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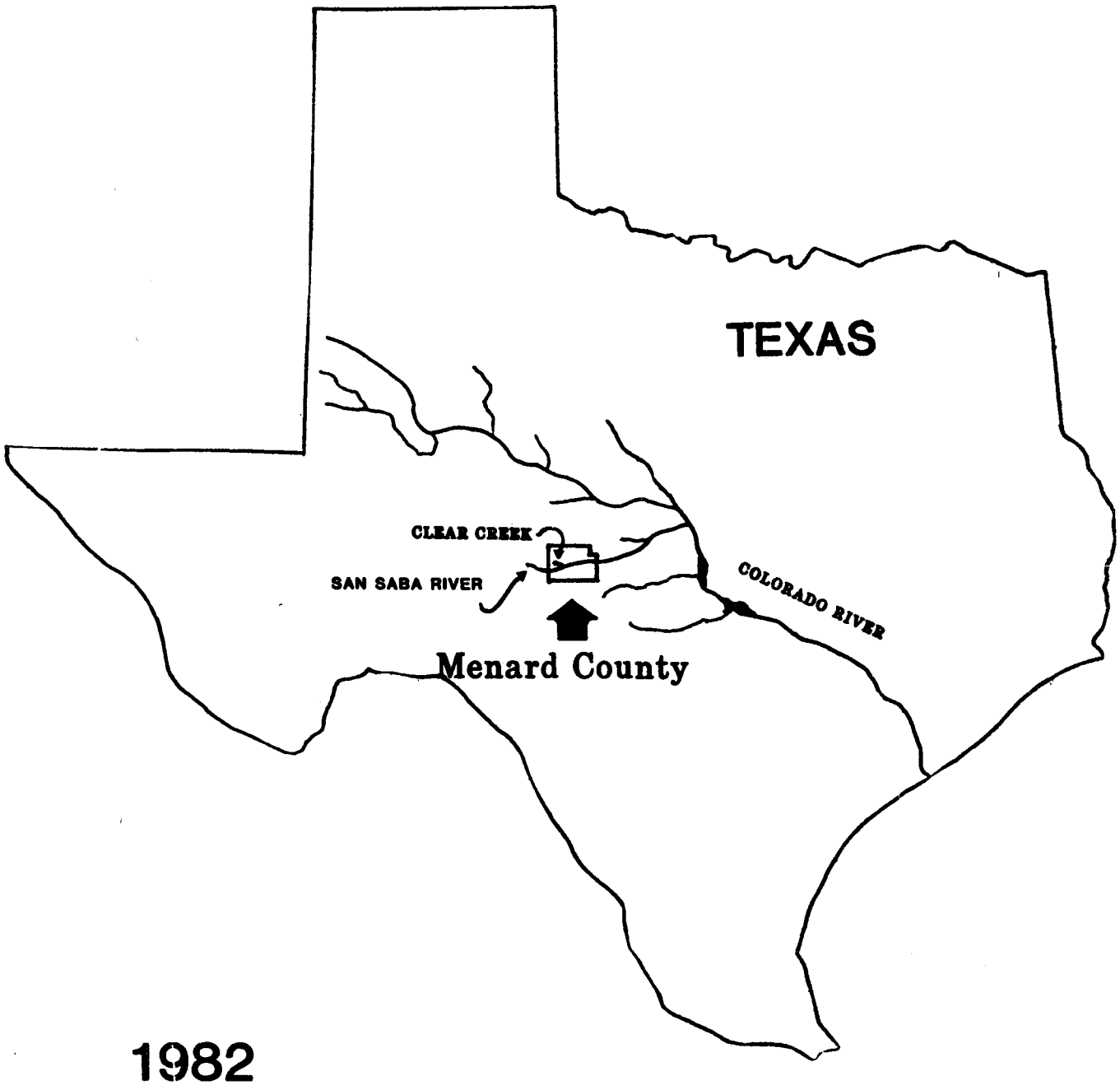
CLEAR CREEK GAMBUSIA

RECOVERY PLAN



1982

RECOVERY PLAN

FOR

CLEAR CREEK GAMBUSIA

Gambusia heterochir Hubbs, 1957

PREPARED BY

THE RIO GRANDE FISHES RECOVERY TEAM

April 16, 1980

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1/14/92

Date

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PREFACE

The Clear Creek Gambusia Recovery Plan was developed by the Clear Creek Gambusia Recovery Team, an independent group of biologists sponsored by the Albuquerque Regional Director of the U.S. Fish and Wildlife Service.

The recovery plan is based upon the belief that State and Federal conservation agencies and knowledgeable, interested individuals should endeavor to preserve the Clear Creek gambusia and its habitat and to restore them, as much as possible, to their historic status. The objective of the plan is to make this belief a reality.

The recovery team has used the best information available to them and their collective knowledge and experience in producing this recovery plan. It is hoped the plan will be utilized by all agencies, institutions and individuals concerned with the Clear Creek gambusia and the Clear Creek ecosystem to coordinate conservation activities. Periodically, and as the plan is implemented, revisions will be necessary. Revisions will be the responsibility of the recovery team and implementation is the task of the managing agencies, especially the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service.

This completed Clear Creek Gambusia Recovery Plan has been approved by the U.S. Fish and Wildlife Service. The plan does not necessarily represent official positions or approvals of cooperating agencies and does not necessarily represent the views of all recovery team members. This plan is subject to modification as dictated by new findings and changes in species status and completion of tasks assigned in the plan. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints.

Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1980. Clear Creek Gambusia (Gambusia heterochir) Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque New Mexico. 29 pp.

ACKNOWLEDGMENTS

The recovery team was assisted in all phases of this study by the cooperation of the Wilkinson family. The Wilkinsons have demonstrated an unusual level of environmental concern in aiding the perpetuation of the Clear Creek gambusia, as well as cooperating with the recovery team action. The actions of the Wilkinsons are to be commended as exemplary of landowner care and concern for the environment.

The efforts to maintain the environmental status quo were aided (in addition to cooperation by the Wilkinsons) by Mr. Black from the Menard SCS office and Ms. Alice F. Echelle, Doyle Mosier, Dr. Edie Marsh, Dr. Robert J. Edwards, Gary P. Garrett, David Marsh, S. Michael Dean and Jerry F. Bentley. All of the above made major contributions to the protection of the dam site.

PART I:

CLEAR CREEK GAMBUSIA

RECOVERY PLAN

INTRODUCTION

The Clear Creek gambusia (Gambusia heterochir) is a small, stocky species in the Poeciliidae. Males are distinguished from all other livebearing poeciliids by a deep notch in the dorsal margin of the pectoral fin. The species occurs only in the headwaters of Clear Creek, Menard County, Texas, and derives its common name from the creek.

A series of interconnected springs on the Wilkinson Clear Creek Ranch comprise the known range of the Clear Creek gambusia. Competition (genetic and environmental) with mosquitofish (Gambusia affinis) and the possibility of losing the extremely limited geographic range of G. heterochir threaten the long-term survival of this species. The fish was first listed as an endangered species by the U.S. Department of Interior in 1967 and by the Texas Parks and Wildlife Department in 1973.

