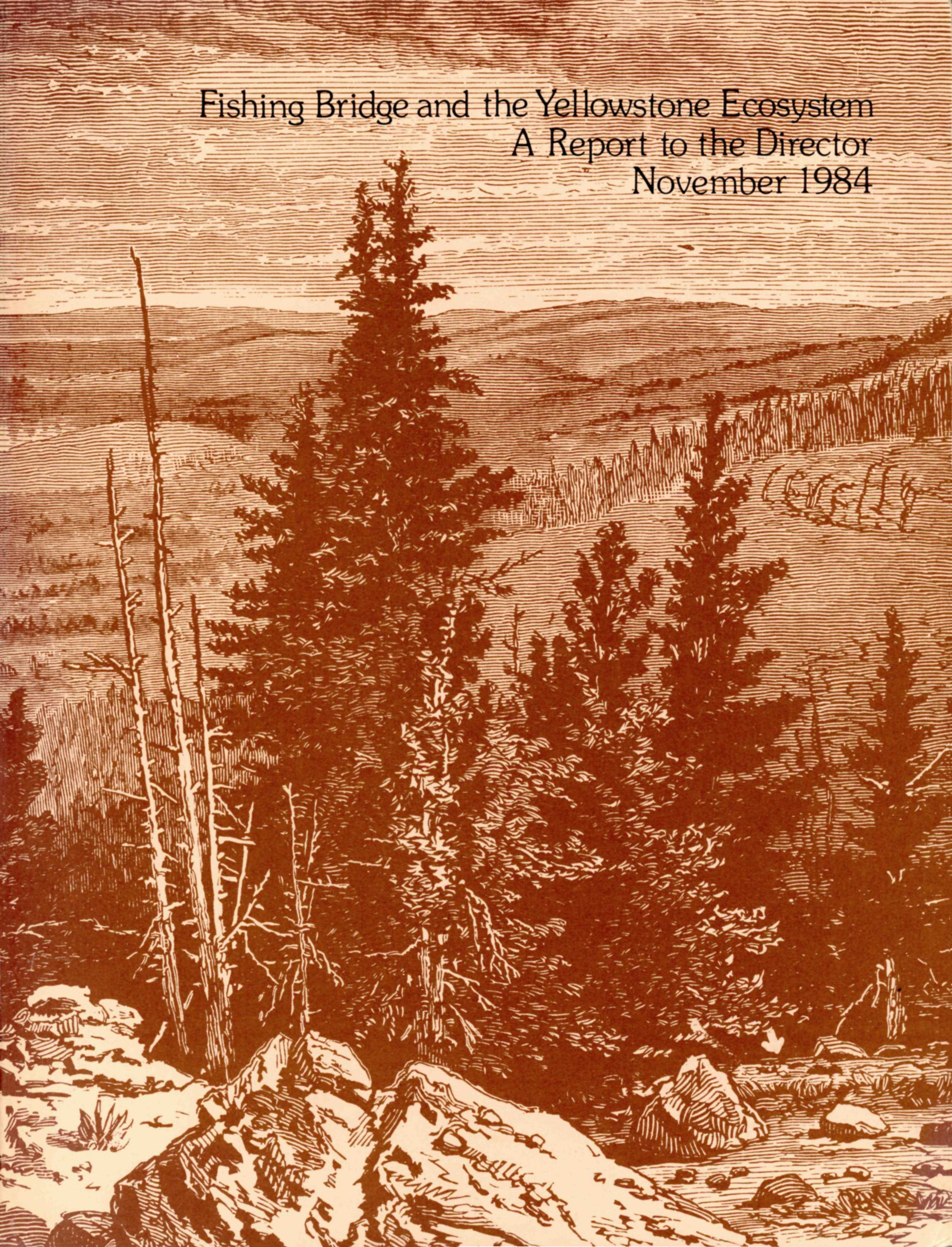
# Fishing Bridge and the Yellowstone Ecosystem

## A Report to the Director

November 1984



# Fishing Bridge and the Yellowstone Ecosystem

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# EXECUTIVE PERSPECTIVE

In 1981, Yellowstone Park Superintendent John Townsley confirmed an agreement between the National Park Service and the U.S. Fish and Wildlife Service that allowed the completion of the Grant Village development on the condition that the Fishing Bridge development be removed. It was the opinion of the U.S. Fish and Wildlife Service that the new development at Grant Village would not constitute jeopardy to the grizzly bear in Yellowstone Park at higher than current levels of impact if the Fishing Bridge development was removed. The following report presents data that evaluate, in ecological and management terms, the removal of the Fishing Bridge development.

The agreement between the National Park Service and the U.S. Fish and Wildlife Service is still formally in effect. The following report provides substantial and comprehensive evidence that the removal of Fishing Bridge is not only appropriate but a matter of some urgency.

There are two major topics of concern addressed by the report. The first is the ecological significance of the Fishing Bridge area. When measured by a variety of means, including vegetation, animal life, and aquatic resources, the Fishing Bridge area and nearby Pelican Valley constitute an extraordinarily diverse setting by Rocky Mountain standards. The outlets of Yellowstone Lake and Pelican Creek are a crossroads of energy flows and life forms that is unique in Yellowstone Park. In many ways, human use is affecting and reducing the natural functioning of this area.

The second topic of concern is the grizzly bear. Under the terms of the Endangered Species Act the grizzly bear is currently classified as "threatened," and the National Park Service is required to maintain and protect critical habitat for the grizzly bear. This report analyzes the considerable impact the Fishing Bridge development has had and continues to have on the grizzly bear population, an impact that is greatly out of proportion to the impacts induced by other park developments. The report then analyzes the relative worth of the Fishing Bridge area as natural grizzly bear habitat, and demonstrates that, as the area's ecological diversity and richness would suggest, it is superb grizzly bear habitat, among the finest in Yellowstone Park. Because of the impacts on the grizzly bear by the development at Fishing Bridge, and because of the Fishing Bridge area's exceptional value as grizzly bear habitat, the removal of the Fishing Bridge development is necessary.

The use of the Fishing Bridge area by park visitors has a tradition of more than seventy years, thus causing some people to wonder why now, after so much time has passed, the development must be removed. The answer is relatively simple: it has only been within the past twenty years that sufficient scientific

information has accumulated to measure the impact of the development. Merely that the development has been present for many years is no proof it is not harmful or misplaced. We cannot fault early park administrators for what they did not know about ecosystem management, but we are not bound to preserve their mistakes.

The harm done by the Fishing Bridge development to grizzly bears is of concern to a far greater number of people than the number who may be affected by the relocation of campsites from Fishing Bridge. The grizzly bear is in a real sense a ward of the people of the United States, who have entrusted its welfare to the National Park Service. Though all efforts must be made to accommodate the needs of visitors in Yellowstone, ultimately there must be equal concern for accommodating the needs of the grizzly bear too. For most of Yellowstone Park's history visitors were given preference over the wild setting in many ways (Haines 1977; Schullery 1980); this often happened because the wild setting was not well understood, but it did happen frequently, whatever the reason. For reasons explained in detail in the following report, Yellowstone Park's grizzly bear population can no longer afford for this to happen at Fishing Bridge.

In light of the legislative mandate of the National Park Service, Fishing Bridge has proven itself to be an ecological mistake with serious consequences. Under the terms of the National Park Service Act of 1916, the agency was given the mandate "to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." As the following report demonstrates, the Fishing Bridge development is making it extremely difficult for the National Park Service to honor that mandate in Yellowstone Park.

A possible criticism of park management is that by reducing development it risks losing sight of the language of Yellowstone Park's founding legislation of 1872, that the park is "for the benefit and enjoyment of the people." It must be pointed out, however, that national parks are by legal definition not in existence for the same reasons as are most areas of public recreation. The National Park Service Act, quoted above, requires that public enjoyment of the parks not impair them for future generations. But the legislation was not enacted merely to protect the natural setting. It also aimed at affirming a specific direction for public enjoyment that would make that enjoyment qualitatively different from public recreation in other places. Though national parks may quite properly be used and enjoyed through such traditional recreational activities as boating, hiking, fishing, and camping, national parks provide a setting whose primitive character makes those activities different than if they were practiced in most other places. In national

parks, public enjoyment is centered on engaging in recreational activities in an unimpaired natural setting. In other words, Yellowstone is to be enjoyed because of, rather than at the expense of, its wild state. Enjoyment of the park, as defined by the National Park Service Act, is diminished if the park's natural setting is impaired.

More than a century of experience has shown that high levels of human use and enjoyment in Yellowstone need not be significantly harmful to the overall health of the park's ecological character. The Master Plan for Yellowstone Park, adopted in 1974, addressed the proper management of human use in order to ensure that the park could be both heavily used and reasonably healthy ecologically. Furthermore, there is no mention in any park legislation of preserving the park setting in a perfectly primitive condition. The realities of public use preclude maintaining Yellowstone in a totally undisturbed state, but they do not preclude maintaining the overall wholeness of the wilderness setting in good condition. Though there will always be a constructive tension between public use and preservation, neither must be permitted to gain the upper hand. At Fishing Bridge, human use has unquestionably held the upper hand for many years, to the serious harm of the wilderness setting.

At the same time that scientific information on Yellowstone has accumulated, the worth of the park has been defined and heightened in other ways. Yellowstone Park became a Biosphere Reserve as a part of the UNESCO program in 1976. One of the primary goals of the Biosphere Reserve program is the preservation of ecological and genetic diversity. We now know that in Yellowstone there are few if any areas as diverse as the Fishing Bridge area, and perhaps none as significant to such a wide variety of park life forms. As the following report indicates, Fishing Bridge should have a special role to play in Yellowstone Park's stature as a Biosphere Reserve; it cannot play that role as long as the Fishing Bridge development exists.

In 1978, Yellowstone was designated a World Heritage Site by UNESCO, further increasing world attention on and respect for the park. The Fishing Bridge development and its problems do not live up to the honor accorded by the World Heritage Site designation.

This report on the ecological implication of maintaining the Fishing Bridge development is only one part of the process by which the problems associated with the development may be solved. As yet unresolved are numerous eocnomic and management-related issues which must be addressed fully as the process continues. Some studies of travel patterns and visitor use of the Fishing Bridge area have already been completed and are incorporated into this report where they reveal much about ecological impacts of visitor use, but additional studies must be undertaken. Now that the damage caused by the Fishing Bridge development has been

sufficiently assessed, the next stage is to carefully plan for its removal in a practical, economically acceptable manner. Among the issues involved in this planning are the relocation of campsites and other visitor use facilities, the evaluation of possible economic impacts of the removal both on park concessioners and on commercial facilities near the park, and the development of interpretive programs that will enable visitors of the future to fully appreciate the richness and diversity of the Fishing Bridge area.

# HUMAN USE IN THE FISHING BRIDGE AREA

## Historical Summary of Human Use in the Fishing Bridge Area

Camping has been popular in the Fishing Bridge area for a very long time. Taylor (1964) noted that "the sandy beaches of the Fishing Bridge Peninsula appear to have been as attractive to prehistoric occupants as, in fact, they are to peoples of today." Wright noted a general concentration of prehistoric use along the west and north sides of Yellowstone Lake and along the Yellowstone River from the outlet of the lake to Chittenden Bridge. The true magnitude of this use is not yet adequately reported because, as Wright pointed out, "Yellowstone National Park is one of the poorest known archeological areas of North America" (Wright 1982). Even at that, however, the archeological evidence of prehistoric use of the Fishing Bridge area is considerable.

Taylor (1964) mapped known archeological sites in the Fishing Bridge area. Most of these are relatively minor, consisting of modest evidence of occupation, but one is extremely significant by the standards of Yellowstone archeological research. Site 48YE1 is the "only known Native American burial from the Park" (Wright 1982). The site was discovered in 1941 by a sewer workman and was originally examined and reported on by David Condon (Condon 1948) in Yellowstone Nature Notes. Because the site may be regarded as one of considerable cultural significance in this national park setting, Wright's summary of it follows:

> Originally missexed as a male (Condon 1948), it is in fact a female. She was about 40-45 years of age and about 154 cm. tall. She exhibits several pathologies on the cranium, teeth, long bones, and the right iliac blade. The latter pathology may have derived from a wound which produced acute infection. No ethnic designation of the woman is possible.
>
> The burial also apparently included two domestic dogs (Condon 1948), but only one was present in the material that I studied. It was incomplete. According to its dentition, it was 6 to 7 months old (the permanent canines are visible anteriomedial to the corresponding deciduous canines in the maxilla). The dental measurements show that the specimen fits at the smaller end of the 8 size classes of prehistoric domesticated dogs defined by Haag (1948). Some artifacts are reported but were unavailable to me.
>
> The burial, itself, was in an ovate pit, 100 cm. in depth that began 13 to 21 cm. below the present ground surface. It lay below an undisturbed charcoal

> layer, and the top of the pit was covered by 37 flat rocks (Condon 1948). A stratigraphically controlled series of obsidian hydration dates from 48YE1 indicates an age of ca. 3200 to 3100 B.P. for the construction of the burial pit (Wright 1982).

Wright further dated occupation of the site of the burial to 4675 B.P., the earliest date his survey revealed in the Fishing Bridge area. He hypothesized that use around Yellowstone Lake was based on interest in fishing and the harvesting of blue camas (Camasia quamash) and other root crops (Wright 1982). Malouf (1958) concluded that "man has occupied Yellowstone National Park for several thousand years, and the occupation has been continuous and relatively heavy" (Malouf's emphasis). It appears from the preliminary work that has been done that Fishing Bridge was one of the most popular occupation sites in present Yellowstone Park.

The early history of European exploration of the Yellowstone area, as well as the story of the establishment and early management of the park, is a matter of historical record (Haines 1974, 1977). Prior to the arrival of formal exploration parties (1869-1871), the lake was visited frequently by parties of trappers and others, some of whom described its beauty and wildlife. The descriptions made by the explorers were more detailed and appreciative. Cornelius Hedges, a member of the Washburn-Langford-Doane Expedition of 1870, was enthralled by the "wonderful beauty" of the lake when he first viewed it from near the outlet of Pelican Creek, about three miles east of the outlet of the lake. Among his other comments he observed the wealth of wildlife:

> About the mouth of the little stream that we had just crossed were numerous shallows and bars, which were covered by the acre with ducks, geese, huge white-breasted cranes, and long-beaked pelicans, while the solitary albatross, or sea gull, circled above our heads with a saucy look that drew many a random shot and cost one, at least, its life . . . Before sunset of the first day I had traced several miles of the lake beach alone, gathered many curious specimens of watery mechanism, and in spite of the high-rolling waters had bagged four of as handsome trout as ever kindled the enthusiasm of a genuine disciple of Isaac Walton (Hedges 1870).

Others made similar observations, such as General W. Strong, who was a member of a military outing through the park in summer and fall of 1875. Again, he was discussing the river below the outlet and the lake itself near the outlet:

> From the river, lakes, and bayous great flocks of wild fowl arose, among which we saw geese, brant, swan, pelican, and sand-hill cranes, blue herons, and

> a large variety of ducks, including the mallard, red-head, green and blue-winged teal, widgeon, and pintails. I fired at a flock of wild geese three hundred yards distant, and at the report of the rifle large numbers of wild fowl got up all about us from lakes and streams which were before hidden from our view (Strong 1968).

Though the shore of Yellowstone Lake east of the outlet was used by tourists in the park's early years (1872-1900), it was not a major area of interest until after the completion of the East Entrance road. Work on this project began in 1900, and was completed in 1903 (O'Brien 1965). The first bridge across the outlet has been described:

> The bridge over the Yellowstone River was 360 feet long, carried on piling bents 16 feet apart. This first bridge (which in 1914 would be called Fishing Bridge) differed from the present structure both in location and appearance. It used the same western abutment, but crossed the river diagonally upstream (that is, toward the lake), and its center was elevated in "camel-back" fashion to allow the passage of row boats beneath (Haines 1977).

This first bridge was completed in 1902 (Figure 1), well before camping in the park was confined to a few specific locations. Regulations at that time required campers to follow only a few general rules, such as camping more than 100 feet from any roadway. Commercial "permanent camps" were maintained at various locations, but travelers were not compelled to use them; the individuals who camped at will in the forest were known as "sagebrushers".

Reed (1970) observed that camping gradually became localized to some extent by the campers' practice of using sites that were established in earlier years. Though the military administration of the park did not attempt to formalize this practice, by 1912 they were to some extent patrolling and monitoring these most popular areas. By 1914 these areas were called "public camping grounds" in the Acting Superintendent's report (Reed 1970). The area near the outlet of Yellowstone Lake was quite popular with campers because of its obvious scenic and recreational attractions.

Formal development of the Fishing Bridge area began after the establishment of the National Park Service in 1916. Haines (1977) and Culpin (1981) reviewed various construction projects. The bridge was rebuilt in 1919 (Figure 2). The first auto campground was established in 1921, though there were enough campers in the area to justify a Hamiltons Store in 1920. The store was doubled in size in 1925 and had a filling station attached to it in 1927.

Fig. 1 The original Fishing Bridge constructed in 1902.

Fig. 2 Fishing Bridge in 1935, two years before the 1937 replacement.

A cafeteria was built to serve campers in 1926, and the first bathhouse for the campground was added in 1927. In 1930-1931 the present museum was constructed, the final of the four early museums built in the park in this period. In 1932 the first campground amphitheatre was added.

