

**White River Report
1974-75**

by

Chad Crosby

FISHERIES
UTAH DIVISION OF WILDLIFE RESOURCES

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INTRODUCTION

Initial phase of field investigation on physical stream parameters; fish species composition and their relative abundance were completed through cooperative efforts of the Division of Wildlife Resources, the Bureau of Land Management, the U. S. Fish and Wildlife Service, and VTN in 1975 on the White River in Northeastern Utah. In addition to satisfying stipulations set forth in a pre-oil shale prototype environmental awareness investigation, the data will be used to compile an environmental impact statement for the proposed White River impoundment.

The Utah Fishing Waters Inventory and Classification System (see description in Appendix A) described the White River as 59 miles of Class 4 water. Class 4 streams are typically poor in quality with limited fishery value. Water development plans should include proposals to enhance fishery values in strategically located Class 4 waters where feasible.

The White River drains 4,020 square miles of one of the top outdoor recreation areas of the nation: Consider in Colorado, the high lake and stream fisheries both surrounding and within the Flattop Wilderness Area, the wild cutthroat trout fishing at Trappers Lake, the White River elk herd and the Piceance Creek deer herd. In Utah the North Book Cliffs area once contained and still has the potential of containing one of the finest deer herds in the State; not to mention the valuable cougar and bear hunting resource in that area. The White River Drainage is one of the few remaining areas which has not been devalued by a major impoundment.

Degradation of the White River begins to be noticed by the casual observer between Meeker, Colorado and the Piceance Creek confluence. Below this confluence downstream to the state line the gradient of the stream slows considerably and the White River begins to meander more extensively. Throughout this segment the river begins carrying a large load of sediment as a result not only of natural erosion from the drier climate but also because of more extensive agricultural practices. Additional degradation was imposed upon the White River by the oil industry of the 1950's surrounding Rangely, Colorado. More recently industrial imposed pollution and soil erosion has subsided somewhat and the river has begun to heal.

The White River enters Utah a few miles upstream from the small gilsonite mining settlement of Bonanza. The surrounding terrestrial environment along the entire stream course in Utah has been described as a desert biome of deep canyons as well as rolling hills and rarely flatter terrain. Riparian vegetation is a cottonwood-tamarick overstory to a big sage-rabbitbrush, saltgrass-cheatgrass understory which is heavily overgrazed by cattle and sheep.

At best, only piecemeal information ~~has been~~^{was} gathered on the White River biota prior to 1974. Olsen (1973) reported "whereas there is some information available regarding the kinds and relative abundance of fish in the Green River, this type of data is very scanty for the White River. No data is available for either watercourse pertaining to kinds and numbers of aquatic invertebrates. A reason that the White has received little attention is that it provides little in the way of a significant sport fisheries and is not amenable to management for same." Both Olsen (above) and (Holden 1973) were strong advocates of investigations to determine if certain rare and endangered species of fish inhabit^s the White River Drainage. Four of these fishes are known to occur in the Green River drainage of which the White River is a segment. These are as follows (Miller 1972): humpback chub and Colorado squawfish, considered "rare and endangered" (i.e., actively threatened with extinction and continued survival unlikely without special protective measures), the humpback sucker considered "rare" (i.e., not under immediate threat of extinction, but occurring in such small numbers and/or in such a restricted or specialized habitat that it could quickly disappear); and the bonytail chub, considered "depleted" (i.e. still occurring in numbers adequate for survival, but the species has been heavily depleted and continued to decline at a rate substantially greater than can be sustained). As part of his study on the distribution and abundance of fishes of the Upper Colorado River Basin (Holden 1973) used gillnets, seines, and occasionally electrofishing gear to sample fishes in the Green River drainage between 1969 and 1971. According to his dissertation fishes were not collected in

the vicinity of tracts Ua and Ub, on the White River. However, a collection was made east of Rangely, Colorado but no reference was made as to ^{Species,} numbers, or abundance of these fishes. Olsen (1973) reported further, through a personal communication with Holden in November, 1973, that 16 species of fish had been identified from the Green River near the confluence of the White River and were placed in relative abundance classes. These included red shiners, flannelmouth suckers, and channel catfish categorized as abundant; all four of the threatened species were recorded but all were rare in abundance and only one, the Colorado squawfish was collected near the confluence of the White River. ~~Others~~ ^{The} difficulty encountered by biologists in sampling fish from the White River was described by Wilson (1973) when he concluded that "after five attempts at sampling White River fishes, we have only collected four species. In addition to the fishes collected, we hear infrequent reports of channel catfish being taken by anglers. I would suspect that carp are present near the Green River confluence, although this is not confirmed. It is apparent that fish are not numerous in the White River, I feel that reasonable effort has been made to collect fishes, and no amount of extra effort will locate something that is not there."

WHITE RIVER AQUATIC INVENTORY

Fisheries habitat in Utah is being inventoried and classified on a statewide basis. A review draft entitled "Utah Fishing Waters, Inventory, and Classification" was prepared in 1970 by the Utah State Division of Wildlife Resources. This report summarized the habitat inventory and evaluation completed to that time. In addition to physical inventory, each lake or stream section was rated using three other criteria: esthetics, availability and productivity. The White ^{River} has been described as 59 miles of Class 4 water between the Colorado-Utah state line and the Green River (see Method of Classification - Appendix 1)

General Definition of Class I and II Streams

Class IV lotic waters are of minor importance to the fishery resource of Utah. Some of the factors that adversely affect the fishery values are dewatering, diversions, dams, heavy or complete drawdown on reservoirs, natural drought, or waters carrying extreme sustained loads of sediment or colloidal earth. Whenever it is possible and economical, these waters should be improved for fisheries.

Esthetics - Waters are of fair value but lack unusual or outstanding scenic qualities.

Availability - Access is often difficult or posting is so extensive as to seriously restrict fisherman access.

Productivity - Waters are generally small. There is a short growing season and excessive drawdown or dewatering may occur. Catchables are required to maintain a sport fishery. Summer or winter mortality problems may occur. The various habitat factors are not suitable for the survival and growth of game fish in numbers necessary to provide a reasonable fishery.

Class IV waters can thus be made into valuable fisheries. Fluctuating reservoirs with high storage responsibilities generally produce fantastic fisheries between the third and ninth year after filling but productivity generally falls off markedly and may continue to become less valuable in time until they virtually become deserts so far as fisheries are concerned. However, tailwater fisheries are much more amenable from a fishery management standpoint if water use is compatible with fish management. ^{On} stream impoundment can turn Class IV streams into Class I fisheries. One example of course, is the shaping of the Green River into a Blue Ribbon stream by Flaming Gorge Dam.

Procedures and Equipment

The physical, chemical and biological characteristics of the White River were studied by VTN Engineering Corporation, the Bureau of Land Management, Brigham Young University, and the Utah State Division of Wildlife Resources.

Information on the invertebrate fauna collected by VTN has not been made public at this time, therefore, the remainder of this report was derived from information gathered by the remaining three agencies described above. Data on the physical characteristics of the White River was collected by one Fish and one Wildlife Biologist employed by the Bureau of Land Management.

