KENDALL WARM SPRINGS DACE

RECOVERY PLAN

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Prepared by

Region 6

of the

U.S. Fish and Wildlife Service

APPROVED: Robert C. Smith

Director, U.S. Fish and Wildlife Service

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This is the completed Kendall Warm Springs Dace Recovery Plan. It has been approved by the U.S. Fish and Wildlife Service. It does not necessarily represent official positions or approvals of cooperating agencies who played the key role in preparing this plan. This plan is subject to modification as dictated by new findings and changes in species status and completion of tasks described in the plan. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints.

Acknowledge should read as follows:

The Kendall Warm Springs Dace Recovery Plan, dated July 12, 1982, was prepared by the U.S. Fish and Wildlife Service in cooperation with the Wyoming Game and Fish Department and U.S. Forest Service.

Additional copies may be obtained from:

Fish and Wildlife Reference Service
Unit i
3840 York Street
Denver, CO 80205
Telephone: 303/571-4656

Cover photo by LuRay Parker.

PREFACE

This recovery plan for the Kendall Warm Springs dace was prepared by the U.S. Fish and Wildlife Service, Billings Endangered Species Team, with the assistance of the Wyoming Game and Fish Department and the U.S. Forest Service. Representatives from the above agencies concluded that preparation of a complete in-depth recovery plan at this time would be premature. It should first be conclusively determined if the Kendall dace is in fact a distinct subspecies. The objective of this plan is thus to continue present management while conducting studies to resolve the taxonomic question. When or if these studies determine the subspecies' distinction, a revised Implementation Schedule will be developed which identifies additional actions needed to achieve recovery and downlisting or delisting.

The recovery plan includes an introduction providing background material on the Kendall dace, a step-down outline and narrative explaining the steps needed to meet the plan objective, and an implementation schedule recommending lead agencies and funding responsibilities. The introduction is essentially a revision of the Forest Service's Biological Unit Management Plan for Kendall Warm Springs (Bartshi 1978).

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PART I

INTRODUCTION

GENERAL DESCRIPTION

The Kendall Warm Springs dace was first described in 1937 by Hubbs and Kuhne as a subspecies of the Western dace (Apocope osculus thermalis). Later work on the fishes of Wyoming designated the Kendall dace as Rhinichthys osculus thermalis (Hubbs and Kuhne). The dace inhabiting the adjoining Green River was described as Rhinichthys osculus yarrowi (Jordan and Everman), thus perpetuating a subspecies differentiation (Simon 1951). However, the 1970 revision of Wyoming Fishes questions this designation by listing the Kendall dace and the dace found in the Green River as one taxa, Rhinichthys osculus (Girard) (Baxter and Simon 1970).

Hubbs and Kuhne (1937) made morphological comparisons of several hundred dace and reported that the spring dace differ from the Green River dace by having fewer scales and fin rays, larger heads and fins, and a smaller body size. Kendall dace adults range from 23 mm (0.9 in.) to 54 mm (2.1 in.) in size and prefer mainstream eddies and pools. Breeding males are often a bright purple color but the females are typically dull olive green.

PRESENT AND HISTORICAL DISTRIBUTION

The Kendall Warm Springs are located on the Bridger-Teton National Forest in western Wyoming. The spring area and short stream (300 meters; 984 feet) comprise the total habitat of the Kendall Warm Springs Dace The springs are located 50 km (31 mi.) north-northwest of Pinedale, Sublette County, Wyoming, in portions of the W 1/2 SE 1/4 and the SW 1/4 of section 2, T 38 N, R 110 W.

HABITAT

Kendall Warm Springs (elev. 2,390m, 7,840 ft.) is made up of numerous seeps and springs scattered along the north face of a small limestone ridge. The consolidated flow travels southwest towards the Green River for a distance of 300 m (984 ft.) before it cascades into the river over a travertine embankment (Binns 1978). Average stream flow is approximately 0.2 CMS (7 CFS) with an average width of 1.8 m (6 ft.) and a depth generally less than 0.31 m (1 ft.). Average gradient of the 300 m (984 ft.) stream is 4 percent.