Throughout the period 1924-1942, the one-, two-, and three-room "tourist cabins" were built, as were many additional utility buildings, comfort stations, and other concession and government buildings.

Culpin has described the construction of the bridge that now spans the outlet of Yellowstone Lake (Figure 3):

> The bridge is a two-lane log trestle bridge built in 1937 by the National Park Service. The spans (pilings, braces, and caps) and stringers were imported cedar logs. The guardrails and guardrail posts are native lodgepole pine. Timbers are used for the decking and sheathe the concrete abutments at each end of the bridge. In addition there are two stairways of log construction which provide access to the pedestrian way. Log benches are built into the guardrail system. The bridge is 532 feet long and 24 feet wide with 19 spans spaced 28 feet apart. The road surface is asphalt over timber decking (Culpin 1981).

Increases in visitation following World War II caused serious overuse and deterioration of visitor facilities in Yellowstone. The Mission 66 program, initiated in the mid-1950's with a goal of upgrading park facilities by 1966, attempted to address these problems, with mixed success at best (Haines 1977). In 1957-1959, a new, larger campground was built at Fishing Bridge, with 14 new comfort stations and a ranger station. In 1963-1964, the present trailer court was constructed, bringing the camping capacity of the area to present levels (National Park Service 1965). It was at this time that, partly as a reaction to the Mission 66 developments and partly as an independent response to visitor use of national parks in general, the Fishing Bridge development began to receive reconsideration.

In the early 1960's a combination of forces increased both management and public interest in preservation of pristine wild settings in Yellowstone Park. Significant evaluations of policy direction (Leopold et al. 1963; Robbins et al. 1963) by government appointed committees redirected or reconsidered past actions and priorities, with the result that the welfare of natural settings in parks was given more attention. This redirection was followed by intensified research efforts aimed at determining levels of impact and degree of departure from natural conditions in many parks. Fishing Bridge quickly attracted attention, both from Park

Fig. 3 The present Fishing Bridge completed in 1937 (photograph taken in 1965).

Service researchers and from independent observers, as a troubling presence in Yellowstone Park.

This reconsideration operated on more than one level. Many were concerned about the esthetics of development as much as about possible ecological damage. Darling and Eichhorn (1967), who conducted a study of conditions in parks immediately after the publication of the Leopold and Robbins Reports, had harsh words for "that national park slum called Fishing Bridge" (Figure 4).

The Fishing Bridge situation acquired a new urgency in the late 1960's when scientific research began to yield information about the area's true value to wildlife. In 1968 a Yellowstone Park research biologist, William Barmore, responding to early planning proposals for a bypass around the Fishing Bridge area, reviewed the ecological significance of that area:

> Lower Pelican Valley between Mary Bay and Lake and as far north as LeHardys Rapids on the Yellowstone River has unique ecological value for the following reasons:
>
> 1. The merging of lake, river and terrestrial ecosystems creates a complex of environmental conditions and habitats that supports a great diversity of plant and animal life (The "edge effect" in ecological parlance).
>
> 2. Areas with the ecological diversity of the lower Pelican Valley are uncommon in or out of the park (compared, for example, with the abundance of representative areas of lodgepole pine or subalpine forest). In areas other than parks such attractive and productive areas are usually developed for ranching or as townsites (The original location of the Fishing Bridge development where it is may reflect this latter tendency).
>
> 3. The likelihood that the Yellowstone River and Pelican Creek valleys provide important corridors for animal movement (bison, elk, grizzly bear, moose) between Hayden Valley and Pelican Valley.
>
> For these reasons, greater than usual concern should be shown for maintaining the ecological integrity of lower Pelican Valley (Barmore 1968).

Barmore recommended that the development be removed:

> Eliminate all concessioner facilities at Fishing Bridge, the trailer court, and the Fishing Bridge and

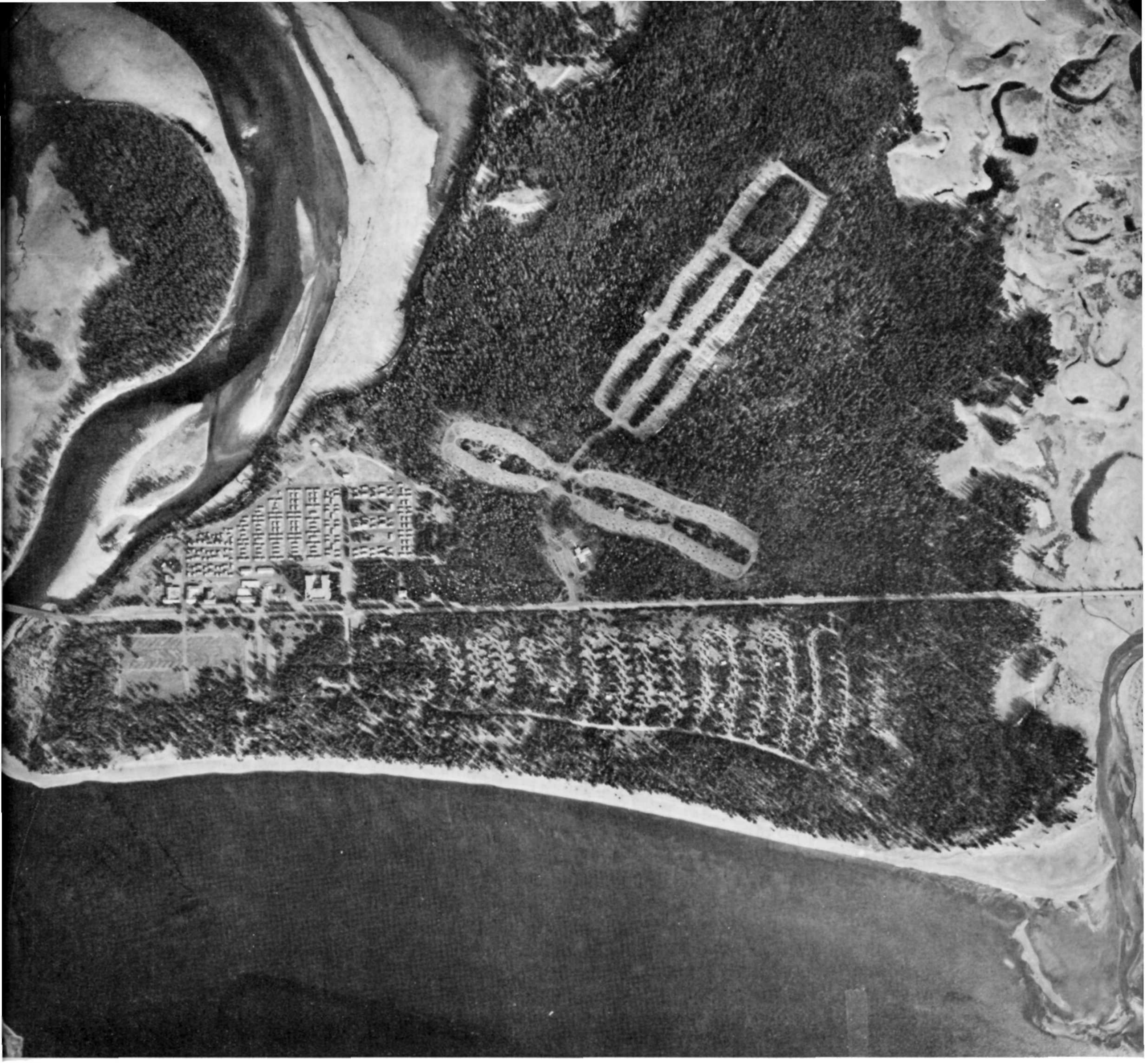


FIGURE 4: AERIAL PHOTOGRAPH - FISHING BRIDGE DEVELOPMENT

> Pelican Creek campgrounds. Limit facilities to those necessary for day use and visitor enjoyment and understanding of the area (visitor center, nature trails, scenic overlooks, perhaps a picnic area or two, etc.).
>
> Justification: If we had it all to do over again, it seems unlikely that we would create an extensive and heavily used development at Fishing Bridge. Thus it seems reasonable from a long term standpoint to eliminate these facilities and to restore the natural integrity of the area.
>
> The facilities at Fishing Bridge are old, shoddy, and will either have to be replaced or eliminated in the not too distant future. We should use this opportunity to eliminate the facilities.
>
> In this modern day and in the future, overnight facilities, including campgrounds, are not needed at Fishing Bridge for enjoyment and understanding of the area's values (Barmore 1968).

Additional ecological evidence accumulated in the period between 1968 and 1971. In August of 1971, Supervisory Research Biologist Glen Cole, in a memorandum to the Superintendent on the subject of bear management, pointed out that the Fishing Bridge area was of special value to grizzly bears:

> Something in addition to the occasional camper's icechest appears to be attracting grizzlies into the Lake Outlet's Fishing Bridge and Pelican areas. This is suggested to be an abundance of natural food in the form of spawning fish and fish carrion which drifts back downstream, or is swept into the lake's north beach by prevailing winds. Studies will be expanded to document actual relationships, but it should be anticipated that these could show that substitute overnight facilities should be provided away from what is apparently prime grizzly habitat (Cole 1971b).

In July of 1972, Yellowstone Park plant ecologist Don Despain noted:

> for the period 1943-1959, of the total 48 grizzly bears killed (including accidental as well as control kills), 24 came from Fishing Bridge and Pelican Creek, and 3 from Lake. For the same period a total of 328 black bears were killed, with 37 from Fishing Bridge and 28 from Lake. As indicated by Mr. Cole, there is more involved here than the attraction of grizzly bears to a campground (Despain 1972).

Other comments on the wisdom of such heavy use in the Fishing Bridge area echoed these and similar sentiments of concern for the welfare of the ecological setting (Dean 1972; Halladay 1972).

If the period from 1920 until 1965 was one of gradual expansion of the Fishing Bridge development, 1965-1972 was a plateau period where the development did not change significantly in size. Following 1972, however, there began a contraction of the size of this complex of visitor use facilities as the National Park Service attempted to reduce the effect Fishing Bridge was having on surrounding natural systems.

Because of growing evidence that the Fishing Bridge development was indeed an ecological mistake, the original 1972 Master Plan (approved in 1974) called for the elimination of that development:

> Current planning proposes to ultimately relieve congestion and eliminate accommodations and services from this existing developed area in order to facilitate restoration of critical wildlife habitats at Yellowstone Lake's outlet. The existing campground, trailer village, store, and service station will, however, be retained for an interim period (National Park Service 1974).

Because of persistent and heavy use of the area by grizzly bears, the nearby Pelican Creek Campground was closed permanently in 1972. In 1973, as noted later in this report, fishing was prohibited from the Fishing Bridge itself in an effort to protect spawning trout and to restore naturally-occurring levels of trout in the area; other similarly-motivated regulations were instituted elsewhere in the area.

In 1975, visitor use of the aging visitor cabins in the Fishing Bridge development was discontinued and the cabins were scheduled for removal. Removal proceeded as follows: 1980 - 138 cabins; 1981 - 52 cabins, cafeteria and dorm; 1982 - 22 cabins; 1984 - remaining 44 cabins scheduled for removal.

By 1977, the growing scientific evidence coupled with management experience, resulted in the restriction of the Fishing Bridge campground to hard-sided vehicles only because of the known presence of grizzly bears in this area.

Between 1979 and 1981, the National Park Service and the U.S. Fish and Wildlife Service held consultations (in accordance with Section 7 Interagency Cooperation Regulations and the Endangered Species Act Amendments of 1978) to review plans for expansion of the Grant Village development. These consultations resulted in an opinion from the U.S. Fish and Wildlife Service that the increased development at Grant Village would not "constitute jeopardy" to the grizzly bear in the Yellowstone Ecosystem (Figure 5) at

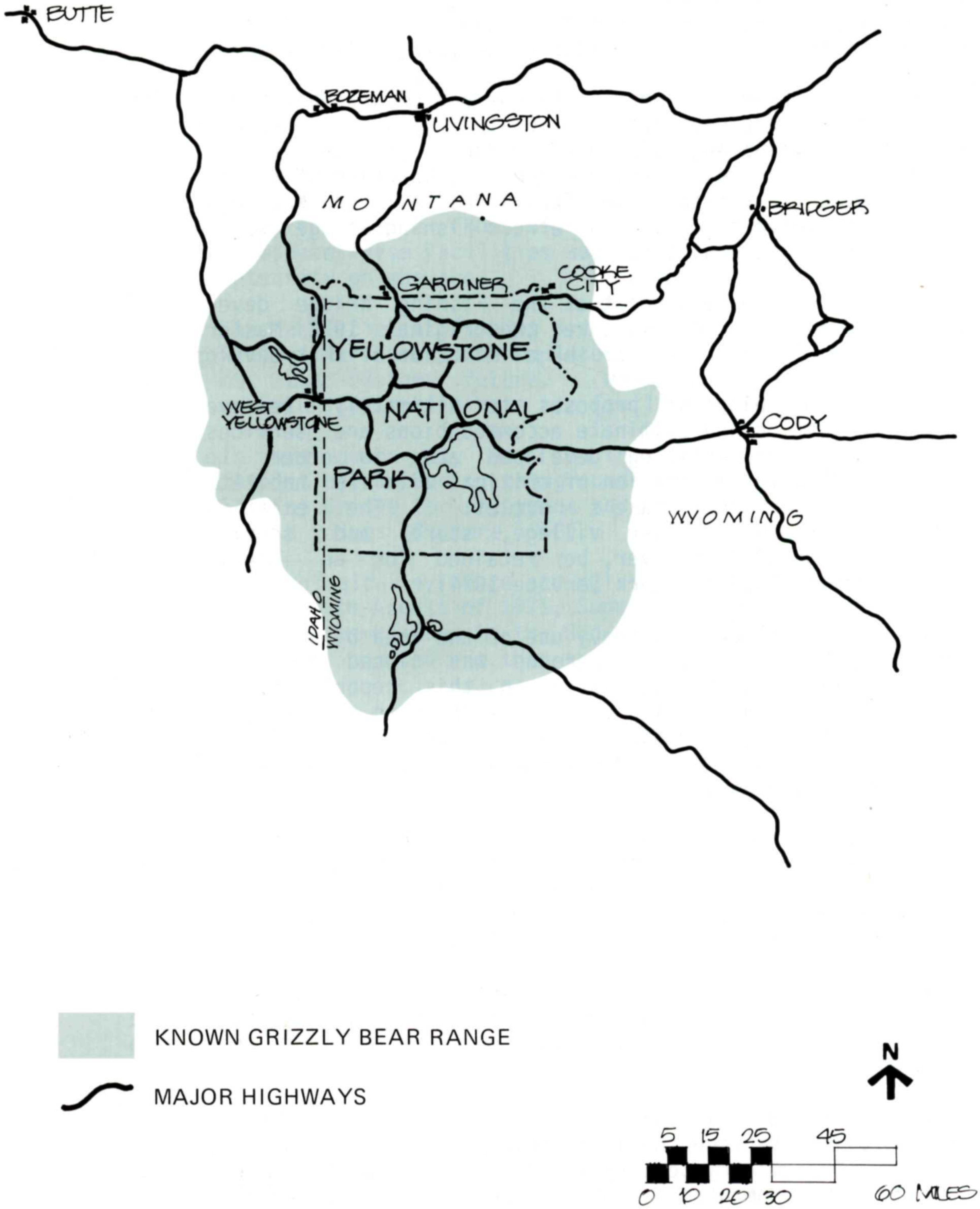



**FIGURE 5: KNOWN GRIZZLY BEAR RANGE IN THE YELLOWSTONE REGION**

YELLOWSTONE NATIONAL PARK
WYOMING/MONTANA/IDAHO
UNITED STATES DEPARTMENT OF THE INTERIOR/NATIONAL PARK SERVICE

101 | 40,153
DSC | AUG 84

greater than previous levels if the Fishing Bridge phase-out was completed as planned (Acting Regional Director, U.S. Fish and Wildlife Service, Region 6, 1979). In 1981, the National Park Service reaffirmed its commitment to the dual objectives of expanding Grant Village while eliminating Fishing Bridge (Townsley 1981).

In 1983, a series of meetings were held in and near the park to acquaint the public with the draft alternatives for removal of this development. Public response to a questionnaire on possible futures for the development indicated that approximately half of those responding favored no removal of facilities while half favored removing facilities entirely or relocating the campsites elsewhere in the park.

Park staff conducted a survey of campgrounds in the park and those outside the park within 50 miles of the Grand Loop Road in the summer of 1983 to determine where expansion could occur, and determined that additional campsites to replace those removed from Fishing Bridge could be accommodated either in the park or "outside the park in vacant space within existing campgrounds" (Barbee 1984).

In 1983, the Squaw Lake group campground was closed because of concern for visitor safety in an area of heavy grizzly bear concentration.

In December of 1983, Superintendent Barbee and members of his staff met with the Director, National Park Service, to consider the manner in which the Fishing Bridge development would be removed and the options for mitigation for lost campsites. The result of that meeting was a decision to review, in consultation with the U.S. Fish and Wildlife Service, the ecological data and rationale upon which the removal of the Fishing Bridge development was based. The present report examines both the data and the rationale for said removal.