Survey stations, 1600 feet in length, were laid out at locations S1 through S8. These are permanent monitoring stations established by VTN in 1974 at the onset of their operations (see map). At each of 5 crosssections, spaced 400 feet from one another, the following measurements were taken with a range finder: wetted stream channel width; flood channel width; length and width of pools; and the extent of stream bottom type classed gravel, rubble, boulder, silt or sand. Three stream depths per crosssection were taken at 1/4, 1/2 and 3/4 of the distance of the wetted stream width. Also recorded per station were: the extent of shade offered by riparian vegetation; the stability of the stream banks; and the estimated volume of discharge in cubic feet per second. An Abney Level was employed to measure the landform gradient, as well as the stream bottom gradient. The water velocity of the river was estimated. A 16' Grummon canoe was used to convey personnel and equipment from one survey station to another.

On August 11 and 12, 1975, a team of invertebrate zoologists from BYU identified and quantified larval macroinvertebrate fauna from four stations on the White River (see map). For their work quantitative samples were collected on a meter square fiberglass handscreen by the kick drift method. Adult insects were collected at the Bonanza Bridge station by sweeping riparian vegetation with an ultraviolet light trap after dark. Quantitative samples were collected from the four stations with a modified Surber Sampler. Specimens were fixed in formal (a mixture of 10% formalin and 70% alcohol), enumerated, categorized taxonomically, and preserved in 70% alcohol. Water samples were collected concurrently, were sent to the BYU Environmental Testing Laboratories for analysis. Biomass was determined in the laboratory by drying organisms from two of four samples collected at each site

for 24 hours at 80° C and then by weighing them to the nearest 0.1 mg on a Mettlen[®] H 10 T balance.

Fish collections were made by Utah Division of Wildlife Resources between October 15-17, 1974, November 20-22, 1974, August 11-14, 1975 and on September 9, 1975. On those dates the stations sampled on the White River were located at the mouth of Hell Hole Canyon; at the Bonanza Bridge; at the mouth of Preacher Canyon; below Asphalt Ridge; above the Bitter Creek confluence; at the Mountain Fuel Bridge; at the east boundary of the Ouray Indian Reservation, and at the Ouray Bridge. Conditions for sampling the fish populations were more adverse in 1975 than in 1974 because of increased precipitation resulting in a higher, more turbid river. For that reason only one-quarter as many fish were collected during the 1975 effort. This difference was noticeable for all species, but particularly the small members of the minnow family.

High turbidities, extreme fluctuations in flow, channel width, deep swift current, and difficult access made fish population studies on the White River difficult. Of the six sampling techniques employed (electrofishing, explosive, seining, hoop netting, trapping and gill netting), only electrofishing, and to a lesser extent, explosives produced effective results. Electrofishing samples were obtained in continuous 2,000 foot stretches of river. Direct current was supplied by a 230 volt, 21.8 ampere generator and was conveyed by 500' of cable to the electrodes. Conventionally fish are taken by shocking upstream, however, because of deep, fast current of the White River, complicated by high turbidities, it was found that shocking downstream produced better results. This technique was employed on the near side, far side, and whenever possible, several sections of the middle of the stream. All divide channels in each sampling segment were shocked by that method. Sampling stations were not blocked off while electrofishing.

Explosives were used successively at two of the sampling stations in smaller holes and glides. Best results were obtained when ditching powder was attached to

long lengths of primer cord at 10 foot intervals. Immediately downstream from the sampling area (approximately 50 yards), minnow seines were set across the stream to intercept fish as they floated out of the blast area.

Results of Cooperative Study

Section 1 - Green River Confluence to State Line

Section 1 of the White River is described by eight stream survey stations located at S-1 through S-8. ~~(see map)~~^{see map}.

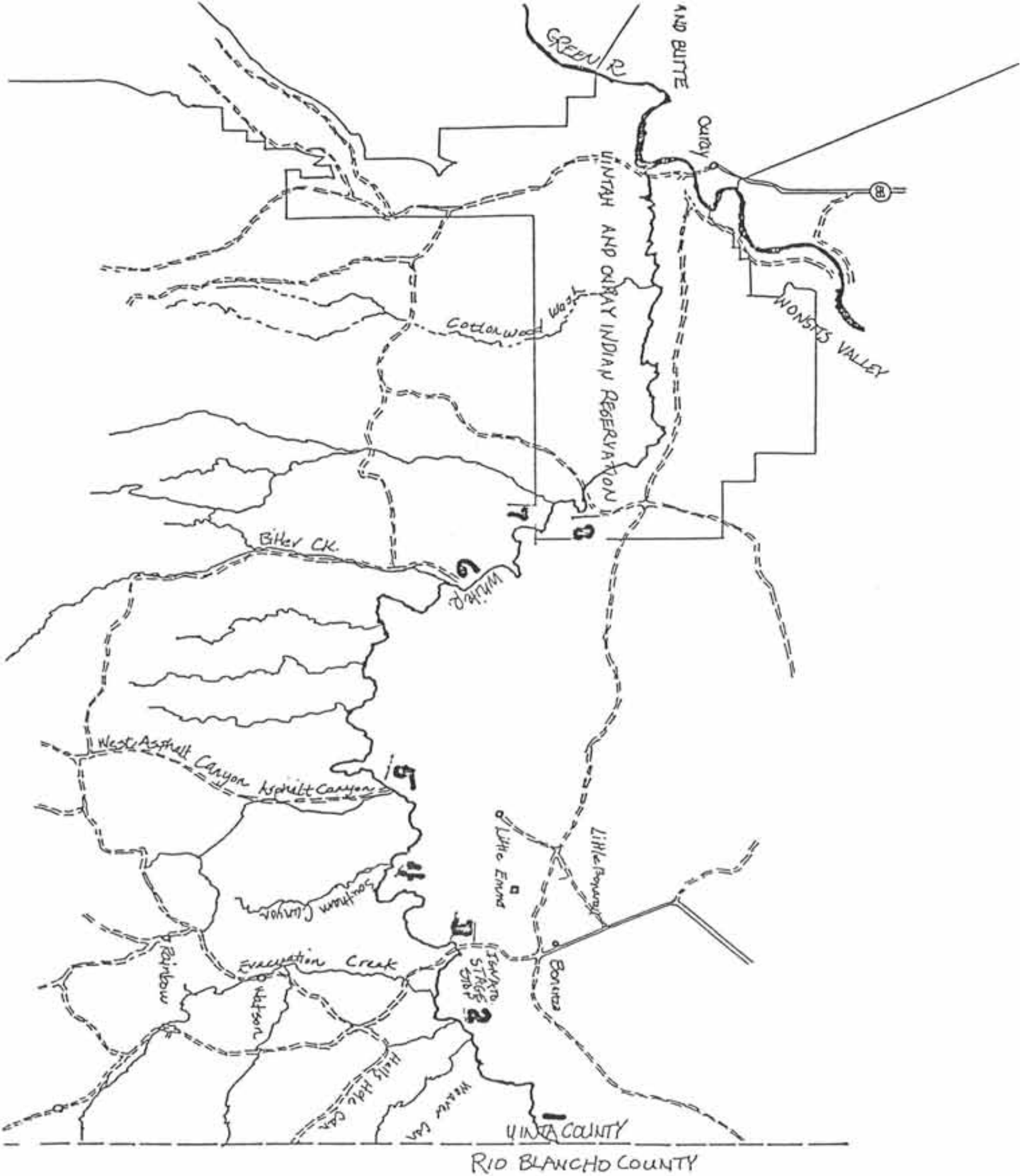
Length and Discharge

Section 1 is approximately 59 miles in length. Over a 42 year period the average discharge was 711 cfs and flows varied between an extreme low of 52 cfs on July 19, 1934 and 8,160 cfs on July 15, 1929. Winter flows (November to April) ranged between 220 cfs and 1650 cfs between 1964 and 1965. The U.S.G.S. stream gauging station is located 350 feet downstream from the Bonanza Bridge. Discharge ranged between 396 cfs and 600 cfs (est.) during the BLM survey.