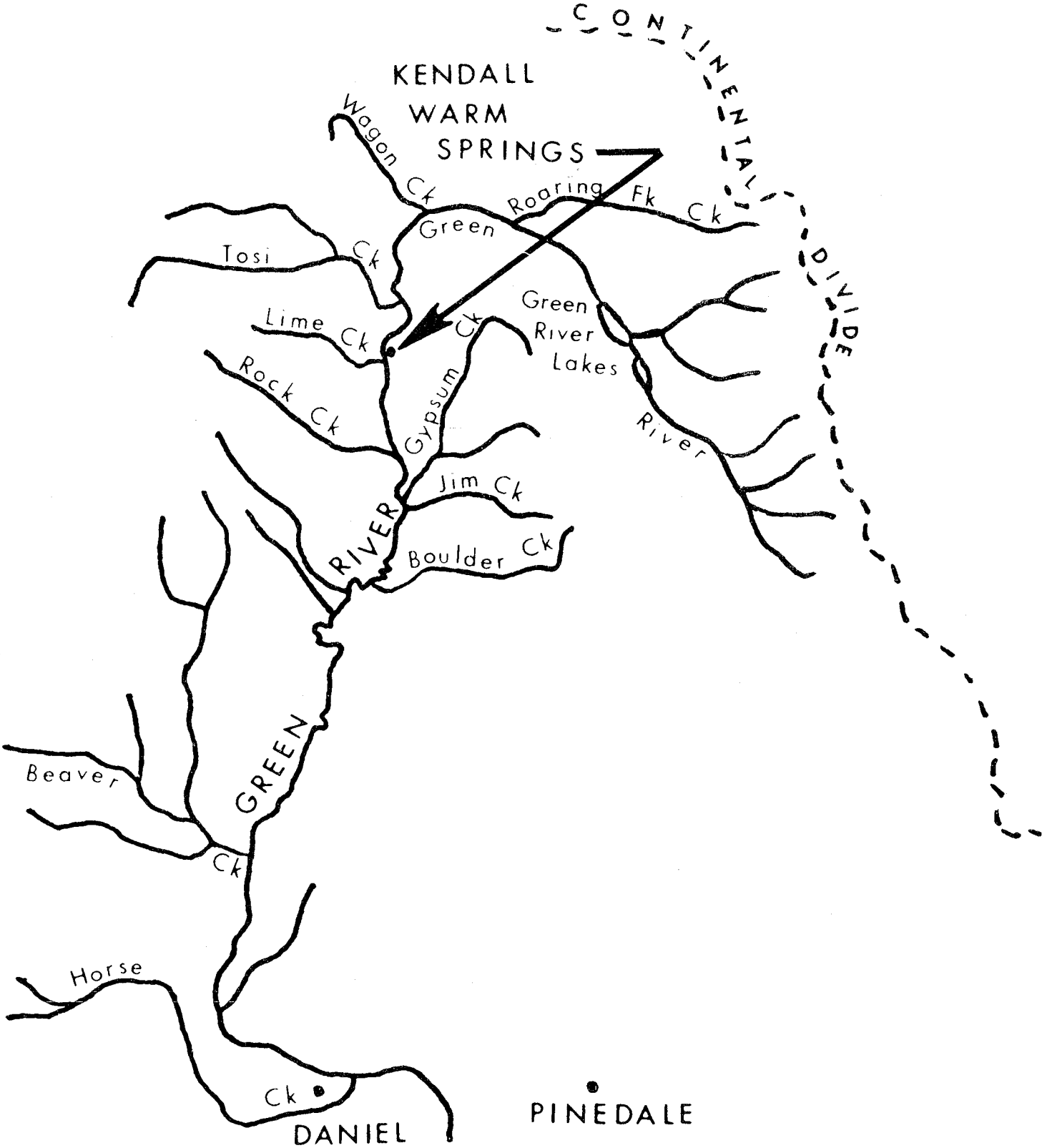

Figure 1: Map of the Upper Green River Drainage, Sublette County, Wyoming, showing location of the Kendall Warm Springs study area. (from Binns 1978)

In the past, man has dammed the stream with rocks to form three bathing pools. Downstream from the pools the creek is mostly fast riffles with a substrate of gravel, small rock and loose marl. A travertine pavement develops towards the lower end of the creek and is prominent near the outfall to the river.

The ridge from which the springs flow has been identified as a limestone formation by Binns (1972) and Zwinger (1975). Although several other mineralized springs flow from limestone formations in this area, none are thermal. Kendall Warm Springs originate at near 29.4 degrees C (85 degrees F) and the outfall temperature drops as low as 25.6 degrees C (78 degrees F) in the winter.

Water flowing from Kendall Warm Springs is well mineralized, slightly alkaline, and moderately high in total dissolved solids (average 1,014 mg/l) and specific conductance (1,261 mhos). Dissolved oxygen is low and carbon dioxide high at the spring source but concentrations of both gases are moderated by the time the water tumbles over the rocks and reaches the head of the second pool (Binns 1978).

Terrestrial vegetation near the spring complex is limited to various grasses, forbs and low growing shrubs and trees, such as willow (Salix), sagebrush (Artemesia), and aspen (Populus tremuloides). Aquatic vegetation surrounds the main channel and is often heavy in the pools. Monkeyflower (Mimulus) and moss are the dominant aquatic plant species found above the third pool. Below this area, sago pondweed (Potamogeton pectinatus), moss (Drepanocladus aduncus polycarpus), and stonewart (Chara contraria) are the most common species (Binns 1978).

The primary escape cover for the Kendall dace is plant growth. A skittering flight to the nearest clump of plants is a typical danger avoidance reaction, although some also flee to the deeper, turbulant areas in the main current (Binns 1978).

POPULATION AND REPRODUCTIVE STATUS

Kendall dace are well dispersed throughout the creek, except at the extreme upper end where abundance decreases sharply near the springs, possibly due to low oxygen and high carbon dioxide levels (Binns 1978). Still water pockets in the dense mats of aquatic vegetation, located within the main channel but adjacent to the main flow, are utilized by fry as nursery areas. Fry distribution suggests that spawning is widespread in the creek and probably occurs several times a year, if not throughout the year. Adult dace may occur in the main current but most remain in the pools or quiet eddies where plant growth or other debris breaks the current. The dace generally occur in small schools, possibly due to space limitations. Such schooling may also reflect an inborn behaviorial preference.

There have been no thorough estimates made of population size because the dace are small and sampling efficiency is poor. The mineralizatopm of the water is above the optimum range required for efficient shocking, and the shallow, weed-filled stream inhibits seining. Hubbs and Kuhne (1934) roughly estimated the population to be between 200,000 and 500,000 individuals. Recent observations suggest this figure may be high but there are definitely several thousand dace. A precise estimate would require more extensive studies than have been done in the past. Since an acceptable estimate of population size would require considerable disturbance and stress to the dace population and habitat, determination of actual population size should have low priority. The presence of dace can be easily verified by walking along the stream.

TAXONOMIC STATUS

Paramount to this fish qualifying to remain on the endangered list is its taxonomic status. Adequate studies to resolve this question have not been done.