## Current Levels of Human Use in the Fishing Bridge Area

The main purpose of this presentation is to suggest the degree to which the Fishing Bridge area and Pelican Valley have become something other than wilderness and to show the extent to which Fishing Bridge development contributes to that process. It is not inappropriate for a national park to contain highly developed and densely populated areas, but the magnitude of visitor use of the Fishing Bridge area has not been fully described until now. As pointed out in the Historical Summary, potential overnight use capacity of the Fishing Bridge development peaked in the 1970's before the closure of the Pelican Creek Campground and the retirement of the visitor cabins at Fishing Bridge. The current overnight accommodations at Fishing Bridge are restricted to

camping facilities for visitors and dormitory facilities for employees. There are two campgrounds at Fishing Bridge: a 353-site concessioner-operated R.V. park, and a 308-site National Park Service campground. Occupancy of these, with an estimated rate of 2.5 people per site in the R.V. park and 3.2 people per site in the National Park Service campground, has a maximum estimated nightly total of 1,868 people. This does not include employees of concessioners or Park Service staff who reside in the area. Computations this simple do not represent the true level of use in the Fishing Bridge area or in Pelican Valley, but do give a basic notion of the size of the Fishing Bridge "village" during summer months.

In order to more fully analyze human use of the Fishing Bridge area, use by visitors has been defined by category in the following discussion, then related by geographical area in a series of figures. The presentation reveals not only an interlocking of use patterns but a potential for even more heavy use in the future if the development at Fishing Bridge is not removed.

The following discussion analyzes visitor use of the Fishing Bridge area in terms of density of visitors. Human density is measured in "person-days per square mile". A person-day is the occurrence of a visitor in the area on a given day. There are certain recognized limitations in this system, including its potential for equally weighting person-days that represent radically different lengths of stay (the person who drives through versus the person who stays 24 hours, for example), and the necessity of "evening out" visitor concentration over a certain area for purposes of graphic presentation (anglers concentrate on the area nearest water, though their area of impact on wildlife may extend a mile or more from the stream, for example).

Destinations compiled from trail registers, campsite registrations, angler locations and naturalist walks were used to estimate each type of user area of impact. Delineations of these zones also rely on meadow boundaries and trail locations. Anglers and day users are often off-trail and their impact zones reflect this.

The presentation is based on the season of heaviest visitation, the months of July and August. The figures given as total person-days are the average of three years, 1981-1983 (Table 1).

The area of most concentrated use includes the tip of the Fishing Bridge peninsula and the associated travel corridors. This area of 1,300 acres sustains a use of 4,694 persons per day during July and August. This is a daily density of 2,311 persons per square mile (Figure 6).

Day users in the immediate vicinity of Fishing Bridge affect an area of 1,090 acres (Figure 7). Approximately 30,256 person days

Table 1. Types and densities of visitor use in the Fishing Bridge/Pelican Valley study area.

| | Person days (average 81-83 peak season) | Total days in peak season | Average Users Per day | Acreage | Persons per square mile | |
|---|---|---|---|---|---|---|
| Type of use by area | | | | | | |
| Fishing Bridge developed area and road corridors (total use) | 291,028 | 62 | 4,694 | 1,300 | 2,311 | |
| Yellowstone Lake-angler use along shore (no boating impact) | 18,870 | 138 | 137 | 954 | 92 | |
| Yellowstone River-angler use along Yellowstone River and Howard Eaton Trail | 13,376 | 108 | 124 | 750 | 105 | |
| Pelican Valley-angler use | 2,156 | 62 | 35 | 7,677 | 3 | |
| Pelican Valley (Storm Point naturalist walks) | 2,092 | 62 | 34 | 944 | 23 | |
| Sulphur Hills naturalist walks | 12 | 62 | 0.2 | 1,895 | 0.1 | |
| Pelican Valley - overnight use | 1,360 | 62 | 22 | 7,278 | 2 | |
| Pelican Valley - overnight stock | 702 | 62 | 11 | 7,278 | 1 | |
| Pelican Valley - day use | 1,670 | 62 | 27 | 5,332 | 3 | |
| Day users near developed area of Fishing Bridge | 30,256 | 62 | 488 | 1,090 | 287 | |
| Ceiling limits overnight use[a] | | | | | | |
| Pelican Valley (overnight visitors only) | 10,168 | 62 | 164 | 7,278 | 14 | 7.5 x current level |
| Pelican Valley (overnight stock only) | 12,710 | 62 | 205 | 7,278 | 18 | 18.1 x current level |

[a]With unlimited angler increases and unlimited day use.

are included in this group, which, when divided by 62 days (the length of July and August), equates to 488 persons per day. This is a daily intensity of 287 persons per square mile. The number in this group is an estimate, probably less precise than in most other categories of users given here.

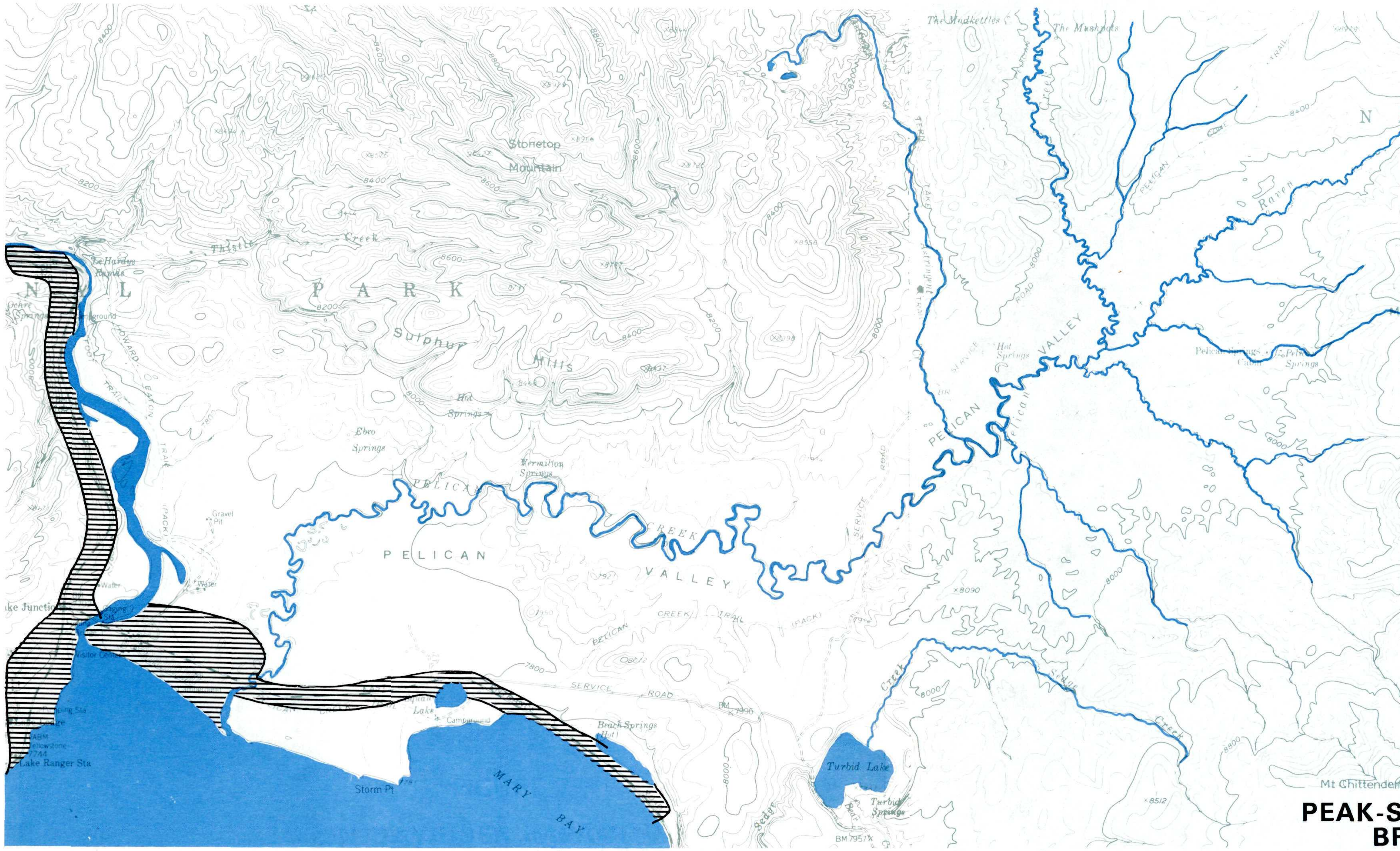
Figure 7 also shows day-user impact in the Pelican Valley. They are estimated to affect an area of 5,332 acres. There are 1,670 person-days in this group, for an average daily density of 3 persons per square mile.

There are several good fishing waters in the vicinity of Fishing Bridge (Figure 8). Angling pressure is quite heavy along the lake shore, where 18,870 anglers use 945 acres in July and August, for an average of 137 anglers per day and a daily density of 92 persons per square mile. Pressure is heavier on the Yellowstone River, where 13,376 anglers use an area of 750 acres for an average of 124 anglers per day and a daily density of 105 persons per square mile. Pelican Valley supports 2,156 angler-days in the peak season, or 35 anglers per day; this amounts to 3 persons per square mile.

Ranger-naturalist conducted walks are taken into the area (Figure 9). Walks to Storm Point and along Pelican Creek have an impact area of 944 acres with a total of 2,092 people during July and August, or a daily average of 34 persons. This is a daily density of 23 persons per square mile. Naturalist walks to the Sulphur Hills have an impact area of 1,895 acres, but the total number of persons involved in this walk is quite small. Daily density of persons in its area of impact is less than one person per square mile.

Overnight use in Pelican Valley (Figure 10) is considerable. Because of the complexity of this use, it will be discussed in parts. Visitor use is 1,360 persons in 62 days, or 22 persons per day. In an area of 7,278 acres this amounts to a density of 2 persons per square mile. But this is a minimum figure. Most important, it does not reflect overnight use by stock. Figures 11 and 12 show how closely the number of nights spent by stock in Pelican Valley approaches the number of nights spent by people. Figures 13 and 14 show similar comparisons of total number of people and stock traveling overnight (some stayed for more than one night, thus the lower totals than in Figures 11 and 12) in Pelican Valley. This high number of stock using the Pelican Valley has a significant additional impact on the area. Horses not only have more feet, they are metal-shod, thus having more erosive effect. They, unlike most human visitors, also eat considerable vegetation and they have an impact farther from the overnight campsites than do human visitors.

Figure 15 is a composite of the impact areas and person-densities shown in Figures 6-10. By its key, a clearer idea of the extent




FISHING BRIDGE DEVELOPED AREA AND RELATED TRAVEL CORRIDORS
1300 ACRES / 4,694 PERSONS PER DAY

N

NO SCALE

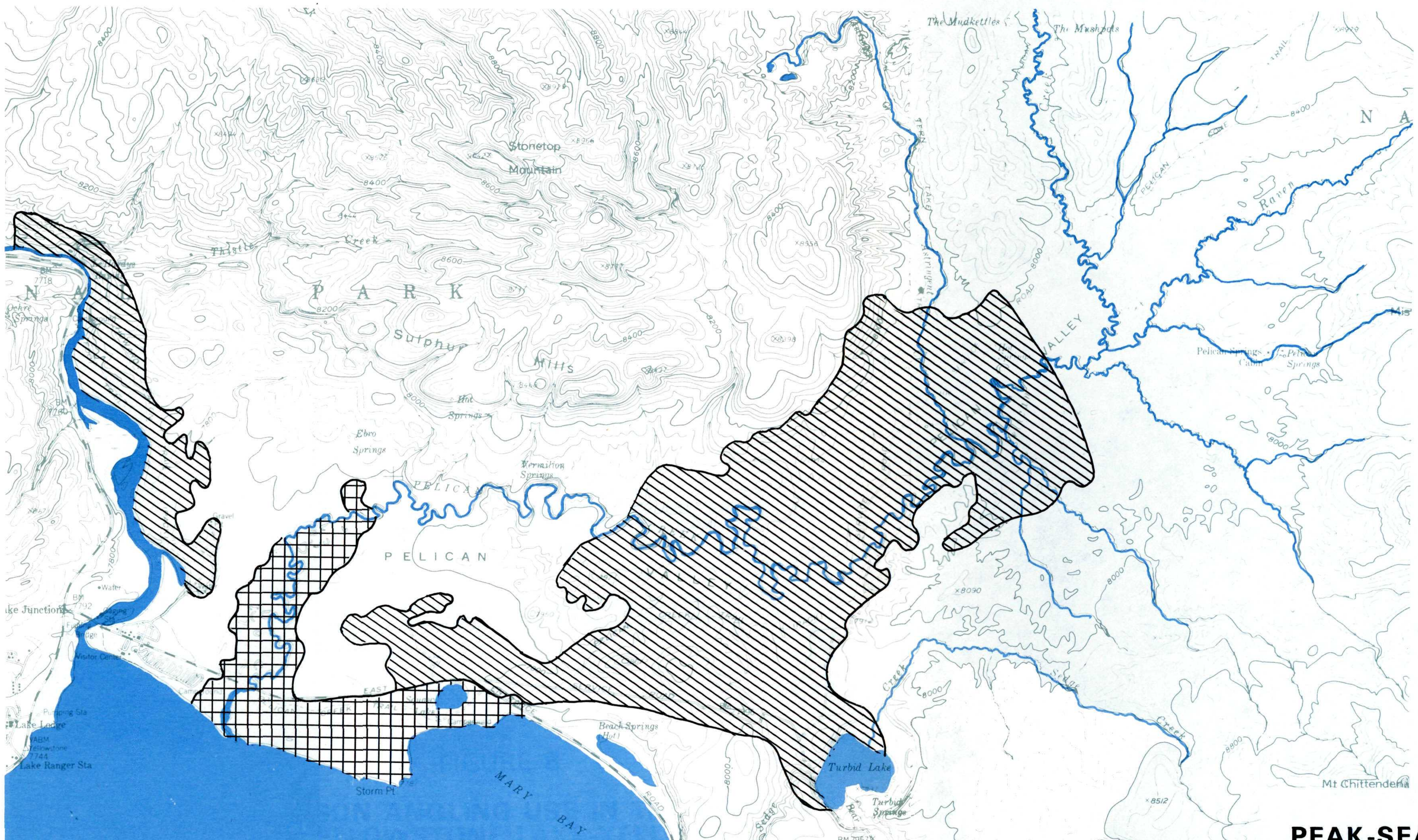
FIGURE 6

## PEAK-SEASON HUMAN DENSITY IN THE FISHING BRIDGE DEVELOPMENT AND RELATED TRAVEL CORRIDORS/1981-83

### YELLOWSTONE NATIONAL PARK
WYOMING/MONTANA/IDAHO

UNITED STATES DEPARTMENT OF THE INTERIOR-NATIONAL PARK SERVICE

101 | 40,143
DSC | NOV 84




PELICAN VALLEY – 5,332 ACRES / 27 PERSONS PER DAY

FISHING BRIDGE – 1,090 ACRES / 488 PERSONS PER DAY

N

NO SCALE

FIGURE 7

## PEAK-SEASON DAY-USER IMPACT IN THE FISHING BRIDGE-PELICAN VALLEY AREA/1981-83

**YELLOWSTONE NATIONAL PARK**

**WYOMING/MONTANA/IDAHO**

UNITED STATES DEPARTMENT OF THE INTERIOR-NATIONAL PARK SERVICE

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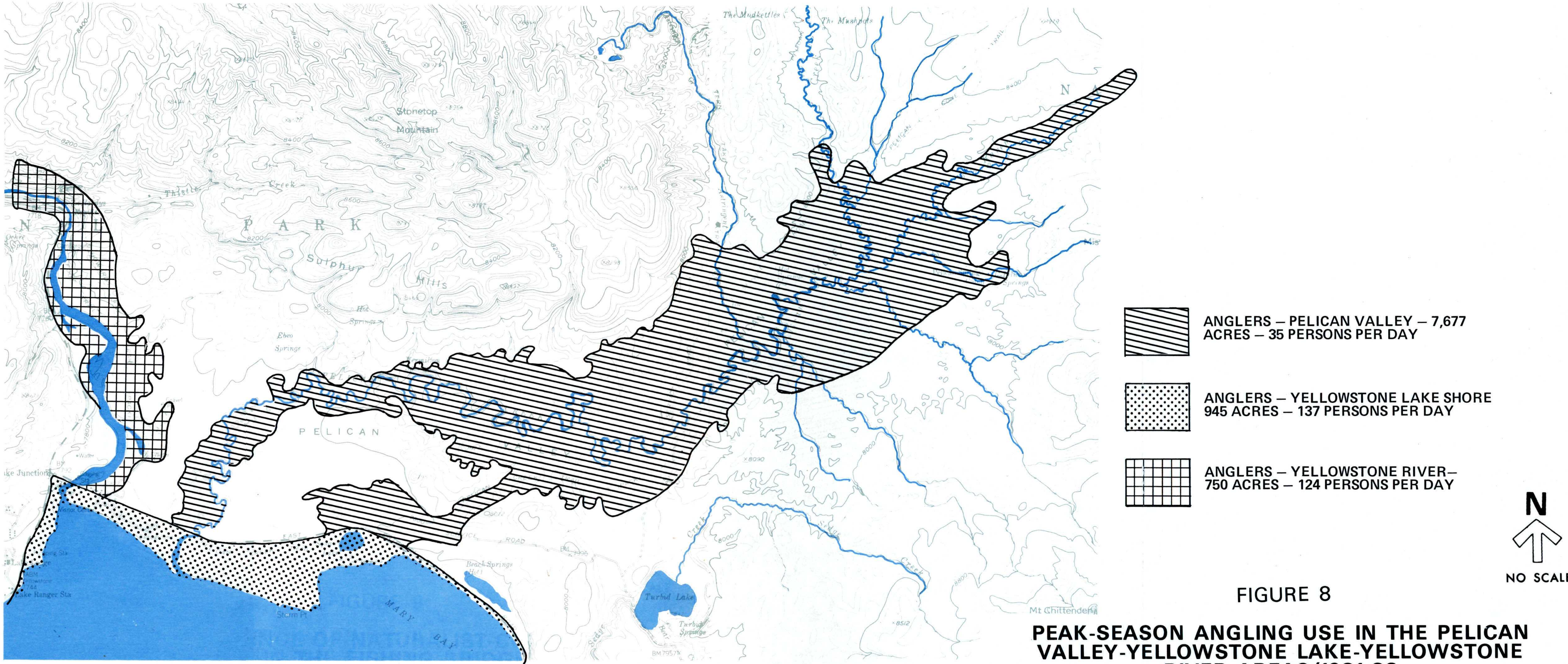