At the present time (1980), the Clear Creek Ranch is for sale, and although the Wilkinson family has demonstrated long-term concern for the species, the concern of future owners cannot be predicted.

What is known of Clear Creek gambusia life history and ecology may be found in Hubbs (1971). An analysis of the effects of an attempt in 1979 at habitat restoration has been initiated to test Hubbs' conclusions regarding the interaction of the mosquitofish and Clear Creek gambusia.

DESCRIPTION

The Clear Creek gambusia is a stocky gambusia with a metallic sheen. Scattered terminal dark marks on some lateral or dorsal scales form distinctive crescentic marks. There is no predorsal streak or caudal speckling. Females have a pronounced anal spot.

Males exhibit the most distinctive attributes--see Hubbs (1957) for illustrations. The deep notch in the dorsal margin of the pectoral fin of adult male G. heterochir is unique among poeciliids (Hubbs and Reynolds 1957, Warburton et al. 1957). The gonopodium has short spines on ray 3, a pronounced elbow and separate distal elements on 4 long serrae and a simple terminal hook on 4P, a pronounced blunt tip and a rounded terminal hook on 5.

TAXONOMIC STATUS

The Clear Creek gambusia was described formally in 1957. It was placed in the Gambusia nicaraguensis species group by Hubbs (1957) but later assigned to the Gambusia nobilis species group by Rosen and Bailey (1962), Rivas (1963), and Minckley (1962), an assignment endorsed by Peden (1975).

The long documented, historic hybridization with Gambusia affinis was not shown to impact the genetic integrity of Gambusia heterochir by Hubbs (1971).

DISTRIBUTION AND DESCRIPTION OF THE HABITAT

The existence of Gambusia heterochir was first documented on February 22, 1953. On that date, Gambusia heterochir, G. affinis, and some hybrids were obtained by Clark Hubbs and Kirk Strawn while sampling for the greenthroat darter (Etheostoma lepidum) in Wilkinson Springs on the Clear Creek Ranch, 16 kilometers west of Menard, Texas.

Upper Clear Creek consists of a series of limestone springs (Wilkinson Springs) originating from the Edwards Aquifer. Flows in Clear Creek averaged around 25 cfs in the early 1900's. During the drought period of the mid-1950's, the average flow dwindled to the 7.3 cfs recorded in 1956 (Brune 1975), and flows in the 1960's measured 10-15 cfs. Although no flow records are available for the 1970's from Clear Creek, flow from nearby Ft. McKavett Springs, with a similar flow pattern, was very high (Brune 1975).

Upper Clear Creek has been altered extensively for irrigation and domestic uses. Prior to 1900, a low, earth-concrete dam was built about 75 meters downstream from the headsprings. Three additional dams were built downstream from the original dam in the 1930's, ponding water to the base of each subsequent dam (Hubbs 1971) and flooding previously irrigated fields.

Extensive collecting in Clear Creek in 1956 and 1957 more precisely defined the geographic range of G. heterochir as the springfed, uppermost pool. (A few individuals were obtained from small springs within or adjacent to the pool below the headspring dam.) Gambusia heterochir is a spring-dwelling species restricted to that part of Clear Creek with clear, stenothermal, low pH (6.1-6.5) waters and abundant aquatic vegetation composed mostly of an endemic, undescribed morph of Ceratophyllum sp.

Because of the small area of the headspring pool (about 1 hectare) and relatively large spring influx, suitable habitat for the Clear Creek gambusia is available throughout the pool. Below the first dam, habitat and species composition change abruptly, with higher pH's (7.4-7.8), greater temperature fluctuations, Myriophyllum sp. replacing Ceratophyllum

sp., and Gambusia affinis replacing G. heterochir. In 1971, Hubbs reported hybridization between G. affinis and G. heterochir and placed the major zone of intergradation around a breach in a deteriorating section of the upper dam. This breach occurred prior to 1956 and allowed G. affinis continued access into the upper pool, a habitat from which they were formerly excluded by the dam. The original earth-concrete dam acted as a barrier to winter migrations of G. affinis into warmer waters of the headspring pool, and thereby helped prevent genetic swamping of G. heterochir by G. affinis (Hubbs 1959, 1971).

HABITAT REQUIREMENTS

The greatest abundance of Gambusia heterochir is found in stenothermal waters with low pH. Ceratophyllum sp. (an aquatic plant), Hyalella texana (an endemic amphipod) and Gambusia heterochir are closely associated in ascending trophic sequence. In contrast, Gambusia affinis in Clear Creek abounds in all eurythermal, relatively alkaline environments containing Myriophyllum sp. and Hyalella azteca. Stocks of G. heterochir have been maintained in the laboratory under a variety of circumstances, but only in the absence of G. affinis. Long-term survival of G. heterochir in the wild can be assured only by maintenance of a substantial area under environmental conditions inhibiting G. affinis competition.

ASSOCIATED SPECIES

Clear Creek gambusia cohabit the upper pool with the roundnose minnow (Dionda episcopa) and the greenthroat darter (Etheostoma lepidum). These small fishes have minimal environmental overlap. Dionda is a midwater fish with omnivorous food habits; Etheostoma and gambusia feed on small invertebrates such as Hyalella, but Etheostoma lives on the substrate and gambusia lives near the surface. Two anurans (Acris crepitans and Rana berlandieri) occupy the shores of the upper pool and may occasionally feed on aquatic invertebrates on the surface. Their tadpoles inhabit the shores of the upper pool, but are herbivores.

A variety of potential predators which presumably feed on gambusia have been recorded in Clear Creek. These include the largemouth bass (Micropterus salmoides), green sunfish (Lepomis cyanellus), longear sunfish (Lepomis megalotis), exotic redear sunfish (Lepomis microlophus) and yellow bullhead (Ictalurus natalis). Semi-aquatic snakes (Nerodia sp. and Thamnophis sp.) and bullfrogs (Rana catesbeiana) have been seen along shore and likely feed on gambusia. These piscivorous vertebrates have a long history of occurrence in central Texas and their predation would be a normal selective factor on Gambusia heterochir. Unless the habitat is seriously altered (e.g., removal of aquatic plants), the predatory activities of these vertebrates are not expected to deplete the gambusia seriously. An apparently recent introduction

to Clear Creek is the rainwater killifish (Lucania parva), first collected in 1980. The rainwater killifish is a brackishwater species formerly known only from coastal waters and the Pecos River, but it is expected to reproduce in Clear Creek. If the killifish reproduces and becomes established in Clear Creek, its impact on G. heterochir cannot be predicted. Both Lucania and G. heterochir occupy similar niches and are likely to compete for food and cover.