Channel Description

Between the state line and the Green River confluence the White River drops 413 feet in 59 miles. The gradient at each survey station ranged between 0.50 and 1.80 percent and averaged 1.08 percent. The estimated water velocities from BLM records ranged between 3.5 and 5.5 feet per second. These figures appear quite high for the gradient, therefore, a current meter should be employed to describe the water velocity of the White River. The pool-riffle ratios from S-1 to S-8 ~~was~~^{were} nearly optimum. They ranged between 7 and 82 at S-5 and S-8 respectively, but averaged 47.4 for all eight stations. A good percent of the pools were judged good to excellent not just because of their size and not because of vegetative canopy, ^{but because of the good pool depth,} In fact stream shade was never over 10% for any given station. Stream bank vegetation included a Fremont cottonwood overstory with a Willow-Tamarick sub-canopy. Browse plants were rabbitbrush, big sagebrush, guttierrezia and ^{f.} gragmitus. Sweet clover was the dominant forb while grass species were primarily

cheatgrass and galleta grass. The landform gradient (average per station) ranged between 1 and 23 and depended largely upon the occurrence of high vertical stream-banks. Streambank stability ranged between 45 and 100 percent stable and at all but one station was over 60% stable. The average stream width for Section 1 ranged between 55 and 139 feet at S-2 and S-5 respectively while the average station depth range 1.3 and 4.1 feet at S-2 and S-8 respectively. The mean depth for Section 1 (represented by S-1 thru S-8) was 2.66 feet. The average flood channel width of 173 feet is indicative of the extreme variations in discharge. The relatively high value for stream bottom percent (see table) shows that the stream bottom type between S-1 and S-8 is composed of more desirable substance as follows: rubble - 44% sand and silt- 25%; gravel - 13%; muck - 8%; boulder - 6%; and bedrock - 1%.



Sedimentation percent was quite low between S-1 and S-8. However, below S-8 to the confluence of the White River, the gradient slows considerably, resulting in an area of deposition. If Section 1 were better represented with stations downstream from S-8, sedimentation percent would be much greater. Turbidity was abnormally low from S-1 to S-3 at the time of the survey, but increased to nearly normal from S-4 to S-8. Water color was likewise green or clear at the three uppermost stations, but became brown below S-4.

Bottom Flora and Fauna

The White River is nearly devoid of aquatic vegetation. Only at S-1 was there any vegetation. This was described as clinging and was probably algae. High continuous turbidity, no doubt, limits the development of aquatic plants. Baumann and Winget (1975) considered the White River a unique, large river with highly specialized fauna. The results, discussion and water quality sections of their report follows.

Results and Discussion

The White River is one of the few large rivers (USGS records show mean discharge of 711 cfs) in Utah, and as such is of prime importance to the energy developments presently planned. The use of the White River waters is imperative but should be planned so as to coincide with the requirements of the aquatic communities in the White River which are unique to the Western large rivers.

Most of the species of aquatic invertebrates collected are highly specialized for this particular habitat; and most of them (Table 1) (e.g. Oemopteryx fosketti, Lachlania saskatchewanensis,

Aquatic Physical Habitat
Quality of the White River

Station*	Pool-Riffle Ratio	Pool Measure %	% Pools Rated 1, 2, or 3	Pool Structure %	Stream Bottom %	Stream Environment %	Streambank Stability %	Habitat Condition %	\bar{X} Depth in Feet	\bar{X} Width in Feet	Stream Shade %	Clinging Aquatic Plants	Routed Aquatic Plants	Sedimentation %	\bar{X} Stream Gradient %	\bar{X} Water Velocity (ft/sec)	\bar{X} Landform Gradient	Stream Discharge (cfs)	Turbidity +,-	Color Clear(C), Green(G), Brown(B)	Access
S-1	63	74	1	74	81	25	90	69	3.2	104	10	11	0	0	0.5	-	1	396	-	G	Low
S-2	36	72	77	55	89	25	100	68	1.3	55	0	0	0	0.9	1	4.7	7.3	396	-	C	Low
S-3	54	92	100	92	76	30	45	67	2.4	92	10	0	0	0.1	1	-	10	400	-	C	Remot
S-4	52	96	96	93	62	25	65	68	2.8	105	10	0	0	0.3	1	3	13	600	+	B	Low
S-5	7	14	1	14	100	35	60	44	1.7	139	10	0	0	0	1	5	23	450	+	G	Low
S-6	28	56	1	56	80	30	60	56	2.9	137	10	0	0	0.2	1.8	5.5	1	550	+	B	Remot
S-7	57	86	1	86	72	25	60	66	2.9	121	0	0	0	0.3	1.3	3.5	1	600	+	B	Remot
S-8	82	36	1	36	31	60	65	46	4.1	108	0	0	0	0.7	1	3.5	13	600	+	B	Remot

*S-1 T9S, R25E, S24
 *S-2 T10S, R25E, S5
 *S-3 T10S, R25E, S10

*S-5 T10S, R23E, S20
 *S-6 T10S, R22E, S11
 *S-7 T10S, R22E, S28

Ephoron album, and Paracloedes sp.) are probably geographically isolated populations which would be unable to move to a new stream if the White River was rendered unsuitable for them. These species are not fragile--tolerant to only a narrow range of ecological change--but rather, are relatively tolerant, having evolved in a rapidly changing environment. Several environmental factors rapidly and often drastically fluctuate in the White River, including discharge, suspended solids load, and temperature. This indicates that these organisms are adapted to survive sensible use of the water resource, but care should be taken as to the extent of habitat modification undertaken.

Factors of concern would be: chemical additions including oil, grease, salts, detergents, heavy metals, and other toxicants; thermal effluents; and flows below minimal requirements. From Table 3 it is evident that aquatic organisms in the White River are highly gregarious with clumped distribution. Most of the clumping coincides with distribution of particular habitats, especially substrate materials within the river bed. Some species (e.g. caddisflies: Brachycentrus sp., Glossosomatinae, and Hydroptilidae) require a solid substrate for attachment of themselves and one of their major food sources, periphyton (attached algae). Minimum flows would have to be adequate to cover the limited solid substrates in the White River.

From Tables 2 and 3, it is obvious that distribution and density of most species relates directly to availability of these hard, stable substrates. Site S-2 was largely sand-silt with no obvious gravel or larger rock substrate which is reflected in the

low density ($245/\text{ft}^2$) and evident dominance by one species, Traverella albertana, a mayfly especially adapted to sandy substrates. This dominance by one mayfly is reflected in the low SCI_T and \bar{d} values of 4.2 and 1.51, respectively (Table 7). Site S-1a, also all sand, showed extremely low density ($13/\text{ft}^2$) with SCI_T and \bar{d} extremely low at 3.6 and 1.12, respectively (Table 7). The density and dominance diversity values at Sites S-1b, S-3, and S-4 are low compared to a cold water mountain stream, but are significantly higher than the strictly sand-silt areas of S-1a and S-2. The difference in these community measurements is directly related to the presence and amount of rocky substrates at Sites S-1b, S-3, and S-4 (Tables 1, 2, 3, and 7).

