

JOB COMPLETION REPORT

As Required By

FEDERAL AID IN FISHERIES RESTORATION ACT

TEXAS

Federal Aid Project No. F-5-R-8

Fisheries Investigations and Surveys of
the Waters of Region 3-B

Job No. B-15 Basic Survey and Inventory of Species
in the Rio Grande River of Texas in Region 3-B

Project Leader Lawrence S. Campbell

H. D. Dodgen
Executive Secretary
Texas Game and Fish Commission
Austin, Texas

Marion Toole
D-J Coordinator

Eugene A. Walker
Director, Program Planning

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ABSTRACT

Sampling of fish populations included 71 gill net collections and 31 seining collections from the Rio Grande River between El Paso and the mouth of the Devil's River. Examination of thousands of fish obtained by seining and 1,523 fish captured in gill nets established occurrence of 42 species of fish belonging to 11 families. Distribution and relative abundance of fish were found to conform to three basic ecological associations: turbid intermittent pool, permanent flow clear water, and turbid indolent flow. The basic distribution patterns were as outlined for the Chihuahuan Biologic Province by Dr. Clark Hubbs. Floods, as they occur in the Rio Grande, are believed to be detrimental to propagation of many game fish. This, plus water quality, limit production of some game fish such as centrarchids. The upper third of the stream, from El Paso to Presidio, is dominated by rough and forage species that were 94.27 per cent of the netted sample. The clear water associations produced 33.49 per cent usable game fish and represent the most productive stream areas in the region. Data on the lower third of the stream, from Regan Canyon to the mouth of the Devil's River, are insufficient and tends to be biased by the conditions that prevailed when field work was done.

Generally, the Rio Grande is the most productive stream in the region, and is the longest and most desirable fishing area that is now open to public access without charge. For that reason, it is afforded priority for fishery management.

A new reservoir, now under construction near Del Rio, should be investigated to determine what may be done to promote game fish production. Reconnaissance studies in the future should include work to provide additional data on the lower third of the stream. Inquiries should be made to determine if flood retention structures on tributaries of the stream can be utilized for public fishing. The canal system in El Paso County should be re-examined in an effort to find means of employing these structures for that purpose.

JOB COMPLETION REPORT

State of Texas

Project No. F-5-R-8

Name: Fisheries Investigations and Surveys
of the Waters of Region 3-B

Job No. B-15

Title: Basic Survey and Inventory of Species,
as well as Their Distribution in the
Rio Grande River of Texas in Region 3-B

Period Covered: April 1, 1960, to February 28, 1961

Objectives:

To gather fundamental data on the above water in regard to physical, chemical and biological aspects, and to determine the distribution of species present and their relative abundance. To also determine ecological factors influencing species distribution.

Techniques Used:

Standard procedures were used which supplied the information necessary to complete stream survey forms similar to those given by Lagler in his "Handbook of Freshwater Biology". Inquiries and investigations to locate means of access to the river, and reconnaissance trips on the stream by boat or raft were necessary to locate netting and seining stations.

Seventy-one overnight sets were made with gill nets at 28 locations. Nylon gill nets were used that measured 125 feet in length and 8 feet in depth. The nets were made up of 25-foot sections with mesh sizes beginning with 1-inch square mesh and increasing in each succeeding section by one-half-inch intervals to a 3-inch square mesh.

An attempt was made to use hoop and fyke nets for sampling; however, unexpected increases in stream flow rendered this effort non-productive.

Seining collections were obtained at 31 locations. Each location or collection consisted of several drags with either a 12- or 20-foot one-fourth-inch mesh nylon straight seine. A sample of the fish captured at each location was examined in detail and the relative abundance of various species was noted. Individuals whose identity was not positively established when examined in the field were preserved and identified in the laboratory. Detailed water quality data were obtained for six locations on the river. Data included determination of pH, total solids, chlorides, sulphates, sodium chloride, dissolved oxygen and biochemical oxygen demand. This detailed analysis was provided by the International Boundary and Water Commission and by the State Health Department. Hydrology records were obtained from those organizations and from the United States Geological Survey. Water temperatures, turbidity and pH were taken at 21 stations. Rotenone sampling of pools was planned but not completed because the desired and necessary conditions were not encountered during field work.

Introductory Statement

The Rio Grande River rises on the eastern face of the continental divide in southern Colorado. At the river's cold water source, temperatures average about 14° F. in January, and near 50° F. in July. Precipitation averages about 5 inches per year. At the semi-tropical mouth, temperatures average near 50° F. in January, and about 68° F. in July. Precipitation there averages between 20 and 30 inches. From source to estuary, the stream falls nearly three miles, and meanders nearly 1,900 miles, making the Rio Grande the second longest river in the United States.

The river commonly does not carry a great volume of water, and in many places, especially where it traverses desert, the stream is sometimes dry. Local storms create flood conditions that subside in a few hours, and most of the annual run-off, which averages nearly 4,000,000-acre-feet, enters the river from this sporadic source. Where flow is permanent, it is usually sustained by springs and seepage. The topographic basin, which includes 335,500 square miles, is semi-arid and only about one-half of that area, 171,900 square miles, is contributive.

After the river leaves the mountain streams, it intermittently cleaves through mountain canyons, wide level plains, and desert terraces. Pastoral valleys, varying in width from a few hundred yards to a few miles, are interspersed along the stream for three-fourths of its length. The river and these valleys are the artery for biologic and economic life within the river basin. The river receives comparatively few tributaries, and many are entirely dry except for sporadic flow.

Man's influence and use of the river pre-dates recorded history, but from the year 1600, when Spanish colonization encouraged settlement, irrigation in the rich alluvial bottom land has progressed toward total usage of the river's water. Today, over 2,500,000 acres are irrigated from the river's watershed. Primarily to control irrigation, a series of reservoirs have been constructed. These include Rio Grande, Continental, Santa Maria, Terrace, Mountain Home, Sanchez, Costilla, El Vado, Bluewater, Elephant Butte, Caballo, Almogordo, McMillan, Avalon, Red Bluff, Willacy, McClure, Devil's Lake and Lake Walk on the United States watershed. In Mexico they are Boquilla, La Colina, Rosetilla, Madero, Venustiano Carranza, Marte Gomez, Culebron, and Palito Blanco. These structures, with International Falcon Reservoir, effectuate storage for 8,000,000 acre feet of water. Work included in this survey was restricted to the Rio Grande River and does not include tributaries. Survey reports for the Devil's River are included under Project No. F-9-R-2, Job No. B-4, for the Pecos River under Project No. F-5-R-5, Job No. B-13, and for Terlingua Creek under Project No. F-5-R-2, Job No. B-11. In all, 680.1 miles of stream, beginning with the American Dam in El Paso and ending at the mouth of the Devil's River, were included in this investigation.

Findings:

Most of this mid-section of the Rio Grande can arbitrarily be classified as belonging to, or being dominated by, one of three basic ecological associations. (See Figure 1.) These are: turbid intermittent pool, permanent flow clear water, and turbid and indolent flow associations.

In an attempt to present a clear picture of the stream and its fishery potential, some materials and data obtained will be grouped and included under each association as it is taken up in discussion. This is also done so that the influence of the various associations on species distribution and relative abundance of species will be more apparent, and to attempt to prevent misleading data that would result from overall averages.

Intermittent Pool Associations: Nearly all of the stream that should be classified in this category is located above the river's confluence with the Concho River of Mexico. For over 293.5 miles, from El Paso to the mouth of the Conchos, the stream and its included fish life are adversely affected and regulated by intensive irrigation demands. As is illustrated in hydrology data in Tables 1 through 9, flow expands to great proportions only to return to a minimum flow within a few days. In that area of the state, over 1,200 miles of canals and laterals are constructed that carry water from the river to fulfill irrigation commitments for more than 155,000 acres annually. Other irrigation by wells from subsurface sources directly influence stream flow and are of extreme consequence during non-flow periods to residual pools. Irrigation demands are greatest in late spring and through the summer. During that time the stream is usually rapidly diminished until it is reduced to pools. These are then decreased by evaporation and seepage as water percolates into subsurface sands to fill vacancies created by withdrawals through wells for irrigation. Through these processes, the chemical composition of the remaining water is affected, and salinity, total dissolved solids, insoluble carbonates and pH increase. The stream bed is wide throughout most of this valley and flow velocities, except during occasional flooding, are rarely sufficient to adequately carry off suspended silt and organic debris. This debris decays rapidly in warm waters which sometimes exceed 90° F. In many instances, dissolved oxygen is reduced below critical requirements for many game fish, while carbon dioxide content nears saturation. Turbidity usually increases. More specific and detailed data are available in Tables 1 through 11, and as shown therein, oxygen deficiencies occasionally occur even when flow is above average. As a result of these conditions, most game fish and/or their progeny (if any) are destroyed. At the same time, undesirable tenaceous fish survive and successfully reproduce. Even when game fish of advanced sizes are released in these waters, their survival is at best temporary. At all gaging stations from the American Dam to Upper Presidio, lack of flow frequently occurs and usually lasts for ten or more succeeding days within each year. At the El Paso-Hudspeth County line, about mid-point of this stream area, flow was recorded for only 13 days in 1952, and for only 4 days in 1954. A few spring areas, such as the radioactive waters of Indian Springs in Hudspeth County, are present. Within these few widely separated spring areas, a few game fish survive.

In El Paso County, the terrain is uninhibiting and most of the stream is available and accessible to the public for fishing. However, from the Hudspeth County line to Presidio, access is often difficult or near impossible. Canals and a few small control reservoirs supply nearly all of the fishing for this area, and apparently offer the only potential means of meeting the public demand for recreation with the presently existing facilities. (See Figure 2.)

Permanent Flow Clear Water Associations: Beginning a few miles below the mouth of the Concho River, the stream bed narrows and the average fall of the stream increases from 3.89 feet per mile to 4.78 feet per mile. The frequency of

walled canyons increases and these constrict flow and increase velocity of the stream. From here, and continuing for many miles, a series of steps in the stream bed give momentum to flow between pools, and this movement is reduced as the water passes through the more level gradient of the pools. A build-up of ground water increases and tends to stabilize flow as irrigation demands decrease. Within 78 miles, a rapid transition takes place. The pools become more frequent and less turbid as flow from the subsurface is forced upward after appearing and disappearing many times in the stream bed. Water movement through pools is more pronounced and a permanent flow finally establishes between pools. Stream ecology changes so radically that it appears to be virtually unrelated to the previously described intermittent pools. Periodic floods and confined permanent flow of the stream are retained in narrow canyon walls such as Santa Elena, Mariscal, Boquillas and others, and the increased scouring action of the current sweeps gravel and rock rubble clear of debris that would otherwise be deposited from above. Clear waters are protected by canyon walls during much of the day from direct exposure to sunlight, and as a result, extreme temperatures are less common. As shown in Tables 12 through 14, the water quality improves and food production and other factors are conducive to game fish survival. This stream area, from a few miles below the mouth of the Concho River to a few miles below the mouth of Regan Canyon, is about 200 stream-miles long and is the largest and most desirable area of stream within this region that is now available to the public. However, this stream area is largely inaccessible and it was necessary to work much of the stream by floating trips that often included portages. (See Figure 3.) Future construction of access roads should make clear water associations more usable to the public.

Turbid Indolent Flow Associations: A few miles below the mouth of Regan Canyon the stream again broadens to fill the expanded canyon walls, velocity of flow decreases as gradient is reduced to 3.02 feet per mile. Meanders are broader and turns are longer and more gradual. Much of the silt and debris carried from above by flood waters is deposited in the stream bed, on bars at turns in the river, on occasional flood plains and along narrow shelves at the foot of canyon walls. The stream's basic direction shifts to align itself almost directly with the daily travel of the sun during the summer and stability of flow reduces as springs exercise less influence. The stream is usually very turbid, and in summer, water temperatures sometimes build up to and exceed 90° F. As shown in Tables 15 through 18, water quality decreases as salinity, total dissolved solids, and pH increase beyond desirable limits. Dissolved oxygen deficiencies are common, and excessive carbon dioxide content is frequently recorded. Fluctuations in the stream level prevents reliable spawning activity of many game fish and all factors tend to favor production of many undesirable species. Where infrequent springs or clear water flow enters the stream, such as the mouth of the Pecos and Devil's Rivers, Goodenough Springs, San Felipe Springs and a few others, game fish congregate and are sustained by those conditions. The 109 miles of stream between Regan Canyon and the mouth of the Devil's River are largely inaccessible. This is partly because of steep canyon walls that extend, virtually unbroken on the United States side, along the entire stream course. Also, landowners are not inclined to permit access to the river by persons who are unknown to them. Since this stream is an international boundary, their reasoning is obvious. This final association may be said to epitomize the popular public concept of the lazy Rio Grande. (See Figure 4.)