FIGURE 8

**PEAK-SEASON ANGLING USE IN THE PELICAN VALLEY-YELLOWSTONE LAKE-YELLOWSTONE RIVER AREAS/1981-83**

**YELLOWSTONE NATIONAL PARK**

**WYOMING/MONTANA/IDAHO**

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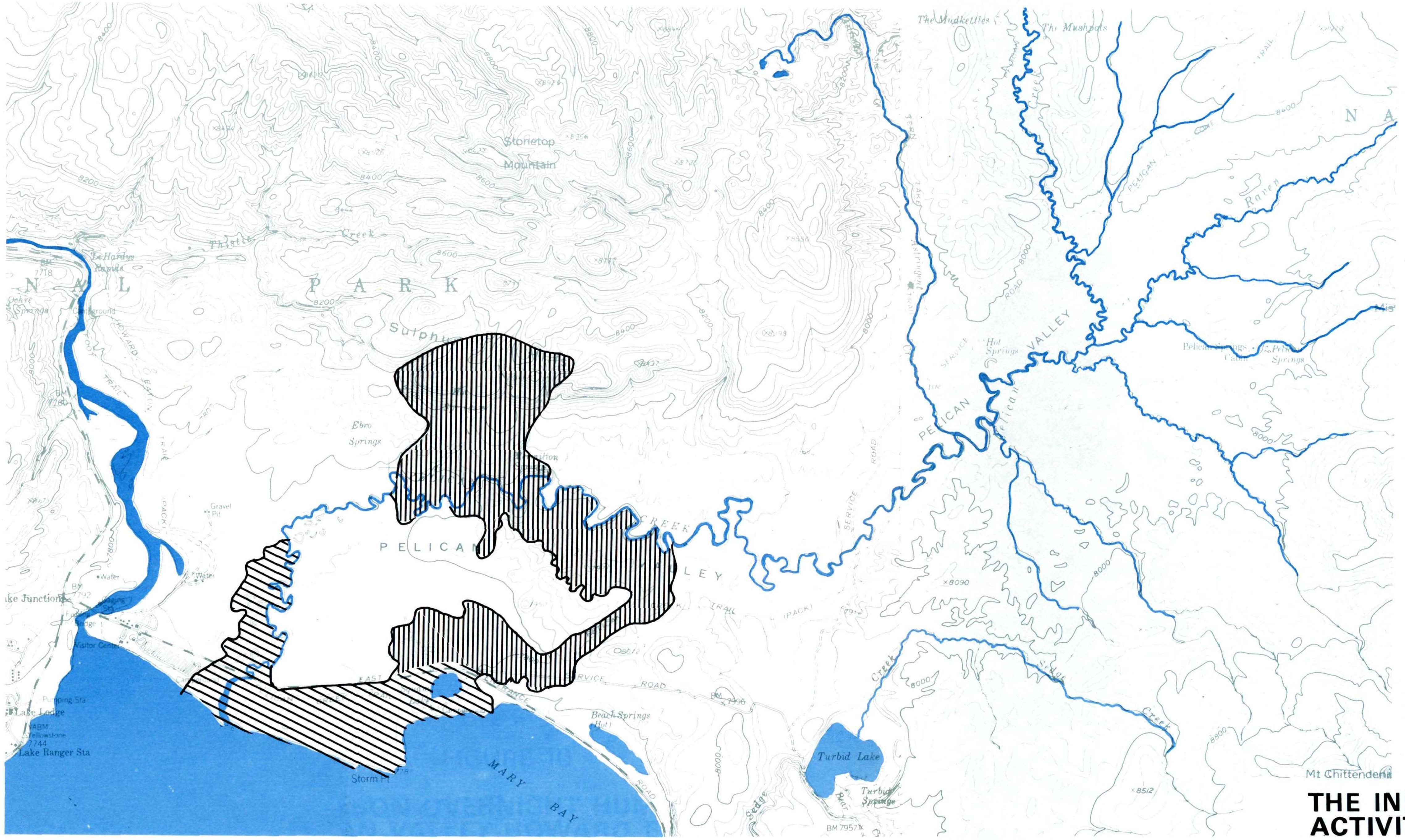


NATURALIST WALK (PELICAN VALLEY, STORM PT.) 944 ACRES — 34 PERSONS PER DAY

NATURALIST WALK (SULPHUR HILLS) 1,895 ACRES — 1 PERSON PER DAY

N

NO SCALE

FIGURE 9

## THE INFLUENCE OF NATURALIST-CONDUCTED ACTIVITIES IN THE FISHING BRIDGE-PELICAN VALLEY AREA/1981-83

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OVERNIGHT PELICAN VALLEY – 7,278 ACRES – 1,360 PERSON DAYS / 702 STOCK DAYS – 22 PERSONS PER DAY – 11 HEAD PER DAY

N

NO SCALE

FIGURE 10

## PEAK SEASON OVERNIGHT HUMAN USE IN THE PELICAN VALLEY-HOWARD EATON TRAIL AREAS/1981-83

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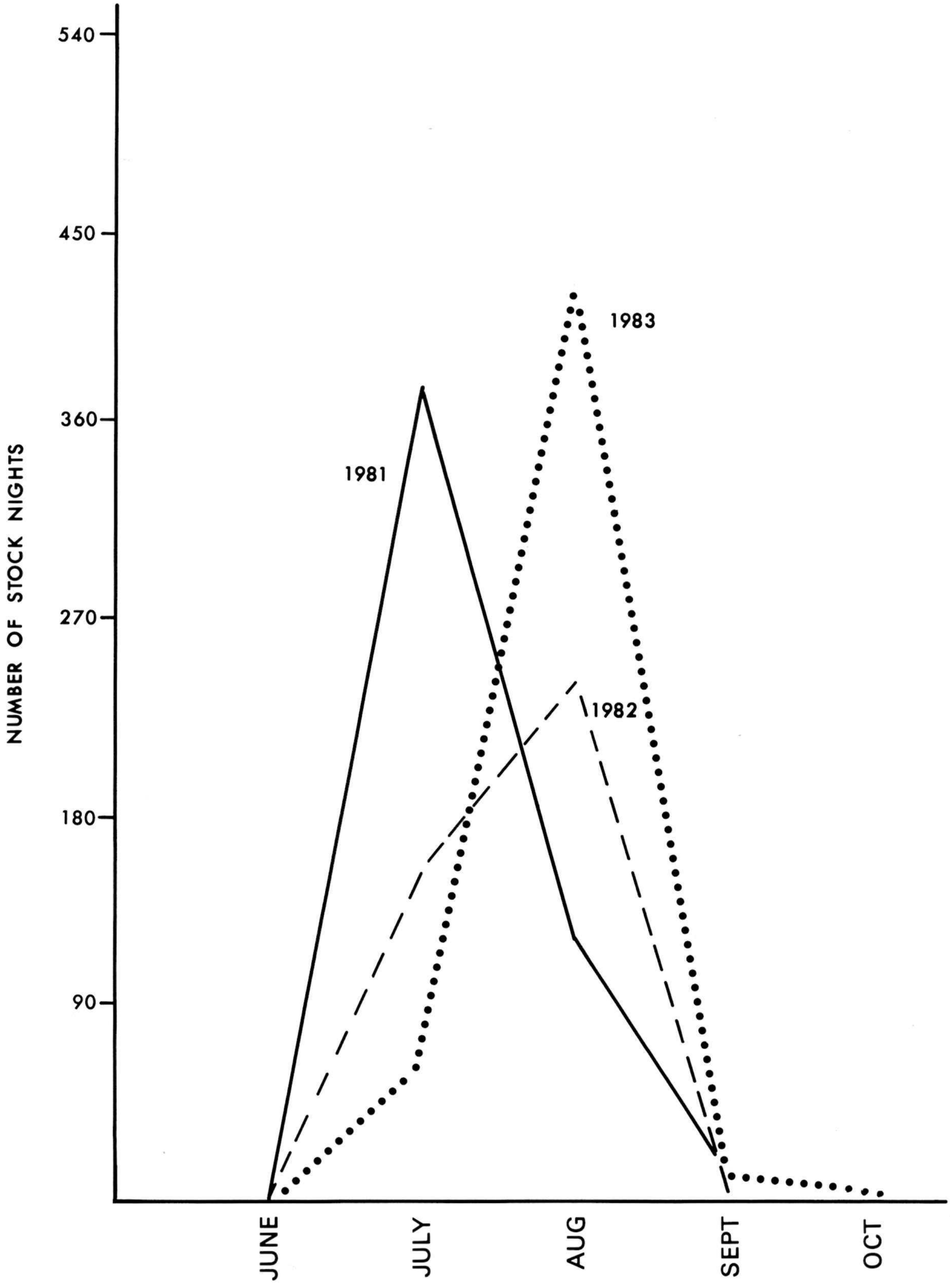


