	12.0
1-2	Picea pungens	1.2	58.0	24.0	56.0	23.0	11.0
1-3	" "	.9	50.0	10.0	50.0	50.0	23.0
1-4	" "	1.3	56.0	14.0	50.0	22.0	29.0
	Average	1.3	52.0	16.5	47.8	32.5	18.8
2-1	Picea pungens	.9	64.0	20.0	57.0	18.5	12.0
2-2		1.1	60.0	18.0	55.0	19.3	8.0
2-3		2.8	107.0	32.0	100.0	39.0	16.0
2-4		1.2	60.0	18.0	55.0	44.0	76.0
	Average	1.5	72.8	22.0	66.8	30.2	28.0
3-1	Populus angustifolia	2.2	63.0	25.0	20.0	16.0	3.0
3-2	Picea pungens	2.1	84.0	28.0	80.0	55.0	35.0
3-3	" "	1.8	90.0	Dead		21.0	28.0
3-4	" "	1.9	90.0	25.0	80.0	17.0	34.0
	Average	2.0	81.8	26.0	60.0	27.3	25.0
4-1	Picea pungens	1.2	87.0	17.0	70.0	14.5	3.0
4-2		2.0	85.0	24.0	74.0	15.0	15.0
4-3		.6	52.0	9.0	40.0	24.0	27.0
4-4		1.8	80.0	25.0	76.0	18.0	18.5
	Average	1.4	76.0	18.8	65.0	17.9	15.9
5-1	Populus angustifolia	3.1	76.0	40.0	63.0	17.0	3.0
5-2	Picea pungens	1.1	42.0	14.0	23.0	15.0	29.0
5-3	Populus angustifolia	2.3	67.0	34.0	42.0	13.0	3.0
5-4	Picea pungens	1.4	58.0	27.0	50.0	12.0	14.0
	Average	2.0	60.8	28.8	44.5	14.3	12.3
6-1	Populus angustifolia	.8	42.0	14.0	40.0	30.0	82.0
6-2	Picea pungens	2.2	103.0	25.0	95.0	24.0	23.0
6-3	" "	1.3	62.0	31.0	46.0	17.0	18.0
6-4	Populus angustifolia	2.8	70.0	30.0	64.0	18.0	18.0
	Average	1.8	69.3	25.0	61.3	22.3	35.3
7-1	Populus angustifolia	2.4	80.0	34.0	30.0	8.0	45.0
7-2		1.9	70.0	30.0	55.0	16.0	34.0
7-3		1.6	57.0	32.0	50.0	10.5	16.0
7-4		2.6	60.0	35.0	45.0	23.0	26.0
	Average	2.1	66.8	32.8	45.0	14.4	30.2
8-1	Populus angustifolia	1.2	50.0	20.0	50.0	12.0	11.0
8-2	" "	1.3	53.0	23.0	52.0	10.0	9.0
8-3	Picea pungens	.6	28.5	12.0	28.5	12.5	15.0
8-4	" "	.5	26.0	10.0	26.0	13.0	17.0
	Average	.9	39.4	16.3	39.1	11.9	13.0
9-1	Picea pungens	1.3	90.0	Dead		15.0	9.0
9-2		1.8	87.0	36.0	67.0	8.0	21.0
9-3		2.3	83.0	27.0	83.0	21.0	3.0
9-4		1.4	52.0	17.0	40.0	42.0	75.0
	Average	1.7	78.0	26.7	63.3	21.5	27.0
	TOTAL AVERAGE	1.6	66.3	23.5	54.4	21.4	22.8