Other Basic Factors that Directly Influence Fish Life: As previously stated, local floods of a sporadic nature occur every year. However, more extensive

flooding is not uncommon. From 1902 to 1960, flooding that affected at least one or more of the described ecological areas occurred on 19 occasions. During that same period, seven major floods affected the entire length of the river. The effect of floods on fish life is not completely understood. However, tremendous current velocities are built up as tributaries fall into valleys. As these water levels exceed stream banks, the inundated loose soils of intensively cultivated fields are picked up and carried with the stream in great quantity. The stream load is probably greater than is common for many rivers, and is primarily made up of adobe, other adhesive clays, sand, gravel and organic debris. A smothering affect on some species of game fish or their progeny is believed to occur. It is also possible that chemicals toxic to fish, such as insecticides commonly used in agricultural practices, enter the stream during flood conditions. Many instances of fish kills have been reported during and immediately after flooding. (See Tables 19 and 26.)

Pollution is known to enter the stream from several sources on the United States watershed. Parts of Devil's River and the Pecos River are known to be polluted by oil field operations and lesser tributaries probably receive similar pollutants. The extent and total detrimental effect of this factor is not known, but hydrology and water quality data indicate that this damage may be extensive. Virtually nothing is known of sources of pollution from Mexico. However, the lack of soil conservation techniques, the lack of proper facilities for disposal of polluting substances, and public apathy where such problems are concerned is obvious.

In spite of the prevailing conditions, the production of invertebrate food for sustaining fish life is often excellent. Many beetle larvae (Coleptera), primarily of the genus Berosus, are present in the coarse gravel of clear water stream beds. Other insects and larvae encountered in clear water associations are larvae of crane flies, Diptera, mayflies and their nymphs, Ephemera, and damselflies and dragonflies, Odonata. Aquatic Hemiptera are also present.

In intermittent pools and in turbid slow-flow waters, only Diptera and their larvae were abundant. A few Hemiptera were also observed.

Mollusca were common but seldom abundant through the entire river.

Aquatic vegetation is not regarded as constituting a major problem in any of these stream associations. This is primarily the result of scouring action of periodic floods, the normal fluctuation of the stream and in many instances constant turbidity. A complete and accurate inventory of plants present was not possible under the conditions that prevailed when field work for this survey was done. However, some of the more important species that are known to occur are pondweeds (Potamogeton diversiflora) with additional species of that genus probably occurring, arrowhead (Sagittaria sp.), tapegrass (Vallisneria sp.), yellow waterlily (Nuphar advena), and muskgrass (Chara sp.). Positive species identification of most of these plants was impossible since such identification is often dependent upon flowering parts of the plants. It was necessary, because of other work commitments, that the survey work be done at a time when these parts of the plants were absent or were undeveloped. Along shores, cattails (Typha latifolia) were common and were especially numerous in sunny marshy areas near canals and in other places of permanent moisture. Other shore plants included were bulrushes (Scirpus americanus), rushes (Juncus nodosus) with other plants of this same genus also probably occurring, sedges (Carex sp.), smartweed (Polygonium sp.), desert willow (Chilopsis linearis), dock (Rumex mexicanus), alfalfa (Medicago saliva) that had escaped

from domestic cultivation, Dipetalis subulata which has no accepted common name, umbrellagrass (Fuirena hispida), common reeds (Phragmites communis), and giant reedgrass (Arundo donax). These latter reeds and reed-like plants are common on bars in the river, along shelves at the foot of steep canyon walls, and tend to border much of the stream on both sides as soil accumulations will permit. The most common trees along the Rio Grande are the cottonwood (Populus palmeri), quaking aspen (Populus tremuloides), and several species of willows (Salix nigra; Salix interior; Salix gooddingii; and Salix taxifolia). Ferns, Polypodiaceae, are common in a few spring areas. Beaver (Castor canadensis) are common along the clear water associations, and were very detrimental to nets used in sampling fish populations. Nutria (Myocastor coypus) are reported in lower regions of the watershed.

Species Present and Their Distribution: Several problems were encountered in establishing distribution of species. Decisions, involving the inclusion in the river's fauna of species that appeared to be endemic to springs near the mouths of tributaries, were required. In other instances, a particular species appeared to have temporarily expanded its distribution as a result of specific and unusual conditions that could not be expected to prevail for any extended period. Conformity of distribution, as governed by basic stream ecology, had to be considered. Consideration was also given to whether species introduced by hatcheries and bait dealers should be included.

Field work was adversely affected by several circumstances. Flooding prevented effective seining during much of the time spent making collections. No accurate and reliable means of predetermining stream conditions were discovered. This was because of the inaccessible nature of the stream, the lack of knowledge of the extent of rainfall in Mexico, and because of the length of time required to reach the stream from the regional headquarters. Flooding occurred during all field work with one exception. When the frequency of occurrence of flooding is taken into account, the degree of misfortune can be apparent. Much seining effort was rendered unproductive by the expansion of the stream during flooding on shore areas that were heavily vegetated. Counts of fish taken under the limiting circumstances are regarded as being entirely misleading. Because of this, the abundance of minnows and several other species is best expressed in discussion. The seining stations worked and a description of their location are included in Figure 8.

Annotated Checklist of Species of Fish
Occurring in the Chihuahuan or Mid-Rio Grande River

Lepisosteidae - Gars

Alligator gar (Lepisosteus spatula) were common but not abundant and were taken as far west as Presidio. They were much more common in lower stream areas after permanent turbidity is apparent.

Spotted gar (L. oculatus), whose presence was questioned and identity unconfirmed, was represented by a single fish from the mouth of the Pecos River. It was too large to be preserved with the ordinary equipment present when this collection was made.

Longnose gar (L. osseus) was the most common species of this group throughout the stream, and was taken in abundance as far west as the mouth of the Concho River. This species probably also occurs in a few localities in the intermittent pools above, but confirmation from netting is not yet obtained.

Clupeidae - Herrings

Gizzard shad (Dorosoma cepedianum) probably were the most common and relatively abundant species of the stream. They were less numerous but of greater size in clear water associations.

Caracidae - Tetras

Mexican tetra (Astyanax mexicanus) were very abundant near the mouth of the Devil's River, in San Felipe Springs, near the mouth of the Pecos River, and often abundant in other spring areas. They are probably located throughout the stream and tributaries as a result of introductions by bait dealers. None were taken west of the mouth of the Pecos River.

Catostomidae - Suckers and Buffalofishes

Blue sucker (Cycleptus elongatus) was found primarily in clear water associations as far west as Presidio. They were relatively abundant in a few localities, but never as dominating as other species of this group.

Smallmouth buffalo (Ictiobus bubalus) were taken as far west as Presidio. Young fish are abundant in Big Bend National Park, but never abundant in the other stream areas. Reproduction was indicated in riffle areas.

River carpsucker (Carpionodes carpio) were very abundant and the dominating species in intermittent pool associations and in turbid waters below Regan Canyon. It was encountered less frequently in clear waters with rapid flow where similar species appear to dominate. It was the most problematical species in the stream.

Gray redhorse (Moxostoma congestum) was common but seldom found in abundance, and was taken as far west as Presidio. It cedes dominance to other sucker-type fish in intermittent pool and turbid associations, but may be regarded as being in contention in clear rapid flow waters. It may occasionally be dominant in this latter association.

Cyprinidae - Shiners and Minnows

Carp (Cyprinus carpio) was found throughout the watershed but much more abundant in intermittent pools and in turbid waters. Possibly the most adaptable single species, it is regarded as being the second most problematic species in the watershed.

Golden shiner (Notemigonus crysoleucas) was present and known to be introduced from hatcheries. It was prevalent in small reservoirs such as Lake Ascarate and those of the Diablo tributary group.

Speckled chub (Hybopsis aestivalis) was apparently rare and not actually taken during this inventory. It was included in this region by Hubbs.

Rio Grande chub (Gila pandora), a riffles species, was found only in clear water associations near the mouth of the Devil's River and the Pecos River.

Rio Grande shiner (Notropis jemezianus) was common but of questionable abundance, and apparently located only east of the Big Bend.

Chihuahua (N. chihuahua) abounds from the mouth of the Concho River to the mouth of Santa Helena canyon.

Tamaulipas shiner (N. braytoni) was common and in localities relatively abundant, especially in Big Bend National Park.

Red shiner (N. lutrensis), the most widely spread species of minnow, was usually much less numerous than is common in tributaries.

Roundnose minnow (Dionda episcopa) was common and very abundant in clear water tributaries, but not collected west of the Pecos.

Devil's River minnow (D. diaboli) was found exclusively in the Devil's River.

Fathead minnow (Pimephales promelas) was common and abundant as far west as the Big Bend.

Mexican stoneroller (Campostoma ornatum), common but never numerous, was taken primarily near the mouth of Terlingua Creek and near Lajitas.

Ameiuridae - Freshwater Catfishes

Channel catfish (Ictalurus punctatus) was common but rarely abundant, and appears to dominate other species of this genus in intermittent pools and occasionally in very turbid waters. It yields dominance in clear water associations.

Blue catfish (I. furcatus) was probably the most important game species in the river and definitely so in clear water associations of the stream. This species tends to concentrate in clear pools below riffles and is particularly abundant near the mouth of the Pecos River and near the mouth of Santa Elena Canyon. It was regarded as being the most beautiful and desirable game fish of the catfish group.

Flathead catfish (Pylodictis olivaris) was common and relatively abundant for the species in a few localities. It is considered important commercially.

Cyprinodontidae - Killifishes and Topminnows

Rainwater killifish (Lucania parva) is primarily a Pecos River species, but believed to also be present in saline waters of other tributaries of the Rio Grande, and possibly in a few other specific areas of the river.

Rio Grande killifish (Fundulus zebrinus) occurs in a few backwaters in the Big Bend area, and may occur near the mouth of other tributaries that offer saline waters.

Poeciliidae - Mosquitofishes

Big Bend gambusia (Gambusia gaigei) was found only in Graham Ranch Spring in the Big Bend National Park.

Largespring gambusia (G. geiseri) was not collected, but believed to probably occur in some spring areas.

Mosquitofish (G. affinis), common and abundant, was primarily found in backwaters, canals, intermittent pools, and stock tanks along the river. It was abundant near Indian Springs.

Serraniae - Sea Basses

White bass (Roccus chrysops) was actually taken near the mouth of the Pecos River, but believed to migrate as far west as Regan Canyon.

Centrarchidae - Black basses and sunfishes

Largemouth bass (Micropterus salmoides) were not captured from the upper stream, and their status is questionable. However, the species is included in view of recent releases from hatcheries. Water quality and other data indicate that the species probably cannot be maintained without frequent reintroductions.

Redear sunfish (Lepomis microlophus) was not collected but included for the same reason as largemouth bass.

Green sunfish (L. cyanellus) was very common and abundant throughout the stream. Only a few of these fish were large enough to provide satisfaction to sportsmen.

Bluegill (L. macrochirus) was abundant and found in virtually all locations of the watershed, but was usually too small for sport.

Longear sunfish (L. megalotis) was rare in most areas, but taken in intermittent pools above Presidio, possibly as a result of introduction from hatcheries.

White crappie (Pomoxis annularis) was rare in the stream and limited to the El Paso area. Control reservoirs and stock tanks near the river contain this species.

Black crappie (P. nigromaculatus) was found only in Lake Ascarate and Devil's Lake, and also was probably released by hatcheries in the stream.

Sciaenidae - Croakers, Drum and Weakfishes

Freshwater drum (Aplodinotus grunniens) was taken as far west as Presidio, but was never abundant.

Relative Abundance of Principal Species as Indicated by Gill Net Collections:
The preceding checklist, which includes 42 species of fish from 11 families, was compiled primarily from seining collections and resulted from the examination of several thousand individuals. It is believed that relative abundance of the principal species is probably better expressed in tables of data made up from netting collections. Gill nets captured 1,523 fish and of this group, 292 (19.17 per cent) were game fish. This figure of relative abundance is higher than similar data for any of the other streams of this region. As is shown in Tables 21 through 44, most of the basic means of subsistence within the stream's waters has been diverted into unusable production, and this is especially true for intermittent pool associations.

A composite of all fish captured in the upper one-third of the stream, largely made up of the previously described intermittent pools, indicated that rough fish and forage species made up 94.27 per cent of the total fish. All game fish, 48 (or 5.73 per cent), of the total sample, were heavily parasitized and were otherwise in poor physical condition. Virtually no reproduction of game fish was indicated.

In clear water associations, 33.49 per cent of the total sample were game fish in excellent condition. This figure may be conservative as netting conditions were regarded as tending to bias sampling toward selection of forage and rough species. Other data are also interpreted to support this possibility.