**FIGURE 11: MONTHLY PATTERN OF TOTAL STOCK NIGHTS (HORSES/MULES) IN PELICAN VALLEY 1981–83**

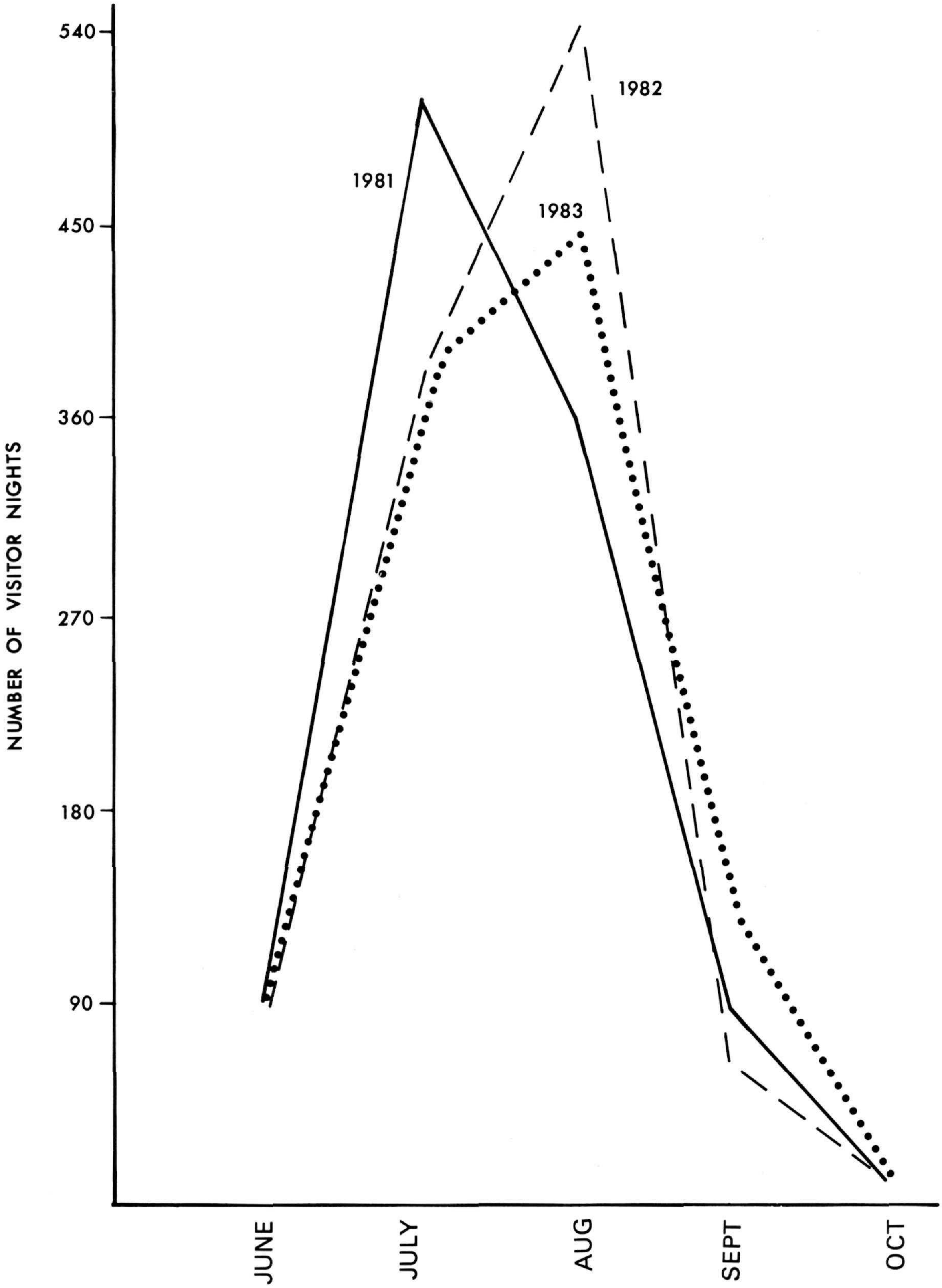


**FIGURE 12: MONTHLY PATTERN OF TOTAL VISITOR-NIGHT USE IN PELICAN VALLEY 1981–83**

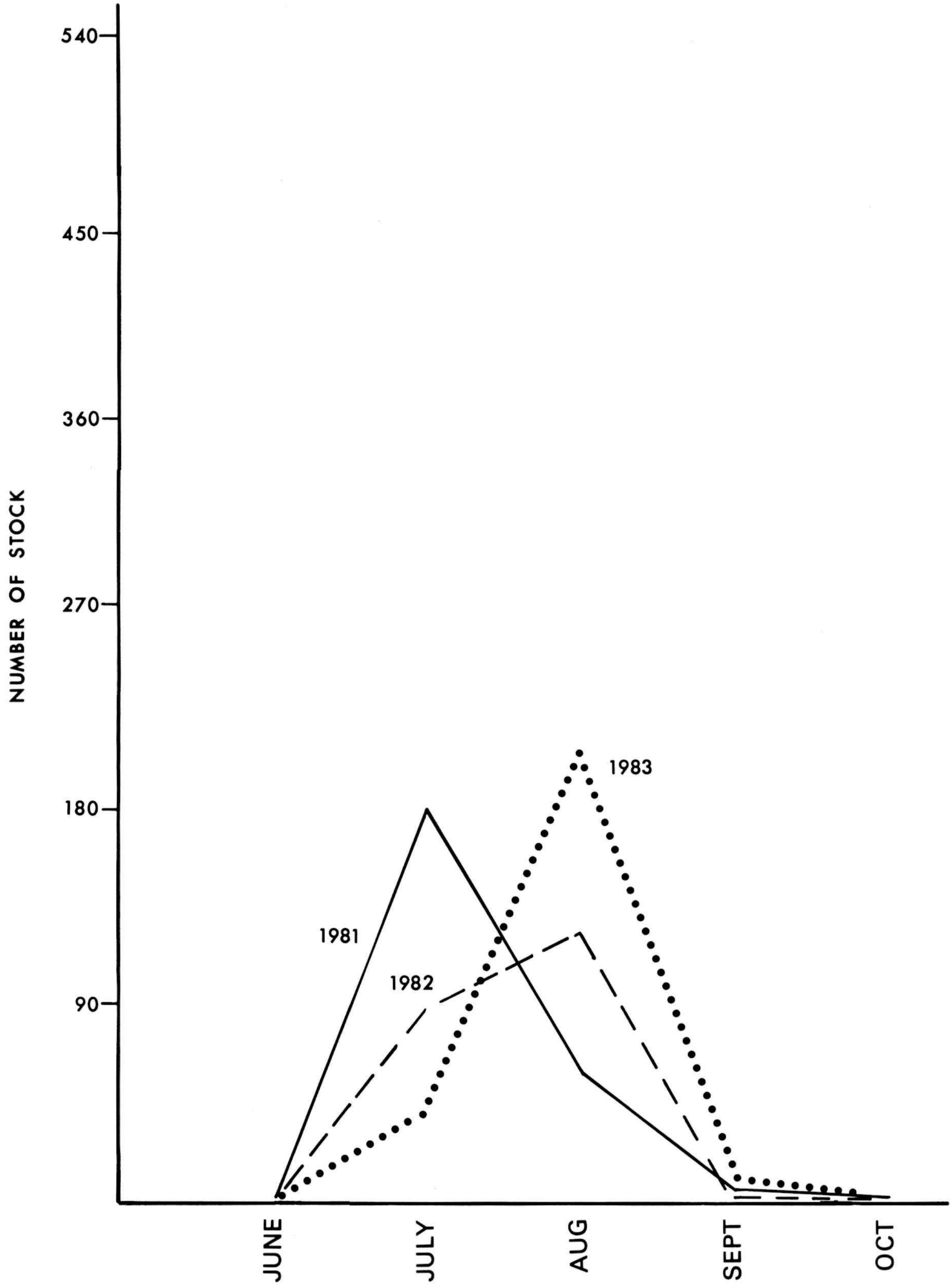


**FIGURE 13: MONTHLY PATTERN OF TOTAL STOCK (HORSES/MULES) USING PELICAN VALLEY 1981–83**

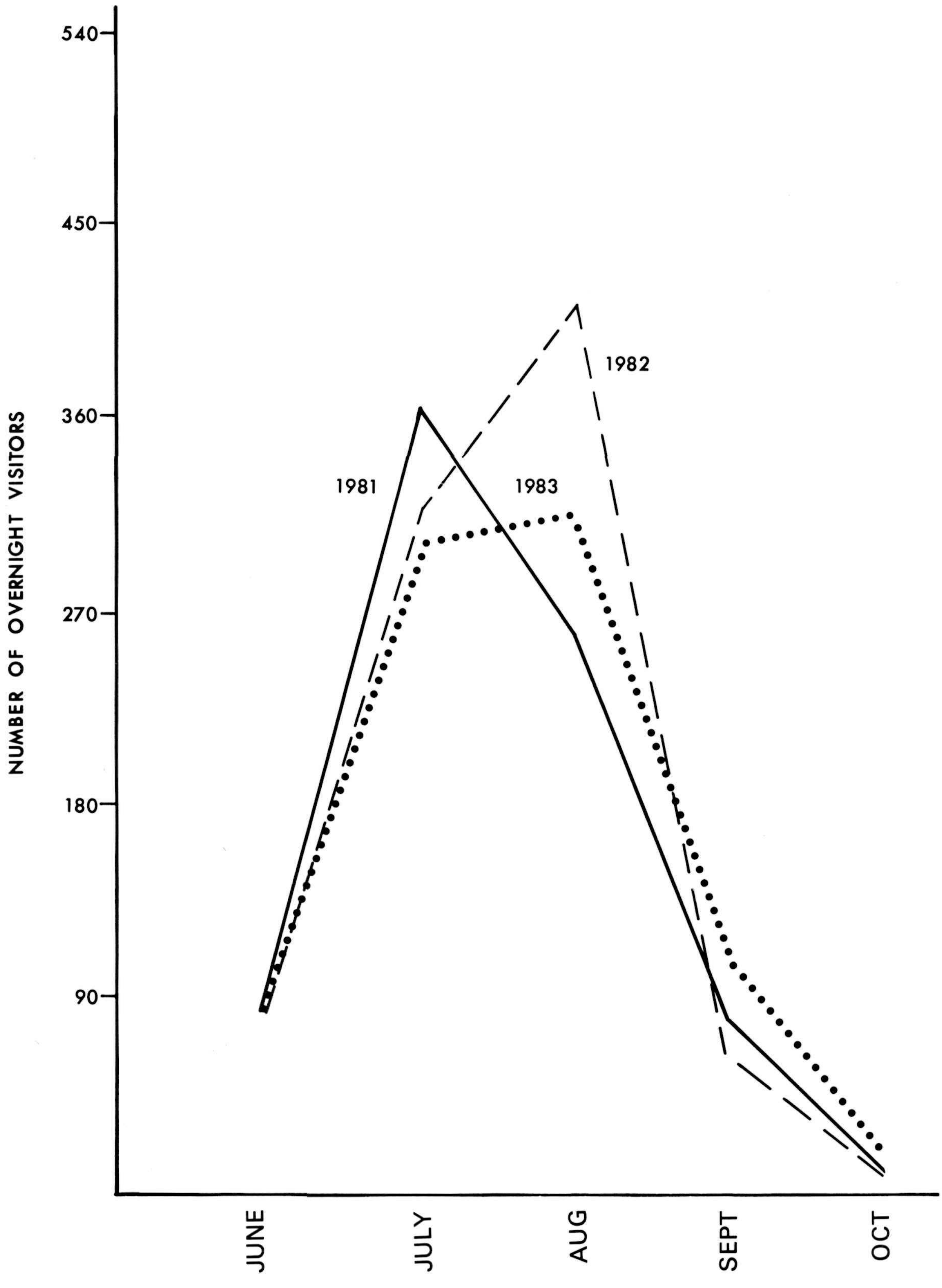


**FIGURE 14: THE MONTHLY PATTERN OF OVERNIGHT VISITORS IN PELICAN VALLEY 1981–83**

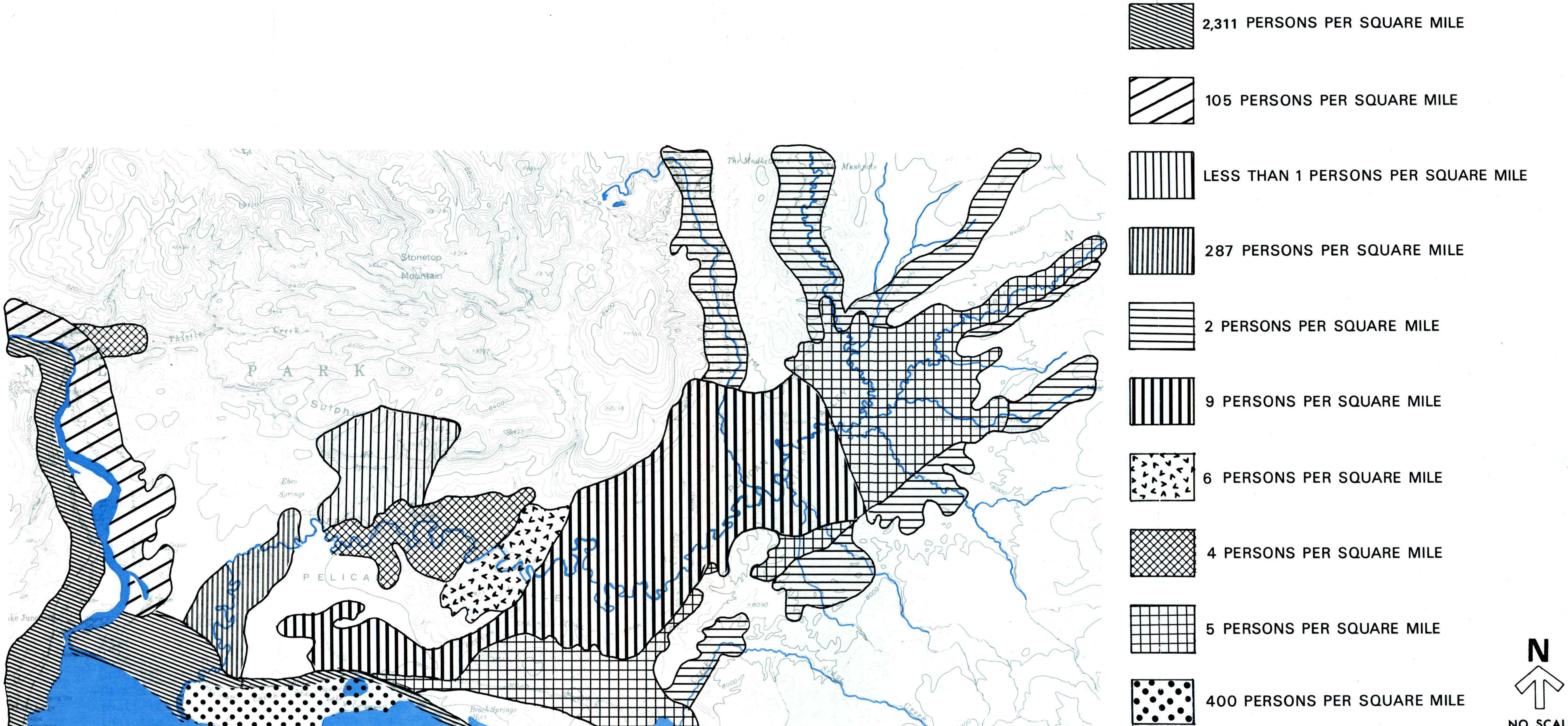


FIGURE 15

**COMPOSITE OF HUMAN DENSITY VALUES (FROM FIGURES 6-10) DURING THE PEAK SEASON IN THE FISHING BRIDGE-PELICAN VALLEY AREA/1981-83**

**YELLOWSTONE NATIONAL PARK**

**WYOMING/MONTANA/IDAHO**

UNITED STATES DEPARTMENT OF THE INTERIOR-NATIONAL PARK SERVICE

101 | 40,148A
DSC | NOV 84

and magnitude of visitor impact on the Fishing Bridge/Pelican Creek area can be appreciated. Note that the white area, at something less than one person per square mile, is the only part of the study area that approaches a truly wilderness condition.

The areas nearest the development or the road are the heaviest used. The development itself, as already noted, has a density of 2,311 persons per square mile. For purposes of comparison, densities near Fishing Bridge may be compared to densities in other parts of the country, recognizing that such comparisons are based on different types of statistical data. Washington, D.C., has a density of 12,524 persons per square mile. The difference between Washington, D.C., and Fishing Bridge in this instance may be that campers rarely establish multi-story dwellings. To put these values into context, the two most populous states in the union have an average density of 812 (Rhode Island) and 807 (New Jersey).

High densities of people would be expected in such a development, but might seem less likely in surrounding areas. However, at Fishing Bridge high densities of people are found a considerable distance from the established development. The lake shore from the outlet of Pelican Creek for several miles eastward supports more than 400 persons per square mile (similar to New York). Pelican Creek and riparian zones north of the campground support 287 persons per square mile (similar to Maryland). The Yellowstone River and its shorelines, though only accessible by trail or wading the river, support 105 persons per square mile (same as California). In fact, in most of the lower Pelican Valley, visitor density exceeds five persons per square mile, a density higher than the average population density of several western states.

It is clear from the foregoing that a development can have an influence on its surrounding region far greater than would at first be apparent. Heavy human use of Yellowstone Park is expected, and does not necessarily have a negative effect on the park's naturally functioning systems. But, in the case of Fishing Bridge, the development is indeed having negative effects on the park's ecosystem. The above presentation does not in itself prove that; it is presented here in order to establish at the outset that the area under consideration is being used intensively, and to further establish that it may be inappropriate, or at least generously optimistic, to describe any of this area as true wilderness. Current levels of use of the Fishing Bridge/Pelican Valley area are great enough that the traditional "wilderness experience" is probably not found here as often as it is in other parts of the park. Perhaps more important, the threshold of wilderness is more distant from Fishing Bridge than from other developments; thus the average visitor's opportunity to experience adjacent wilderness is diminished.

Current campsite capacity of overnight use in Pelican Valley permits a maximum of 10,168 persons in 62 days. This is 7.5 times the present level of use and allows as many as 14 persons per square mile in those areas which currently come closest to wilderness. Stock limits are set at 12,710 animals in 2 months or 18.1 times today's use. If left unchecked, it permits 18 animals per square mile.

## A Few Words on Visitor Impact on Vegetation

Relatively little work has been done in national parks to measure most forms of visitor impact on vegetation. Some types of impact, such as automobile emissions causing lead concentrations in roadside vegetation, have recently been measured (Harrison and Dyer 1984), but many more have not. We do have a working knowledge of some general impacts around a developed area.

On its grandest scale, a development requires the removal of vegetation, most noticeably trees but also any smaller vegetation that must make way for campsites or buildings.

The thinning of trees makes the remaining trees more vulnerable to blowdown, and the opening of the forest canopy may set off a chain of events resulting in a significant departure from naturally-occuring animal forms; some may be encouraged, others may be distressed.

The alteration does not stop with the establishment of the many areas where plants are no longer allowed to grow. Soil compaction and trampling in and around campsites will further alter the natural setting. Wagner (1971) documents effects of typical campground use on groundcover in and near campsites at Bridge Bay. A host of conjectures could - and probably will - be made regarding the "hospitable" effects of a development on certain wildlife forms. Does, for instance, the presence of humans attract certain animals (gray jays and ground squirrels for example), either to easy food sources or to areas where predators fear to travel?

Far less conjectural is the influence of the campground on surrounding vegetation. Campers range progressively farther and farther into the nearby terrain in search of downed wood, and frequently remove any dead branches they can reach. These removals have a whole chain of effects on surrounding settings. Soil buildup is retarded by the loss of that much organic matter. The great assortment of insect larvae that would normally be associated with deadfalls and rotting trees is not present, and is therefore not fed on by meadow mice and other animals. Fungi fed on by redback voles are likewise not present. Adult insects that inhabit down trees will not be there, nor will birds, chipmunks, or bears be able to feed upon them.

Changes of this sort are realities of any campground. In Fishing Bridge there are other changes as well. A good example occurs along the shore of Yellowstone Lake. The shoreline has, of course, long ago been scoured of driftwood, but a more subtle effect has also occurred. An entire plant community, a relatively unusual one, has been removed by visitor use of this shoreline.

Along the shore of the lake east of the outlet of Pelican Creek there exists a community of plants featuring sand verbena, some grasses, rabbit brush, and cutleaf fleabane. Though conditions are identical west of the mouth of Pelican Creek, this community is entirely absent from the area west of the mouth all the way to the outlet of Yellowstone Lake. Because it is in the path of shoreline visitor use, and because it is both low and limited to a narrow band of shoreline habitat, this community has been extirpated from the Fishing Bridge area (Despain pers. comm.).

These sorts of changes in the ecological setting are not in themselves even suggestive justifications for the removal of the development. It would seem, however, that if we regard Fishing Bridge as highly as we ought to for its unusual ecological diversity, they are changes that become more difficult to write off as a necessary evil.

# FISHING BRIDGE IN THE YELLOWSTONE ECOSYSTEM

## Introduction

As the following presentations indicate, Fishing Bridge is an exceptional if not unique area ecologically. In this particular setting Yellowstone presents to us a level of ecological diversity uncommon for this region and unparalleled for this national park. Some of the elements of this diverse setting have been only poorly measured in the past, and so the following presentation is sometimes tentative. It is, however, conclusive when viewed in terms of its total argument, regardless of any individual part of that argument.

We can acknowledge that the enlightened ecologist does not make value judgments about an ecosystem merely in terms of its diversity; a perceptive ecologist does not necessarily consider a complex rain forest ecosystem on the upper Amazon somehow "better" than an arctic tundra ecosystem simply because the former has more total life varieties. Yet under the principles of the National Park Service Act and the Biosphere Reserve concept, ecological diversity is to be preserved in Yellowstone, and from that we can certainly assume that the most ecologically diverse portions of the park are worth special efforts at preservation. At least a part of the justification for protecting national parks is because they are, after all, unusual in some ways.

The foundation for this case is vegetation. As will be shown, the Fishing Bridge area is exceptional in its diversity in terms of vegetation. Its vegetative diversity is by no means unique, or the most diverse area in the park, but it is by that basic measurement considerably more diverse than any other developed area. In fact, among the random areas around the park with which it was compared, it ranked in the top quarter of them all, and was alone among that 25 percent in having a development in it.

But vegetation and habitat types are not fully indicative of an area's true ecological diversity. By considering the Fishing Bridge area in terms of other elements of the ecological setting we find that it can be ranked even higher than its vegetation diversity would seem to suggest. Considerations of a variety of wildlife use of the area enhance and broaden our appreciation for the area's true significance as an ecological "crown jewel" in Yellowstone.

Fishing Bridge is important to the park in more urgent ways than as an exceptionally diverse setting. It is of extreme importance to grizzly bears. Following the review of ecological diversity at Fishing Bridge is an evaluation of the effects that development

has had and is having on grizzly bears, and an examination of the area's importance to grizzly bears as habitat.

It must be pointed out that the large quantitites of data that have gone into this report were not originally gathered for this purpose. The report has been put together based on data from a variety of studies with differently-shaped study areas. Some involved only the immediate vicinity of Fishing Bridge, and some involved much larger areas, even the entire Yellowstone Ecosystem. Preparing this report was a useful exercise for park staff because it revealed the untapped informational resource and the flexibility of its worth to park management, and suggested previously unexplored avenues of evaluation of park resources.

In fact, the array of perspectives that were adapted for this report permit an unusually comprehensive examination of Fishing Bridge, an examination more meaningful than a narrower one based on a single specific study design. It can only help that there are so many different ways to measure the ecological worth of an area; if they are redundant to some extent they are also reinforcing of one another. It is certainly necessary to be able to examine more than the Fishing Bridge development itself to truly appreciate its value to the park. For example, it is impossible to adequately consider either the importance of Fishing Bridge to grizzly bears or the impact of visitors on the Fishing Bridge area without also considering the Pelican Valley; the Fishing Bridge peninsula and the Pelican Valley are inextricably linked ecologically as well as topographically. For another example, no part of the park can be fully evaluated without placing it in relative context with the rest of the park. For reasons such as these, an effort has been made to approach the evaluation of Fishing Bridge from as many directions as possible.