The Kendall dace is the only fish species inhabiting the Kendall Warm Springs and Creek. Hubbs and Kuhne (1937) attributed the origin of the Kendall dace to its isolation behind a travertine barrier formed at the confluence of the springs flow and the Green River. This separation provides a unique and isolated habitat, and is speculated to have allowed the Kendall dace to evolve differently from the dace in the river. However, a visual inspection of the creek shows that the creek has not always flowed over the falls and for some periods the only barrier has probably been the thermal property of the spring water.

"The validity of the R. o. thermalis subspecies designation remains unclear and needs further investigation. On one side of the argument is the fact that speckled dace are apparently eurythermic, and very adaptable, which may suggest that dace in the creek are merely opportunistic speckled dace. On the other hand, the dace population in Kendall Warm Springs Ceeek may be a distinct evolutionary reality existing in a unique habitat. Hubbs and Kuhne (1937) demonstrated taxonomic differences between the spring dace and the river dace, but a basic question remains. Are the differences due to the unique, warm springs environment or are they true genetic differences?" (Binns 1978).

"Only a thorough examination and comparison of dace in the spring flow, the upper Green River and such places as Witch Creek will help clarify the taxonomic confusion surrounding R. o. thermalis. The physiological aspects must also be considered by such study. That is: 1) what is the impact of the warm, mineralized water on physical characteristics and; 2) with proper acclimatization, can dace from the spring survive in the river and vice versa" (Binns 1978).

INFLUENCE OF HUMAN ACTIVITIES

Human activities have influenced the Kendall Warm Springs for years. Cattle grazing and trampling have affected the integrity of the stream channel and plant life in and around the spring flowage. Livestock use has often been heavy because the springs are located along an old cattle driveway used for trailing cattle up the river's east side. In 1969 the Forest Service enclosed 64 hectares (160 acres), surrounding three sides of the spring area to protect it from further impact. The enclosure consists of fence on three sides and the river on the fourth side. To date there has been little problem from cattle crossing the river during low flows. However, improved fence maintenance is needed to keep cattle out of the enclosure (Hurley pers. comm.).

A road was built across the lower end of the creek prior to 1934 and is still the main transportation route for access into the upper Green River and the northern end of the Bridger Wilderness. Hubbs and Kuhne (1934) reported the two culverts under the road were backing up a small pond above the road. This ponding no longer exists as culvert capacity has been reduced by sediment deposits. Presently, the road does not significantly impact Kendall dace habitat except where 7.6 m (25 ft.) of stream were replaced by the culverts. Culverts may prevent upstream movement of dace. Although this may be insignificant, it does isolate the upper half of the population (Stone pers. comm.).

One of the most potentially harmful impacts to the aquatic community has come through man's use of the springs to bathe and wash clothing. Several rock dams have been constructed over the years to provide small bathing and soaking pools. People have also been seen washing their clothing in the warm water. Hubbs and Kuhne (1934) reported the CCC "boys" were using the spring for bathing. Binns (1978) invertebrate sampling results suggest that the use of soaps and detergents had depressed the aquatic community until such use was prohibited in 1975. Water pollution from cleaning agents may seriously impact aquatic organisms and always holds the risk of a fish kill. To protect against this, the Forest Service closed the waters to bathing or wading and prohibited the use of soaps, detergents, or bleaches. In addition, the vehicle access was blocked off along the creek and a parking area designated.

Fishermen used the Kendall dace as fish bait for many years until the Wyoming Game and Fish Department prohibited issuance of permits to seine or trap the dace in the early 1960's. Additional protection from this use has been provided since 1970 when the dace was designated an endangered species.

SCALE: 1 inch = 100 feet (2.54cm = 30.48 m)

(approximate)