REPRODUCTION

The Clear Creek gambusia is viviparous (bears living young). Once inseminated, females store sperm for several months, thus males need not be present during much of the reproductive season (Hubbs 1971). In the lab at 25°C, each female produces up to 50 young every 42 days, depending upon her size. In Clear Creek at the lower temperature of 20°C, the estimated interbrood interval is 60 days. In Clear Creek, females are reproductive for 7 months (March-September) and all stream reaches inhabited by Clear Creek gambusia have pregnant females during the midsummer reproductive period. Factors limiting reproduction are unknown, but photoperiod, temperature and food availability all influence fecundity and length of interbrood intervals in poeciliids.

THREATS

1. Hybridization

   Gambusia affinis and the Clear Creek gambusia hybridize where they occur together (Yardley and Hubbs 1976). Hybrids are fertile; thus, the genome of the endemic Clear Creek gambusia can be contaminated. Hybridization may lead to two separate problems: 1) reduction in recruitment of Gambusia heterochir due to females carrying hybrids and 2) competition for resources between hybrid and Clear Creek gambusia. If the latter problem exists, it could be critical because fish hybrids typically display hybrid vigor and are likely to exclude their parental species from prime environments. Hybrids are most likely to result from G. affinis female x G. heterochir male matings (Hubbs 1971). Therefore, female G. affinis, rather than G. heterochir females, carry most of the hybrids, leaving G. heterochir females free to bear the young of their own species. Because females store sperm and males are very promiscuous, it is unlikely that the time spent by male G. heterochir courting G. affinis will have a direct adverse impact on Clear Creek gambusia recruitment.

2. Competition.

   Although G. heterochir can be maintained in a variety of environments in the laboratory, the restriction to stenothermal waters in nature suggests a biological factor, perhaps competition, as the major factor

limiting distribution. The migratory movements of Gambusia affinis at Clear Creek distinctly exacerbate competition. Gambusia affinis has a warmwater preference. Thus, in winter they migrate from the eurythermal environment to the stenothermal environment, i.e., towards the headspring, where G. heterochir is restricted. In summer, the reverse migration of mosquitofish occurs. During the winter primary productivity is decreased and the fishes concentrate upstream. However, metabolic demands of the fishes are not altered substantially because of the constant spring temperatures, and at these times of increased population densities, food resources appear to limit population sizes.

A fish that migrates from the stream into the warmer spring waters maintains an elevated metabolism and could continue growing through the winter. Those fish that return to the stream during ambient summer (warm) water temperatures would have increased growth, (during preceding winter) could produce more young per brood and could reduce their interbrood intervals more than nonmigratory individuals. Also, recruitment would be enhanced so that migratory females of G. affinis have about seven times as many young annually as equivalent, but nonmigratory, G. affinis females.

3. Development.

The Clear Creek Ranch is currently for sale. One potential use of the ranch would be resort housing. Resort housing could cause deterioration of the headspring pool by construction, siltation or chemical contaminants and could cause eutrophic conditions.

4. Dam deterioration.

Any development of the area might result in removal of the earth-concrete dam. Removal of this dam would permit invasion of the headsprings by G. affinis and probably eliminate G. heterochir.

The earth-concrete dam will maintain a Gambusia heterochir environment isolated from major invasion by Gambusia affinis; therefore, any circumstances that increase the rate of dam deterioration must be avoided. Two factors, besides age, seem to be involved: 1) Nutria were introduced in the 1940's and proceeded to dig tunnels into the core of the earth-concrete dam, thus providing openings for piping (erosion), and 2) the expansions of the root systems of previously planted trees and shrubs have split containment walls. Also, because the dam is narrow (2-3 m wide), the root bases of large trees are not sufficiently wide to resist strong winds and some trees have blown over, breaking the containment walls when they fell.

5. Recharge zone.

The Clear Creek gambusia habitat is obviously dependent upon a reliable and substantial supply of spring water; therefore, it is essential that the Edwards-Trinity Aquifer recharge zone remain undisturbed. Most of the local recharge zone appears to be in ranchland north and west of the headspring. Although this area is likely to retain its current use, any change affecting water quality and quantity could have disastrous consequences.

6. Runoff.

The watershed emptying into Clear Creek is extremely limited. Four intermittent creeks are marked on the U.S.G.S. Clear Creek Lake Texas (Menard County, 7.5 minute series 1:24,000; 1970) quad for the Clear Creek area. Each is about 1 kilometer long and has a basin of about 1 km^2. The effect of flooding on the headspring pool is minimal, because all four intermittent creeks empty into Clear Creek downstream of the head pool. The watershed of the upper pool is about 10 hectares.

STREAM PERTURBATIONS

Originally, Clear Creek was a clear springrun that freely flowed about 5 km to its confluence with the San Saba River. Most or all of the stream was probably inhabited by springrun biota, i.e., Gambusia heterochir, Hyalella texana, Ceratophyllum sp. and associated organisms. The following description portrays the possible status of Clear Creek before human intervention.

Clear Creek began as a series of springs along the base of a cliff (Fig. 1), flowed south about 200 meters with a number of western springfed tributaries (Fig. 2) contributing additional flow, emptied into a large shallow pool, and then turned east for about 3.5 kilometers. Three hundred meters east of the bend a large springrun entered from the north side. The 3.5 km eastern flow meandered and spread over a variety of shallows. Clear Creek then turned south again and flowed rapidly and precipitously one kilometer to the San Saba River. Presently, Clear Creek has an elevation difference of about 15 meters from headsprings to confluence. The first major change in the stream was construction of the earth-concrete dam (Dam 1) that forms the present head pool. This dam may have been built before the Wilkinson Ranch was established in 1878, but certainly before 1890. Abandoned irrigation ditches can still be traced from the ends of the dam to large flats a kilometer downstream. Cultivated fields were irrigated by gravity flow until the 1930's, when they were mostly flooded by water impounded behind an earthen dam (Dam 2) constructed about 1.5 km downstream from Dam 1. This second dam