The biomass data shown in Figure 1² indicates that the White River is fairly productive at Stations 3 and 4 but drops off sharply toward the mouth. This is due primarily to the high habitat diversity and presence of stable rocky substrates at the upper stations, while the substrate near the mouth is mostly sand and silt.

The difference in total biomass between Stations 3 and 4 are probably due to the limited accessibility of the habitat at the time of sampling.

The five dominant groups of invertebrates (mayflies: Dactylobaetis cepheus, Traverella albertana, and Tricothyodes sp.; caddisflies: Hydropsyche sp. A and sp. B; and the black flies, family Simuliidae) are all detritivores and herbivores except for simuliids which are mainly herbivorous. Not one of the dominant organisms is predatory. This indicates that the White River in the areas studied is largely heterotrophic, meaning the major source of

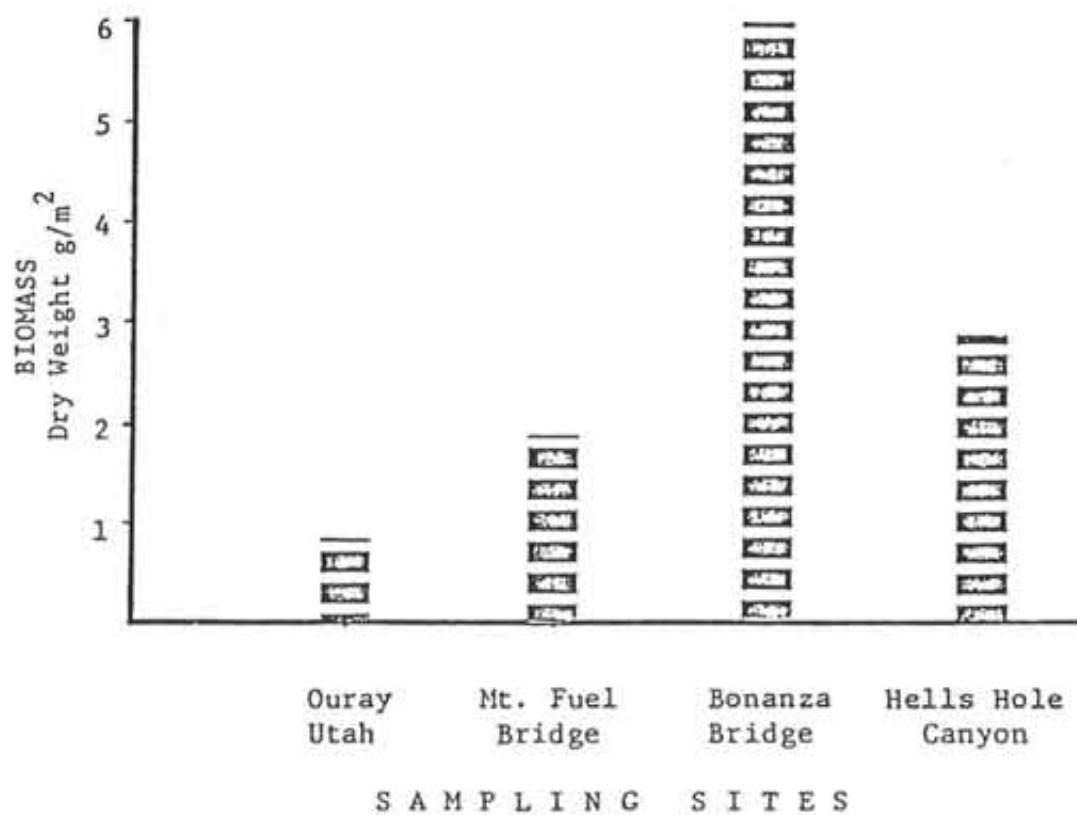


Figure 1~~6~~. Comparison of macroinvertebrate standing crop (biomass) at four sites on the White River on August 11-12, 1975.

energy for the aquatic communities is from outside the stream in the form of leaves and pollen from stramside vegetation. Algal growth on substrate materials in the White River is limited by the high turbidity of the water whcih restricts light penetration. Even with adequate nutrients, the algal growth would be highly limited.

Thus, the macroinvertebrate community in the White River is highly specialized for life in a clean, large river and could be drastically altered by pollution from the sources mentioned above, but some of its water could be used for industrial purposes if reasonable care is exercised.

The best information for predicting how alterations in the White River habitat would effect the total ecosystem could be obtained by detailed studies of the ecology and life histories of a few of the highly specialized macroinvertebrates in the orders Plecoptera: Oemopteryx fosketti, Capnia vernalis, and Acroneuria abnormis; Ephemeroptera: Traverella albertana, Lachlania saskatchewanensis, and Ametropus albrighti; Trichoptera: Hydropsyche guttata, Hydropsyche occidentalis, and Nectopsyche albida.

Water Quality

Table 8 contains some selected water quality measurements from August 11 and 12, 1975.

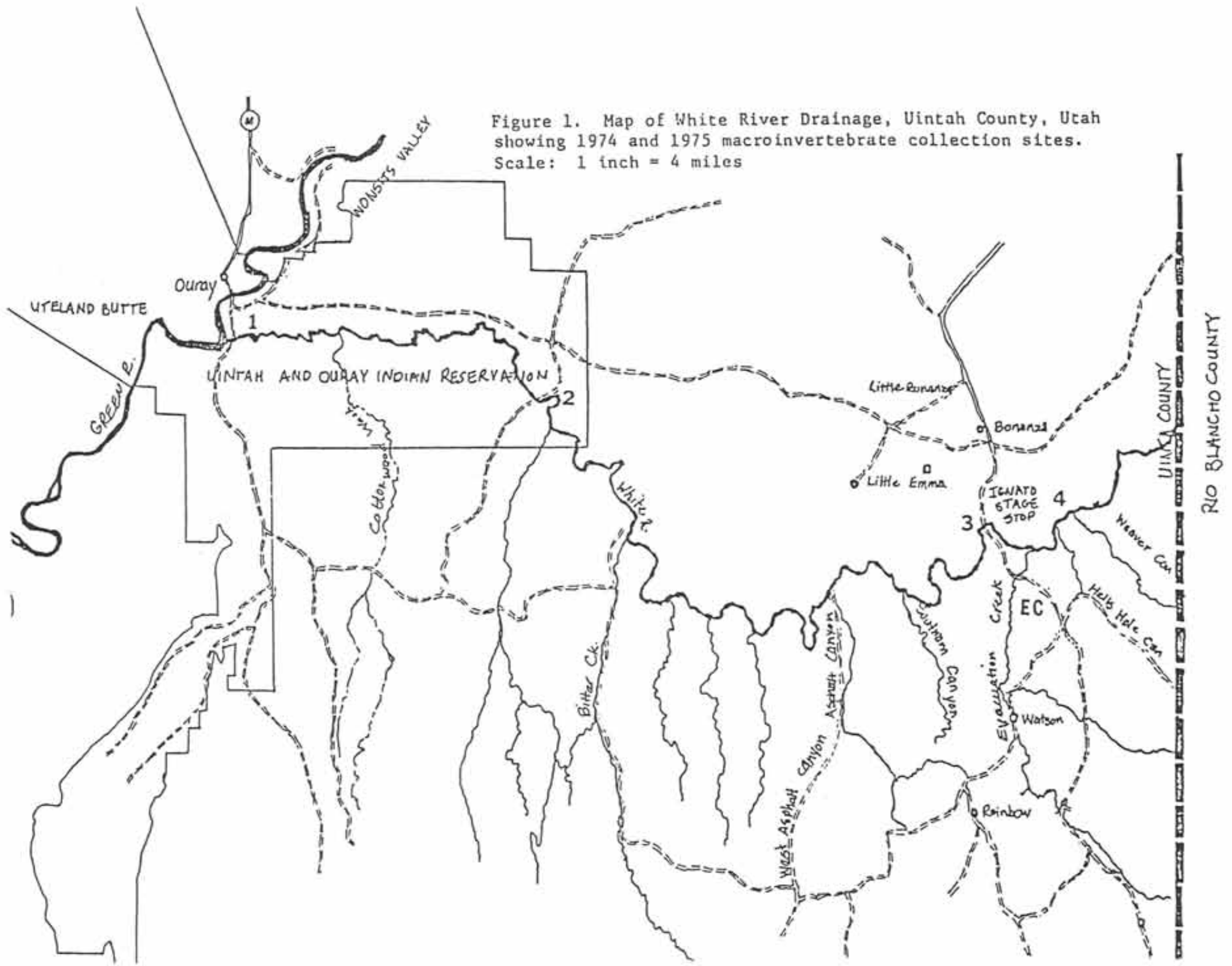
The White River from Hells Hole Canyon downstream to the Green River (the area of this study) is a wide valley meandering stream with high turbidities and water temperatures. The waters are hard (263-299 mg/l) and bicarbonate buffered (214-223 mg/l) with no appreciable free CO₂ (0 to 4 mg/l) or dissolved carbonate