Turbid indolent associations of the lower river were apparently above the stream average in game fish production. However, the 28.27 per cent figure obtained, indicating prevalence of game species, would have been considerably less if netting collections from the Lower Pecos River were not included. Actually, these collections could, or perhaps should, have been included in clear water associations because of the basic stream ecology. For these reasons, conclusions should not be made pertaining to the lower third of the river until future field work supplies data to fill this deficiency. Results from only four netting collections are available for the entire 109 stream miles that are between Regan Canyon and the mouth of the Pecos River.

Netting also indicates that Devil's Lake and Lake Walk are more productive of game fish than is the stream where sampling indicated that about 39.94 per cent of all fish were game fish. However, the inclusion of stunted white crappie and sunfishes make this figure debatable.

Conclusions:

Much of the Rio Grande River is the most productive stream in the region. This is certainly the longest and most desirable stream area for fishing that is now open for public access. For that reason, it is considered logical that management of the stream should be given priority. A basic problem of inaccessibility is being reduced through the construction of new roads, and many factors point to a greater use of the stream for recreation. Certain information and data obtained in this survey are regarded as being insufficient or are too biased to support final conclusions. For that reason, additional reconnaissance work should be done in the future when time is available for that work. A special study should be included in future work to determine what should be done to provide or facilitate maximum production of game fish in a new reservoir now being constructed in the Del Rio area.

Recommendations:

Further study should be made of the intermittent pool areas to determine if the extensive canal system of the El Paso area can be used to provide fishing. Additional inquiries should be made to determine if flood retention structures on tributaries of the stream can be employed to provide fishing for the public.

Reconnaissance work should be included in a future effort to supply more data on the stream from Regan Canyon to the mouth of the Pecos River. A

detailed study of the major reservoir now under construction near Del Rio should be made as soon as time is available for that work.

Prepared by Lawrence S. Campbell
Project Leader

Approved by Marion Toole
D-J Coordinator

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The following persons assisted in this survey:

State Game Wardens Edgar Sturdivant, George Vickers, Sanford DeVoll, Harvey Adams and Norbin Taylor, the officials of the National Bank Service, the staff of the Big Bend National Park, Dr. W. B. McDougal, Dr. Omer E. Sperry, Dr. Clark Hubbs, landowners Marty King of Comstock, Clay Slack and George McCarthy of Presidio, Ray Johnson of Alpine, and others, and personnel of the United States Air Force.

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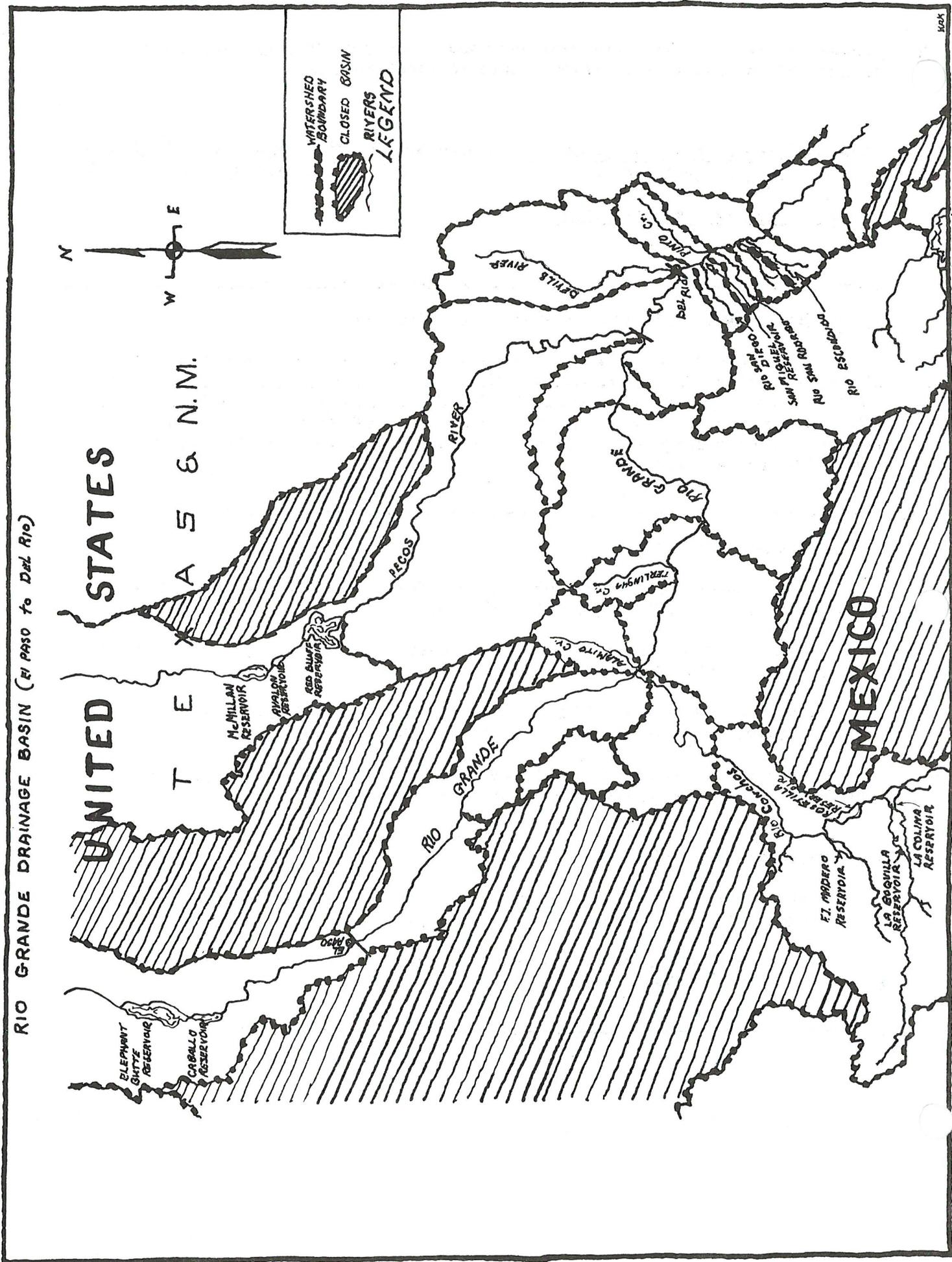
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Figure 1. Mid-section of the Rio Grande River
RIO GRANDE DRAINAGE BASIN (El Paso to Del Rio)



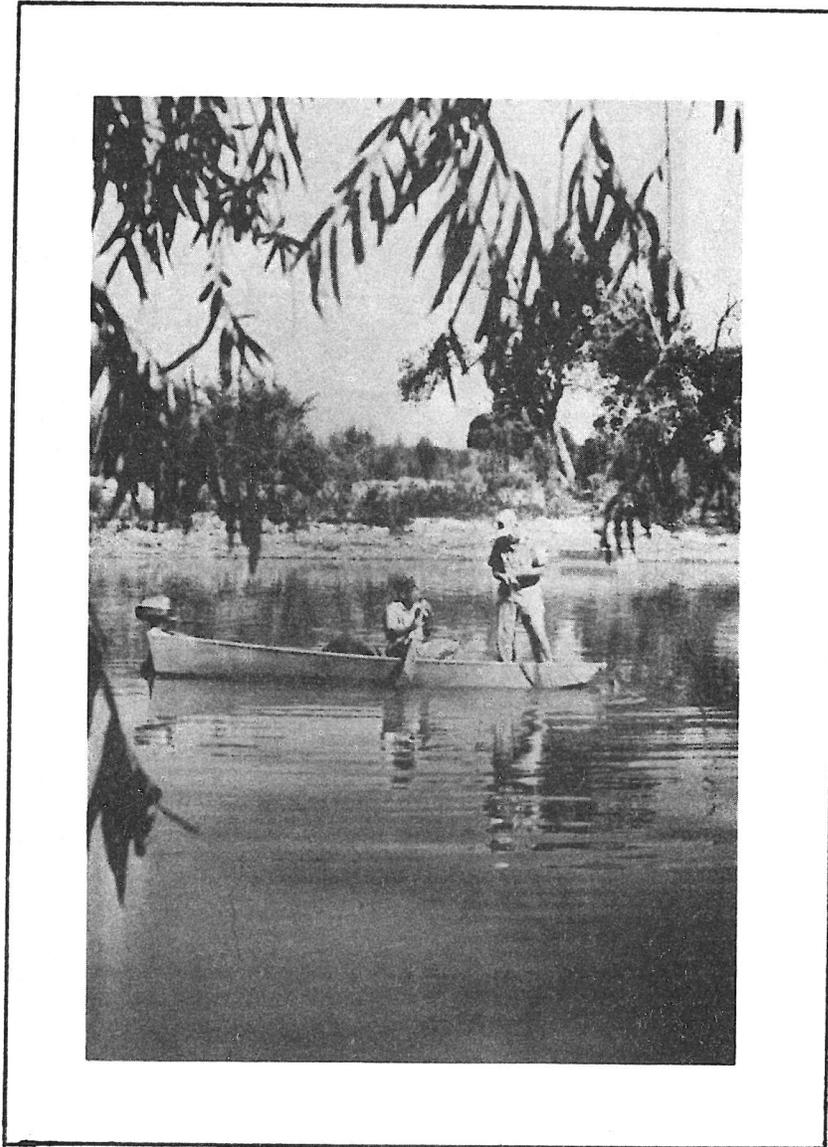


Figure 2 - Netting in the larger intermittent pools near Presidio.

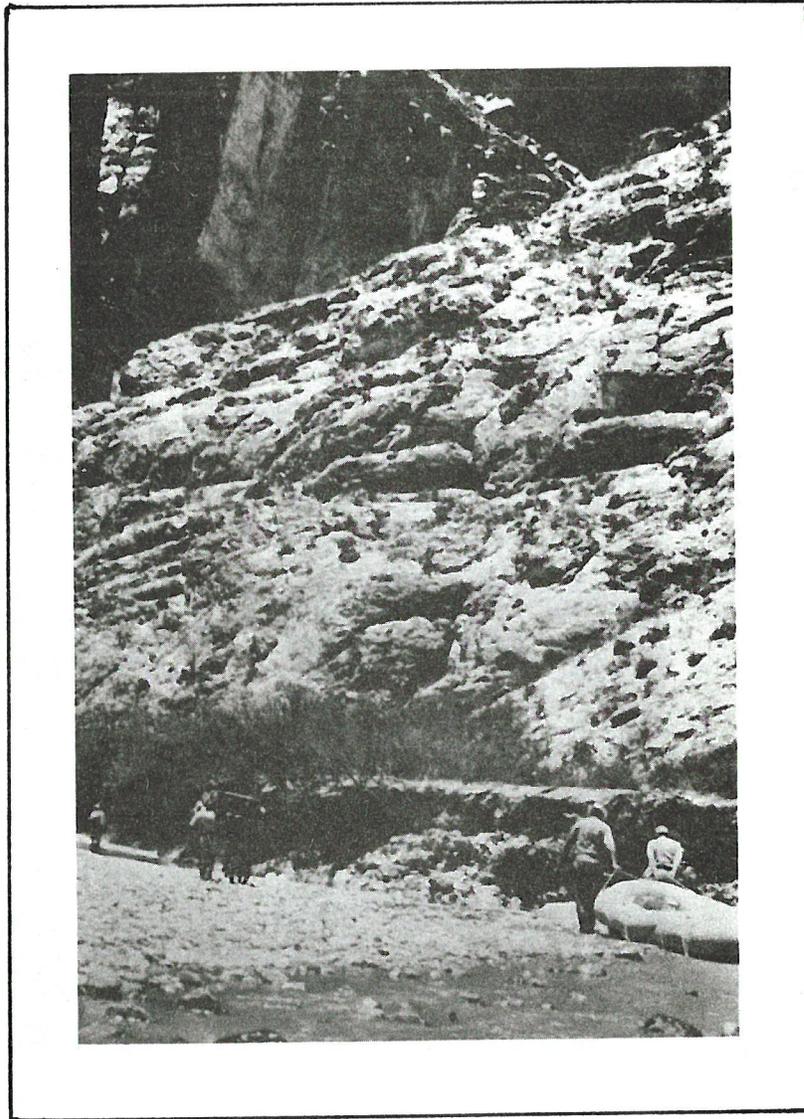


Figure 3 - Portages were common in the stream areas of intermittent pool association.