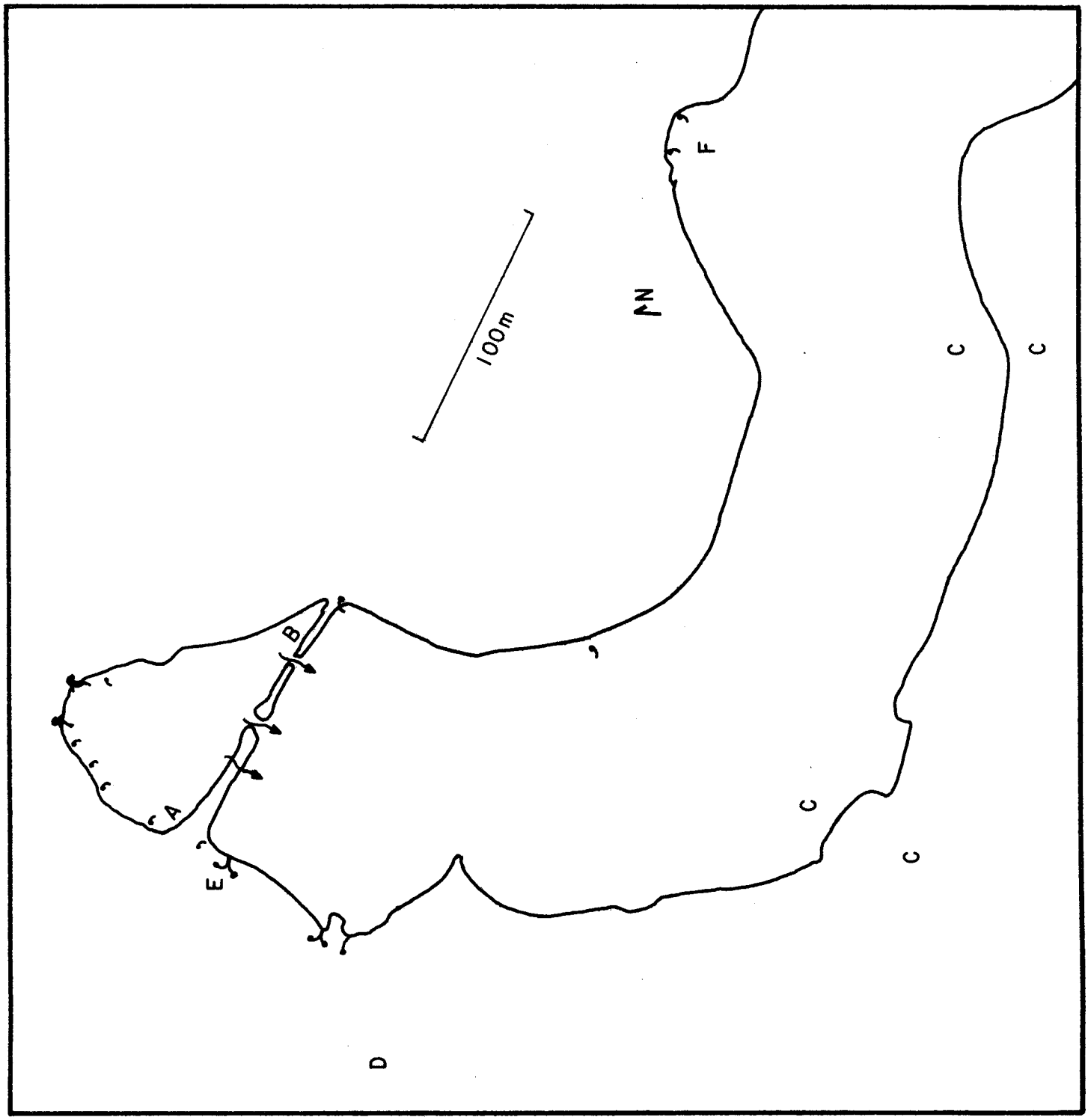

Fig. 1. Map of the Clear Creek headwaters. Dots with trailing lines designate spring sources. A = type locality; B = areas where dam had broken; C = old irrigated fields (presently inundated part now dominated by Gambusia affinis); E = old homestead; F = eastern spring group. Dam is between A and B.

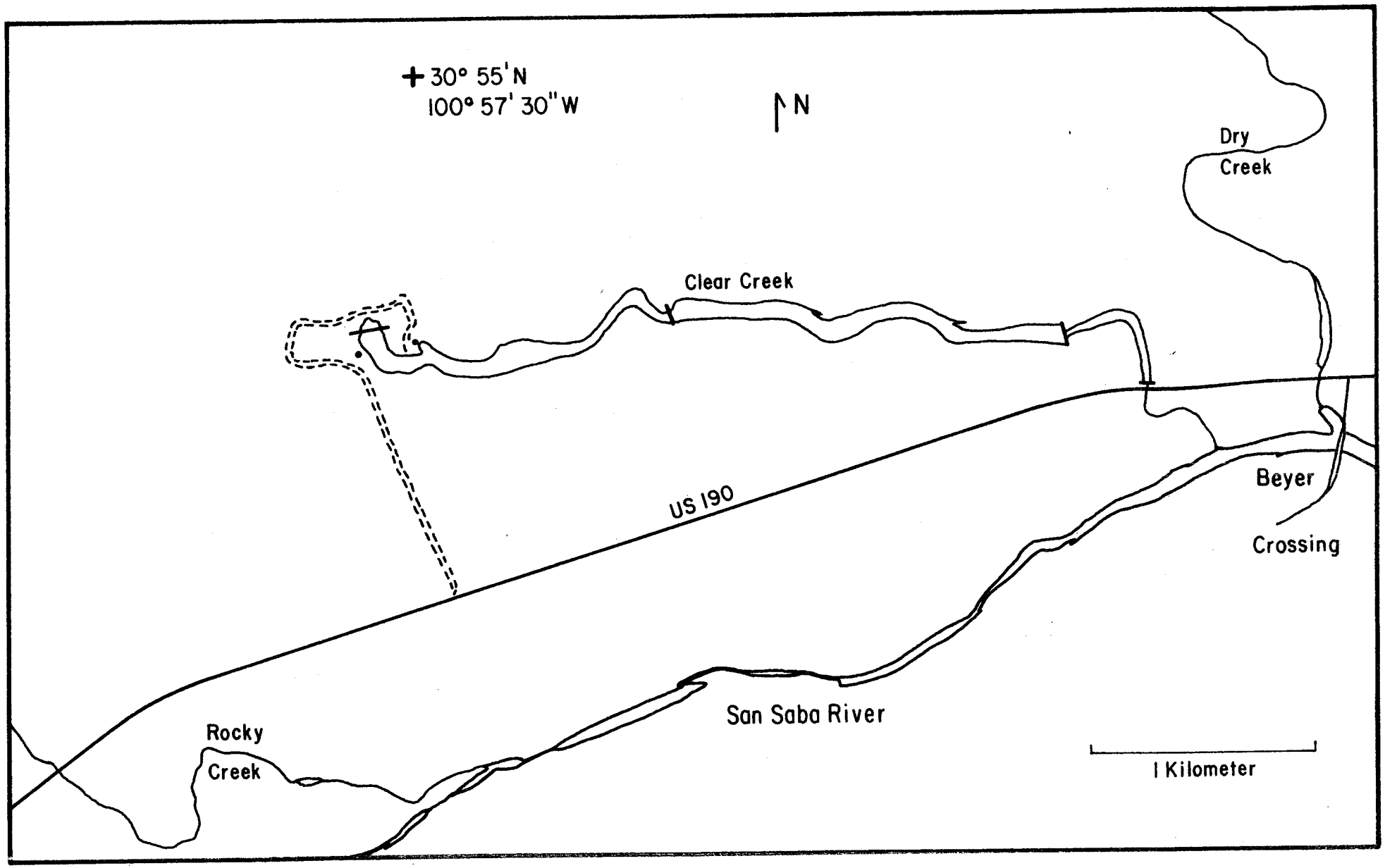

Fig. 2. Map of the Clear Creek area.

backed water up to the base of Dam 1. Shortly afterward, a third earthen dam (Dam 3) was constructed 1.5 km farther downstream from Dam 2. The pool elevations of Dams 2 and 3 were similar, resulting in occlusion of Dam 2. Even later, a fourth dam (Dam 4) was built 0.4 kilometers downstream from Dam 3 and about 100 meters upstream from the present location of U.S. Highway 190. The large pool behind Dam 3 slowed stream flow and flooded the previously irrigated fields with shallow water. The resulting changes in habitat encouraged population buildups of eurythermal organisms that soon overwhelmed the springrun fauna not isolated upstream from Dam 1. During the 1930's, poplars were planted on Dam 1 to provide shade for fishermen. Strong winds toppled some of the poplars, knocking down sections of the containment wall. In 1938, the Wilkinsons repaired and raised Dam 1 about 0.5 m and held the water near crest level--previously the water level had been high only during the irrigation season. The added water pressure exacerbated the problems caused by toppled trees and resulted in numerous breaches in the dam. In the 1940's, introduced nutria began tunnelling into the earthen dams, culminating in a serious state of dam disrepair necessitating renovation of Dam 1 in 1979.