APPENDIX E-1

AREA OF VEGETATION UNITS AND WATER SURFACES

Overlay	Unit letters and Area Acres 1 Streamside	2 Terrace	3 Hillside	4 Farmland	Water surface	Area Acres Total	Planimeter	Average
BLUE MESA RESERVOIR								
GUNNISON RIVER								
1	a-c 24.9			a 3.0	9.0	36.9	36.6	36.8
2	a-d 40.9	a 0.7	a-d 12.4		15.6	69.6	69.2	69.4
3	a-b 16.2		a-b 17.0		13.0	46.2	47.2	46.7
4	a-f 86.2	a 22.2	a-e 152.2	a-c 168.6	35.0	464.2	462.0	463.1
5	a-e 33.0	a 25.8	a-b 168.4	a-d 601.2	29.8	858.2	853.8	856.0
6	a-k 107.7	a-e 44.1	a-d 532.8	a-c 204.6	40.3	929.5	932.2	930.9
7	a-d 24.0	a-b 41.9	a-d 287.1	a-b 26.4	35.1	414.5	416.9	415.7
8	a-c 61.7		a-c 366.4	a-c 57.5	43.9	529.5	533.0	531.3
9	a-d 106.0	a 35.2	a-c 859.2	a-c 204.2	40.2	1244.8	1250.0	1247.4
Cebolla Creek								
9a	a 28.0		a-b 174.6		14.0	216.6	215.9	216.3
9b	a 4.2		a 16.0		1.0	21.2	21.2	21.2
10	a-e 38.8	a 17.4	a-d 641.2	a 63.5	31.2	792.1	797.0	794.5
11	a-b 4.5		a-b 375.2		12.8	392.5	391.4	392.0
12	a-c 41.6		a-f 690.8	a-b 77.2	26.6	836.2	838.2	837.2
West Elk Creek								
12a	a 37.8		a-b 37.4	a 6.6		81.8	82.2	82.0
13	a-c 112.8		a-f 672.6	a-c 486.3	24.8	1296.5	1297.2	1296.9
Soap Creek								
13a	a 82.6		a-d 231.0			313.6	313.8	313.7
14	a-c 15.4		a-e 421.0	a-b 156.4	13.6	606.4	602.4	604.4
Lake Fork								
14a	a 11.9		a-b 271.3		6.0	289.2	290.2	289.7
14b	a 14.4		a-b 197.3		3.7	215.4	215.6	215.5
14c	a-b 7.6		a-b 27.0		3.2	37.8	38.4	38.1
Total	900.2	187.3	6150.9	2055.5	398.8	9692.7	9704.4	9698.8
Veg.units	66	12	65	28				
MORROW POINT RESERVOIR								
15	a-b 1.8				6.0	7.8	7.8	7.8
16	a-b 4.8		a-b 5.3		18.3	28.4	28.4	28.4
17	a-b 5.0		a-b 24.6		18.0	47.6	47.6	47.6
18	a-b 3.6		a-b 40.0		23.4	67.0	65.8	66.4
19	a-b 3.8		a-b 58.4		14.6	76.8	77.2	77.0
20	a-b 8.6		a-d 217.0		40.0	265.6	263.6	264.6
21	a-b 6.2		a-e 263.4		23.8	293.4	292.4	292.9
Total	33.8		608.7		144.1	786.6	782.8	784.7
Units	14		17					
CRYSTAL RESERVOIR								
22	a 6.8		a-c 87.2		43.6	137.6	136.8	137.2
23	a 6.3		a-b 227.3		42.0	275.6	274.6	275.1
Total	13.1		314.5		85.6	413.2	411.4	412.3
Units	2		5					
TOTALS								
Areas	947.1	187.3	7074.1	2055.5	628.5	10892.5	10898.6	10895.8
Veg.units	82	12	87	28		209		

APPENDIX E-2

CURECANTI RESERVOIRS BASINS

RIVER MILEAGE TABLE

For convenience in locating important geographic points within the Curecanti Reservoirs basins, this river mileage table is given. It lists important places successively from the upper end of the reservoir downstream to Crystal Creek, and Lake Fork Creek. The mileages used in the table are thos calculated upstream from an arbitrary point selected as mile 20 at the east portal mouth of the proposed Gunnison tunnel. Those on tributaries are measured upstream from the mouth. The letters L and R following the mileages indicate respectively the left and right side of the river looking downstream. The letter M indicates midstream of a span across the stream. Altitudes used were those given on the USGS topographic sheet quadrangles.