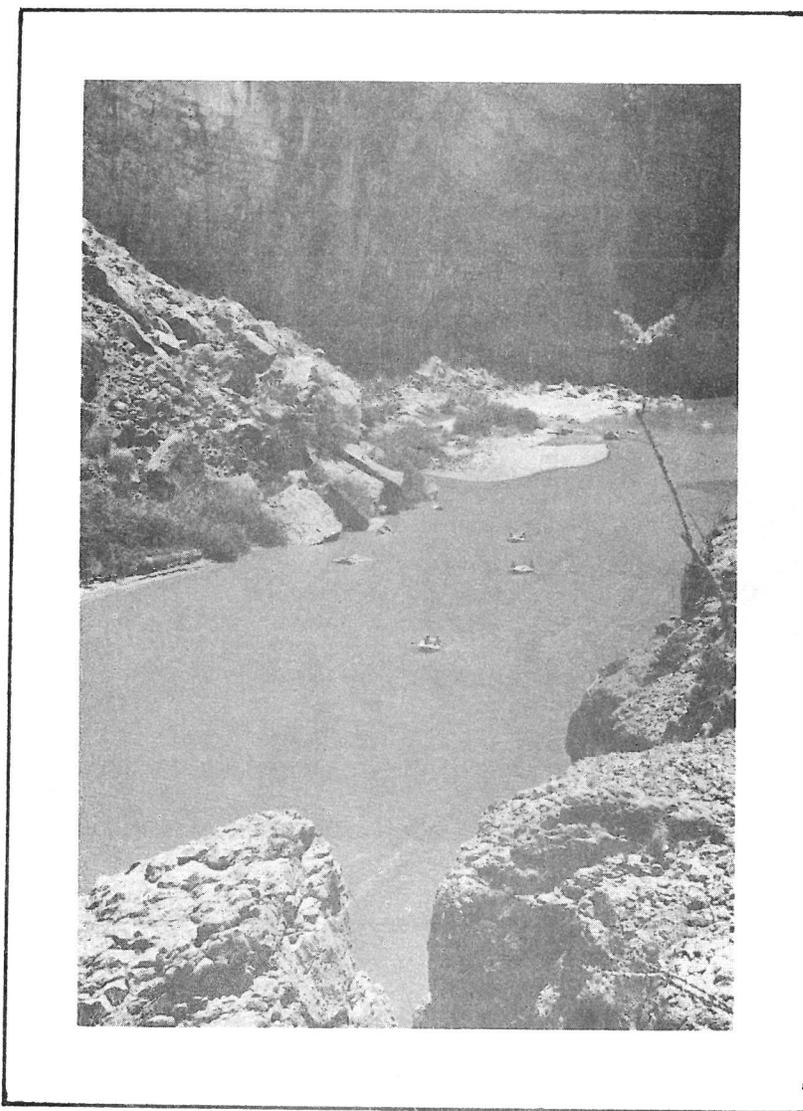


Figure 4 - Travel through Santa Elena Canyon after permanent flow is established.

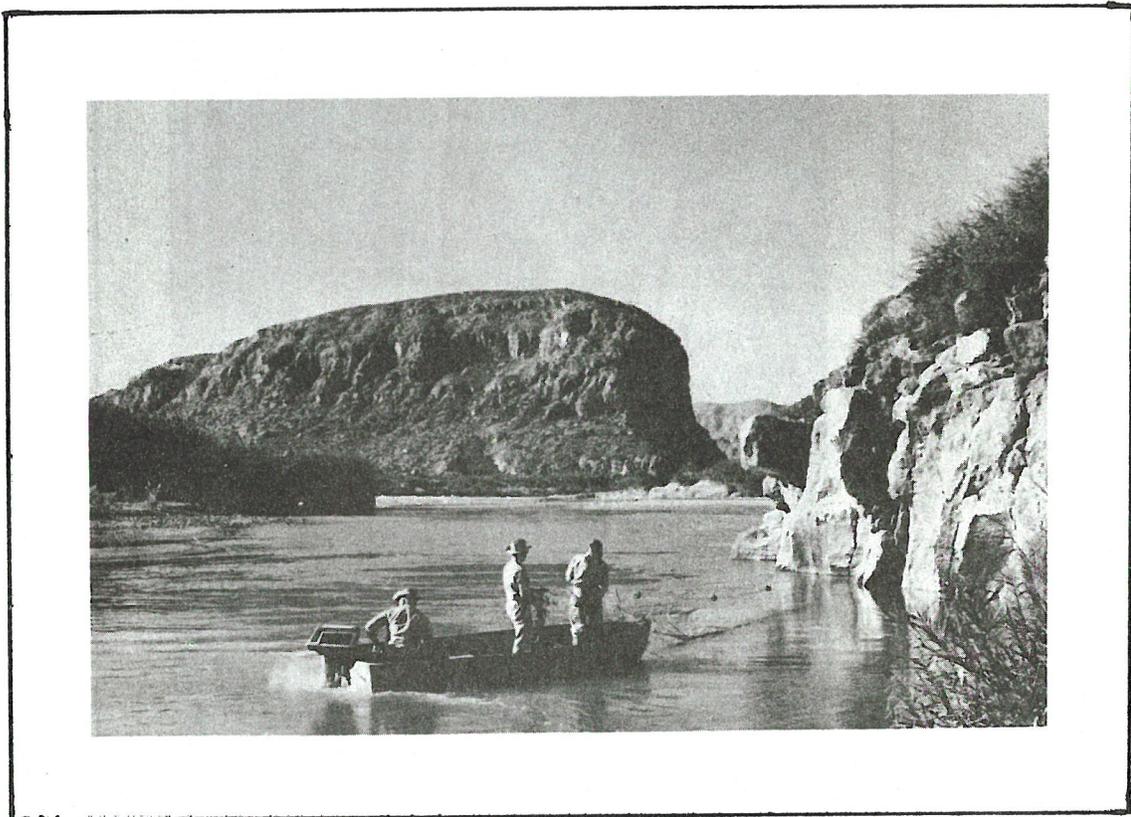


Figure 5 - Setting gill nets near the mouth of Horse Canyon on the Black Gap Wildlife Management Area.

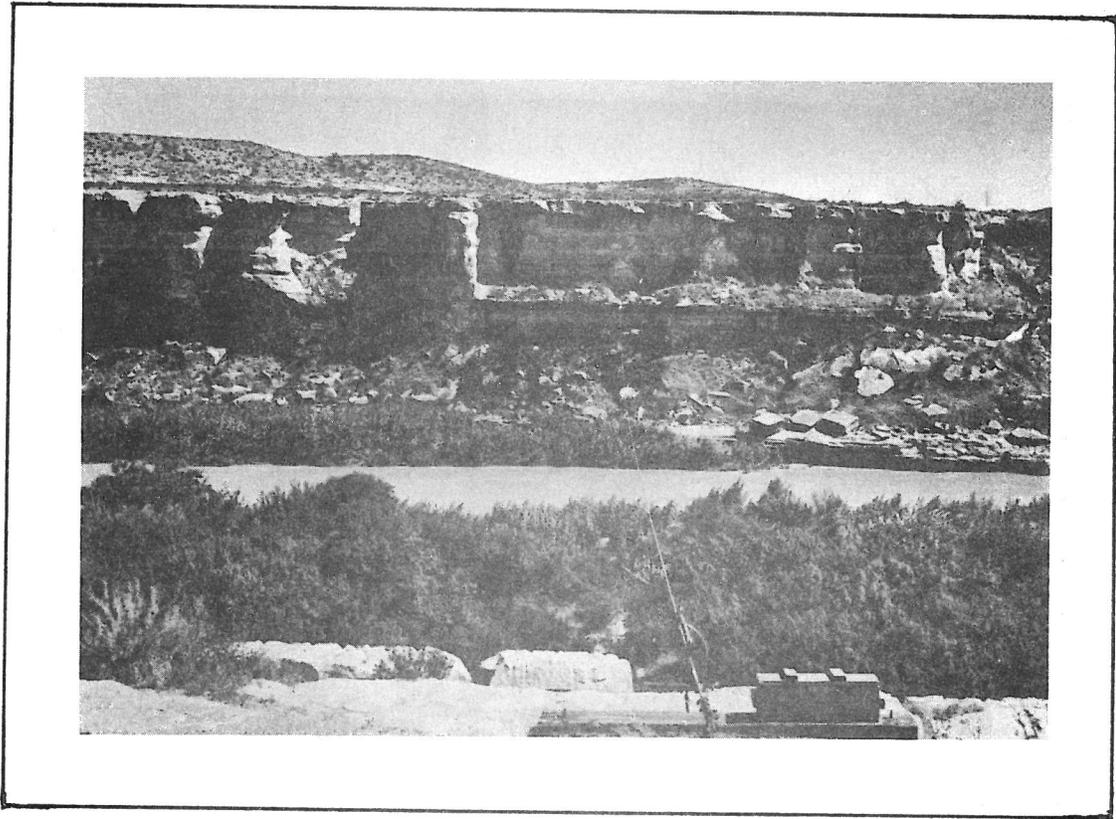


Figure 6 - The turbid-oolite association at Langtry.

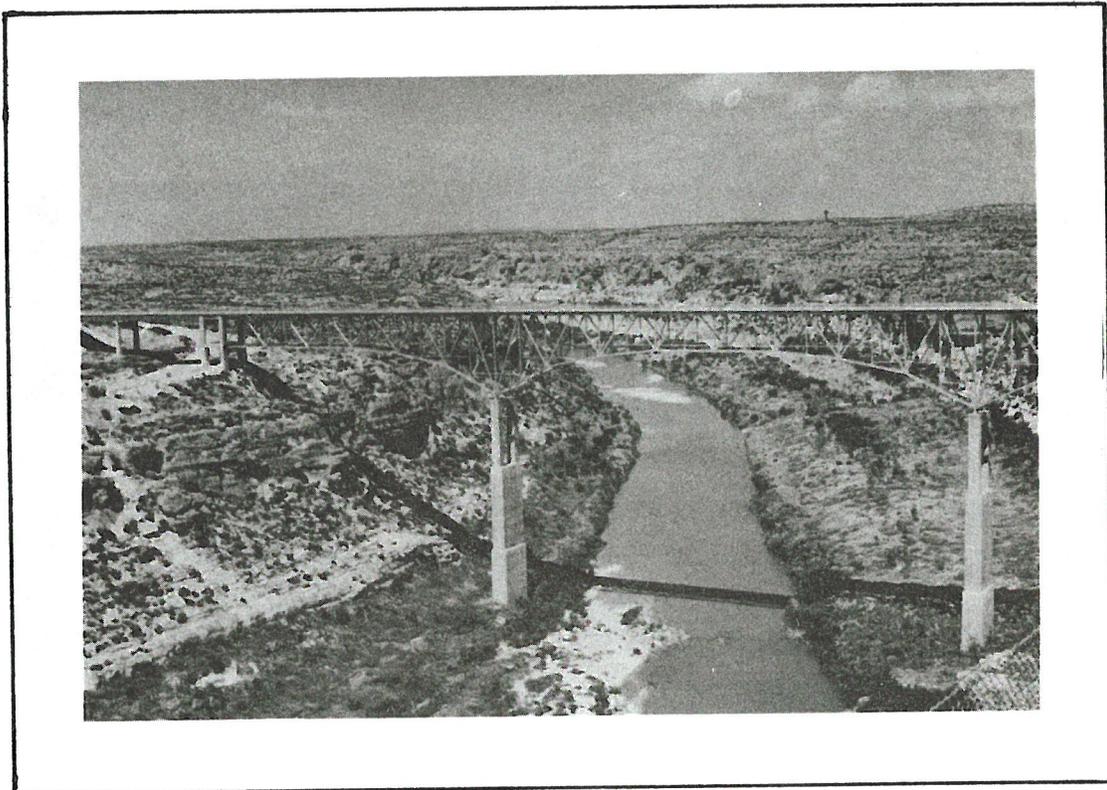


Figure 7 - The mouth of the Pecos River near Comstock.

Figure 8. Location and description of seining stations

1. Lake Ascarate, located in the city of El Paso in Ascarate Park in the south-east quarter of the city.
2. Rio Grande River at Island Station near Clint, Texas, 27 stream-miles below the American Dam on rectified channel.
3. Fort Quitman, 81 stream-miles below the American Dam at a historic site.
4. Indian Springs, a health resort southeast of Sierra Blanca near the mouth of Quitman Arroya.
5. Upper Presidio Station, 7.8 miles above the confluence of the Concho Rivers of Mexico near Chinati.
6. Mouth of the Concho River, 3.7 miles above International Bridge in Presidio.
7. Lower Presidio Station, two miles below the mouth of the Concho River.
8. Mouth of Alamito Creek, six miles below and east of Presidio.
9. McCarthy Farm, about eight miles below or east of Presidio.
10. Clay Slack Farm, about five miles east of Presidio.
11. Redford Station, located 1.5 miles south of Redford community.
12. Lower Redford Station, located four miles east of Redford.
13. Upper Lajitas Station, four miles northwest of Lajitas.
14. Lajitas, one mile above to one mile below Lajitas store.
15. Lower Lajitas Station, approximately four miles east of Lajitas.
16. Entrance of Santa Elena Canyon, approximately eight miles east of Lajitas.
17. Mouth of Santa Elena Canyon and mouth of Terlingua Creek, about a 500-yard area near these locations. Big Bend National Park.
18. Castolon Station, one mile below Castolon. Big Bend National Park.
19. Smoky Creek Station, located about one mile below the mouth of Smoky Creek. Big Bend National Park.
20. Johnson's Ranch, Big Bend National Park.
21. Solis Ranch Station. Big Bend National Park.
22. Graham Ranch at Hot Springs. Big Bend National Park.
23. Boquillas Station, in riffle areas near crossing to village of Boquillas. Big Bend National Park.