CONSERVATION EFFORTS

To date, chief conservation efforts for the Clear Creek gambusia have been to maintain the status quo. The Wilkinson family has minimized any activity detrimentally impacting the fish in the creek. They have endeavored to control nutria and to prevent brush and tree growth on the dam crest.

Despite these measures, Dam 1 continued to deteriorate in the 1970's until the future integrity of the G. heterochir population seemed threatened. An extensive repair effort was made August 27 - September 1, 1979. This project was funded by the U.S. Fish and Wildlife Service and carried out by individual recovery team members and their associates. Three sections of collapsed dam wall (each about 8 meters long) were rebuilt, holes were filled and woody vegetation was removed. This action reduced water flow through the dam by more than 80% and has helped to ensure separation of the two fishes for at least a decade. The major breach through Dam 1 was blocked so that G. affinis immigration ceased on August 29, 1979. Plans are underway to monitor the upper pool to determine what transpires now that immigration has ceased.

During repair, the upper pool was lowered to a level near that of the middle pool. A substantial decrease in the outflow of the large east bank spring immediately downstream from Dam 1 was noted, suggesting a common aquifer source.

A dye test administered after dam repair showed minimal dam discharge.

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PART II

RECOVERY

The ultimate goal of the Recovery Plan is to secure survival of the Clear Creek gambusia and its natural environment. This goal should result from implementation of the Recovery Plan proposed below. As the plan is implemented, the Fish and Wildlife Service, with assistance from the Recovery Team, will recommend appropriate reclassification under Section 4 of the Endangered Species Act. The species could be considered for reclassification to threatened status when the Clear Creek headsprings habitat has been protected through purchase or easement. However, because of the extremely limited distribution of *G. heterochir*, it may never be delisted completely.

RECOVERY OUTLINE

Primary goal: Assure the survival of the Clear Creek gambusia (*Gambusia heterochir*) through improvement of its status.

1.0 Maintain and enhance the existing Clear Creek gambusia population and its habitat.

- 1.1 Identify individual and population needs.
  - 1.11 Competition with *G. affinis*
  - 1.12 Prey species biology
  - 1.13 Reproductive variables
  - 1.14 Predation
  - 1.15 Survivorship
  - 1.16 Diseases and parasites
- 1.2 Identify habitat requirements.
  - 1.21 Map Clear Creek topography
  - 1.22 Substrate and sediment distribution
  - 1.23 Seasonal changes in chemistry and temperature
  - 1.24 Seasonal distribution of aquatic plants
  - 1.25 Seasonal distribution of fishes
  - 1.26 Seasonal distribution of other organisms
  - 1.27 Determine habitat requirements
    - 1.271 Prepare maps
    - 1.272 Analyze relationships
    - 1.273 Define seasonal habitat requirements

1.3 Manage Clear Creek gambusia.

1.31 Monitor existing population and habitat.

1.311 Establish monitoring procedures and schedules
1.312 Prescribe remedial activity in case of need
1.313 Recommend changes in listed status of Clear Creek gambusia as appropriate

1.32 Maintain a captive population of Clear Creek gambusia.

1.4 Manage Clear Creek for the perpetuation of the Clear Creek gambusia.

1.41 Protect Clear Creek gambusia habitat.

1.411 Protect the headspring area
1.412 Onsite security

1.42 Restore the original habitat conditions
1.43 Recommend essential habitat
1.44 Designate critical habitat

2.0 Produce information for public consumption.

2.1 Information pamphlet
2.2 News releases

3.0 Law enforcement.

3.1 Status
3.2 Habitat integrity

Recovery Goal: Assure the survival of the Clear Creek gambusia (Gambusia heterochir) through improvement of its status.

1.0 Maintain and enhance the existing Clear Creek gambusia population and its habitat.

The only known natural population of the Clear Creek gambusia inhabits Clear Creek. The recovery team recommends that the first priority for recovery be acquistion of management rights of the property from the present owners by purchase or easement. If the environment remains in the present status, the survival of the species seems likely. Nevertheless, the exceedingly small geographic range is of great concern because one minor enviromental change could exterminate the species.

1.1 Identify individual and population needs.

In addition to securing management rights to Clear Creek, biology and ecology are also essential to its recovery. A data base of current biological information is vital in case unforeseen adverse events necessitate rapid management actions.

1.11 Competition with G. affinis

Extensive involvement of G. affinis as a threat to G. heterochir mandates comparative studies to ascertain interactions between the species in critical areas of feeding and reproduction.

Although G. heterochir and G. affinis replace each other in Clear Creek, the basis for the competition is not understood fully. Since G. heterochir lives in the same environment as Hyalella texana and G. affinis with H. azteca, it is possible that these invertebrates are the respective preferred foods. However, each fish species may merely live with the appropriate prey species and would eat the other species of Hyalella, if it were equally available. Tests should be run to determine food preferences. Similarily, G. affinis eats a larger fraction of insects than G. heterochir, and tests should incorporate effect of insect availability on the diets of the fish.

Competition can involve space as well as food. Gambusia males are known to be territorial and exclude conspecific males. Tests should be conducted to determine if male G. affinis attempt to exclude G. heterochir from established territories, and vice versa. Because G. heterochir males are larger than those of G. affinis, tests should also

determine if male G. heterochir routinely exclude G. affinis males from breeding sites. Similar tests should be done with females.

Territorial interactions can involve feeding territories as well as reproductive exclusion. Therefore, tests should include experiments on territoriality under a variety of food availabilities. These tests should be run under headspring environmental conditions.

1.12 Prey species biology

Hyalella spp. comprise a major portion of the diet of Gambusia spp. in Clear Creek. Little is known of the biology of the two species of Hyalella in Clear Creek. Knowledge of the factors limiting each species could permit minor environmental adjustments favoring a particular Hyalella population density and, consequently, an increase in growth and abundance of the predatory gambusia species.

1.13 Reproductive variables

Although the size-related fecundity of Clear Creek gambusia has been ascertained, the interbrood interval is still in question. The interbrood interval has been ascertained in the laboratory without influence of direct natural sunlight at 25°C, but the ambient spring water temperature is consistently 20°C. Ascertaining the interbrood interval at 20°C would help to predict the available rates of recruitment of young.