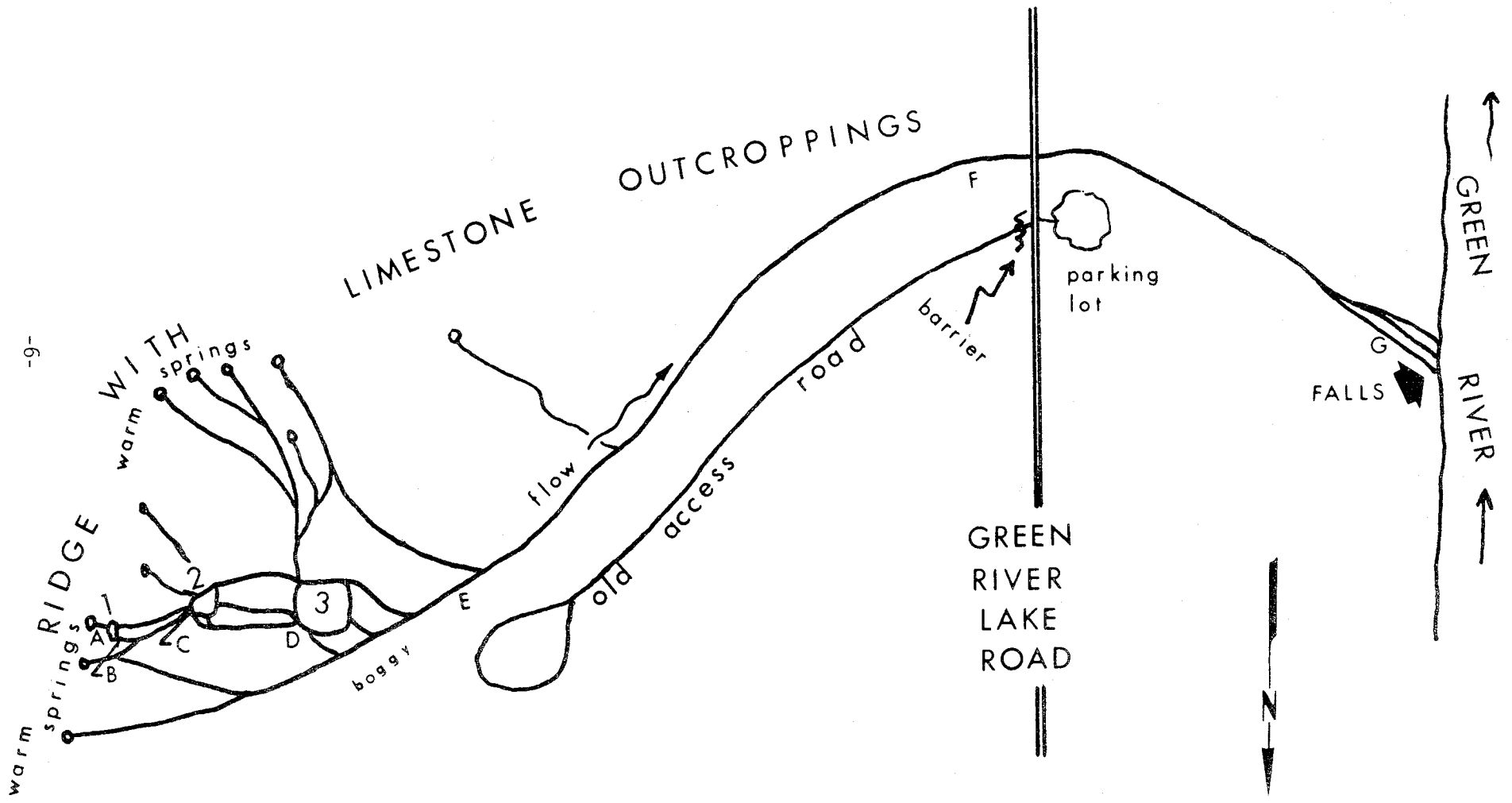

Figure 2: A sketch map of Kendall Warm Springs showing invertebrate sample sections (letters), primary pools (numerals) and other salient features.

(from Binns 1978)

PRESENT MANAGEMENT

Sixty-four hectares (160 acres) have been identified by the Forest Service as the Kendall Warm Springs Biological Management Unit (Bartschi 1978). The boundaries include most of the small watershed and adjacent terrestrial communities which surround and directly affect the spring and stream section.

The following protective measures are presently being applied to the Management Unit:

1. Sixty-four hectares (160 acres) were withdrawn from mineral entry under EO-10355 in 1962.

2. The Wyoming Game and Fish Department adopted a formal policy not to allow seining or trapping of Kendall dace in the early 1960's.

3. Sixty-four hectares (160 acres) were fenced to exclude grazing in 1969.

4. Unathorized vehicle use adjacent to the Kendall Warm Springs Creek was eliminated with barricades and designated parking areas were provided in 1969.

5. Bathing, wading and the use of soaps, detergents or bleaches was prohibited and signed against in 1975.

6. An interpretive sign explaining the Kendall dace's significance was posted in 1975.

7. The Forest Service listed the fenced 64 hectares as "essential habitat" for the dace in 1977.

RESEARCH NEEDS

Studies and reports about the Kendall Warm Springs and the Kendall dace have been limited and usually brief and general. The two exceptions are the original study done in 1934 by Hubbs and Kuhne and a more thorough habitat study published by Binns in 1978. The following is a list, as outlined in the Forest Service Biological Unit Management Plan (Bartschi 1978), of additional studies needed. This list was developed by the Forest Service in cooperation with the Wyoming Game and Fish Department.

1. A thorough taxonomic study to determine the validity of the subspecies designation of the Kendall Warm Springs dace should be completed. Binns (1978) pointed out that the speckled dace inhabiting the Green River is apparently eurythermic since specimens have been reported from waters having a variety of temperatures. Rhinichthys osculus has been reported by Simon (1951, 1953) as occurring in Witch Creek in Yellowstone National Park, where water temperatures may exceed 27 degrees C (80.6 degrees F) and in the Kelly Warm Springs (28.3 degrees C; 83 degrees F). Rhinichthys osculus also occurs in the Green River where water temperatures range between 0.6 degrees C (31 degrees F) and 24 degrees C (75.2 degrees F). This suggests that the speckled dace are very adaptable and that the Kendall Warm Springs dace may merely be an opportunistic speckled dace.

On the other hand, Hubbs and Kuhne (1937) demonstrated there were morphological differences between the Kendall dace and Green River dace. Whether these differences are taxonomic differences or are due to the unique, warm springs environment is not clear.

A complete study designed to answer this question needs to be conducted. This study should include (1) a detailed meristic and electrophoretic comparison of Kendall dace and dace from other habitats, such as the Green River and Witch Creek, and (2) an analysis of the physiological aspects, that is, are the physical characteristics of the Kendall dace affected by the warm mineralized water and can the dace from the spring survive in the river and vice versa. The physiological aspects can be investigated through artifical propagation of speckled dace at several temperatures and comparison of the temperature preferences of speckled dace and Kendall dace. Analysis of the subspecies validity of the Kendall dace should also consider the geological and hydrological evidence assembled through the study discussed under (2).

2. A geologic and hydrologic study of the springs and surrounding terrain should be completed. Anything that changes the Kendall Warm Springs flow holds the potential for adversely affecting the dace population. It is therefore important to determine the springs source and its relationship with other springs and flows in the area. There is the potential for timber sales, road construction, oil and gas exploration and drilling as well as other activities in the upper Green River area. Before the potential effects of these activities on the spring can be evaluated we must know more about the geology and hydrology of Kendall Springs. An additional benefit from a geologic study would accrue if an approximate age could be determined for the travertine barrier at the river's confluence. This would help determine how long the dace may have been isolated and be one more factor to use in subspecies determinations.