GUNNISON RIVER

River mile	Side	Alt. feet	Name	Comments
63.0	R	7545	Coopers Resort . . . .1 mi. north of river	
63.0	M	7530	Ford across river	
62.9	M	7525	Beginning of large island . . . no name	
62.9	L	7524	Small Creek . . . no name	
62.7	L	7521	South Beaver Creek	
62.7	M	7520	End of large island	
62.7	M	7520	Upper limits of Blue Mesa Reservoir	
62.5	R	7550	Gravel pit . . . .1 mi. north of river	
62.4	R	7520	U. S. Highway 50 enters reservoir area	
62.4	L	7520	Abandoned railroad enters reservoir area	
62.2	M	7510	Two small islands	
61.9	R	7505	Beaver Creek	
61.9	R	7515	Hierro . . . .1 mi. north of river	
61.8	M	7502	Island	
61.4	M	7495	Large island	
61.4	L	7495	Intermittent creek	
61.1	M	7490	Small island	
60.9	L	7485	Intermittent creek	
60.0	M	7470	Two large islands . . . each .1 mi. long	
59.7	R	7465	Steuben Creek	
59.7	M	7475	Bridge to Elkhorn	
59.7	L	7465	Ditch	
59.6	L	7470	Elkhorn	
59.6	L	7460	Ditch	
59.6	R	7460	Ditch	
58.6	L	7445	Willow Creek	
58.6	R	7445	Intermittent creek	
57.9	M	7440	Bridge to Iola	

RIVER MILEAGE TABLE (continued)

River mile	Side	Alt. feet	Name	Comments
57.9	R	7560	Landing strip . . .	.3 mi. north of river
57.8	R	7430	Stevens Creek	
57.7	L	7450	Iola . . .	.3 mi. south of river
57.7	R	7520	U. S. Highway 50 leaves reservoir area	
57.3	M	7425	Island	
57.0	M	7418	Island	
56.9	R	7417	Ditch	
56.8	R	7415	Willow Creek	
56.7	M	7415	Bridge	
56.2	L	7410	Intermittent creek	
56.0	M	7405	Five islands	
55.9	M	7410	Abandoned railroad crosses river to right side	
55.6	L	7395	Creek . . . no name	
55.3	M	7395	Island	
54.8	L	7400	Tex Lodge	
54.8	L	7390	Intermittent creek	
54.4	R	7380	Dry Creek	
54.4	R	7520	U. S. Highway 50 crosses arm reservoir area for a short distance	
53.5	R	7375	Trout Haven	
53.3	M	7370	Two islands	
53.1	R	7365	Haystack Gulch	
53.1	M	7365	Island	
52.9	M	7363	Two islands	
52.9	L	7363	Intermittent creek	
52.7	M	7355	Island	
52.6	L	7350	Intermittent creek	
51.4	R	7520	U. S. Highway 50 enters the reservoir area	
51.2	M	7340	Bridge to Henderson Place	
51.2	R	7335	East Elk Creek	
51.1	L	7340	Henderson Place	
50.3	R	7330	Dry Gulch	
50.3	R	7460	Our field camp in Dry Gulch . . .	.5 mi. from river
49.4	M	7315	Large island	
49.3	R	7315	Intermittent creek	
49.2	R	7320	Moncrief Ranch	
49.2	M	7320	Bridge at Moncrief Ranch	
48.9	R	7310	Intermittent creek	
48.7	L	7308	Mouth of Cebolla Creek	

CEBOLLA CREEK

0.0	L	7308	Mouth of Cebolla Creek	
1.0	R	7430	Start of abandoned ditch	
1.9	L	7390	Intermittent creek	
2.2	L	7410	Intermittent creek	
4.0	R	7490	Intermittent creek	
4.6	M	7520	Upper limits of reservoir	

RIVER MILEAGE TABLE (continued)

GUNNISON RIVER (continued)

River mile	Side	Alt. feet	Name	Comments
48.3	M	7305	Island	
48.0	M	7300	Island	
47.7	M	7295	Island	
46.9	R	7282	Red Creek	
46.2	L	7275	Fourmile Gulch	
45.5	R	7255	Dillon Gulch	
45.4	R	7450	Gravel pit . . . .2 mi. north of river	
44.7	M	7255	New bridge	
44.6	M	7245	Large island	
44.1	M	7235	Island	
43.7	R	7230	West Elk Creek	