(2 to 4 mg/l). The waters are slightly basic (ph 7.9 to 8.5).

Dissolved oxygen does not appear to be a limiting factor to aquatic organisms with 7 to 9 mg/l of O_2 on August 11 and 12 and water temperatures of 21 to 24°C.

Probably the greatest physical and chemical stresses on aquatic organisms come from the high total dissolved solids (366 to 600 mg/l); high turbidities; and extreme fluctuations in total suspended solids and stream discharge.

Olsen (1973) remarks generally on "water quality" or sediment loads and notes that in 1972, the water quality was poor. The comments are as follows.



Unfortunately, data regarding suspended sediment either on a weight/volume basis or in terms of optical turbidity units, is extremely scanty for the White River. This data is not taken at the U.S.G.S. station at the Highway 45 Bridge. However, a sediment recording station is to be installed in the very near future at a point on the White River approximately two miles upstream from its confluence with the Green River. This station will yield continuous data on the velocity-weighted concentration of suspended sediment in a zone from the water surface to a point approximately 0.3 foot above the bed expressed as milligrams of dry sediment per liter of water-sediment mixture as well as total sediment discharge and periodic data on particle-size distribution of the suspended sediment.

The only turbidity data from the White River consists of the samples taken May 9, 1973, at the Highway 45 Bridge and at the mouth of Southam Canyon (Table 24). The former sample yielded a reading of 468 JTU (Jackson Turbidity Units) and the latter 576 JTU. Spring run-off had commenced with the discharge on May 7-9 approximately twice that of two weeks prior; however, discharge was about one-half that of the long-term spring mean peak which occurs later in May and June. (The very high turbidity (1,188 JTU) recorded from Evacuation Creek at this same time indicates that heavy sediment loads were being carried into the river from permanent and intermittent tributaries throughout the drainage basin.) Without baseline comparative data, interpretation of the White River turbidity readings noted above is difficult. However, it is probably safe to assume that much higher readings occur later in May and throughout June when spring run-off is at its peak. Although turbidity readings during non-runoff periods should not be speculated upon, the chances are that they are considerable since casual observations indicate that the river appears turbid throughout the year. The significance of the turbidity values is pointed out by Tarzwell (1968) who notes that, "Fish productivity is ultimately dependent

Trib
cont.

upon plant life and a good bottom fauna; there can be little of either above 3 JTU if that turbidity is maintained continuously."

Turbidity was one of the factors analyzed in the Green River water samples taken monthly in 1969 and 1970 at the Ouray Bridge (Table 25). The sampling station was above the confluences of the White and the Duchesne Rivers and the turbidity readings, therefore, does not reflect the contributions to the Green's suspended sediment load made by these two streams. Although the mean annual discharge of the Duchesne is approximately the same as that of the White, the mean dissolved solids concentration is about 1.5 times greater. The turbidity values at the Green River station ranged from a low of 30 JTU in December to a maximum of 700 JTU in late May and averaged 215 JTU for the nine sampling periods. From March through November, all turbidity measurements were in excess of 100 JTU, and were greater than 200 JTU in the samples taken in April, May June and September. Because of differences in the size and characteristics of the Green and White River drainages, it is not presumed that these Green River turbidity values or the trends indicated are necessarily representative of the White River.

Some comprehension of the magnitude of the turbidity and siltation problems in the area can be obtained by examination of the sediment records obtained from the U.S.G.S. station (#092610) on the Green River at Jensen, approximately 50 river miles upstream from Ouray (U.S.G.S., 1972). The figures to be cited are the mean daily suspended sediment concentrations on a weight/volume (mg/l) basis. There is no way of correlating these measurements with turbidity units since the latter are largely dependent upon the particle size distribution of the sediment which varies greatly at different sampling times. At Jensen, where sediment records have been kept since 1948, the maximum daily sediment concentration has been 40,600 mg/l. During water year 1971, mean daily concentrations usually ranged from 25-100 mg/l from June through January. During

the four peak months, the average and extremes of the mean daily suspended sediment concentrations were as follows: February, 200 (65-362); March, 1,679 (51-8,300); April, 1,072 (330-2,800); and May, 875 (336-1,450) mg/l.

In the "Final Environmental Statement for the Prototype Oil Shale Leasing Program" (U.S.D.I., 1973), recommendations were made regarding the monitoring of water quality to identify and assess the effects of oil shale development:

To adequately measure impact of an oil shale mine or other installation, it would be necessary to install continuous recording stream flow stations that include a recording turbidity meter, water quality monitors to record temperature and specific conductance, and an automatic device to collect samples for chemical analysis with control for variable sampling rates according to stream flow. In addition, an automatic sampler for suspended sediment would be required and rigged to collect one sample each day and actuated when stage exceeds predetermined levels so that extra samples of the peaks are obtained. Chemical quality samples collected by the automatic samplers would be analyzed for calcium, magnesium, sodium, aluminum, silica, carbonate, bicarbonate, dissolved-solids concentration, chloride and total organic carbon (unfiltered samples). Other ions such as fluoride or boron would be determined periodically to establish transient concentrations. Sediment samples would be analyzed for concentration and for size where concentrations are sufficient to permit determination. Bed material samples would be collected for size analysis about twice a year. About once each month, the sampling sites would be sampled for macroinvertebrates and periphyton.