3. Life history studies need to be completed. To be able to manage a species, such things as age at maturity, fecundity, population numbers, age structure, and habitat requirements needs to be determined. Virtually nothing has been done to answer any of these questions. Studies of this type make good graduate theses and could be contracted to universities. Such studies would have to be carefully designed to avoid stressing the dace population.

4. An alternate road location or bridge crossing needs to be evaluated. The present road crossing the stream has eliminated approximately 7.6 m (25 ft.; 3%) of habitat. There is a good possibility that because of increased recreational use of the upper Green River area this road will need to be improved and upgraded in the near future. The resulting widening of the road would further decrease the dace's already limited habitat.

Visual observation indicates it may be possible to re-route the road around the spring area to the east along an existing bench area. This possibility needs to be explored by an interdisciplinary team to determine its feasibility, impacts, and costs. Any other locations which become known should also be explored. With a total useable habitat of less than 300 m, the Kendall dace cannot afford to lose any more.

5. The potential of the Kendall Springs ecosystem for designation as a Research Natural Area needs to be evaluated. The Federal Committee on Research Natural Areas states there are three main objectives to establishing such areas. They are: (1) preservation of examples of all significant natural ecosystems for comparison with those influenced by man; (2) preservation of educational and research natural areas for ecological and environmental studies; (3) preservation of gene pools for typical and rare and endangered plants and animals.

The thermal spring, Kendall Dace, aquatic vegetation and associated terrestrial vegetation together form a unique ecosystem which may qualify for the purposes of a Research Natural Area. This possibility needs to be evaluated along with whether there is any need to include this type of an ecosystem in the state and whether this would be the best management alternative for the area. Although the requirements of the Endangered Species Act apply to all Federal lands regardless of the classification, designation of Kendall Warm Springs as a Research Natural Area may also provide a means to reduce the complexity of fulfilling the responsibilities of ESA. Although it is considered inappropriate to use the classification of a Research Natural Area solely to protect the Kendall dace, such a designation may be justified on the basis of several factors, including the presence of the dace. Thus, while protection of the Kendall dace would not be the main objective of a Natural Research Area, the classification may provide adequate protection to facilitate the eventual delisting of the dace.

PART II

RECOVERY

Objective: To recover the Kendall Warm Springs dace through maintenance of current population levels and protection of existing habitat.

Population levels and distribution of the Kendall dace have not suffered a decline but the extremely limited habitat requires special management efforts to maintain the status quo. Under this recovery objective, the existing population and habitat will be monitored through present management direction until taxonomic studies can determine the validity of differentiating the Kendall dace as a separate subspecies. The delay in initiating additional recovery actions while taxonomic studies are completed will not alter the present status of the Kendall dace or reduce or preclude the potential for future recovery efforts. The dace is believed to be at optimum population levels in its present habitat and no immediate threats have been identified. Perpetuation of current management programs (habitat protection) as well as the protection afforded by State regulations and the Endangered Species Act will assure continued security for the Kendall dace.

STEP-DOWN OUTLINE

1. Maintain the existing population and habitat through present management direction.

    11. Maintain a reproducing population at or above existing levels.

        111. Develop criteria and procedures to monitor changes in population levels.

        112. Monitor to determine changes in population levels.

        113. Monitor to determine if all age groups are present.

    12. Maintain the biological and physical integrity of stream habitat.

        121. Monitor habitat conditions.

            1211. Periodically inspect springs and enclosure to assess habitat conditions and identify any problems with trespassing by livestock or people.

            1212. Establish photographic and/or biological stations to document habitat conditions and trends.

        122. Prevent adverse modification of existing habitat.

            1221. Maintain present fencing to effectively exclude livestock grazing.

            1222. Continue restrictions on unauthorized vehicle use adjacent to Kendall Warm Springs Creek.

            1223. Continue prohibition on bathing, wading, and use of soaps, detergents, bleaches, and other cleaning agents in Kendall Warm Springs Creek.

            1224. Continue on-site I & E program through interpretive sign.

        123. Monitor effectiveness of present protective measures.

            1231. Implement additional measures or changes in present protective measures if needed.

13. Enforce laws protecting the Kendall dace and its habitat.

131. Monitor the area on a regular basis to help prevent illegal taking of dace.

132. Implement law enforcement responsibilities in instances of taking.

133. Assure compliance with Section 7 of ESA by Federal agencies responsible for activities that may affect the Kendall dace or its habitat.

2. Determine the taxonomic status of the Kendall dace.

21. Conduct taxonomy studies to determine if the Kendall dace subspecies differentiation is valid.

211. Identify techniques to accomplish taxonomic study.

212. Recommend agencies and/or personnel to conduct study.

213. Initiate and complete study.

2131. Determine the effect of rearing temperature on scale and fin ray counts, and head, fin and body size of the speckled dace through artificial propagation.

2132. Determine thermal preferences of the Kendall Warm Springs dace and the speckled dace.

2133. Examine the relationship between Kendall dace and speckled dace in the Upper Green River through biochemical genetic studies.

2134. Examine the relationship between Kendall dace and speckled dace in the Upper Green River through routine meristic study.