First, then, the ecological diversity of the Fishing Bridge area will be considered. Then the grizzly bear will be discussed.

## Ecological Diversity and the Fishing Bridge Area

### ECOLOGICAL DIVERSITY AND VEGETATION ANALYSIS: FISHING BRIDGE AND THE PARK

In order to evaluate the diversity of the Fishing Bridge area in relation to the rest of the park, the diversity of vegetation for the area must be established. Vegetation may be seen as the foundation for other elements of ecological diversity near Fishing Bridge.

To assess the diversity of the Fishing Bridge area, a rectangle was delimited around the area that was judged to be influenced by the Fishing Bridge development. This rectangle is highlighted in Figure 16. It includes the lower portion of the Pelican Creek

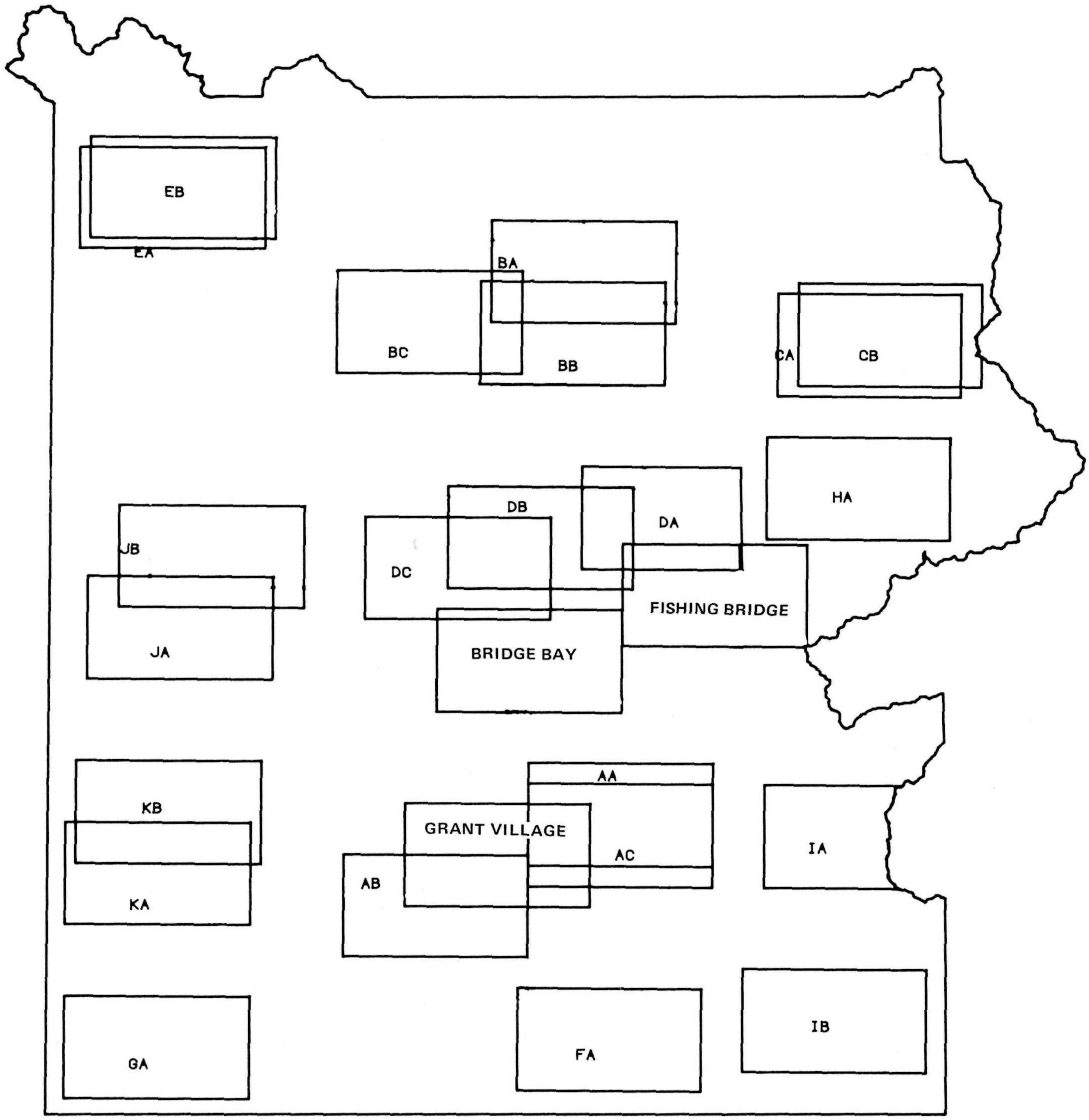


FIGURE 16: TWENTY-TWO RANDOMLY SELECTED COMPARISONS AREAS WITH SELECTED AREAS DELINIATED FOR FISHING BRIDGE, GRANT VILLAGE, AND BRIDGE BAY

drainage. For comparison purposes, 22 identically-sized rectangles, or comparison areas, were placed at random around Yellowstone Park, as shown in Figure 16.

Evaluation proceeded by deriving from digitized vegetation data the diversity of each comparison area. Diversity was measured in two ways.

The first way was a simple count of the number of vegetation types in each area. Table 2 presents this information, with notes that explain the method used to derive the number of types. It can be seen that Fishing Bridge, with 48 vegetation types, is above the average but is not exceptionally high by this measurement. Another measure of diversity is reflected in the following, more sophisticated index.

The second way to measure the diversity considers not only the total number of vegetation types but gives added weight to smaller vegetation types. The mere presence of a certain number of vegetation types is not in itself sufficiently revealing of ecological diversity. It is also necessary to know how those types are dispersed in terms of size and distribution. For example, is each vegetation type represented by only one large unit of that type or by dozens of small units or, is most of the area covered by one type, and the other types confined to a small part of the area? How are the units arranged in relation to one another? These are significant factors in determining ecological diversity because for many forms of wildlife a mosaic of many smaller vegetation units, well intermixed, is more useful and productive than a few large units, even if there is the same total number of vegetation types in both cases. As will be pointed out later, the grizzly bear is an example of an animal whose welfare depends in part upon such factors; it thrives in a mosiac with a high "edge density", that is, an area with numerous borders between relatively small units of each vegetation type.

A graphic illustration of the significance and appearance of these mosaics is provided by Figures 17 through 21. The Fishing Bridge comparison area has a noticeably richer intermixture.

For convenience sake, and because maps that showed all vegetation types would become difficult to read, Figures 17 - 21 show only habitat types, not vegetation types. Even on this simpler level they serve the purpose of illustrating the mosaic effect referred to above. (For a definition of these terms see Appendix A.)

Figure 17 is a comparison area of low diversity on the Madison Plateau. Most habitat types present are represented by large units, and "edge density" is correspondingly low. Figure 17 is one of the least diverse of the 22 comparison areas.

Figure 18 is an area of average habitat diversity, from the mean of the 22 comparison areas. It is in the Gallatin Range.

Table 2. Number of vegetation types in 22 randomly chosen comparison areas and selected developed areas.

| Comparison area | Number of types | Fishing Bridge | Grant Village | Bridge Bay |
|---|---|---|---|---|
| KB | 19 | | | |
| KA (Madison Plateau, Fig. 17) | 23 | | | |
| DC | 23 | | | |
| | | | | 25 (Fig. 21) |
| AA | 27 | | | |
| JA | 28 | | | |
| | | | 28 (Fig. 20) | |
| DB | 29 | | | |
| AC | 30 | | | |
| DA | 36 | | | |
| GA | 37 | | | |
| AB | 42 | | | |
| IB | 45 | | | |
| EB (Gallatin Range Fig. 18) | 46 | | | |
| JB | 47 | | | |
| | | 48 (Fig. 19) | | |
| IA | 49 | | | |
| FA | 51 | | | |
| EA | 51 | | | |
| BC | 56 | | | |
| BA | 57 | | | |
| BB | 60 | | | |
| CA | 60 | | | |
| CB | 63 | | | |
| HA | 81 | | | |

Notes on Methods: Vegetation diversity is considered here in terms of vegetation types. Vegetation type is actually a combination of two elements, habitat type and cover type. Appendix A summarizes the various habitat types and cover types identified for Yellowstone Park. Each vegetation type in an area is defined in terms of its habitat type and cover type. Habitat type is a reflection of site conditions as indicated by species present in the potential or climax plant community. Cover type is a measure of the current successional stage as indicated by the overstory species present. By considering both habitat type and cover type, a full picture of the site is obtained that reflects both the environment of the site and the dynamics of the plant life.

Several examples of this method applied to the comparison areas are presented in Appendix B.

- Subalpine fir/grouse whortleberry — grouse whortleberry phase
- Wet forests
- Sedge meadows and marshes
- Water
- Silver sagebrush/Idaho fescue
- Subalpine fir/golbe huckleberry
- Subalpine fir/elksedge
- Lodgepole pine/elksedge
- Mosaic of wet forests and subalpine fir/globe huckleberry
- Subalpine fir/pinegrass
- Talus and rockslides
- Tufted hairgrass/sedge
- Douglas-fir/pinegrass
- Subalpine fir/meadowrue
- Idaho fescue/bearded wheatgrass
- Subalpine fir/grouse whortleberry — whitebark pine phase
- Subalpine fir/twinflower — grouse whortleberry phase
- Big sage brush/Idaho fescue — sticky geranium phase
- Willow/sedge
- Idaho fescue/tufted hairgrass
- Mosaic of tufted hairgrass/sedge and sedge meadows and marshes
- Alpine tundra
- Idaho fescue/bearded wheatgrass
- Subalpine fir/ross' sedge
- White bark pine/grouse whortleberry
- Big sagebrush/Idaho fescue
- Subalpine fir/grouse whortleberry — pinegrass phase
- Mosaic of subalpine fir/grouse whortleberry — grouse whortleberry phase and wet forests
- White bark pine/elksedge