24. Stillwell Crossing Station, one mile radius of this crossing, Blackgap Wildlife Management Area, Texas Game and Fish Commission.
25. Mouth of Horse Canyon Station, near mouth of this canyon, Blackgap Wildlife Management Area, Texas Game and Fish Commission.
26. Maravallis Creek Station, area of mouth of this creek, Blackgap Wildlife Management Area, Texas Game and Fish Commission.
27. Regan Canyon Station, near mouth of this canyon, about 30 miles south of Sanderson.
28. Langtry Station at Langtry.
29. Goodenough Springs, 12 miles southwest of Comstock at springs.
30. Pecos River Station, area near the mouth of the Pecos River.
31. Devil's River Station, area near the mouth of the Devil's River.

Figure 9. Location and description of gill netting stations

1. Lake Ascarate, located in the city of El Paso in Ascarate Park in the south-east quarter of the city.
2. Upper Presidio Station, 7.8 miles above the confluence of the Concho Rivers of Mexico.
3. Mouth of Concho River, 3.7 miles above the International Bridge.
4. McCarthy Farm, about eight miles below and east of Presidio.
5. Clay Slack Farm, about five miles east of Presidio.
6. Lajitas Station, one mile above and one mile below Lajitas store.
7. Lower Lajitas Station, four miles below Lajitas.
8. Upper Santa Elena Station, four miles above entrance to Santa Helena Canyon.
9. Mid-Santa Elena Station, in canyon about two miles above mouth.
10. Mouth of Santa Elena Canyon, at mouth of Terlingua Creek, Big Bend National Park.
11. Stillwell Crossing Station, at crossing and for several miles below to the mouth of Horse Canyon, Blackgap Wildlife Management Area, Texas Game and Fish Commission.
12. Horse Canyon Station, at mouth of this canyon and extending to the mouth of Marvallis Canyon, Blackgap Wildlife Management Area, Texas Game and Fish Commission.

13. Maravallis Station, at mouth of this canyon and extending below and east along the river for seven miles, Blackgap Wildlife Management Area, Texas Game and Fish Commission.
14. Langtry Station at Langtry.
15. Rio Grande River above the mouth of the Pecos River, the area beginning two miles above the mouth of the Pecos River and to the mouth.
16. Rio Grande River at the mouth of the Pecos, the stream area within one mile of the mouth of the Pecos River.
17. Pecos River above mouth, two miles above the mouth of the Pecos River.
18. Rio Grande River below the Pecos River, the area within two miles below the mouth of the Pecos River.
19. Devil's River Station, the area within one mile of the mouth of the Devil's River.
20. Upper Devil's Station, Devil's Lake and Lake Walk.

Table 1. Rio Grande River below American Dam

Extreme Flow From Records: Momentary: Maximum 6,770 second-feet on May 18, 1942, with a gage height of 9.77 feet. Minimum .1 second-foot on November 15, 1954.

Average Flow in Second-Feet

Daily:	Max. 6,040	May 20, 1942	Min. .1	Nov. 15, 1954
Monthly:	Max. 4,880	May 1942	Min. .5	Nov. 1954
Yearly:	Max. 1,510	1942	Min. 29.9	1954

Average Flow Period June 1938-1954

Acre-Feet

	Average	Maximum	Minimum
January	7,818	12,000	3,250
February	4,651	32,800	521
March	3,121	17,500	91
April	11,089	74,500	2,230
May	29,639	300,000	4,290
June	25,148	250,000	300
July	20,504	155,000	2,070
August	18,067	114,000	3,070
September	17,095	124,000	198
October	3,508	19,000	197
November	2,507	8,700	28
December	1,603	7,760	120
Yearly	144,750	1,093,553	21,640

Table 2. Rio Grande at El Paso, Texas

Extreme Flow From Records: Maximum 24,000 second-feet on June 12, 1905, with a gage height of 6.0 feet at the lower gage. Minimum occasionally no flow. Since Elephant Butte Dam was closed in 1915, the largest peak flow to pass this station was 13,500 second-feet on September 3, 1925.

Average Flow in Second-Feet

Daily:	Max. 23,680	June 12, 1905	Minimum 0	Occasionally
Monthly:	Max. 14,300	June 1905	Minimum 0	Occasionally
Yearly:	Max. 2,780	1905	Minimum 70.1	1902

Average Flow Period 1924-1954

Acre-Feet

	Average	Maximum	Minimum
January	10,277	17,500	3,250
February	16,758	52,200	2,010
March	37,381	62,500	5,470
April	61,220	139,000	22,700
May	69,076	357,000	12,700
June	71,165	304,000	12,500
July	77,855	198,000	16,200
August	80,292	158,000	11,700
September	58,465	171,000	2,430
October	23,667	57,900	3,790
November	15,515	29,500	540
December	14,580	27,700	435
Yearly	536,251	1,559,200	93,725

Table 3. Rio Grande at Island Station

Extreme Flow From Records: Momentary: Maximum 6,490 second-feet on May 19, 1942, with a gage height of 16.06 feet. Minimum frequently no flow.

Average Flow in Second Feet

Daily:	Maximum 6,140	May 19, 1942	Minimum 0	Frequently
Monthly:	Maximum 4,880	May 1942	Minimum 0	Several months 1951, 1953, and 1954
Yearly:	Maximum 1,490	1942	Minimum 7.9	1952

Average Flow Period September 1938-1954

Acre-Feet

	Average	Maximum	Minimum
January	7,549	11,900	2,020.0
February	5,831	37,000	161.0
March	3,931	21,000	20.2
April	7,182	70,500	5.0
May	21,236	299,800	1.4
June	17,950	241,000	0.0
July	13,790	118,500	0.0
August	12,699	99,400	277.0
September	14,758	119,200	0.0
October	6,668	42,800	0.0
November	1,581	7,270	0.0
December	3,063	12,900	0.0
Yearly	116,238	1,079,340	5,708.5

During 97 days there was flow of water.

Table 4. Rio Grande at Fort Quitman

Extreme Flow From Records: Momentary: Maximum 10,600 second-feet on October 5, 1946, with a gage height of 10,000 feet. Minimum frequently no flow.

Average Flow in Second Feet

Daily:	Maximum 5,890	May 19, 1942	Minimum 0	Frequently
Monthly:	Maximum 5,030	May 1942	Minimum 0	April and May, 1952
Yearly:	Maximum 1,750	1942	Minimum 15.3	1952

Average Flow Period 1938-1954

Acre Feet

	Average	Maximum	Minimum
January	11,778	20,900	165.0
February	11,674	50,100	164.0
March	9,674	38,900	0.0
April	12,019	77,000	0.0
May	21,812	309,000	20.2
June	19,859	240,000	973.0
July	20,682	140,000	185.0
August	25,443	127,000	108.0
September	28,680	147,000	51.6
October	21,222	66,500	67.6
November	13,650	24,500	43.2
December	14,131	31,000	
Yearly	210,624	1,270,400	11,129.0

There was a daily discharge in second-feet of water for 345 days

Table 5. Rio Grande at County Line Station

Extreme Flow From Records: Momentary: Maximum 6,340 second-feet on May 19, 1942, with a gage height of 8.66 feet. Minimum frequently no flow.

Average Flow in Second-Feet

Daily:	Maximum 6,180	May 18, 1942	Minimum 0.0	Frequently
Monthly:	Maximum 4,920	May 1942	Minimum 0.0	Frequently
Yearly:	Maximum 1,720	1942	Minimum .5	1952 and 1954

Average Flow Period 1938-1954

	Acre Feet		
	Average	Maximum	Minimum
January	11,646	20,000	0
February	10,059	47,900	0
March	8,818	38,900	0
April	13,343	84,200	0
May	25,719	303,000	0
June	22,719	239,000	0
July	20,834	140,000	0
August	19,909	123,000	0
September	22,754	140,000	0
October	15,173	61,400	0
November	10,252	20,400	0
December	11,293	29,700	0
Yearly	192,519	1,247,500	347.5

There were 362 days of daily discharge.

Table 6. Rio Grande at Upper Presidio Station

Extreme Flow From Records: Momentary: Maximum 14,000 second-feet on June 14, 1905. A gage height of 10.57 feet was recorded on May 26, 1942, with a flow of 5,160 second-feet. This level was the highest reached during the years 1923-1954, inclusive. Minimum frequently no flow.

Average Flow in Second-Feet

Daily:	Maximum 13,700	June 13 and 14, 1905	Minimum 0	Frequently
Monthly:	Maximum 10,150	June 1905	Minimum 0	Frequently
Yearly:	Maximum 1,970	1905	Minimum 0	1953

Average Flow Period 1924-1954

	Acre Feet		
	Average	Maximum	Minimum
January	10,979	24,400	0.0
February	10,169	40,800	0.0
March	8,059	39,100	0.0
April	6,631	41,600	0.0
May	15,892	240,000	0.0
June	15,628	216,000	218.0
July	21,590	158,000	13.1
August	27,970	133,000	120.0
September	31,168	151,000	0.0
October	26,713	105,000	0.0
November	12,787	34,500	0.0
December	12,422	30,900	0.0
Yearly	200,008	1,176,700	9,085.0

There were 129 days daily discharge of water.

Table 7. Rio Concho River near Okinaga, Chihuahua

Extreme Flow From Records: Momentary: Maximum 162,000 second-feet on September 11, 1904. Minimum no flow several days in May, June, July, 1953.

Average Flow in Second-Feet

Daily: Maximum	148,900	September 11, 1904	Minimum	0.0	Several days 1953
Monthly: Maximum	23,540	September 1904	Minimum	11.0	May, 1902
Yearly: Maximum	3,720	1914	Minimum	155.0	1953

Average Flow Period 1924-1954

	Acre Feet		
	Average	Maximum	Minimum
January	53,877	147,000	11,500
February	47,358	87,700	10,600
March	42,134	80,800	5,410
April	28,228	79,700	855
May	33,991	148,000	1,560
June	39,975	91,900	760
July	88,188	502,000	8,890
August	118,531	601,000	7,660
September	233,922	1,173,000	6,770
October	144,138	798,000	5,890
November	56,395	110,000	9,510
December	48,895	97,700	9,940
Yearly	935,532	2,431,850	111,885

Table 8. Rio Grande at lower Presidio station

Extreme Flow From Records: Momentary: Maximum 162,000 second-feet on September 11, 1904. Minimum 0 occasionally in 1953.