22. Evaluate results of taxonomy study.

221. Identify additional actions needed to accomplish study objective if results are inconclusive.

222. Identify taxonomic status based on results of study.

2221. Recommend delisting if subspecies status is invalid.

2222. Continue to implement and revise existing recovery plan as needed if subspecies is determined valid.

3. Complete additional research needs.

   31. Conduct a geologic and hydrologic study of the springs and surrounding terrain.

   32. Conduct life history studies.

   33. Evaluate an alternative road location or bridge crossing.

   34. Evaluate the potential for designation of the Kendall Warm Springs ecosystem as a Research Natural Area.

   35. Identify other research needs.

1. Maintain the existing population and habitat through present management direction.

   Population levels and distribution of the Kendall dace have not suffered a decline but the extremely limited habitat requires special management efforts to maintain the status quo. Present management direction appears to be successfully accomplishing this objective.

   11. Maintain a reproducing population at or above existing levels.

      The existing population is believed to be at or near optimum levels with normal reproduction occurring. These conditions should be maintained.

      111. Develop criteria and procedures to monitor changes in population levels.

         No method has been developed to determine actual dace numbers while offering adequate habitat protection. The habitat is easily damaged and recovers slowly. Criteria and methods to obtain population estimates and/or indices to population changes, and procedures necessary to implement these methods need to be identified.

      112. Monitor to determine changes in population levels.

         Using the criteria and procedures developed under Job 111, the population should be monitored to identify any changes in the conditions outlined under Job 11.

      113. Monitor to determine if all age groups are present.

         The presence of all age groups distributed throughout the creek is indicative that normal reproduction is occurring.

   12. Maintain the biological and physical integrity of stream habitat.

      The Kendall dace exists under very specific habitat conditions that must be maintained to assure its continued survival.

      121. Monitor habitat conditions.

         Criteria and procedures for monitoring and identifying habitat changes should be developed and implemented. Methods developed under Job 111 should be used to correlate changes in population levels with habitat changes.

1211. Periodically inspect springs and enclosure to assess habitat conditions and identify any problems with trespassing by livestock or people.

1212. Establish photographic and/or biological stations to document habitat conditions and trends.

122. Prevent adverse modification of existing habitat.

Certain past activities at Kendall Warm Springs were demonstrated or believed to adversely affect the dace habitat. These and other activities that may cause unfavorable changes in habitat should be prevented.

1221. Maintain present fencing to effectively exclude livestock grazing.

Past livestock use has damaged both stream bank stability and the plant life in and around the springs. Livestock trampling in the stream and its feeder springs has high potential for disruption of the aquatic ecosystem.

1222. Continue restrictions on unauthorized vehicle use adjacent to Kendall Warm Springs Creek.

Vehicle use adjacent to the creek can affect the vegetative community and physical structure of the stream bed.

1223. Continue prohibition on bathing, wading, and use of soaps, detergents, bleaches, and other cleaning agents in Kendall Warm Springs Creek.

Pollution from cleaning agents and other foreign chemicals has the potential to seriously impact the aquatic community.

1224. Continue on-site I & E program through interpretive sign.

Public information programs regarding the status and legal protection of the Kendall dace are important to promote public awareness and gain support.

123. Monitor effectiveness of present protective measures.

Monitor as necessary to determine if objectives are met and if protective measures are adequate.

1231. Implement additional measures or changes in present protective measures if needed.

If monitoring shows present protective measures to be inadequate, identify and implement additional measures to meet objectives.

13. Enforce laws protecting the Kendall dace and its habitat.

131. Monitor the area on a regular basis to help prevent illegal taking of dace.

132. Implement law enforcement responsibilities in instances of taking.

Violations of State and Federal laws should be promptly reported to the appropriate officials. Prosecution of violations should be pursued.

133. Assure compliance with Section 7 of ESA by Federal agencies responsible for activities that may affect the Kendall dace or its habitat.

Any Federal agency that considers authorizing, funding, or carrying out any action that may affect the Kendall dace or its habitat should be aware of the requirements of Section 7 of the Endangered Species Act and coordinate with the USFWS accordingly.

2. Determine the taxonomic status of the Kendall dace.

The objective is to determine if the differences between the Kendall dace and the dace inhabiting the Green River are genetic or due to a warm springs environment.

21. Conduct taxonomy studies to determine if the Kendall dace differentiation is valid.

The results of these studies will be used to make recommendations regarding the endangered classification of the Kendall dace.

211. Identify techniques to accomplish taxonomic study.

Valid techniques to accomplish the study objectives should be identified by the WG&FD and USFWS. Samples of Kendall dace will be needed and an Endangered Species permit required.

212. Recommend agencies and/or personnel to conduct study.

Availability of appropriate research facilities and expertise of personnel should be considered.

213. Initiate and complete study.

The study should be initiated as soon as possible and completed in two or three years.

2131. Determine the effect of rearing temperature on scale and fin ray counts, and head, fin, and body size of the speckled dace through artificial propogation.

Eggs should be obtained from wild or artifically maintained adult speckled dace. Eggs and larvae should be reared in several water temperatures until bony elements of the juvenile fish are completely formed. Routine meristic counts can then be made and related to water temperature.

2132. Determine thermal preferences of the Kendall Warm Springs dace and the speckled dace.

Dace should be acclimated to several temperatures prior to testing. Standard methods for determining preferred temperatures and final preferendum should be used.

2143. Examine the relationship between Kendall dace and speckled dace in the Upper Green River through biochemical genetic studies.

A background on biochemical genetic studies was provided by Dr. Charles Berry, Assistant Unit Leader, Utah Cooperative Fishery Research Unit:

An overview of the use of biochemical genetic techniques can be found in Utter et al. (1974) and Avise (1974). While electrophoretic techniques have been useful in many cases to show genetic differences between species, the high degree of similarity between most conspecific populations has made it difficult for biochemical systematists to identify subspecies. Only where subspecies have undergone

an exceptional amount of divergence (perhaps during times of strong isolation by geographic barriers) have populations become monomorphic or nearly so for different alleles (Avise 1974). When biochemical techniques were applied to pupfish (Cyprinodon), enzyme differences were not significantly different, even among species (Turner 1974, Avise and Selander 1974). The authors concluded that marked habitat differences between various populations caused striking divergence in some adaptive anatomical or physiological traits without altering a major portion of the genome, i.e. striking morphological differentiation was not accompanied by enzyme differentiation."