The U.S.G.S. station on the White River near the Highway 45 bridge has provided more than 20 years of baseline data on temperature, specific conductance and each of the chemical elements noted above with the exception of aluminum and total organic carbon. Upon installation of the sediment station which, as noted earlier, is to be placed on the White River about two miles upstream from its confluence with the Green, the suspended sediment monitoring requirement will be satisfied. No system of monitoring turbidity, size analysis of bed samples, or macroinvertebrates or periphyton has been instituted. Samples for chemical analysis would have to be taken on a continual basis or at least far more frequently than the current once per month schedule if the above recommendations are to be met.

The U.S.G.S. gaging station and water chemistry sampling site located where it is just downstream from the Highway 45 Bridge, is not at an optimum position for assessing water quality changes associated with oil shale development in the prototype leasing area. Examination of a detailed topographic map (Figure 4) shows that essentially all the drainage from the western portion of the area (all of Tract U-a) enters the White River from three to eight miles downstream of the station. Evacuation Creek drains most of the eastern portion of the prototype area (Tract U-b) and, since it enters the White two miles upstream from the Highway 45 Bridge, samples taken at the present gaging station would reflect activities on this portion; however, there are areas of this tract which drain into the river below the gaging station. A sampling site located downstream from the mouth of Southam Canyon would monitor all water quality changes associated with development on both prototype tracts. It is noteworthy that both of the Colorado prototype oil shale lease tracts are also in the White River drainage and thus water quality changes in this river could be affected by a total of four oil shale development operations.

One final factor which should be noted that has affected the aquatic habitat of the White River in the past is oil pollution. Madsen (1961) made a survey of the extent and nature of water pollution existing in Utah from June 1 to October 1, 1968 and one of the drainages studied was the White River. Pollution 0.1 He found that the Rangely Oil Field in Rangely, Colorado, was a serious source of oil pollution in the adjacent White River. The oil field is traversed by numerous washes and gullies leading to one central drainage which empties into the White slightly downstream from the town of Rangely. Waste oil was being stored in poorly constructed surface ponds located next to a dry wash or gully, and these would frequently overflow and/or break during storms releasing oil to the White. Madsen includes nine photographs illustrating conditions in the oil field and accumulations of oil in backwaters

and on sandbars of the White for miles below Rangely including one taken "near the Utah-Colorado state line." He notes that these accumulations had caused considerable damage to grazing, eliminated fur-bearing animal populations along the river, and had seriously impaired fishing.

Mr. Louis Vidakovich, a Wildlife Conservation Officer, Colorado Division of Wildlife, Rangely, Colorado, verified the above conditions but noted that vast improvements had occurred primarily in the last five years in regard to instituting numerous safeguards against oil leakage into the river and also in regard to a much greater environmental concern on the part of the oil industry.

The effect of this oil pollution on the fishery of the White River in Utah is difficult to assess. The Rangely field is located 15 river miles east of the Utah line and it is another 12 miles from the state line to the Utah Highway 45 Bridge so there would be a certain amount of dilution and retention by river banks, vegetation and other structures upstream. However, since the Rangely field began operations in the early 1940's and apparently little effort was made to prevent oil from entering the river until the mid-1960's, there was a period of 20 or more years when oil pollution was a common influence on the aquatic habitat of the White. It is difficult to avoid speculating that over this long period the oil had detrimental effects on plant growth, benthos and the survival and spawning of fish; the effect on the latter would be particularly severe in the backwater areas which is where the oil tended to accumulate and which is also the habitat preferred by several of the endemic fish species either as adults or young. Even though oil pollution from the Rangely field apparently has not been significant for the last several years, the effects of the long period when it was maybe a contributor to the low populations of fish and low quality aquatic environment currently present. It is interesting to note that although Holden and Seeling found several species of fish abundant in the White in 1971 and 1973, their sampling was upstream from Rangely, above the oil field.

~~Electrofishing samples were obtained in continuous 2,000-~~
~~foot stretches of river. Direct current, which was supplied by a~~
~~230-volt, 21.8-ampere generator, and~~ ^{conveyed by 500 feet of cable to} ~~500-foot of cable was used as~~
~~the electrodes,~~
~~a power source. By experimentation it was found that shocking down-~~
~~stream produced the best results. This procedure was employed~~
~~on the near side, far side, and wherever possible, several sections~~
~~of the middle of the stream. All divided channels in the sampling~~
~~segment were shocked using this procedure. Electrofishing areas~~
~~were not normally blocked off while sampling.~~

Explosives were used successfully at two of the sampling
stations in smaller holes and slides. Best results were obtained
~~when ditching powder was attached to long lengths of primer cord~~
~~at 10-foot intervals. Immediately downstream from the sampling~~
~~area (approximately 50 yards), minnow seines were set across the stream~~
~~to intercept fish as they floated out of the blast area.~~

~~Results and Discussion~~

Of the fish sampling methods employed on the White River,
only electrofishing consistently took many and varied fishes.
Normally, this type of gear is more effective for large fish than
for small. However, with only a few exceptions, the fish taken
were small in size. Perhaps larger individuals are not numerous
in the system or were not present in that portion of the river during
sampling. However, it is definitely possible that the large fish
were able to escape the electrical field.

A few larger fish, including three carp, four suckers,
two round-tailed chubs, some smaller shiners, and two dace were

collected in minnow seines and dip nets after being immobilized by explosives.

Quantitative estimates of the fish population were not practical because of the high turbidities and other factors that made fish collection difficult. Therefore, efforts were concentrated to determine relative abundance and distribution of the fish species present.

A total of 1,776 fish, including 98 young-of-the-year fish too small to be classified accurately, were captured from the eight stations sampled (Tables 9 and 10). Eleven different species were taken during the two-year sample period. Approximately 95 percent of all fish collected were under six inches in total length.