Average Flow in Second-Feet

Daily:	Maximum	149,200	September 11, 1904	Minimum	.1	May 10, 1953
Monthly:	Maximum	24,870	September 1904	Minimum	7.8	April 1953
Yearly:	Maximum	4,870	1906	Minimum	163.0	1953

Average Flow Period 1924-1954

Acre Feet

	Average	Maximum	Minimum
January	64,945	164,000	11,600
February	57,425	99,700	10,700
March	50,150	89,400	5,400
April	34,303	84,100	464
May	49,608	270,000	1,760
June	55,313	267,000	4,540
July	109,062	564,000	8,910
August	146,174	675,000	10,200
September	265,141	1,324,000	7,370
October	170,966	864,000	6,050
November	69,252	141,000	9,510
December	61,365	116,000	9,940
Yearly	1,133,704	3,466,700	117,734

Table 9. Water quality data for the Rio Grande near Anthony, El Paso County
September 1957 thru November 1959

Station	Dates of Collection of Samples										1957-1958	
	9/57	10/15	10/29	12/3	1/3	1/17	2/4	2/20	3/4	3/21	4/2	4/18
URG-7	7.7	7.7	7.9	7.8	7.9	8.0	8.0	7.9	7.8	7.5	7.8	7.8
TOT.SOL.	462	597	1410	1596	2850	3120	4200	4080	612	510	519	630
CHLORIDE	48	92	280	152	620	700	920	980	90	60	56	60
SULPHATE	253	955	850	675	925	763	1200	1225	136	251	245	247
CL.DEM.	1.8	1.8	.9	0.9	0.9	0.9	0.9	3.5	1.8	0.5	0.5	.5
D.O.	4.8	6.1	7.4	9.0	8.3	8.5	7.7	5.6	5.3	6.1	7.0	5.6
B.O.D.	0.5	.5	1.6	0.5	1.0	1.8	2.7	0.5	1.6	0.5	2.4	.5
Station	Near Anthony			Dates of Collection of Samples					Bridge US 80		1958	
URG-7	5/2	5/15	6/3	6/16	7/1	7/16	8/4	8/18				
pH	7.8	7.7	7.8	7.9	8.0	7.6	8.0	7.9				
TOT.SOL.	498	510	630	543	540	516	542	528				
CHLORIDE	52	60	70	68	68	64	68	64				
SULPHATE	230	343	216	216	205	238	229	490				
CL.DEM.	0.5	0.9	3.5	0.5	2.7	0.9	0.5	0.5				
D.O.	6.0	4.4	4.8	5.3	5.0	3.2	4.6	3.9				
B.O.D.	0.5	0.5	0.6	0.5	0.5	0.5	0.5	1.5				
Station	Same			Dates of Collection of Samples					Bridge US 80		1959	
URG-7	9/58	9/15	10/13	10/37	11/6	11/19	12/9	12/29	1/8/59	1/22	2/3	2/24
pH	7.5	7.7	8.0	8.0	8.1	8.1	8.0	8.4	8.0	8.1	E	8.1
TOT.SOL.	522	422	1230	1350	1440	1380	1500	1476	1500	1500	P	1770
CHLORIDE	80	92	100	210	240	260	300	260	260	260	T	300
SULPHATE	248	180	375	420	420	500	525	480	480	500	Y	480
CL.DEM.	0.5	0.9	1.8	0.5	0.5	1.8	0.9	1.8	0.9	2.7		0.9
D.O.	0.3	6.4	5.9	6.9	5.5	8.5	9.3	10.0	7.3	6.0		8.3
B.O.D.	1.7	0.5	1.1	1.6	0.5	0.5	0.5	1.0	2.5	1.6		1.2
Station	Same			Dates of Collection of Samples					Bridge US 80		1959	
URG-7	3/10	3/23	4/6	4/15	5/6	5/21	6/4	6/19	7/1	7/13	8/6	8/18
pH	7.2	7.9	7.8	7.7	7.7	7.8	7.7	E	7.6	7.7	7.7	7.7
TOT.SOL.	460	417	540	591	570	615	564	P	528	580	581	585
CHLORIDE	60	60	72	76	72	120	76	T	68	76	82	72
SULPHATE	193	185	200	200	220	230	200	Y	195	210	230	240
CL.DEM.	2.7	0.5	1.8	0.5	8.3	0.5	0.3		5.3	0.5	2.7	0.5
D.O.	7.1	6.1	6.2	4.8	5.2	5.3	4.2		5.3	5.0	3.4	4.0
B.O.D.	0.5	0.5	0.5	1.5	1.0	0.8	0.5		0.5	0.5	2.0	1.4
Station	Same			Dates of Collection of Samples				Bridge US 80		1959		
URG-7	9/14/59		9/29	10/12	10/27	11/10	11/23					
pH	8.0		8.1	7.9	7.9	8.2	8.2					
TOT.SOL.	585		1440	1500	1440	1530	1470					
CHLORIDE	110		240	230	240	280	58					
CL.DEM.	0.6		0	2	1.5	6.5	2.0					
D.O.	6.5		7.0	4.1	7.0	8.0	7.8					
B.O.D.	0.5		0.5	1.0	0.5	1.5	0.5					

From September 1958 through December 1959 there was no water in the river at the international bridge in El Paso, and this condition prevailed in Hudspeth County as far east as Fort Hancock. Flow was minor and no water quality data was available from that point to Presidio.

Table 10. Water quality data for the Rio Grande near Presidio
February 1957 thru November 1959

Station	Dates of Collection of Samples											1957
URG-3	2/20/57	3/15	4/25	5/13	6/4	6/17	6/3	7/16	7/31	8/18	8/31	
pH	7.8	7.7	7.5	7.6	7.2	7.3	7.3	7.6	7.5	7.8	7.2	
TOT. SOL.	1200	1530	2070	1980	954	1470	1080	1500	234	285	612	
CHLORIDE	152	160	300	300	90	200	160	220	12	16	32	
SULPHATE	492	531	802	778	395	47	549	520	66	32	245	
CL. DEM.	0.5	0.5	0.5	0.5	0.5	2.7	0.5	3.5	6.2	0.9	0.5	
D.O.	8.3	9.6	7.0	7.0	5.6	5.3	5.9	4.9	2.1	5.1	4.0	
B.O.D.	2.0	0.5	1.2	0.6	0.5	0.5	0.5	0.5	0.5	2.1	0.5	
Station	Dates of Collection of Samples											1957-1958
URG-3	8/20/57	9/1	9/21	10/31	11/21	12/12	12/27	12/18	1/10	1/21	8/7	4/5
pH	7.0	7.4	7.6	7.2	7.9	7.5	7.9	8.0	7.7	8.0	7.8	7.5
TOT. SOL.	1425	1020	88	1296	1290	1428	990	2226	1092	1320	1320	1440
CHLORIDE	20	140	140	140	130	130	150	320	130	120	160	430
SULPHATE	900	450	560	570	425	515	56	875	505	550	494	810
CL. DEM.	2.7	0.5	0.5	1.8	.5	0.9	.5	3.5	1.8	1.8	0.5	.5
D.O.	3.5	4.6	5.7	7.0	8.1	6.1	6.9	8.3	8.2	8.9	9.2	6.4
B.O.D.	3	4.0	0.5	.5	6.9	1.7	2.9	.5	.5	6.5	0.5	2.6
Station	Dates of Collection of Samples											1958
URG-3	4/6	4/19	5/14	6/2	6/17	7/2	7/17	8/6	8/23			
pH	E	7.6	7.6	7.6	7.6	7.2	7.3	7.7	7.5			
TOT. SOL.	P	1248	1500	1374	1224	1050	1182	1170	510			
CHLORIDE	T	140	160	170	160	80	150	130	36			
SULPHATE	Y	600	540	640	570	620	450	480	350			
CL. DEM.		0.9	0.5	2.7	0.5	1.8	1.8	0.9	0.5			
D.O.		8.9	5.5	6.6	6.7	3.5	6.6	6.1	4.9			
B.O.D.		1.7	0.5	1.8	0.5	1.6	2.4	1.6	0.5			
Station	Dates of Collection of Samples											Bridge US 67 1958-1959
URG-3	9/14/58	9/23	10/15	10/30	11/18	12/11	12/28	1/14/59	1/29	2/19	3/4	3/16
pH	7.8	7.6	7.5	7.7	8.0	7.9	8.2	8.0	7.9	8.0	7.4	7.5
TOT. SOL.	288	249	411	447	972	1164	1110	1098	1280	1320	1380	1260
CHLORIDE	24	16	32	32	100	120	120	140	160	160	160	180
SULPHATE	62	60	146	124	420	513	480	490	520	560	580	650
CL. DEM.	1.8	0.5	0.9	0.5	0.5	0.5	0.9	1.8	0.9	0.9	0.9	1.8
D.O.	1.2	2.4	5.2	6.2	8.4	10.3	9.3	8.9	5.5	8.5	6.9	8.4
B.O.D.	0.5	1.0	4.2	0.5	0.6	4.0	1.3	0.8	0.5	1.4	1.0	0.5
Station	Dates of Collection of Samples					Bridge US 67 1959						
URG-3	9/12/59	9/29	10/16	11/14	11/27							
pH	8.0	7.9	7.9	8.3	7.9							
TOT. SOL.	960	1170	1170	1400	1080							
CHLORIDE	90	125	118	120	115							
SULPHATE	380	465	443	480	470							
CL. DEM.	0	0	2	2	1.0							
D.O.	7.4	6.5	6.8	11.4	9.2							
B.O.D.	2.0	0	0.5	1	0.5							

Table 11. Water quality data from the Rio Grande at Ojinaga, Chihuahua

Sampling by U.S. Section

Month	No. of Samples	Dissolved Solids Tons per Acre-ft	Total Tons	PH	Ca	Mg	Na	HCO	SO	CL	NO
Jan.	6	1.40	16,100	7.8	5.70	1.76	7.70	2.90	8.98	3.40	.03
Feb.	6	1.39	14,700		#7.06		7.48	2.95		3.00	
Mar.	8	1.40	7,570		#7.36		7.90	2.60		3.55	
Apr.	6	1.18	1,090		#8.06		4.53	2.63		2.15	
May	10	1.37	2,140		#9.75		4.08	2.70		2.15	
June	6	1.62	1,230		#9.39		7.86	2.30		4.90	
July	5	1.16	17,000	8.0	6.74	1.10	4.20	2.45	7.94	1.90	.03
Aug.		.58	76,500		#3.95		2.45	2.42		.89	
Sept.	5	.89	44,500		#5.17		4.53	2.71		1.55	
Oct.	4	1.17	29,400		#6.47		6.13	3.50		2.40	
Nov.	4	1.38	19,100		#7.66		7.10	3.37		2.85	
Dec.	5	1.50	15,500		#7.96		7.98	3.15		3.55	
Mean \emptyset	65	.885	\emptyset 244,830		#5.33		4.24	2.69		1.66	
Period Avg.		.623	514,000		#4.20		2.63	2.60		.955	
Tons of Constituents-1954					36,700		36,700	30,400		22,100	
Avg. Tons Period-1935/1954					67,800		67,800	87,600		38,000	

Rio Grande at Johnson Ranch, Texas

Month	No. of Samples	Dissolved Solids Tons per Acre-ft	Total Tons	PH	Ca	Mg	Na	HCO	SO	CL	NO
Jan.	13	1.41	15,900	7.8	6.02	1.88	7.85	2.95	9.48	3.50	.02
Feb.	12	1.43	13,500		#7.26		8.08	2.80		3.35	
Mar.	14	1.49	6,620		#7.76		8.50	2.63		3.70	
Apr.	12	.97	19,700		#6.67		3.90	3.83		1.00	
May	14	.76	8,820		#5.77		2.25	2.60		.45	
June	18	.73	31,200		#4.88		2.65	3.20		.60	
July	14	.93	18,600		#5.08	.79	3.84	2.65	6.25	.95	.04
Aug.	16	.73	146,000	8.0	#6.17		2.28	3.20		.65	
Sept.	15	.88	55,100		#5.57		4.02	3.00		1.70	
Oct.	6	.96	39,500		#5.87		4.74	3.05		1.95	
Nov.	12	1.35	22,100		#6.47		7.98	1.45		3.60	
Dec.	13	1.44	18,700		#6.96		8.28	1.71		4.00	
Mean \emptyset	159	.874	\emptyset 395,740		#6.05		3.62	3.02		1.29	
Period Avg.		.934	495,000		#5.58		4.45	2.71		2.01	
Tons of Constituents-1954					51,300		51,300	55,800		28,200	
Avg. Tons Period-1948/1954					73,800		73,800	58,700		51,300	

\emptyset Total weighted mean. # Sum of calcium and magnesium.

Table 12. Rio Grande at Johnson Ranch, Big Bend National Park

Extreme Flow From Records: Momentary: Maximum 58,800 second-feet on September 23, 1938, with a gage height of 19.75 feet. Minimum 0 several days in 1953.

Average Flow in Second-Feet

Daily:	Maximum 56,900	September 10, 1942	Minimum 0.0	Several days 1953
Monthly:	Maximum 23,600	September 1942	Minimum 0.0	May 1953
Yearly:	Maximum 4,780	1942	Minimum 167.0	1953

Average Flow Period 1936-1954 April

	Average	Maximum	Minimum
January	54,384	86,400	11,300
February	50,626	80,900	9,460
March	42,512	85,300	4,440
April	22,272	79,300	457
May	47,633	240,000	0
June	63,025	251,000	3,270
July	136,710	620,000	10,700
August	130,784	485,000	12,300
September	287,797	1,404,000	9,350
October	166,570	929,000	4,940
November	62,820	164,000	8,600
December	53,653	110,000	9,510
Yearly	1,118,786	3,461,400	120,747

Table 13. Terlingua Creek Near Terlingua, Texas

Extreme Flow From Records: Momentary: Maximum 34,900 second-feet on May 24, 1935 with a gage height of 17.59 feet. Minimum no flow on September 29-30, 1937.