Beause F_1 hybrids are generally considered to be vigorous, the primary impact of F_1 may be as preferred mates. The reality of this generalization, with respect to the hybrid gambusia in Clear Creek, should be measured by discrimination tests.

1.14 Predation

Resident piscivores are assumed to consume G. heterochir and G. affinis when available. The significance of predation as a survival factor for the Clear Creek gambusia is unknown. Therefore, the degree of utilization and selectivity by predators for prey gambusia should be determined through appropriate research.

1.15 Survivorship

Little is known about survivorship curves for Clear Creek gambusia. Mortality rates for each life history stage should be determined and the information incorporated into a plan for reducing mortality.

1.16 Diseases and parasites

No data are available on the diseases and parasites of Clear Creek gambusia. As the species occupies limited space, an epidemic could seriously impact survival potential. Advance knowledge of the diseases and parasites of Clear Creek gambusia could be of significance in containing an epidemic.

1.2 Identify habitat requirements.

Valuable baseline data for protection and enhancement of the Clear Creek gambusia population would be gained from a survey of physical, chemical, and biotic features of the habitat in relation to abundance of the fish. Preliminary data of this type (Hubbs 1959, 1971) have already contributed significantly to recovery efforts. However, conditions have changed since Hubbs' original surveys, and an updated analysis would allow more confidence regarding predictions of the impacts of environment altering activities.

Data from the following studies on upper Clear Creek should be subjected to an analysis of covariance between habitat variables and abundance of Clear Creek gambusia. Data should be gathered from random sample quadrants in a grid across the study area.

1.21 Produce a detailed map of Clear Creek

Map salient topographic features such as bottom contours and water depth.

1.22 Distribution of base level substrates and overlying sediments in upper Clear Creek

Sample grid quadrants to measure composition and distribution of base substrates and overlying sediments.

1.23 Seasonal changes in water temperature and chemistry

Take a water sample from each quadrant twice in each season for one year. Measure pH, O_2 concentration, total phosphates, total nitrates, hardness and methyl orange, phenolpthalein, and total alkalinities.

1.24 Seasonal distribution of aquatic plants

For each grid sampled in 1.23, and at the same time intervals, estimate or measure percent coverage for each species of aquatic macrophyte.

1.25 Seasonal distribution of Clear Creek gambusia and other fishes

Sample the quadrants with minnow traps twice in each season for one year. In addition to parameters identified in 1.24 and 1.26, include time of day, air and water temperatures, cloud cover, and size, sex and numbers of each fish species.

1.26 Seasonal distribution of other biota

While gathering other data for this section of the plan, make observations, preferably quantified, on other organisms, such as primary prey species, of the Clear Creek gambusia.

1.27 Determine seasonal habitat requirements

1.271 Prepare maps

Map seasonal variations of habitat components identified in 1.22 - 1.26 above.

1.272 Analyze relationships

Relate seasonal habitat variables to G. heterochir abundance by appropriate analysis, covariance or other procedures.

1.273 Define seasonal habitat requirements

Ascertain upper, lower and optimal levels of seasonal habitat variation necessary for maintaining G. heterochir. This is to be done with a particular view toward establishing management guidelines for habitat manipulation, should the need arise, to ensure G. heterochir abundance. Such guidelines are also needed to evaluate proposed habitat modifications with respect to their anticipated effects on essential G. heterochir habitat.

1.3 Manage Clear Creek gambusia.

1.31 Monitor existing population and habitat

Population monitoring provides a means of assessing the well-being of a species and gives feedback on the success of management techniques. To manage Clear Creek gambusia

properly, the population must be monitored periodically and the viability of the species in its required habitat determined. Therefore, the Clear Creek gambusia and its habitat must be monitored at least twice annually. If remedial management procedures are found to be necessary, the monitoring schedule should be modified to obtain the data required for proper evaluation of the technique applied.

Monitoring efforts should not exceed four times annually.

1.311 Establish monitoring procedures and schedules

Sample the headpool at Clear Creek at least in February and August. Use minnow traps to monitor the gambusia population.

Use equipment and techniques described by Hubbs (1971). Standard minnow traps lined with plastic netting (1 mm mesh) to contain small gambusia and baited with dog food have the best catch rates. Traps set longer than 6 hours do not seem to contain additional fish. Cannibalism in the traps appears minimal as only two of the many thousands of analyzed stomachs contained small gambusia (Hubbs 1971).

1.312 Prescribe remedial activity in case of need

When routine monitoring reveals occurrence of any problematic changes in the population status of the Clear Creek gambusia or its habitat, take appropriate remedial actions immediately to correct or alleviate the problem. Management guidelines established as a result of 1.273, above, should facilitate the actions.

1.313 Recommend changes in the listed status of Clear Creek gambusia as appropriate

The prime objective of this plan is to prevent the extinction of the Clear Creek gambusia and then to secure its survival. Achievement of this objective involves providing a secure habitat for the species. Once Clear Creek has been appropriately protected through purchase and/or easement and the habitat restored to natural conditions, the status of Clear Creek gambusia may be considered for reclassification to threatened. Limited geographic range of the species may preclude eventual delisting of the species, however.

1.32 Maintain a captive population of Clear Creek gambusia

Protect the Clear Creek gambusia from possible catastropic loss in its natural habitat by maintaining a captive gene pool at a proper facility. Dexter NFH is the best facility for holding and maintaining a captive population of Clear Creek gambusia. Some of these captive-held individuals can be used in laboratory studies.

1.4 Manage Clear Creek for the perpetuation of the Clear Creek gambusia.

Management of the headspring pool is the key to the survival of G. heterochir. Due to the limited distribution of this gambusia, protection of this single habitat may be enough to assure its survival. Of course, protection of the habitat should include the aquifer that discharges at Clear Creek Springs, the aquifer's recharge, zone and the headspring pool.

1.41 Protect Clear Creek gambusia habitat

The only known habitat of the Clear Creek gambusia is Clear Creek on the Wilkinson Ranch near Menard, Texas. The Wilkinson family has owned the ranch and stream for approximately a century--through four generations. During this time the stream has undergone several changes, but protection of the headspring pool has allowed survival of the Clear Creek gambusia.

1.411 Protect the headspring area

The Wilkinson family has managed the headspring area responsibly in the past, and an agreement maintaining the present condition of the headspring and dam would assure protection of the headspring habitat for the immediate future.

One means of insuring the longterm protection of the Clear Creek gambusia is entering into a management agreement with the property owners through purchase of management rights. The preferred management agreement would be a conservation easement; the easement would allow the owners to retain property rights to and all uses of the headspring compatible with conservation of Clear Creek gambusia. For example, once water has passed through the headspring pool, it could be used for other purposes, including recreation and irrigation.

The less-preferred management alternative is fee simple purchase of the headspring area. Fee simple purchases would allow total managerial control of the habitat. However, the major resource of the ranch is its water and, therefore, purchase of most of the ranch may be necessary to acquire the headspring.