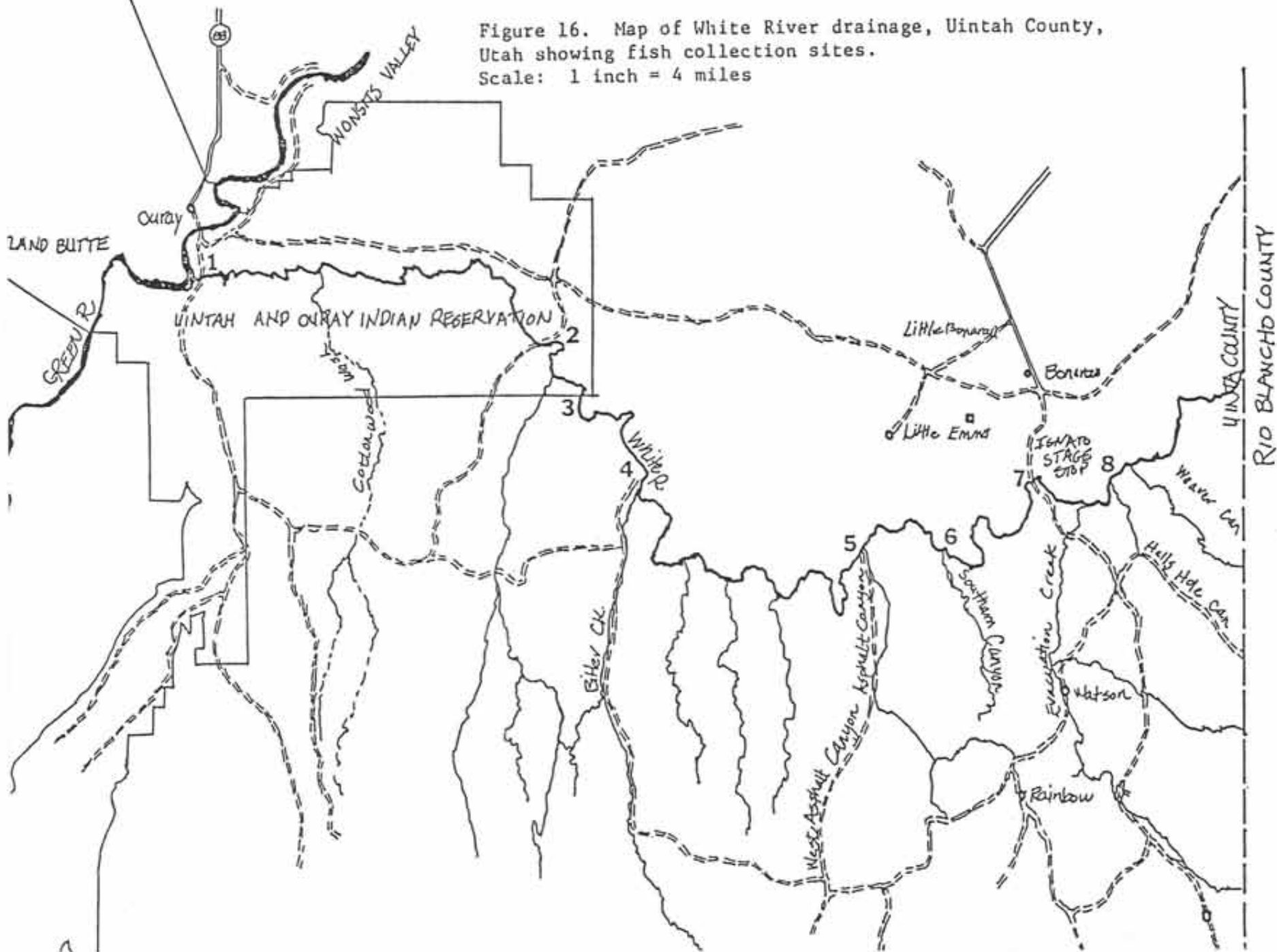
Based on the results of this fish population inventory, it seems that the White River provides marginal habitat for many of the fish species which are known to inhabit the Upper Colorado River system. Only the red shiner, speckled dace, and flannelmouth sucker were captured with consistency at most of the sampling sites. Carp, bluehead sucker, round-tailed chub, and channel catfish were widely distributed but relatively few in number. The fathead minnow was present only at Stations 3 and 5. A single smallmouth bass and a single brown trout were captured near the confluence with the Green River.

No specimens of the Colorado River squawfish, Ptychocheilus lucius; bonytail chub, Gila elegans; humpback sucker, Xyrauchen texanus; or the humpback chub, Gila cypha were found in the survey. It is possible that these rare species may occur in this portion of the White River either as residents or migrants. It seems that the rate of

flow and overall habitat are of sufficient quality to allow passage from the Green River.

It appears that there would be little chance, without modification of some basic habitat factors such as turbidity and bottom type, to produce adequate numbers of the normally acceptable game fish to establish a sports fishery. It would appear that some degradation of this already marginal habitat could be tolerated without significant alteration of the fish resource. However, it should be noted that some stress is apparently being exerted upon the native species from competition with the introduced forms, especially among the smaller minnow species.

Figure 16. Map of White River drainage, Uintah County, Utah showing fish collection sites.
Scale: 1 inch = 4 miles



Proposed Reservoir Operation Schedule

Bingham Engineering supplied information on the probable operation of the White River Dam. The operation plan is based upon the accumulation of flows which would have occurred had the White River Dam been operative between 1931 and 1970. (See Reservoir Capacity chart, end of month storage, and dam release tables in Appendix.) According to the area-capacity chart the base of the dam is at elevation 4900 while the top of dam elevation is 5020 and the spillway is at 5010. Water 110' at the dam would be backed upstream for a distance of approximately 11 miles. The empoundem^cnt would be restricted by the narrow canyon walls and, there would be about 1,875 surface acres or about 118,000 acre-feet of storage capacity. Water released from the reservoir may be used to generate power, to irrigate croplands and for culinary purposes. If the reservoir capacity between 1931 and 1970 is an indication, then fluctuation in the White River Reservoir will not be a limiting factor. Over the 40 year period the average annual pool would have approached 3/4 capacity only one time, 1935.

The mean monthly storage over those 40 years would have been the lowest in August, September, and October and the highest in April, September, and June. However, even at the lowest mean monthly capacity in September the reservoir would have still been 94% of capacity. The relatively high inlet inflow would allow the reservoir to be recharged practically at will. Over the 40 year period the mean average annual release below the reservoir would have been 405,056 acre feet. Over this same period the mean monthly flow below the reservoir would have been lowest during fall and winter months and highest in late spring or early summer. During May of 1935 the lowest discharge in the tailrace would have been 31,635 which amounts to approximately 527 cfs of continous release. At this writing the decision to incorporate hydroelectric capabilities into the project has not been finalized. If generators are installed in the White River Dam we may anticipate daily fluctuations in the release, possibly from 200 cfs to 1200 cfs. This will cause a verticle rise of about 3'.

Discussion and Fishery Recommendations

The life expectancy of the White River Reservoir is relatively short because of extreme sediment deposition unless the planned Yellow Jacket Project Reservoirs in Colorado acts as an upstream settling basin. If this project becomes a realization, wider fluctuations in water levels in the White River Reservoirs could very well be experienced. Such a condition, if extreme, would result in a magnification of both chemical and physical limiting features described below which would inturn decrease the reservoir productivity for fish. Because of this possibility a dead storage or conservation pool of $\frac{1}{4}$ the reservoir capacity should be a segment of the operation plan. Such a measure would have been no problem between 1931 and 1970 since after initial filling the reservoir level never closely approached $\frac{1}{4}$ capacity.

Closure of the White River Dam will cause the river water to slow dropping its silt load, covering the bottom. The bottom fauna will change from a diverse biota rich in *Ephemeroptera* to one dominated by *Tenepididae* and oligochaetes. Mud flats will develop where the river and reservoir meet, the extent of which will be determined by reservoir fluctuation. The silt laden-alkaline water, being rich in nutrients, will cause extensive zooplankton and phytoplankton blooms, especially in clear water protions of the reservoir.

The steep walled sections of the reservoir will be subject to thermal stratification. The hypolimnion will be subject to oxygen depletion due to influx of river-borne organic matter.

Oxygen depletion may be an annual problem if spring runoff is extensive since large amounts of organic matter will be washed into the reservoir, ultimately settling in the hypolimnion. During

years with high spring runoff the entire reservoir can expect to be turbid during spring and early summer, since clays in the area are colloidal. Such turbidity may affect natural reproduction warm water fishes resulting in erratic year classes. The reservoir should clear during summer and fall. Shallower areas subject to wind action will experience an unstable stratification. Wind and river inflow will work to destratify this portion resulting in homothermic and well oxygenated water. The entire reservoir will freeze over during winter and some oxygen depletion problems may exist in shallower areas depending on river flow as ice thickness and depth of snow cover increases. Higher aquatic plants will not establish due to turbidity.