Average Flow in Second-Feet

Daily:	Maximum	17,200	June 1, 1937	Minimum	0.00	Sept. 29-30, 1937
Monthly:	Maximum	921	June 1937	Minimum	0.83	Oct. 1934
Yearly:	Maximum	146	1937	Minimum	5.50	1943

Average Flow Period 1932-1954

Acre Feet

	Average	Maximum	Minimum
January	190	743	82.7
February	138	267	73.4
March	270	2,410	72.4
April	1,339	15,500	55.1
May	4,344	26,000	117.0
June	6,816	54,800	59.5
July	7,673	28,700	518.0
August	3,986	26,680	123.0
September	6,130	24,600	123.0
October	2,151	8,100	50.8
November	323	2,980	64.9
December	360	3,080	90.0
Yearly	33,720	105,807	3,958.0

Table 14. Water quality data from the Rio Grande at Santa Elena Canyon
February 1957 thru November 1959

Station	Near Santa Helena			Dates of Collection of Samples								1957-1958			
URG-2	2/11/57	2/25	3/11	3/25	4/11	4/26	5/14	5/31	6/16	6/30	7/18	7/29			
pH	7.7	7.5	7.7	7.9	7.5	7.8	8.1	7.6	7.7	7.7	7.6	7.7			
TOT. SOL.	1056	1062	1260	1320	1440	1500	1413	1770	1050	522	780	246			
CHLORIDE	140	130	150	170	200	220	220	250	100	52	20	16			
SULPHATE	570	515	461	570	622	630	610	542	530	252	374	94			
CL. DEM.	0.9	0.5	0.5	0.5	0.5	0.5	0.5	1.8	2.7	2.7	3.5	4.4			
D. O.	8.6	6.3	7.0	8.3	7.0	6.0	3.6	3.2	5.1	1.1	1.0	1.5			
B. O. D.	1.5	1.8	0.5	1.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5			
Station				Dates of Collection of Samples								1957-1958			
URG-2	8/20/57	9/10	9/25	10/9	10/22	11/5	11/19	12/3	12/18	12/30	1/14	1/28			
pH	7.5	8.1	7.8	7.5	7.3	7.1	7.9	9.0	7.9	7.6	7.8	7.9			
TOT. SOL.	540	750	690	1128	214	1344	1380	1068	1170	1290	1230	1290			
CHLORIDE	48	108	100	140	8	136	140	120	128	140	130	140			
SULPHATE	156	380	355	513	67	463	525	530	480	510	515	508			
CL. DEM.	2.7	.9	1.8	1.8	.5	.5	.5	0.9	.5	.5	.5	0.9			
D. O.	3.3	5.7	6.4	3.1	5.0	6.5	8.7	7.9	6.3	6.9	8.4	8.7			
B. O. D.	.6	.7	.5	.5	.5	.5	5.7	0.5	.5	2.4	.5	0.5			
Station				Dates of Collection of Samples								1958-1959			
URG-2	9/16/58	9/24	10/15	10/29	11/16	11/28	12/16	12/24	1/13/59	1/30	2/18	2/28			
pH	7.5	7.8	7.9	8.1	7.5	7.8	8.1	7.9	8.1	7.9	7.9	7.7			
TOT. SOL.	356	261	870	267	920	1110	1170	1200	1140	1332	1320	1440			
CHLORIDE	28	20	20	8	100	120	140	140	140	180	160	960			
SULPHATE	150	100	450	140	355	475	520	490	468	535	580	580			
CL. DEM.	0.9	0.5	0.9	1.8	3.5	3.5	1.8		2.7	3.5	1.8	0.5			
D. O.	0.7	1.1	6.2	6.6	6.9	7.0	8.8		8.4	7.7	6.7	5.8			
B. O. D.	1.6	0.5	0.7	3.4	2.2	0.8			1.3	1.6	1.0	0.7			
Station				Dates of Collection of Samples								Park Road		1959	
URG-2	3/12/59	3/31	4/18	4/28	5/18	5/30	6/15	6/24	7/17	7/30	8/15	8/29			
pH	7.6	8.0	7.9	7.9	7.6	7.6	7.8	7.5	7.4	7.4	7.5	7.7			
TOT. SOL.	1452	1518	1560	1326	1170	1170	1470	1350	972	1332	1110	293			
CHLORIDE	200	180	200	180	100	130	160	190	110	160	130	32			
SULPHATE	410	710	575	570	470	470	640	640	350	575	528	115			
CL. DEM.	0.9	3.5	0.5	3.5	3.5	1.8	2.7	2.7	2.7	0.5	0.5	0.5			
D. O.	7.8	7.6	7.5	5.7	5.2	6.6	10.0	5.9	4.1	4.2	3.1	2.3			
B. O. D.	0.6	2.3	1.5	0.7	0.5	2.8	0.5	0.9	0.5	0.5	0.9	0.9			
Station				Dates of Collection of Samples						1959					
URG-2	9/17/59	9/29	10/16	10/29	11/13	11/27									
pH	7.8	7.9	8.0	7.8	8.3	8.0									
TOT. SOL.	990	1170	1230	1230	1080	1110									
CHLORIDE	44	140	150	150	140	120									
CL. DEM.	1.5	0	0.5	1.5	5	0.5									
D. O.	6.3	5.8	7.4	7.1	9.1	9.5									
B.O.D.	0.5	1.0	1.0	1.0	0.5	0.5									

Table 15. Rio Grande at Agua Verde Station

Extreme Flow From Records: Momentary: Maximum: 14,600 second-feet on May 23, 1954 at a gage height of 15.98 feet. Minimum 132 second-feet on April 29, 1953, at a gage height of .42 foot.

Average Flow in Second Feet

Daily:	Maximum 12,000	August 27, 1954	Minimum 145	June 15,16,17, 1953
Monthly:	Maximum 3,460	August 1954	Minimum 182	May, 1953
Yearly:	Maximum 919	1954	Minimum 341	1953

Average Flow Period Dec. 1952-1954

	Average	Maximum	Minimum
January	22,450	24,000	20,900
February	19,350	19,900	18,800
March	19,150	22,900	15,400
April	27,450	43,000	11,900
May	28,950	46,700	11,200
June	46,650	81,900	11,400
July	35,000	36,000	34,000
August	118,850	213,000	24,700
September	59,400	86,400	32,400
October	34,250	50,900	17,600
November	22,400	27,300	17,500
December	21,900	25,000	19,100
Yearly	455,800	665,300	246,600

Table 16. Rio Grande River at Langtry

Extreme Flow From Records: The highest known gage height was 56.9 feet which occurred about 3:00 p.m. on June 17, 1922. The discharge for this stage was 204,000 second-feet, which was estimated by extension of the rating curve. The lowest flow was 208 second-feet, which occurred July 12, 1953.

Average Flow Period 1924-1954

Acre Feet			
	Average	Maximum	Minimum
January	86,128	245,000	27,300
February	75,128	117,000	25,000
March	71,975	118,000	23,300
April	59,613	112,000	17,800
May	90,773	271,000	16,200
June	101,670	299,000	15,800
July	152,262	719,000	31,700
August	186,800	730,000	31,100
September	324,099	1,410,000	19,600
October	223,917	1,063,000	23,200
November	92,680	211,000	22,600
December	81,999	135,000	24,800
Yearly	1,547,044	3,851,500	326,100

Table 17. Devil's River at Del Rio

Extreme Flow From Records: The greatest recorded flow was 597,000 second-feet, which occurred September 1, 1932, at a corrected gage height of 36.60 feet at the present station. This gage height was determined by check levels run during the 1954 flood survey. Zero flow sometimes occurs for a few hours at this station.

Average Flow Period 1924-1954

Acre Feet			
	Average	Maximum	Minimum
January	21,361	45,250	9,150
February	20,191	54,500	8,570
March	20,653	43,300	8,650
April	23,875	67,800	8,030
May	38,911	356,900	10,100
June	66,528	678,000	8,080
July	46,909	377,000	8,460
August	25,200	107,000	8,050
September	69,587	895,990	8,660
October	43,282	349,000	9,780
November	23,651	60,300	9,820
December	22,087	49,520	9,330
Yearly	422,235	1,284,080	131,830

Table 19. Suspended silt in the Rio Grande at El Paso

1954		Period of Record: September 1948-1954							
Month	Water	Tons		No. of Samp.	Average	Acre-feet at 1,452 tons per acre			
		Silt				Average	Max.	Min.	
Jan.	4,414,000	133.0		31	.0030170	.09	.38	1.40	.04
Feb.	2,730,000	18.0		28	.0006604	.01	.55	2.20	.01
March	7,427,000	1,750.0		31	.0235300	1.20	13.50	33.70	1.20
April	30,830,000	5,520.0		30	.0179200	3.80	21.30	45.20	3.80
May	17,322,000	7,820.0		30	.0451700	5.40	16.70	63.30	1.90
June	16,964,000	6,650.0		30	.0391900	4.60	39.30	152.00	4.60
July	21,998,000	1,610.0		20	.0073210	1.10	43.50	124.00	1.10
Aug.	15,891,000	96,800.0		31	.6092000	66.70	39.90	66.70	11.90
Sept.	3,298,000	2,670.0		30	.0810800	1.80	21.30	92.30	1.70
Oct.	5,151,000	54,100.0		31	1.0500000	37.30	7.00	37.30	0.19
Nov.	734,000	78.3		30	.0106700	.05	.54	1.50	.05
Dec.	592,000	62.0		31	.0104800	.04	.04	2.10	.04
Yearly	127,351,000	177,211.3		353	.1392000	122.09	204.45	436.87	76.94

Sample and analyses by U. S. Section, Method A

Table 20. Suspended silt in the Rio Grande River at Johnson Ranch in the Big Bend

1954		Period: October 1951-1954			
Month	Tons	Water	Silt	Acre-feet at 1,452 Tons per acre-foot	
				Average	Minimum
January		15,392,000	1,370	.95	1.10
February		12,861,000	810	.80	1.00
March		6,029,000	392	1.60	4.30
April		27,588,000	1,000,000	287.00	692.00
May		15,736,000	441,000	201.00	304.00
June		58,098,000	1,709,000	914.00	1,570.00
July		27,234,000	258,000	1,626.00	4,030.00
August		271,499,000	5,476,000	1,331.00	3,840.00
September		85,070,000	447,000	242.00	316.00
October		55,803,000	771,000	141.00	492.00
November		22,242,000	2,890	1.20	1.80
December		17,611,000	792	13.40	48.30
Yearly		615,163,000	10,048,254	4,759.95	6,970.30
Rio Grande at Agua Verde Station					
1954		Period: 1953-1954			
Month	Tons	Water	Silt	Acre-feet at 1,452 Tons per acre-foot	
				Average	Minimum
January		28,369,000	3,460	2.20	2.40
February		25,517,000	2,420	.82	1.50
March		20,945,000	1,450	3.60	6.30
April		58,421,000	331,000	113.00	224.00
May		63,432,000	1,248,000	436.00	871.00
June		111,323,000	2,177,000	740.00	1,480.00
July		48,959,000	299,000	222.00	240.00
August		289,325,000	7,728,000	2,670.00	5,230.00
September		117,367,000	721,000	371.00	514.00
October		69,115,000	181,000	83.90	126.00
November		37,084,000	4,150	3.30	3.80
December		33,914,000	1,250	1.20	1.60
Yearly		903,771,000	12,697,730	4,647.02	8,656.15

Table 21. Results of 12 gill nets set in Lake Ascarate at El Paso

Species	Fish Collected				Percent of total Wt.
	No.	Percent of total No.	Wt. lbs. oz.	Avg. Wt. lbs. oz.	
Gizzard shad	295	78.24	140 1	0 8	54.57
Carp	26	6.91	68 2	2 10	26.55
River carpsucker	21	5.57	28 14	1 6	11.25
Sunfishes	18	4.78	1 7	0 1.25	0.68
Largemouth bass	1	0.26	1 13	1 13	0.72
Channel catfish	16	4.24	16 0	1 0	6.23
Totals	377	100.00	256 5		100.00

Comparison of rough and forage species to game fish in Lake Ascarate

Rough fish and forage species	360	95.50			93.05
Game species	17	4.50			6.95

Table 22. Results from 30 gill nets set from Upper Presidio station above the mouth of the Concho River to Lajitas

Species	No.	Percent by No.	Total Wt. lbs. oz.	Avg. Wt. lbs. oz.	Percent by Wt.	Avg. K
Longnose gar	121	40.19	98	13	18.05	.31
Gizzard shad	19	6.32	27	1	5.02	2.32
Smallmouth buffalo	22	7.31	140	6	25.83	3.08
River carpsucker	89	29.56	180	2	33.14	2.63
Carp	12	3.99	44	3	8.24	2.20
Channel catfish	1	.33	12	12	.14	1.40
Flathead catfish	4	1.33	5	1	1.08	1.48
Blue catfish	21	6.97	21	6	3.91	1.89
Blue sucker	10	3.33	22	2	4.18	1.29
Freshwater drum	2	.67	2	1	.41	2.16
Totals	301	100.00	544	7	100.00	

Table 23. Comparison of rough and forage species to game species taken in 30 nets in the Presidio area