1.412 Onsite security

Once a management agreement has been reached with owners of the headspring, security to maintain its present integrity will be necessary. Protection of the habitat will consist of maintenance of Dam 1 and prevention of any adverse alteration of the pool. Care also will be needed to prevent the introduction of any additional fish or plant species to the pool. The amount of security necessary for the headspring pool is anticipated to depend strongly upon the disposition of the downstream portion of the stream. It may be possible to arrange for one or more members of the Wilkinson family to remain living close to the spring and to continue the long term protection they have provided this area, perhaps through a grazing lease. This option should be discussed with the Wilkinson family.

1.42 Restore the original habitat condition

This phase of the recovery is dependent upon 1.412. If the entire stream is not protected, but only the headspring pool, Dam 1 should be retained. But if the entire stream is protected, the Clear Creek gambusia can be restored to the entire reach by elimination of the lower three dams. Removal of Dam 1 can be considered after the lower three dams are removed, if it is determined that the headspring pool population could survive this change. This action would revert the entire 5 km of stream back into a spring streamrun habitat, would allow for the successful competition of G. heterochir with G. affinis, and likely would eliminate most of the exotic predators previously mentioned. Elimination of the dams would expose expansive mud flats that should be seeded and planted with trees as soon as possible to prevent erosion.

1.43 Recommend essential habitat

The Endangered Species Act provides for the protection of habitat critical to the survival of an endangered species. Present regulations require consideration of habitat presently occupied by the species, unless other areas are necessary for the species' conservation, recovery and survival. The entire reach of Clear Creek from its headspring to the confluence with the San Saba River should be considered as essential habitat for the Clear Creek gambusia.

1.44 Designate critical habitat

Once an area has been proposed as critical habitat in the Federal Register, comments received, public hearings held and the proper environmental and economic assessments completed, the Secretary of the Interior has the option to declare the area Critical Habitat for the species. Designation of Critical Habitat will provide the full protection afforded by the Endangered Species Act.

2.0 Provide information for public awareness.

Funds should be expended to inform the public of the Clear Creek gambusia, its survival problems and recovery efforts.

2.1 Information pamphlet

Information relative to the taxonomy, biology, distribution and habitat of Clear Creek Gambusia should be presented in such a manner to enhance the public's awareness of endangered species in general, and this endangered species in particular. An information pamphlet facilitating the accomplishment of this objective should be prepared and revised periodically.

2.2 News releases

Newsworthy events regarding the Clear Creek gambusia preservation and recovery efforts should be publicized by preparing and disseminating appropriate, timely news releases.

3.0 Law enforcement.

The Clear Creek gambusia is currently protected under Federal and Texas laws. Enforcement agencies should be provided information relevant to identification and to legal status of the organism, its

distribution and maintenance of its habitat integrity so that overt, covert or unintentional actions by individuals or projects have no deleterious effect on the species or its habitat.

3.1 Status

Enforcement agencies (Federal and State) will be kept informed of the legal status of the Clear Creek gambusia and its habitat according to Federal and State laws. Assistance will be rendered to these agencies so that they may properly identify the species and know where it occurs.

3.2 Habitat integrity

Those agencies with jurisdiction over project activities which could modify the existing habitat in any way should be kept informed of the status of the Clear Creek gambusia, its distribution and its needs. Section 7 consultation requirements mandate that Federal project specifications preclude any adverse effect on listed species. Protection of the species is a joint responsibility of the U.S. Fish and Wildlife Service and the State of Texas.

PART III - IMPLEMENTATION SCHEDULE

GENERAL CATEGORY (1)	PLAN TASK (2)	TASK # (3)	PRIORITY # (4)	TASK DURATION (5)	RESPONSIBLE AGENCY FWS REGION (6)	RESPONSIBLE AGENCY FWS PROGRAM (6a)	RESPONSIBLE AGENCY OTHER (7)	FISCAL YEAR COSTS (EST.) FY83 (8)	FY84	FY85	COMMENTS (9)
M3	Maintain and enhance population and habitat	1.0	2	2 yrs.	2	mgmt.	TPWD*		15,000	15,000	composed of tasks 1.0 to 1.16.
I3	Species requirements	1.1									
I10	Competition with G. affinis	1.11									
I3	Prey species biology	1.12									
I7	Reproductive variables	1.13									
I9	Predation	1.14									
I7	Survivorship	1.15									
I11	Diseases and parasites	1.16									
I3	Habitat requirements	1.2	3	2 yrs.	2	mgmt.	TPWD		15,000	15,000	Composed of tasks 1.2 to 1.27
I6	Map Clear Creek	1.21									
I3	Substrate and sediment distribution	1.22									
I3	Seasonal changes in chemistry and temp.	1.23									

*Texas Parks and Wildlife Department

PART III - IMPLEMENTATION SCHEDULE CONT.

GENERAL CATEGORY (1)	PLAN TASK (2)	TASK # (3)	PRIORITY # (4)	TASK DURATION (5)	RESPONSIBLE AGENCY FWS REGION (6)	RESPONSIBLE AGENCY FWS PROGRAM (6a)	RESPONSIBLE AGENCY OTHER (7)	FISCAL YEAR COSTS (EST.) FY83 (8)	FISCAL YEAR COSTS (EST.) FY84	FISCAL YEAR COSTS (EST.) FY85	COMMENTS (9)
I3	Seasonal distribution of aquatic plants	1.24									
I3	Seasonal distribution of fishes	1.25									
I3	Define habitab requirements	1.27									
M3	Manage Clear Creek gambusia	1.3	3	ongoing	2	mgmt.	TPWD		10,000	5,000	Composed of tasks 1.3 to 1.32.
M3	Monitor population and habitat	1.31									
M3	Establish monitoring procedures & schedules	1.311									
M3	Remedial activity	1.312									
O3	Reclassify status	1.313									
M1	Maintain captive population	1.32									1.27
A3	Manage Cleark Creek	1.4	3	ongoing	2	mgmt.			10,000	10,000	Composed of tasks 1.4 to 1.44.
A2	Secure protection	1.41									
A2	Secure headspring area	1.411									

PART III - IMPLEMENTATION SCHEDULE CONT.

GENERAL CATEGORY (1)	PLAN TASK (2)	TASK # (3)	PRIORITY # (4)	TASK DURATION (5)	RESPONSIBLE AGENCY FWS REGION (6)	RESPONSIBLE AGENCY FWS PROGRAM (6a)	RESPONSIBLE AGENCY OTHER (7)	FISCAL YEAR COSTS (EST.) FY83 (8)	FISCAL YEAR COSTS (EST.) FY84	FISCAL YEAR COSTS (EST.) FY85	COMMENTS (9)
M3	Restore original habitat	1.42									
03	Recommend critical habitat	1.43									
03	Designate critical habitat	1.44									
01	Public information	2.0	3	ongoing	2	educ.	TPWD		2,000	2,000	Composed of tasks 2.1 to 2.2.
01	Information pamphlet	2.1									
01	News releases	2.2									
02	Law enforcement	3.0									Composed of tasks 3.1 and 3.2
02	Status	3.1									
02	Habitat integrity	3.2									

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FILE Clear Creek Gambusia Rec. Plan

April 30, 1980

Acting Regional Director,
United States Dept. of the Interior,
Fish and Wildlife Service,
P.O. Box 1306,
Albuquerque, New Mexico 87103

Dear Sir,

I have read your "Technical Review Draft of the Clear Creek Gambusia Recovery Plan" with considerable interest.