WEST ELK CREEK

0.0	R	7230	Mouth of West Elk Creek	
0.1	M	7270	Bridge and U. S. Highway 50 crosses West Elk Creek	
1.3	R	7375	Ditch	
2.5	M	7520	Upper limits of reservoir	

GUNNISON RIVER (continued)

43.6	M	7230	Island	
43.6	L	7230	Intermittent creek	
43.0	R	7225	Soap Creek	

SOAP CREEK

0.0	R	7225	Mouth of Soap Creek	
0.1	M	7235	Bridge and U. S. Highway 50 crosses Soap Creek	
2.1	R	7375	Intermittent creek	
2.8	R	7390	Saddle Creek	
2.9	L	7395	Intermittent creek	
2.9	M	7398	Ford across Soap Creek	
3.4	L	7415	Coal Creek	
4.2	R	7510	Chance Creek	
4.2	M	7520	Upper limits of reservoir	
4.4	R	7550	Ditch	

GUNNISON RIVER (continued)

42.7	M	7215	Island	
42.3	R	7252	Sapinero . . . .2 mi. north of river	
41.9	M	7220	Bridge and U. S. Highway crosses Gunnison River	
41.3	L	7205	Mouth of Lake Fork	

LAKE FORK CREEK

0.0	L	7205	Mouth of Lake Fork	
0.1	M	7340	Bridge and U. S. Highway 50 crosses Lake Fork	
1.3	L	7260	Creek	

RIVER MILEAGE TABLE (continued)

River mile	Side	Alt., feet	Name	Comments
			LAKE FORK CREEK (continued)	
2.6	L	7305	Willow Creek	
3.4	L	7340	Intermittent creek	
3.6	R	7350	Intermittent creek	
4.3	R	7370	Intermittent creek	
4.7	R	7390	Intermittent creek	
5.0	L	7405	Creek	
5.5	R	7430	Intermittent creek	
5.9	L	7440	Intermittent creek	
6.0	M	7450	Small island	
6.4	R	7455	Intermittent creek	
6.5	R	7460	Intermittent creek	
7.4	L	7490	Little Willow Creek	
8.0	M	7520	Upper limits of reservoir	
			GUNNISON RIVER (continued)	
40.7	M	7520	U. S. Highway 50 leaves reservoir area	
40.6	L	7185	Damsite of Blue Mesa Reservoir	
39.8	L	7162	Pine Creek	
39.8	M	7160	Upper limits of Morrow Point Reservoir	
39.7	L	7160	State road 92 enters reservoir area	
39.1	R	7145	Cottonwood Gulch	
38.0	R	7120	Haypress Creek	
37.9	L	7115	Intermittent Creek	
36.9	R	7090	Corral Creek	
36.4	M	7093	Bridge and state road 92 cross river	
35.9	L	7065	Blue Creek	
35.9	R	7065	Curecanti Creek	
35.1	M	7043	Island	
35.1	L	7042	Intermittent creek	
33.9	R	6980	Intermittent creek	
33.6	L	6975	Intermittent creek	
33.0	R	6950	Myers Gulch	
32.1	R	6910	Intermittent creek	
31.8	L	6895	Round Corral Creek	
31.8	M	6895	Cable	
30.0	R	6835	Twin Gulch	
29.9	L	6830	Intermittent creek	
28.8	R	6805	State road 92 leaves reservoir area	
28.8	M	6770	Morrow Point Damsite	
28.7	M	6800	Bridge and state road 92 cross river	
28.6	M	6750	Upper limits of Crystal Reservoir	
28.4	L	6745	Cimarron Creek	
28.2	R	6740	Mesa Creek	
27.0	R	6715	Intermittent creek	
26.6	R	6710	Long Gulch	
26.0	R	6690	Intermittent creek	
25.8	L	6685	Intermittent creek	
25.2	L	6665	Intermittent creek	
24.8	L	6650	Intermittent creek	
24.4	R	6630	Crystal Creek	
23.3	L	6590	Intermittent creek	
22.6	L	6570	Intermittent creek	
22.4	R	6565	Spring Gulch	
22.3	L	6560	Pool Gulch	
20.8	M	6530	Crystal Damsite	
20.0	L	6520	East Portal	

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