Species	No.	Percent by No.	Total Wt. lbs. oz.	Percent by Wt.
Rough and forage species (Longnose Gar, Shad, Small-mouth buffalo, Carp, River carpsuckers, Blue suckers, Drum)	275	91.37	516 11	94.46
Game species (Channel catfish, Flathead catfish, Blue catfish)	26	8.63	27 12	5.54
Totals	301	100.00		100.00

Table 24. Results from 4 gill net sets at McCarthy farm 6 miles east of Presidio

Species	No.	Percent by No.	Total Wt. lbs. oz.	Avg. Wt. lbs. oz.	Percent by Wt.	Avg K
Longnose gar	19	22.61	15 10	13.2	9.26	.36
Gizzard shad	10	11.91	14 6	1 7	8.53	2.15
Smallmouth buffalo	6	7.14	37 10	6 7	22.31	3.08
Carp	1	1.19	5	5	2.96	2.32
Flathead catfish	1	1.19	1 9	1 9	.93	1.59
Freshwater drum	1	1.19	1 5	1 5	.78	2.31
Blue catfish	3	3.57	3 12	1 4	2.22	1.36
Blue sucker	3	3.57	7 14	2 10	4.67	1.21
River carpsucker	40	47.63	81 8	2 1.1	48.34	2.35
Totals	84	100.00	168 10		100.00	

Table 25. Comparison of rough and forage species to game species taken in 4 nets set 6 miles east of Presidio

Species	No.	Percent by No.	Total Wt. lbs. oz.	Percent by Wt.
Rough species (Long-nose gar, Gizzard shad, Smallmouth buffalo, Carp, Freshwater drum, Blue sucker, River carpsucker)	80	95.23	163 5	96.84
Game species (Blue catfish, Flathead catfish)	4	4.77	5 5	3.16
Totals	84	100.00	168 10	100.00

Table 26. Comparison of rough and forage species to game species as taken in 8 gill nets set at Clay Slack and Tommy McCall farms in the Presidio area

Species	No.	Percent by No.	Total Wt. lbs Oz	Percent by Wt.
Rough species (Long-nose gar, Gizzard shad, Smallmouth buffalo, Carp, Freshwater drum, Blue sucker, River carpsucker)	74	98.66	147 13	99.49
Game species (Channel catfish)	1	1.33	12	.51
Totals	75	100.00	148 9	100.00

Table 27. Results of 8 gill nets set on Clay Slack and Tommy McCall farms in the Presidio area

Species	No.	Percent by No.	Total Wt. lbs. oz.	Avg. Wt. lbs. oz.	Percent by Wt.	Avg. K
Longnose gar	26	34.66	21 7	13.2	14.42	.29
Gizzard shad	8	10.67	11 8	1 7	7.75	2.48
Smallmouth buffalo	8	10.67	51 8	6 7	34.66	2.75
River carpsucker	24	32.00	49 8	2 1.1	33.32	2.48
Carp	3	4.00	7 13	2 9.6	5.26	2.26
Channel catfish	1	1.33	12	12	.50	1.40
Blue sucker	4	5.34	5 2	1 4.5	3.45	1.26
Freshwater drum	1	1.33	15	15	.64	2.02
Totals	75	100.00	148 9		100.00	

Table 28. Results of 4 gill net sets located 500 yards below and at Lajitas

Species	No.	Percent by No.	Total Wt. lbs. oz.	Avg. Wt. lbs. oz.	Percent by Wt.	Avg. K
Longnose gar	22	70.96	17 12	12.8	41.76	.32
River carpsucker	2	6.45	4 6	2 3	10.29	2.50
Carp	4	12.91	14 5	3 9	33.68	2.28
Blue catfish	2	6.45	4 14	2 7	11.47	1.52
Flathead catfish	1	3.23	1 3	1 3	2.80	1.37
Totals	31	100.00	42 8		100.00	

Table 29. Comparison of rough and forage species to game species 500 yards below and at Lajitas

Species	No.	Percent by No.	Total Wt. lbs. oz.	Percent by Wt.
Rough species (Long- nose gar, Carp, River carpsucker)	28	90.32	36 7	85.73
Game species (Blue catfish, Flathead catfish)	3	9.68	6 1	14.27
Totals	31	100.00	42 8	100.00

Table 30. Results of 2 gill nets set 4 miles below or east of Lajitas

Species	No.	Percent by No.	Total Wt. lbs. oz.	Avg. Wt. lbs. oz.	Percent by Wt.	Avg. K
Longnose gar	20	51.28	16 9	13.2	32.27	.33
Smallmouth buffalo	1	2.56	6 7	6 7	12.55	3.42
River carpsucker	10	25.64	20 11	2 1.1	40.32	2.88
Carp	1	2.56	5	5	9.74	2.18
Blue sucker	1	2.56	2 10	2 10	5.12	1.39
Blue catfish	6	15.40	No weight or measurement taken.			
Totals	39	100.00	51 5		100.00	

Table 31. Comparison of rough and forage species to game fish 4 miles east of Lajitas

Species	No.	Percent by No.	Total Wt. lbs. oz.	Percent by Wt.
Rough species (Longnose gar, Smallmouth buffalo, River carpsucker, Blue sucker)	33	84.61	51 5	100.00
Game species (Blue catfish)	6	15.39	No weights were taken.	
Totals	39	100.00		100.00

Table 32. Results from 4 gill nets set in stream 2 miles east of Lajitas

Species	No.	Percent by No.	Total Wt. lbs. oz.	Avg. Wt. lbs. oz.	Percent by Wt.	Avg. K
Longnose gar	12	52.17	9 11	12.9	29.41	.30
River carpsucker	8	34.78	13	1 10	39.47	2.28
Carp	1	4.35	2 12	2 12	8.34	2.10
Blue sucker	1	4.35	4 12	4 12	14.44	1.36
Blue catfish	1	4.35	2 12	2 12	8.34	3.46
Totals	23	100.00	32 15		100.00	

Table 33. Comparison of rough and forage species to game fish near Lajitas

Species	No.	Percent by No.	Total Wt. lbs. oz.	Percent by Wt.
Rough species (Long- nose gar, River carp- sucker, Carp, Blue sucker)	22	95.65	30 3	91.65
Game species (Blue catfish)	1	4.35	2 12	8.35
Totals	23	100.00	32 15	100.00

Table 34. Netting results from 2 experimental gill nets set 3 miles above entrance to Santa Helena Canyon

Species	No.	Percent by No.	Total Wt. lbs. oz.	Avg. Wt. lbs. oz.	Percent by Wt.	Avg. K
Longnose gar	2	18.18	1 10	13.2	4.39	
Gizzard shad	1	9.09	1 7	1 7	3.88	
Smallmouth buffalo	3	27.28	19 5	6 7	52.20	No lengths taken
Carp	2	18.18	10	5	27.03	
Blue catfish	2	18.18	2 9	1 4.5	6.92	
River carpsucker	1	9.09	2 1	2 1	5.58	
Totals	11	100.00	37		100.00	

Table 35. Comparison of abundance of rough and forage species to game fish taken in 2 nets set 3 miles above entrance to Santa Helena Canyon

Species	No.	Percent by No.	Total Wt. lbs. oz.	Percent by Wt.
Rough species (Longnose gar, Blue sucker, River carpsucker)	9	81.81	8 14	89.30
Game species (Blue sucker)	2	18.19	1 1	10.70
Totals	11	100.00	9 15	100.00

Table 36. Netting results from 4 experimental gill nets set 1 mile above and in the mouth of Santa Elena Canyon.

Species	No.	Percent by No.	Total Wt. lbs. oz.	Avg. Wt. lbs. oz.	Percent by Wt.	Avg. K
Longnose gar	13	48.14	10 6	13.2	19.36	
Smallmouth buffalo	4	14.82	25 12	6 7	48.08	
Flathead catfish	2	7.41	3 2	1 9	5.86	No lengths taken
Blue catfish	5	18.51	6 4	1 4	11.67	
River carpsucker	3	11.12	8 1	2 1.1	15.06	
Totals	27	100.00	53 9		100.00	

Table 37. Comparative abundance of rough and forage species to game fish taken in 4 net sets 1 mile above and at mouth of Santa Helena Canyon

Species	No.	Percent by No.	Total Wt. lbs. oz.	Percent by Wt.
Rough species (Longnose gar, Smallmouth buffalo, River carpsucker)	20	74.07	44 3	82.49
Game species (Flathead catfish, Blue catfish)	7	25.93	9 6	17.51
Totals	27	100.00	53 9	100.00

Table 38. Results of 12 experimental gill nets set on Blackgap Wildlife Management Area

Species	No.	Percent by No.	Total Wt. lbs. oz.	Avg. Wt. lbs. oz.	Percent by Wt.	Avg. K
Longnose gar	7	63.64	5 4	12	52.83	.31
River carpsucker	1	9.09	1 4	1 4	12.57	3.34
Blue catfish	2	18.18	1 1	8.5	10.70	1.23
Blue sucker	1	9.09	2 6	2 6	23.90	1.10
Totals	11	100.00	9 15		100.00	

Table 39. Comparison for rough and forage species to game fish at Black Gap Wildlife Management Area

Species	No.	Percent by No.	Total Wt. lbs. oz.	Percent by Wt.
Rough species (Long-nose gar, Smallmouth buffalo, Gizzard shad, Carp, River carpsucker)	9	81.81	34 7	93.07
Game species (Blue catfish)	2	18.19	2 9	6.93
Totals	11	100.00	37	100.00

Table 40. Netting results of 5 nets set 1 mile west of mouth of Pecos River

Species	No.	Percent by No.
Alligator gar	5	4.71
Spotted gar	1	.95
Longnose gar	32	30.18
Gizzard shad	42	39.63
Blue suckers	2	1.88
Smallmouth buffalo	1	.95
River carpsucker	1	.95
Carp	1	.95
Blue catfish	14	13.21
Flathead catfish	1	.95
White bass	2	1.88
Largemouth bass*	4	3.76
Totals	106	100.00

*Largemouth bass were released in the lower Pecos River in 1958 from San Angelo hatchery. No floods occurred between that time and the time this netting collection was made. No weights and measurements were recorded because the fish captured were transported to San Angelo to be used in experiments. Blue catfish were used in experimental introductions and unnecessary handling of the fish was avoided.

Table 41. Netting collection from the mouth of the Pecos River using 3 gill nets

Species	No.	Percent by No.	Avg. Wt. Oz.	Percent by Wt.	Avg. K
Alligator gar	1	1.64	240	7.61	0.80
Longnose gar	4	6.56	28	3.55	0.35
Gizzard shad	1	1.64	2	0.06	2.19
River carpsucker	6	9.83	14	2.67	2.24
Blue sucker	1	1.64	43	1.37	1.41
Blue catfish	47	77.05	56	84.07	1.57
Freshwater drum	1	1.64	21	0.67	1.98
Totals	61	100.00		100.00	

Table 42. Netting collections taken 1 mile above mouth of Pecos River using 2 experimental gill nets

Species	No.	Percent by No.	Avg. Wt. oz.	Percent by Wt.	Avg. K
Alligator gar	2	5.56	160	9.67	.70
Longnose gar	3	8.33	305	27.74	.28
Gizzard shad	1	2.78	24	0.73	1.88
River carpsucker	1	2.78	11	0.33	2.58
Blue sucker	4	11.11	59	7.16	1.40
Smallmouth buffalo	3	8.33	144	8.70	3.08
Flathead catfish	1	2.78	336	10.19	1.90
Blue catfish	16	44.44	60	29.11	1.59
Channel catfish	3	8.33	41	2.64	1.55
Totals	36	100.00		100.00	

Table 43. Results of 8 gill nets set in Devil's Lake

Species	No.	Percent by No.
Spotted gar	1	.61
Longnose gar	2	1.21
Gizzard shad	51	30.91
Gray rehorse	4	2.42
River carpsucker	30	18.17
Carp	2	1.21
Channel catfish	29	17.58
Flathead catfish	2	1.21
White bass	4	2.43
Largemouth bass	4	2.43
Warmouth bass	3	1.82
Green sunfish	1	.61
Bluegill sunfish	7	4.24
White crappie	22	13.33
Freshwater drum	3	1.82
Totals	165	100.00

Weights and lengths not recorded as these fish were taken alive to San Angelo for use in E-3 experiment.

Table 44. Results of 8 netting collections from Lake Walk

Species	No.	Percent by No.
Spotted gar	1	.58
Longnose gar	4	2.51
Gizzard shad	40	23.12
Gray redbhorse	19	10.98
River carpsucker	43	24.86
Golden shiner	2	1.17
Channel catfish	37	21.38
White bass	15	8.67
Largemouth bass	4	2.31
Warmouth bass	1	.58
White crappie	6	3.46
Freshwater drum	1	.58
Totals	173	100.00

Weights and measurements were not recorded because these fish were moved alive to San Angelo for use in E-3 experiments.