The reservoir fishery will be basically warm water although a two-story fishery may be developed if dissolved oxygen in the hypolimnion is adequate. The only area suitable for salmonids will be near the dam. Largemouth bass should be the primary game species.

Rough fish species are sure to invade the reservoir rapidly, especially if interstate eradication measures are impossible. The two lacustrine species of primary concern are the Utah chub (Gila atraria) and White sucker (Catostomus commersoni). Both are found in the Green River drainage and there is no reason to believe they are not present in the White River. Carp (Cyprinus carpio) could become a nuisance in shallow portions of the reservoir.

Other species of possible sport value are the Black bullhead (Ictalurus melas) and Channel catfish (Ictalurus punctatus) which are well suited to this type of reservoir and are found in the drainage. The Walleye (Strizostedion vitreum) and Northern pike

White River

(Esox lucius) are found in the Green River drainage and could possibly become established in the reservoir.

The impounding of the White River will result in a eutrophic reservoir the fishery of which depending upon game species stocked and time of stocking. Largemouth bass should be stocked as soon as possible after closure of the dam gates to assure rapid growth and reproduction.

GLOSSARY

ABNEY LEVEL: Apparatus used to measure stream gradient.

BANK COVER: Important when it provides shade in the stream.

BOTTOM MATERIAL: Classified as either boulder, rubble, gravel, sand, silt, or other.

BOULDER: Rocks over 12 inches in diameter. Boulders may provide resting areas for fish.

ELECTROFISHING: Method used to capture fish (i.e. an electrical current temporarily stuns fish which enables them to be netted).

~~GAME FISH: Trout were the only game fish found in this study.~~

GURLEY PYGMY CURRENT METER: Apparatus used to measure the water velocity.

GRADIENT: The natural slope of the streambed.

GRAVEL: Rocks 0.1 to 2.9 inches in diameter.

PERCENT OF MAXIMUM HABITAT: $\text{Sum of pool measure \% + pool structure \% + stream bottom \% + streamside environment \%} \div 400\%$.

POOL: Those parts of the stream where the water flowed more slowly and was deeper than in surrounding portions. Pools are important as resting and hiding cover for fish.

POOL MEASURE: $+ \text{pool riffle ratio} = \text{total feet of pool} \div \text{total feet of stream bottom} \times 100$. When actual pool percent is 50% then pool measure rating is 100%, when actual pool % is less than 50% then actual pool % divided by 50% equals pool measure rating, when actual pool % is greater than 50% then $100\% \text{ minus } (2 \times \text{actual pool \% minus } 50\%) \text{ equals pool measure rating}$.

POOL STRUCTURE: $\text{Pool quality total feet of pools rated 1, 2, or 3} \div \text{total feet of all pools} \times \text{pool measure}$.

RIFFLE: The faster moving, more shallow portions of a stream as contrasted to a pool. Riffles are important aquatic invertebrate food production areas in a stream.

ROUGH FISH: Those fish such as suckers and minnows that are not considered game fish.

SAND-SILT: Particles less than 0.1 inch in diameter.

STREAM ENVIRONMENT: Rating of streamside vegetation, forest 4 points, brush 3 points, exposed 1 point = total points from 10 transects \div total possible points.

STANDARD LENGTH: The measure of a fish from its most anterior terminal end to the hidden bases of the caudal fin rays, where a groove forms naturally when the tail is bent from side to side.

TOTAL LENGTH: This is the greatest possible length of the fish with mouth closed and caudal rays squeezed together to give the maximum overall measurement.

UNDERCUT BANK: Forms either where the water erodes away the bank above which roots of plants hold the soil particles together or where the water has undercut a rock bank. The water flowing under the bank provides shade as well as resting cover for fish.

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Table 9. Relative abundance of fishes collected during the White River Study (1974).

Taxa	Stations								Total
	Hells Hole Canyon	Bonanza Bridge	Placitas Canyon Southam-Canyon	Asphalt Ridge	Bitter Creek Confluence	Mountain Fuel Bridge	East Boundary Indian Reservation	Bridge Near Ouray	
<u>Pimephales promelas</u> Fathead Minnow	0	0	61	0	3	0	0		64
<u>Notropis lutrensis</u> Red Shiner	5	16	0	14	379	277	4	160	855
<u>Rhinichthys osculus</u> Speckled Dace	4	10	33	30	47	15	5	16	160
<u>Cyprinus carpio</u> Carp	0	1	0	0	1	0	3	4	9
<u>Gila robusta robusta</u> Roundtail Chub	0	2	1	1	22	0	2	0	28
<u>Catostomus latipinnis</u> Flannelmouth Sucker	10	26	43	27	38	7	2	0	153
<u>Pantosteus delphinus</u> Bluehead Sucker	2	2	2	14	1	0	0	1	22
<u>Ictalurus punctatus</u> Channel Catfish	0	0	0	0	0	0	0	21	21
<u>Salmo trutta</u> Brown Trout	0	0	0	0	0	0	0	1	1
Total	21	57	140	86	491	299	16	203	1,313

Table 10. Relative abundance of fishes collected during the White River Study (1975).

Taxa	Stations								Total
	Hells Hole Canyon	Bonanza Bridge	Pine Valley Southam Canyon	Asphalt Ridge	Bitter Creek Confluence	Mountain Fuel Bridge	East Boundary Indian Reservation	Bridge Near Ouray	
<u>Pimephales promelas</u> Fathead Minnow	0	0	0	0	1	0	0	0	1 65
<u>Notropis lutrensis</u> Red Shiner	7	0	4	5	30	29	11	55	141 996
<u>Rhinichthys osculus</u> Speckled Dace	38	14	14	12	29	9	13	6	135 295
<u>Cyprinus carpio</u> Carp	0	0	0	0	3	0	0	0	3 12
<u>Gila robusta robusta</u> Roundtail Chub	1	0	3	3	0	0	1	0	8 36
<u>Catostomus latipinnis</u> Flannelmouth Sucker	8	3	6	10	9	0	1	0	37 190
<u>Pantosteus dolphinus</u> Bluehead Sucker	3	3	14	3	0	0	1	0	24 46
<u>Ictalurus punctatus</u> Channel Catfish	2	0	1	0	1	3	2	3	12 33
<u>Ictalurus melas</u> Black Bullhead	0	0	0	1	2	0	0	0	3
<u>Micropterus dolomieu</u> Smallmouth Bass	0	0	0	0	0	0	0	1	1 85
Total	59	20	42	34	75	41	29	65	365

Table 22. Checklist of fishes collected from the White River in the Utah Oil Shale Area by Utah Division of Wildlife Resources personnel during 1973 and near Rangely, Colorado by Paul B. Holden during 1971.

Species	Utah Oil Shale Area	Rangely, Colorado
Cyprinidae		
Roundtail chub		
<u>Gila robusta</u>	X	X
Speckled dace		
<u>Rhinichthys osculus</u>	X	X
Carp		
<u>Cyprinus carpio</u>		X
Red shiner		
<u>Notropis lutrensis</u>	X	X
Catostomidae		
Flannelmouth sucker		
<u>Catostomus latipinnis</u>	X	X
Bluehead sucker		
<u>Catostomus discobolus</u>		X
Ictaluridae		
Channel catfish		
<u>Ictalurus punctatus</u>	X*	X

* Not collected by DWR but known to be taken by fishermen.