"In summary, biochemical genetic studies will probably not provide the final answer to the taxonomic question. There must be polymorphic loci to gather a significant amount of information (Avise 1974). If biochemical analyses support meristic analyses then a strong case can be made for the uniqueness of the subspecies. If not, then: 1) the populations are different and the method was inappropriate because of the reasons stated above, or 2) the populations are similar. The latter conclusion could be strengthened by a broad study of the Kendall dace, the dace from several tributaries in the Upper Green River and the dace from several warm springs."

Dr. Berry described a two-phase study to accomplish the above objective. Phase I would consist of a limited study of the Kendall dace and the dace population in the Green River adjacent to Kendall Warm Springs to gather preliminary information and identify polymorphic loci. The study would require 120 specimens, 60 from each taxon. As many as 20 genetic loci might be examined.

Phase II would require extensive study of several dace populations from the Upper Green River and from warm springs, including Kendall Warm Springs, to investigate the similarity of the Kendall dace to other dace populations. The study could include six river groups, three warm springs groups, and the Kendall dace, 60 specimans from each group that would be examined for many loci.

2134. Examine the relationship between Kendall dace and speckled dace in the Upper Green River through routine meristic study.

This investigation could be organized like and conducted concurrently with the biochemical study. Different data would be collected but data analysis would be similar. Minimum requirements would be body, head, and fin size, and lateral line scale and fin ray counts.

22. Evaluate results of taxonomy study.

The study should result in a conclusion regarding the subspecific status of the Kendall dace.

221. Identify actions needed to accomplish study objective if results are inconclusive.

Identify and resolve problems with initial study. Identify new techniques if necessary.

222. Idenfity taxonomic status based on results of study.

2221. Recommend delisting if subspecies status is determined invalid.

If the Kendall dace is not a separate subspecies it may not qualify for listing under the Endangered Species Act.

2222. Continue to implement and revise existing recovery plan as needed if subspecies status is determined valid.

3. Complete additional research needs.

When taxonomy studies are completed, additional research needed to manage and recover the Kendall dace should be carried out if the species remains listed as a separate subspecies or population.

31. Conduct a geologic and hydrologic study of the springs and surrounding terrain.

    Information is needed on the geology and hydrology of the springs to evaluate the potential for changes in the spring flow that may adversely affect the Kendall dace.

32. Conduct life history studies.

    Basic life history characteristice such as age at maturity, fecundity, population numbers, age structure, and habitat requirements should be determined.

33. Evaluate an alternative road location or bridge crossing.

    An alternative should be determined that will allow restoration of previously eliminated habitat and prevent further encroachment on the habitat should an upgrade of the present road be proposed.

34. Evaluate the potential for designation of the Kendall Warm Springs ecosystem as a Research Natural Area.

    The presence of the Kendall dace, considered with other factors, may qualify the Kendall Warm Springs ecosystem for classification as a Research Natural Area. While protection of an endangered species would not be the main objective, the dace would benefit by the protection this classification provides should the ecosystem qualify on the basis of all factors considered.

35. Identify other research needs.

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PART III

Implementation Schedule

Definition of Priorities

Priority 1 - All actions that are absolutely essential to prevent extinction of the species.

Priority 2 - All actions necessary to maintain the species current population status.

Priority 3 - All other actions necessary to provide for full recovery of the species.

Abbreviations for Agencies

Abbreviation	AGENCY
WG&FD	Wyoming Game and Fish Department
USFS	U.S. Forest Service
USFWS	U.S. Fish & Wildlife Service

Note: Agencies are listed in the Implementation Schedule in the order of responsibility for each task. Lead agencies are denoted by an asterist. All other agencies are listed as cooperators.

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.) FY 83 (8)	FY 84	FY 85	COMMENTS/NOTES (9)
R1	Develop criteria & procedures to monitor changes in pop. levels	111	2	1 year			WG&FD* USFS	1,000 1,000			
I1	Monitor to determine changes in pop. levels	112	2	continuous			WG&FD* USFS	1,000 1,000	1,000 1,000	1,000 1,000	
I1	Monitor to determine if all age groups are present	113	2	continuous			WG&FD* USFS	1,000 1,000	1,000 1,000	1,000 1,000	
I2	Inspect to assess habitat conditions & identify problems	1211	2	continuous			USFS* WG&FD	200	200	200	
I2	Establish station to document habitat conditions and terms	1212	2	continuous			USFS* WG&FD	200			
M3	Maintain fencing	1221	1	ongoing/ continuous			USFS*	250	250	250	

GENERAL CATEGORY (1)	PLAN TASK (2)	TASK (3)	PRIORITY (4)	TASK DURATION (5)	RESPONSIBLE AGENCY FWS REGION (6)	FWS PROGRAM (6a)	OTHER (7)	FISCAL YEAR COSTS (EST.) FY 83 (8)	FY 84	FY 85	COMMENTS/NOTES (9)
M3	Continue restrictions on vehicle use	1222	1	ongoing/ continuous			USFS* WG&FD	100	100	100	
M3	Continue prohibition on bathing, wading, & use of soaps	1223	1	ongoing/ continuous			USFS* WG&FD	100	100	100	
01	Continue on-site I & E program	1224	2	ongoing/ continuous			USFS* WG&FD	100	100	100	
M3	Implement additional protective measures if needed	1231	1	continuous	6	LE/SE	USFS* WG&FD*				Cost unknown at present
02	Monitor to prevent illegal taking of dace	131	1	continuous	6	LE	WG&FD* USFS*				No additional funding anticipated. Monitoring can occur in conjunction with other duties.
02	Implement law enforcement responsibilities in instances of taking	132	1	unknown	6	LE	WG&FD* USFS	500	500	500	