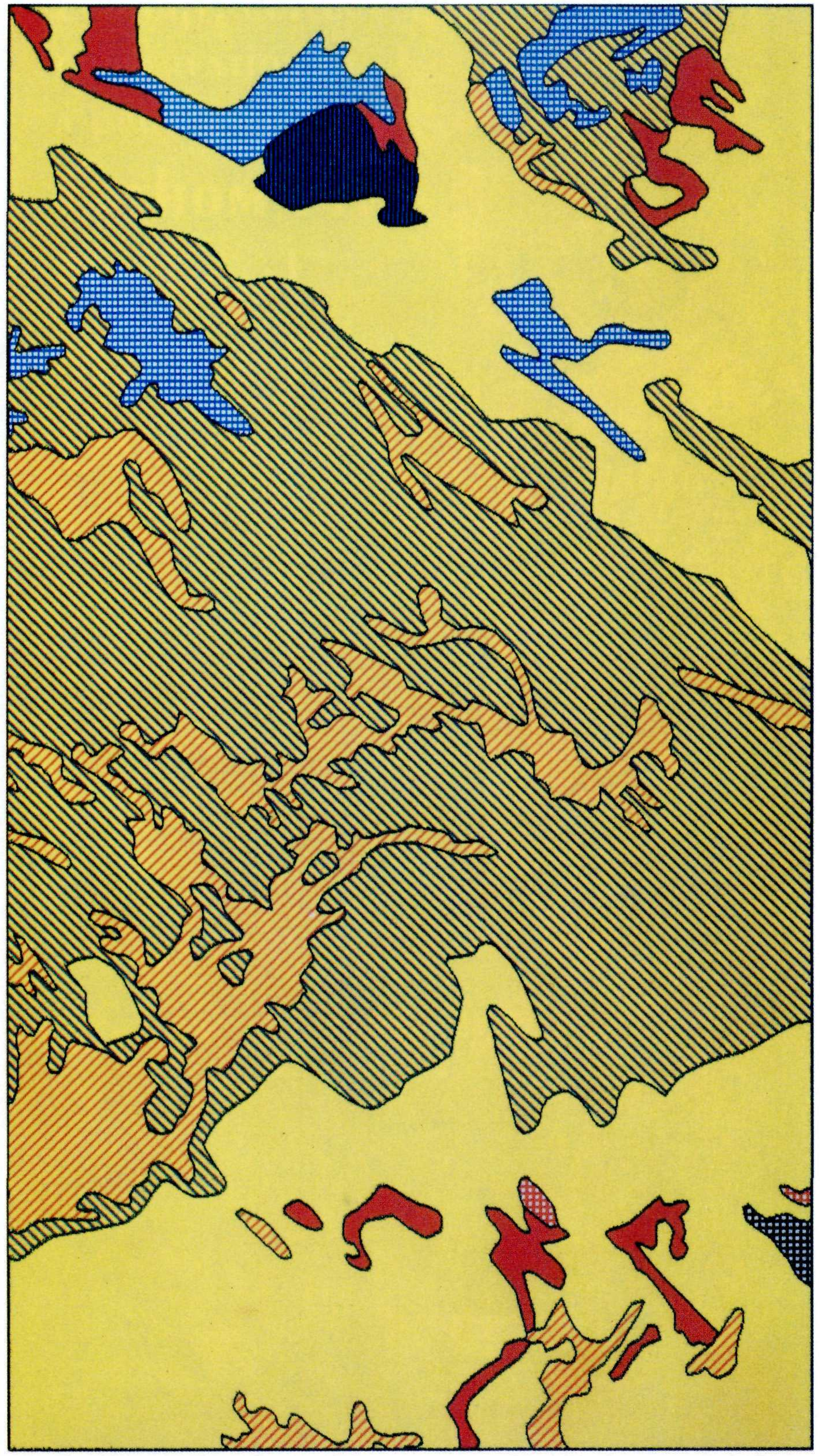

FIGURE 17: HABITAT TYPES OF COMPAS COMPARISON AREA KA ON THE MADISON PLATEAU

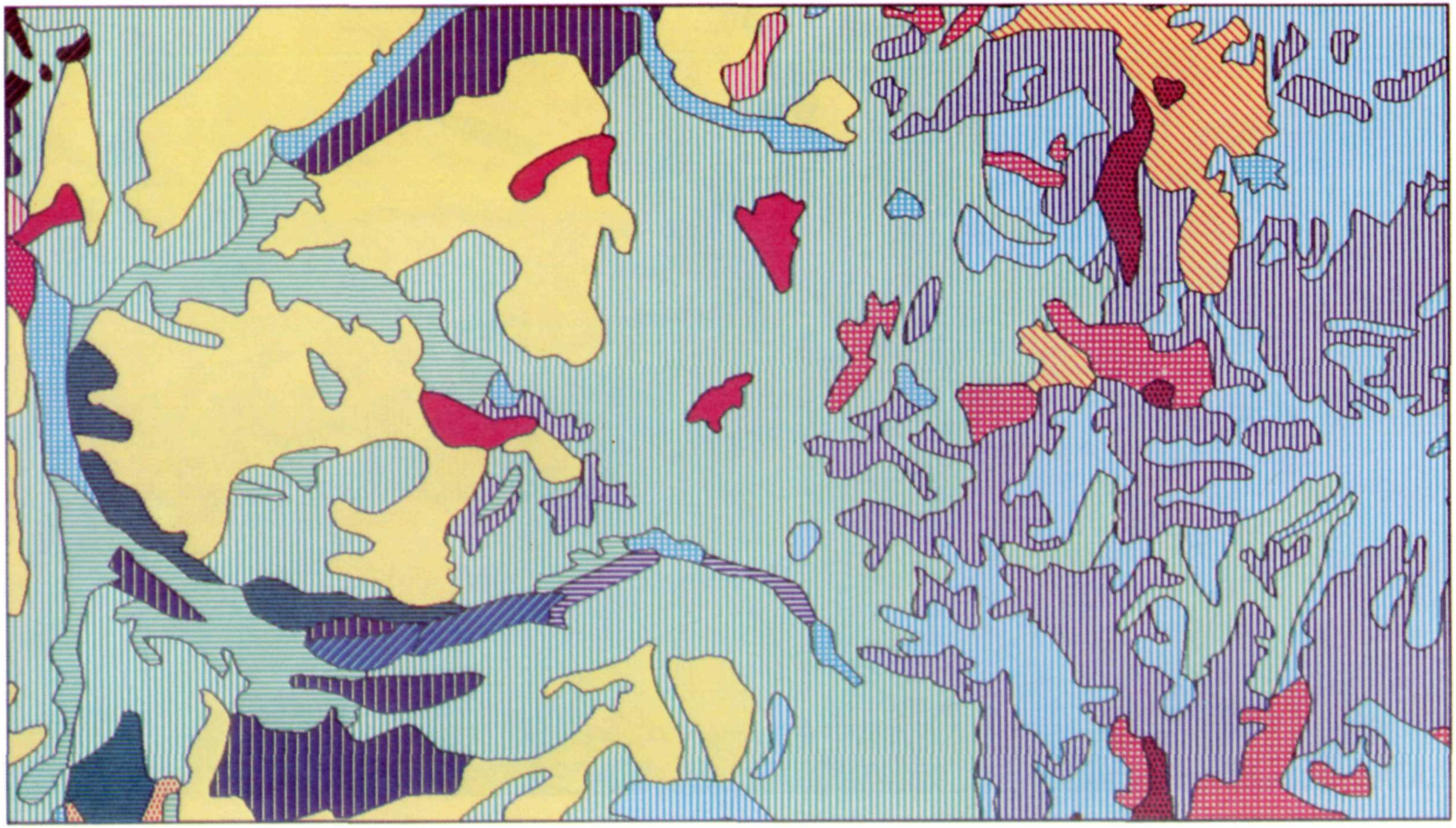

**FIGURE 18: HABITAT TYPES OF COMPARISON AREA EB IN THE GALLITIN MOUNTAIN RANGE**

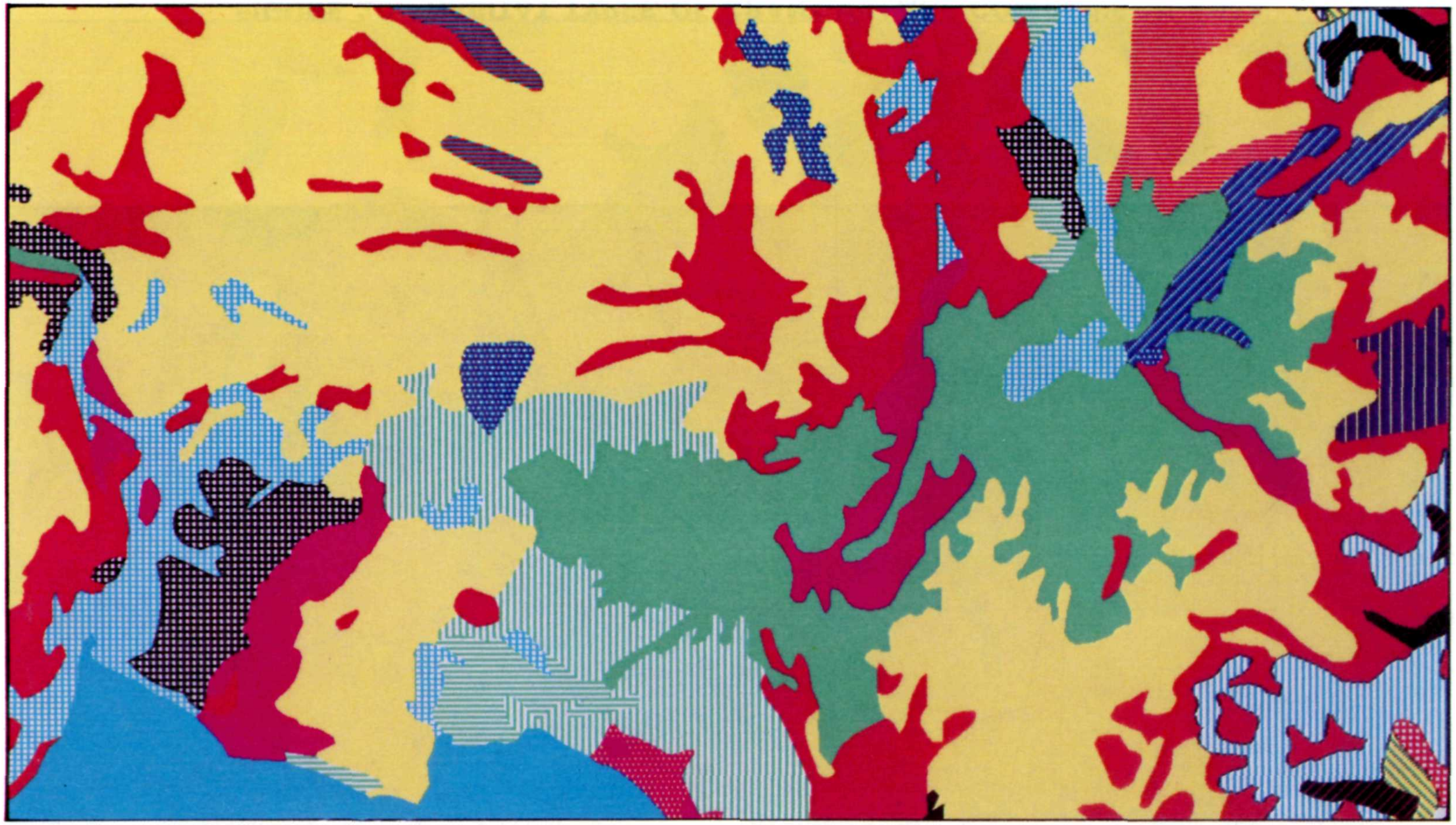

**FIGURE 19: HABITAT TYPES OF THE FISHING BRIDGE COMPARISON AREA**

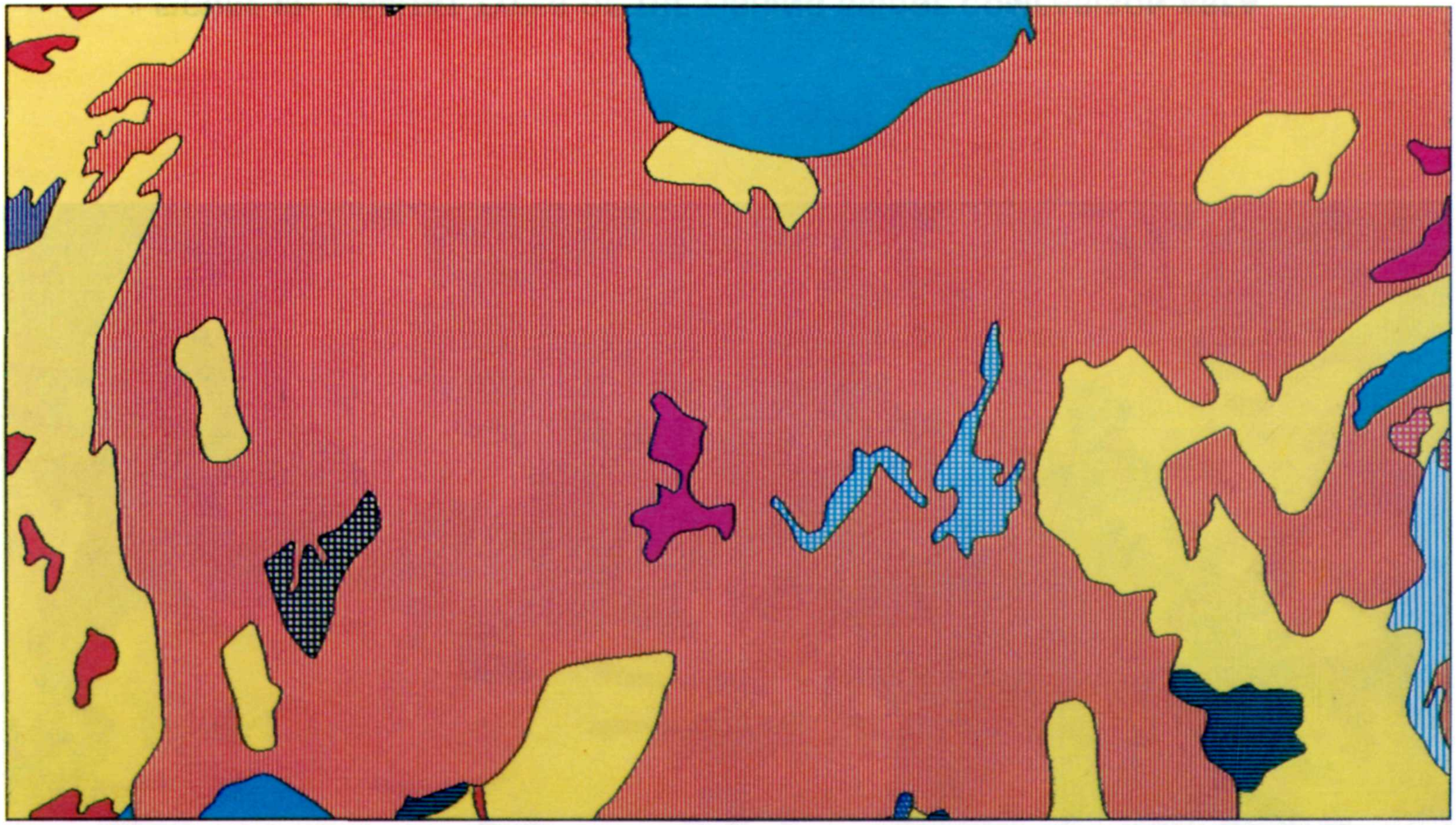

**FIGURE 20: HABITAT TYPES OF GRANT VILLAGE COMPARISON AREA**

**FIGURE 21: HABITAT TYPES OF BRIDGE BAY COMPARISON AREA**

Figure 19 is the Fishing Bridge comparison area. Note especially the number of smaller habitat type units and the frequent areas of high dispersal of one type within another.

Figure 20 is Grant Village. Figure 21 is Bridge Bay. Both are noticeably low in diversity compared to Fishing Bridge. It is this quality of dispersal and related intermixture of vegetation that must be considered in accurately measuring the diversity of an area.

To measure this quality, then, each vegetation type within a comparison area is singled out and its acreage determined from the digitized vegetation data. That acreage is then divided by the total acreage of the comparison area (all comparison areas are identical in size: 44,431 acres each) to determine what percentage of the total area of the comparison area is occupied by that vegetation type. In order to give added value to those comparison areas having the most even distribution of types, that percentage is then multiplied by its natural log, according to a formula known as the Shannon-Weiner Index of Diversity (Shannon and Weaver 1949). This procedure is followed for every vegetation type in the comparison area, and the resulting numbers are simply added together. Their total is a numerical "grade" for the area's diversity; the higher the grade, the higher the diversity. The grade is formally called the diversity index. It is a more comprehensive measurement of ecological diversity than a simple total of vegetation types.

The diversity indices for all 22 comparison areas and selected developed areas are presented in Table 3. It will be noted that according to this table Fishing Bridge ranks quite high; in the top 25 percent. This is a significant deviation from the mean for this group of values, the mean being 2.719.

It is a significant measurement for other reasons as well. First, it places the Fishing Bridge comparison area in a small group of ecologically diverse comparison areas, all of which are quite different from it topographically. Figure 16 shows the location of these most diverse comparison areas. All are associated with the Absarokas, and all of them except Fishing Bridge are without major developments.

It is significant as well as a foundation for further examination of Fishing Bridge's diversity, for it is a measure of only vegetation diversity. As will be shown in the following discussions, other aspects of the Fishing Bridge setting enable it to surpass in overall ecological diversity the areas that are rated above it in Table 3.

Table 3. Diversity indices of 22 random comparison areas and selected developed areas.

| Comparison area | Diversity index | Fishing Bridge | Grant Village | Bridge Bay |
|---|---|---|---|---|
| KB | 1.944 | | | |
| | | | 2.179 (Fig. 20) | 2.196 (Fig. 21) |
| KA (Madison Plateau, Fig. 17) | 2.038 | | | |
| AC | 2.278 | | | |
| AA | 2.289 | | | |
| JA | 2.335 | | | |
| DB | 2.466 | | | |
| DC | 2.468 | | | |
| AB | 2.515 | | | |
| DA | 2.635 | | | |
| JB | 2.646 | | | |
| BC | 2.718 | | | |
| EB (Gallatin Range, Fig. 18) | 2.884 | | | |
| BA | 2.905 | | | |
| IB | 2.909 | | | |
| GA | 2.915 | | | |
| EA | 2.949 | | | |
| FA | 3.023 | | | |
| | | 3.05 (Fig. 19) | | |
| BB | 3.104 | | | |
| IA | 3.111 | | | |
| CA | 3.180 | | | |
| CB | 3.122 | | | |
| HA | 3.388 | | | |

## AQUATIC RESOURCES OF THE FISHING BRIDGE AREA AND THEIR INFLUENCE ON DIVERSITY

As suggested earlier, a study of vegetation does not fully indicate ecological diversity in the Fishing Bridge area. The foremost element that is neglected by a study of vegetation is the aquatic resource.

It is worth pointing out that the aquatic resource of the Fishing Bridge area has values beyond its ecological significance. It may be said to have actual cultural values (beyond those normally associated with a national park) because to our knowledge the outlet of Yellowstone Lake is rare among large lakes in the lower 48 states in not having a dam across it. It is a rare natural lake outlet, but as we will see, even that naturalness has been affected by the Fishing Bridge development.

The aquatic resource of the Fishing Bridge area sets that area apart from the other high-diversity comparison areas in Figure 16. Because of the aquatic resource, the Fishing Bridge area has an ecological diversity and richness that those other comparison areas cannot approach, especially in terms of animal life.

The aquatic resources of the Fishing Bridge area (as defined by the comparison area in Figure 16) comprise an exceptional if not unique element in Yellowstone Park's wilderness setting. This statement is all the more meaningful when we consider just how rich Yellowstone's other aquatic resources are. The Fishing Bridge development is situated along the north shore of Yellowstone Lake between the lake's outlet (the Yellowstone River) and its second largest tributary (Pelican Creek). This is a veritable crossroads of aquatic ecosystems and energy flows, unparalleled for its influence on surrounding terrestrial ecosystems.

The most obvious and celebrated life form in this aquatic setting is the fish. Inasmuch as fish have been more thoroughly studied than other elements of the aquatic resource, fish serve readily as an indicator of the area's significance as well as of our impact on that significance.

The Fishing Bridge development is located near two of the most critical spawning areas for fish of Yellowstone Lake and the Yellowstone River. On the basis of snorkeling studies done in 1982 (Jones et al. 1983), it appears that the area from 0.1 miles upstream of the bridge to about 0.5 miles downstream from the bridge has the largest concentration of spawning gravel between the lake and the Upper Falls, and perhaps the largest in the entire park. Very few cutthroat trout ascend tributaries of the river between the lake and the Upper Falls for spawning purposes, so that the 18 acres of river bottom near the bridge appear to be the primary spawning site for the Yellowstone River trout above

Hayden Valley (Jones et al. 1983). Although only about 20 percent of the available habitat is probably utilized (Lentsch unpub. data), spawning bed location must be considered in any attempt to estimate level of spawning activity. Considering an area of 8.25 square feet per redd (Lentsch unpub. data), approximately 30,000 females or from 50,000 to 75,000 total spawners annually congregate in the Fishing Bridge area near the bridge. Tagged river fish have been noted moving to the bridge to spawn from as far away as LeHardy Rapids (Ball and Cope 1961). Trout from Yellowstone Lake likewise move to the vicinity of the bridge to spawn. Though relatively little is known about the numbers of these fish, it has been reported that they precede the river fish into the area. Longnose suckers from Yellowstone Lake also use the spawning area around the bridge.

Pelican Creek, the largest tributary of Yellowstone Lake except for the Yellowstone River itself, drains about 38,000 acres to the east and north of Fishing Bridge (Ball and Cope 1961). The Pelican Creek network includes about 100 miles of flowing water (Figure 22). The mean number of spawning fish using this stream system from 1980-1983 was 23,991 (Jones et al. 1984).

Of course, fish are only an unusually visible and publicly appealing part of the aquatic ecosystems in the Fishing Bridge area. These waters, from the flowing streams to the quiet sedge marshes to independent bodies of water such as Squaw Lake, host a variety of smaller vertebrates and invertebrates, as well as supporting an impressive variety of birds and mammals. As with the vegetation, one must consider the aquatic resource on two levels: 1) its own internal robustness and diversity, and 2) its influences on other life forms in the area. As we will see momentarily, the influence of the aquatic ecosystem on the rest of the area is formidable, but first it is useful to summarize some human impacts on the aquatic resource at present.

DEVELOPMENT IMPACTS ON THE AQUATIC RESOURCES

The Fishing Bridge developed area has influenced the neighboring aquatic settings in many ways, some quite subtle and still not widely appreciated. Perhaps the most instructive as an example of unanticipated long-term effects of development involves the bridge itself.

The present bridge was completed in 1937. Since that time its pilings have had a measurable effect on the river downstream because they act to break up ice as it leaves the lake. Prior to the construction of a bridge at the lake outlet, ice-out provided an uninhibited scouring, by large pieces of ice, of the river bottom. The bridge pilings reduce the size of the ice chunks and slow and curl the flow. This reduces the extent of the flushing, which has resulted in a buildup of sediment downstream from the bridge (Skinner 1977). An increase in sedimentation has significant impact on the natural setting.

For example, the island downstream from the bridge was barren of tree life until 1937; it is now forested by trees dated to 1938.

Another example: known uplift of the Yellowstone caldera dome near the outlet of the lake is gradually "tilting" the basin and causing the lake to fill more deeply (Pelton and Smith 1979; Pelton and Smith 1982). Sedimentation, by causing the outlet channel to "shallow up", is probably compounding this geological process. The result is that as the dome continues to rise the lake will become deeper, eventually inundating lowlands such as the Molly Islands. Sedimentation is accelerating this event.

The most immediate example, and possibly the most compelling from the standpoint of visitor use of the park, is the well-known adverse effects of siltation on trout spawning success (Stuehrenberg 1975; Platts, Megahan and Minshall 1983; Cordone and Kelly 1961; Koski 1972). Here is one of the finest cutthroat trout spawning areas in North America, and the bridge is causing it to silt in.