COMMENT

A 1

Your recommendations are exactly the sort of things I have wanted to see done. I have long desired to see the lower dams destroyed.

As one of the discoverers of the amphipod Hyalella texana, I would like to see more research on this form. It may also be similarly restricted and threatened in Clear Creek, but its taxonomic and systematic relationships with other amphipods in nearby springs needs study. I once started some experimental hybridization studies on these amphipods but had to abandon the work. In any case, I believe that Clear Creek gambusia and Hyalella texana are part of the same ecological package needing study and protection in Clear Creek.

I had hoped to get to Dexter, New Mexico to see your facility but have not yet managed to work this in.

Sincerely,

Alex E. Peden,
Curator of Aquatic Zoology

AEP/ljm

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ADDRESS ONLY THE DIRECTOR,
FISH AND WILDLIFE SERVICE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

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In Reply Refer To:
FWS/OES 310.6

Memorandum

To: Regional Director, Region 2
Acting Associate
From: Director

Subject: Comments on Technical Review Draft, Clear Creek Gambusia Recovery Plan

We offer the following comments on the above subject Recovery Plan:

COMMENT A 2

(1) A disclaimer sheet, as shown in the "Endangered and Threatened Species Recovery Planning Guidelines," should be added to the plan immediately after the Title Sheet. The following words should be added: "Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints."

(2) When the next updating of the Implementation Schedule is made, you should evaluate actions and reassign priority numbers for each action (task) to coincide with the following criteria:

Priority One - those tasks necessary to prevent extinction;
Priority Two - those tasks necessary to maintain the current population;
Priority Three - all other actions necessary for complete recovery.

(3) Paragraph 2, page 1 - the last line should read "Texas Parks and Wildlife Department" not Commission.

(4) Paragraph 3, page 1 should be rewritten to clarify the problem and explain what kinds of potential activities or developments would result in threats to the species.

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(5) Team recommendations should not be included in the plan. Eliminate the last sentence, paragraph 3, page 2 (Taxonomic Status). Likewise, references to recommendations should be reworded to make them statements or be eliminated in the following items: 1.0, 1.1, 1.11, 1.23, 2.0, 2.1 and 2.2.

(6) Page 6 - It was stated there has been an introduction of rainwater killifish (Lucania parva) into Clear Creek. What are the ecological implications of this? If the implications are unknown or believed to be significant, this information should be outlined and the appropriate studies should be included in the recovery step-down outline.

(7) Page 15 - Change delisting (line 6) to reclassification. Would it be reasonable to assume that if the Clear Creek aquifer and the entire reach of Clear Creek were secured, and a stated population level was maintained that the species could be delisted, with continued population monitoring?

(8) Pages 16-17 - Reorganize outline as noted in attached xerox copy.

(9) Page 18, Item 1.0 - Would management agreements be viable alternatives to acquisition for habitat protection?

(10) Page 23, Item 1.121 - The second sentence should be written as follows: "Seasonal maps should be made which integrate information from the following studies:"

(11) Page 27, Item 1.14 - What is the minimum number of individuals needed for captive propagation? What is the ultimate size of the captive population to be maintained? This should be stated.

(12) Page 28 and 30, Items 1.211 and 1.213 - Is it necessary to purchase the ranches in question along Clear Creek in their entirety or just portions of the watersheds? Descriptions of individual acquisition parcels should be included and described as specifically as possible (be it through purchase, easement, management agreement, etc.). Priorities of acquisition should be indicated for parcels according to priority system outlined above.

(13) Page 30, Item 1.22 - If the status of G. heterochir was in question prior to 1953, what is the basis for the belief that the species occurred along the entire reach of Clear Creek? What prevented hybridization with G. affinis and what would prevent hybridization if the stream is returned to its historical condition (i.e. removal of the dams)? The effect of dam removal on interspecific competition is unclear to the reader from discussions on page 3 and 6. If the answers to some of these questions or the impact of this action is contingent on research findings, this should be stated. In reference to page 15, would not a return of the species to its original range lead to delisting?

We hope these comments will assist you in preparing an Agency Review Draft. Please send us five copies for review and comment.

Attachment

TEXAS
PARKS AND WILDLIFE DEPARTMENT

✓	Coordinator	
	Mgmt.	
	Sec. 7	
	Admin.	
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CHARLES D. TRAVIS
EXECUTIVE DIRECTOR

4200 Smith School Road
Austin, Texas 78744

October 22, 1980

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Mr. Jerry Stegman
Acting Regional Director
U. S. Fish and Wildlife Service
P. O. Box 1306
Albuquerque, New Mexico 87103

Dear Mr. Stegman:

This is in response to your letter of September 2, 1980, SE, requesting this Department to review the draft Clear Creek Gambusia Recovery Plan for agency compliance and technical accuracy.

COMMENT

A 3

The Wildlife staff has reviewed the document and recommends those changes shown in the returned draft be made.

The explanation provided is inadequate for retention as a threatened species. The ultimate goal as stated on page 9 would not remove the species from a threatened status even if all provisions of the recovery plan were accomplished. If a species is restored to its former distribution and probable population parameters, can it not then be considered recovered? The ultimate goal of all recovery plans should be recovery to include delisting.

Funding levels shown in the draft do not provide the estimated costs of the recovery plan to be borne by each of two agencies: U. S. Fish and Wildlife Service or Texas Parks and Wildlife Department.

Thank you for allowing the Department to comment on this draft recovery plan.

Sincerely,

Charles D. Travis

CHARLES D. TRAVIS
Executive Director

CDT:FEP:aeh

Enclosure

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Replies to Comments

A 1. Agreed and incorporated into recovery plan.

A 2. (1) Included.
(2) Priorities assigned and included in Part III.
(3) Corrected.
(4) Rewritten and clarified.
(5) Corrected.
(6) Appropriate explanation included.
(7) Status of G. heterochir will be reevaluated periodically as provided in Section 4 of the Endangered Species Act.
(8) Outline appropriately reorganized.
(9) Conservation, or management, easement is an alternatrive to fee simple purchase.
(10) Changed accordingly.
(11) Definitive population numbers cannot be realistically applied to species with life cycles similar to poeciliids.
(12) Appropriate changes and additions included.
(13) Appropriate explanation was included in text.

A 3. It cannot be assumed that G. heterochir will be delisted even if all of the goals and objectives of the recovery plan are achieved. The very limited distribution of this species may never allow it to be completely delisted. However, protection of the headspring pool should provide enough protection to allow it to be downlisted to Threatened.