GENERAL CATEGORY (1)	PLAN TASK (2)	TASK (3)	PRIORITY (4)	TASK DURATION (5)	RESPONSIBLE AGENCY FWS REGION (6)	FWS PROGRAM (6a)	OTHER (7)	FISCAL YEAR COSTS (EST.) FY 83 (8)	FY 84	FY 85	COMMENTS/NOTES (9)
03	Assure compliance with Sec. 7 of ESA	133	1	continuous	6	SE*	USFS *	200	200	200	Cost incurred by USFS to comply with Section 7
							WG&FD				
							Other Fed. Agencies				
R5	Identify techniques to accomplish taxonomy study	211	3	1 year			WG&FD*	660			
					6	Research		660			
							USFS	660			
R5	Recommend agencies/ personnel to conduct study	212	3	3 months			WG&FD*	165			
					6	Research		165			
							USFS	165			
R5	Determine effect of rearing temperature	2131	3	1.5 to 3 years			WG&FD*	3,330	3,330	3,330	Duration and cost will depend on whether eggs are obtained from the wild or artificially
					6	Research		3,330	3,330	3,330	
							USFS	3,330	3,330	3,330	
R5	Determine thermal preferences	2132	3	6 months			WG&FD*	2,500			
					6	Research		2,500			
							USFS	2,500			
R5	Biochemical genetic studies of Kendall dace and speckled dace	2133	3	1 year			WG&FD*	5,830			
					6	Research		5,830			
							USFS	5,830			

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.) FY 83 (8)	FY 84	FY 85	COMMENTS/NOTES (9)
R5	Routine meristic study of Kendall dace and speckled dace	2134	3	3.5 months	6	Research	WG&FD* USFS	1,830 1,830 1,830			
R5	Identify additional actions needed to accomplish study objective if results are inconclusive	221	3	1 year	6	Research	WG&FD* USFS			1,330 1,330 1,330	
04	Recommend delisting if subspecies invalid	2221	3	1 year	6	SE*	WG&FD USFS				
04	Continue to implement & revise existing recovery plan as needed if subspecies is valid	2222	3	continuous	6	SE*	WG&FD USFS				

APPENDIX A

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

APPENDIX B

Distribution List of Agency Review Draft

DISTRIBUTION LIST OF AGENCY REVIEW DRAFT

Director, USFWS, Washington, D.C. 20240
Regional Director, Region 6, USFWS, Denver, CO 80225
Ecological Services Field Supervisor, USFWS, Cheyenne, WY 82001
Director, Denver Wildlife Research Center, USFWS, Denver, CO 80225
Area Supervisor, Ecological Services, USFWS, Billings, MT 59101
Dr. Charles Berry, Assistant Unit Leader, Utah Cooperative Fishery Unit, Logan, UT 84321
Director, WG&FD, Cheyenne, WY 82001
Mike Stone, Ecological Services Manager, WG&FD, Cheyenne, WY 82001
Glen Dunning, WG&FD, Pinedale, WY 82941
Allen Binns, WG&FD, Lander, WY 82520
Regional Forester, Region 4, USFS, Ogden, UT 84401
Forest Supervisor, Bridger-Teton National Forest, Jackson, WY 83001
Don Bartschi, Wildlife Staff Officer, Bridger-Teton National Forest, Jackson, WY 83001
John Weaver, Zone Biologist, Bridger-Teton National Forest, Jackson, WY 83001
Bob Hurley, Fisheries Biologist, Pinedale Ranger District, Pinedale, WY 82941
Daniel A. Poole, President, Wildlife Management Institute, Washington, D.C. 20005
Peter Willing, Director, Wyoming State Land Use Commission, Cheyenne, WY 82002
Chief, Forest Service, Washington, D.C. 20013
Don Miller, President, Colorado-Wyoming Chaper of the American Fisheries Society, Laramie, WY 82070
Gordon Haugen, President, Western Division of the American Fisheries Society, Tualatin, OR 97062
Ann Gorsche, Administrator, EPA, Washington, D.C. 20460
Stanley H. Anderson, Leader, Wyoming Cooperative Research Unit, University of Wyoming, Laramie, WY 82071
Richard J. Baldes, Project Leader, USFWS, Lander Fishery Assistance Project, Lander, WY 82520
Mark Stromberg, Wyoming Natural Heritage Program, Cheyenne, WY 82001
Robert E. Sundin, Director, Wyoming Department of Environmental Quality, Cheyenne, WY 82002
Representative Dick Cheney, Cheyenne, WY 82001
Senator Malcolm Wallop, Cheyenne, WY 82001
Senator Al Simpson, Cody, WY
Dick Randall, Defenders of Wildlife, Rock Springs, WY 82901
Jocelyn A. Alexander, President, Defenders of Wildlife, Washington, D.C. 20036
Dr. F.R. Scroggin, President, National Wildlife Federation, Washington, D.C. 20036
Brook Evans, Director, Sierra Club, Washington, D.C. 20003
Robert K. Turner, National Audubon Society, Boulder, CO 80307
Alice Herrington, President, Friends of Animals, Inc., New York, NY 10023
David R. Brower, President, Friends of the Earth, San Francisco, CA 94105
W. Leslie Pengelly, President, The Wildlife Society, Washington, D.C. 20014