It is also noteworthy that the present pilings are given a life expectancy of no more than 50 years (T. Hudson pers. comm.), an age they are quickly approaching. The need for major renovation may provide an opportunity for improvement of a sort that would correct past damages. A simple one-span bridge would permit the river to clean itself out and restore the normal scouring processes. It would also solve the problems of ice jams that occasionally form upstream of the bridge and require removal with dynamite.

ANGLING IMPACTS ON THE AQUATIC RESOURCE

The disastrous effects of overfishing on the trout populations of Yellowstone Lake and the Yellowstone River have been documented in detail elsewhere (Varley and Schullery 1983), but may be summarized here.

Until 1921 the daily limit of fish was 20; that year it became 10. In 1949 it was reduced to 5. In 1953 it was revised so that 5 fish could still be taken but no more than 10 pounds plus 1 fish, with a minimum size limit of 6 inches. In 1973 fishing in the area of the bridge was prohibited.

Since then fish populations have steadily become more robust, though they do not yet approach the nearly incredible status reported by many early anglers. It is a measure of how far the populations must yet go to recover - and of how far they fell - that in 1908 a writer in <u>Outing</u> reported catching 50 fish in an hour, but by 1964 it took an average of 7 hours and 40 minutes to catch a single fish from the bridge.

The distribution of angler use near Fishing Bridge was summarized earlier in this report. The north shore of Yellowstone Lake, from

Elk Point to Sand Point, currently sustains about 60 percent of the total angler use (150,000 days) on Yellowstone Lake, or almost 68 percent of the shoreline angler use (approximately 85,000 angler days). The immediate area around Fishing Bridge (18,000 angler days) accounts for approximately 20 percent of the shoreline use and about 12 percent of the total lake angler use. Because campers in the Fishing Bridge development are also the primary users of the shoreline fishery between Pelican Creek and Elk Point, combining use estimates for that shoreline fishery with those from the Fishing Bridge development area may provide the clearest picture of the impact of the campground on levels of human use along the lake. The combination of the use near the bridge with the shoreline use between Pelican Creek and Elk Point suggests that approximately 25 percent of the total shoreline fishing use of Yellowstone Lake may be associated with the Fishing Bridge development. This is an extreme disproportion of use concentrated in a relatively small area of the lake and its shoreline.

Thus it may be suggested that, considering that the northern portion of the lake has been historically the most overfished, modern restrictive regulation on both lake and river are not yet providing those fish populations with sufficient protection to permit them to recover to healthier conditions.

Though there are no historical estimates available of angler use on Pelican Creek, Volunteer Angler Reports indicate that approximately 2,200 angler days are spent annually on that creek (average since 1973). This stream has been classified as catch-and-release since 1973, and so angler impact on resident fish populations is probably slight. It is less easy to measure the effects of this human use of the area on other wildlife, especially bears, which will be considered briefly next.

POTENTIAL USE OF PELICAN CREEK SPAWNING RUNS BY GRIZZLY BEARS

There is ample reason to wonder in what ways current levels of visitor use of the Fishing Bridge area is affecting grizzly bear use of spawning streams in the Pelican Creek drainage. There is considerable evidence that under pristine conditions grizzly bears would be using this resource more heavily than they currently do.

The Pelican Creek system contains about 100 miles of flowing water, much of which is known to be used by spawning fish (Jones et al. 1981; Cope 1957). Cope reported that spawning occurred in the upper portions of the stream beginning about 3.5 miles above Astringent Creek. Inasmuch as most of the stream segments used for spawning in the Pelican Creek drainage are smaller and shallower than the lower portion of the mainstem, fish in these areas represent a potential seasonal food source for grizzly bears. According to an unpublished 1953 map by Ball and Rich, it can be estimated that almost 70 miles of spawning habitat in the

Pelican Creek drainage is of a character that will permit grizzly bears to capture trout (Figure 22).

Studies of grizzly bear feeding habits elsewhere around Yellowstone Lake indicate that the bears are quick to take advantage of spawning trout. Mealey (1975) reported that trout are one of the two most important foods for lake-area grizzly bears (Table 4). Yet studies of grizzly bear feeding habits in the Pelican Creek area do not suggest significant use of spawning fish there. Considering the apparent potential of Pelican Creek for providing fish to bears, it is worth further study to understand why that use seems not to occur.

As documented earlier in this report, visitor use of the Pelican Valley is quite heavy for much of the summer, and is of several types. Angler use is limited to the lower mainstem, much of which is not suitable for bears to capture trout because of its size. As noted earlier in the section "Current Levels of Human Use", hikers and backpackers use an area in Pelican Valley that is considerably larger than that used by anglers, and guided interpretive activities use portions of both areas. No historical estimates occur of earlier bear use, if it did exist prior to heavy human use of Pelican Valley. It is difficult to make a direct correlation between bear use of the spawning run and visitor use of the valley; however, the upstream migration generally peaks a month or more before visitation becomes heavy and the fishing season opens. There are still spawners in the stream when fishing season begins, but their numbers and concentrations are not at peak levels. There are other aspects of this situation which complicate it further.

One involves current management of the fishery. Research on grizzly bear use of this valley goes back at most 25 years. At the beginning of that 25-year period the fish population of Yellowstone Lake was suffering from collapse. It may be that during the many years when the fish population was low, grizzly bears lost the habit of using the spawning streams in the Pelican Valley. It also may be that when the fish population began to recover in the 1970's, visitor use had increased sufficiently that grizzly bears would no longer use the spawning run. Perhaps it had something to do with the openness of some spawning streams, as compared to other more "private" settings south of Yellowstone Lake where bears moved in readily when fish populations increased.

Another possible consideration involves the heavy angler use of the north shore of Yellowstone Lake, as reported earlier. If 25 percent of all shoreline use is concentrated in that section of shoreline between Fishing Bridge and Elk Point, then roughly 25 percent of all shoreline angling harvest would be expected there. In 1982 a total of 27,145 fish were estimated to be harvested by shoreline anglers on Yellowstone Lake. This would mean more than 6,700 fish were removed from the lake between Fishing Bridge and


TROUT SPAWNING STREAMS AVAILABLE TO BEARS:

TROUT SPAWNING STREAMS NOT AVAILABLE TO BEARS:

BARREN WATERS:

FISH BARRIER:

**FIGURE 22: AVAILABILITY OF CUTTHROAT TROUT SPAWNING STREAMS FOR GRIZZLY BEAR FEEDING IN THE PELICAN CREEK DRAINAGE**

**NUMERICAL DATA FOR PELICAN VALLEY SPAWNING STREAMS TAKEN FROM DATA COLLECTED IN 1953 BY O.P. BALL AND L. RICH**

101 | 40,142
DSC | AUG 84

Footnote to Figure 22. Numerical data for Pelican Valley spawning streams, taken from data collected in 1953 by O.P. Ball and L. Rich.

| Stream name | Stream SONYEW[a] number | Length of spawning stream (stream miles) |
| --- | --- | --- |
| - | 0236 | .8 |
| - | 0073 | 9.3 |
| - | 0066 | .1 |
| - | 0067 | .4 |
| - | 0068 | .6 |
| Astringent Creek | 0074 | 9.1 |
| Sage Creek | 0075 | 4.0 |
| - | 0076 | .3 |
| Raven Creek | 0077 | 9.5 |
| Pelican Springs Creek | 0078 | 4.0 |
| - | 0079 | .8 |
| - | 0081 | 1.7 |
| - | 0083 | 4.4 |
| Upper Pelican Creek (above confluence with Raven Creek) | - | 23.7 |

Total trout spawning habitat (steam miles) available to bears: 68.7 miles.

[a]System of numbering Yellowstone waters.

Table 4. Yellowstone National Park lake economy grizzly bear food consumption summary, 1973-74 (from Mealey 1975).

| Food item | Use | Frequency Occurrence Percent | Percent Composition per Item | Percent of Diet Volume | Importance Value | Importance Value Percent |
|---|---|---|---|---|---|---|
| Graminoids (grass/ sedge) | Stems/leaves/ heads | 65.7 | 40.4 | 26.50 | 17.4000 | 39.200 |
| *Salmo clarki* (cutthroat trout) | Entire | 54.3 | 57.8 | 31.40 | 17.1000 | 38.500 |
| *Cirsium foliosum* (elk thistle) | Stems/heads | 39.0 | 45.4 | 17.70 | 6.9000 | 15.500 |
| *Equisetum arvense* (common horsetail) | Stems | 21.0 | 45.7 | 9.60 | 2.0000 | 4.500 |
| *Perideridia gairdneri* (yampa) | Roots | 13.3 | 25.3 | 3.40 | .4500 | 1.000 |
| *Heracleum lanatum* (cow parsnip) | Stems/leaves | 9.5 | 46.0 | 4.40 | .4200 | .950 |
| *Trifolium repens* (white clover) | Stems/leaves/ heads | 2.8 | 75.0 | 2.10 | .0600 | .140 |
| *Cervus canadensis* (elk) | Entire | 3.8 | 30.0 | 1.10 | .0400 | .090 |
| *Vaccinium scoparium* (grouse whortleberry) | Berries/leaves | 1.9 | 100.0 | 1.90 | .0400 | .090 |
| *Thomomys talpoides* (pocket gophers) | Entire | 1.9 | 35.0 | .66 | .0100 | .020 |
| Formididae (ants) | Mature/larvae | 4.7 | 4.4 | .21 | .0100 | .020 |
| *Frageria virginiana* (wild strawberry) | Fruits | 1.9 | 12.5 | .24 | .0040 | .009 |
| *Ruppia pectinata* (wigeongrass) | Entire | 1.9 | 12.5 | .24 | .0040 | .009 |
| *Agoseris* sp. (Agoseris) | Stems/leaves | .95 | 35.0 | .33 | .0030 | .007 |
| *Anacharis* sp. (waterweed) | Stems/leaves | .95 | 20.0 | .19 | .0020 | .005 |
| *Polygonium bistortoides* (American bistort) | Entire | .95 | 10.0 | .09 | .0009 | .002 |

NOTE: Mealey (1975) used methods of deriving Importance Value, Percent Composition, and Importance Value Percent as follows:

In grouped data presentations, food items are presented in rank order according to importance value calculated as:

$$\text{Importance Value} = \frac{\text{Frequency of Occurrence \% x \% of Diet Volume}}{.01}$$

Where Frequency of Occurrence Percent equals the total number of times a specific food item appeared in scats of the sample group, divided by the total number of scats in the sample; and Percent of Diet Volume equals the average percent composition of an item which appeared in scats of the sample group, divided by the total number of scats in the sample.

Percent Composition Per Item and Importance Value Percent were calculated. Percent Compositions per Item indicate the degree of average percent composition of those scats containing a given item by the total number of scats containing that food item. Importance Value Percents were derived by adding the Importance Values in the group and dividing individual values in the group by the sum. Importance Value Percents were calculated to facilitate comparison of food item importance values between and among groups.

Elk Point, with a substantial additional number taken from boats near that shore. The significance of these numbers lies in the source of those fish; Pelican Creek is known to provide the northern end of the lake with the bulk of its fish.

Thus it is true that the aforementioned ongoing overharvest of the lake fishery associated with Fishing Bridge is suppressing Pelican Creek trout numbers. This leaves the question of how much more interest would bears show in the Pelican Creek spawning runs if those runs were permitted to reestablish themselves at full size or near it.

Additional suggestive evidence of bear avoidance of the spawning runs is provided by a 1984 report on bear use at Clear Creek. In 1983 bear management closures were initiated along the east shore of Yellowstone Lake. For six years prior to that the U.S. Fish and Wildlife Service personnel who operated the weir on Clear Creek had kept records of bear presence in the area. At the same time Volunteer Angler Report cards recorded levels of angler use at Clear Creek. The closure of the area to anglers was accompanied by a dramatic increase in the number of bears using the spawning run. Gunther (1984) summarized the situation:

> The greater the human impact in the area, the less the bears made use of it. A linear regression ¼Y=A+(B*X) of the data shows that 65 percent of the variation in bear use is explained by the level of angler use. The years with the highest number of spawners entering the creek were also the years with the most anglers using the area . . . Although bears would be expected to follow the same pattern, bear use was lowest during the peak years of spawning numbers . . . This indicates that heavy human use may have been responsible for keeping bears out of the area.

There exists, then, considerable evidence that grizzly bears may be deprived of a food source to some extent in the Pelican Valley. The valley has long been recognized as excellent grizzly bear habitat on the basis of vegetation. It could be that even its current high potential for supporting bears with vegetation does not approach its true potential should the spawning fish be allowed to restore themselves to greater numbers.

## EFFECTS OF THE AQUATIC RESOURCES ON OTHER ANIMALS

The aquatic resources, working in concert with the high level of vegetation diversity in the Fishing Bridge area, make the area exceptional for larger forms of wildlife. Bison and moose are both common residents of the Pelican Valley, as are elk, deer, and many smaller mammals. The natural hospitality of the area for some of these animals - moose, muskrat, otter, beaver, and so on -

is greatly enhanced by the presence of so much water in so many forms, from flowing to still.

It is in light of this hospitality that Fishing Bridge may be more favorably compared to the other comparison areas that are rated above it in Table 3. A revealing example is bird life.

Using habitat and cover type data provided from digitized vegetation maps (types as outlined in Appendix A), a projection of which bird species should occupy each vegetation type was made. This was based on known information about the preference of various bird species for food, shelter, elevation, and so on. This approach to estimating the potential diversity of bird life in an area was applied to three of the comparison areas shown in Figure 16. Those chosen were KA, one of the lowest; HA, the highest; and Fishing Bridge.

The results (Appendix C) reveal the limitations of judging diversity solely in terms of vegetation. Though comparison area HA had 81 vegetation types to Fishing Bridge's 48, Fishing Bridge was substantially more hospitable to birds, largely because of its assortment of aquatic environments.

Several culturally significant bird species are being affected by the Fishing Bridge development. Swenson (1975) documented a 46 percent decline in osprey nests along Yellowstone Lake shores since 1924; a portion of this decline can be attributed to increased development, including Fishing Bridge. Bald eagle nests are located both on the Yellowstone River near Fishing Bridge and in the Pelican Valley (Alt 1980). Because there are no data on eagle and osprey numbers in the park when it was first explored, nothing precise can be said about their relative abundance now. The susceptibility of both species to human disturbance is well known, however (Swenson 1975, 1979). The Fishing Bridge development is in the heart of known historical osprey and eagle range and yet seems to host fewer nest sites than would be expected.

Less conjectural is the effect of human activity on trumpeter swans near Fishing Bridge. Shea (1979) reported frequent disturbances at the Beach Springs nest site, disturbances severe enough that young have never successfully fledged at this site in recent times.

Birds are an especially useful barometer of diversity; they occur in far greater number of species than park mammals, and yet they often require fairly specialized niches to become occupants of an area. They may be our best single non-vegetative sample type for judging the diversity of Fishing Bridge.

In the interest of thoroughness an attempt was made to project mammal presence based on vegetation data as well. Unlike the bird

projection discussed above, however, the mammal projection was not suggestive of real differences in ecological diversity (D. Streubel pers. comm.). This is probably because most park mammals do not "niche in" to such narrow ecological conditions; being more flexible, for the most part, park mammals may be expected to appear in a broader assortment of ecological contexts than do many birds.

Unfortunately, very little research has been conducted in the park to facilitate these sorts of experimental exercises. Gross numbers of species inhabiting an area are only one measure of its richness. It would also be revealing to know relative densities of the various species, total number of all individuals, length of stay of each seasonal species, and a variety of other elements of activity which would further enhance understanding of an area's value to wildlife. One of the benefits of the present study is in demonstrating how little is yet known about many indices of ecological diversity in Yellowstone National Park.

## The Grizzly Bear

The one element of the ecological setting at Fishing Bridge of greatest current interest is the grizzly bear. The welfare and status of the grizzly bear population in the Yellowstone Ecosystem (Figure 5) has been a matter of serious concern for the past fifteen years (Craighead and Craighead 1972; Cole 1976; Craighead, Sumner and Scaggs 1982). Though there remain disagreements over the actual extent of the decline in the grizzly bear population, a number of biologists believe that the population is on a downward trend (Craighead, Varney and Craighead 1974; Craighead 1980; Knight and Eberhardt 1984, in press). Whatever the population's current status may be, its future is dependent upon keeping man-caused mortalities low while preserving sufficient habitat. Fishing Bridge has been recognized as a drain on the population, as well as an interference with grizzly bear use of key habitat, for some years. Recent advances in our knowledge of grizzly bear needs and the availability of digitized vegetation data now make it possible to comprehensively examine the extent of influence of Fishing Bridge upon the grizzly bear.

The findings of a host of research projects over the past three decades show that the impacts of human activity on grizzly bears can be as complex and difficult to understand as is the ecology of the bear itself. Because no single measurement or interpretation is of itself sufficient or reliable, the following presentation examines the grizzly bears that use the Fishing Bridge area from as many perspectives as practical.

The presentation is divided into two parts. The first shows, based on a review of management actions and bear incidents, the extent to which bears and humans have in recent years been in

conflict in the Fishing Bridge area. It indicates that the level of conflict is extraordinarily high at Fishing Bridge, all out of proportion with corresponding levels in other developments.

The second part reviews the known value of the Fishing Bridge area to grizzly bears in terms of habitat quality, cover type, and other indices of ecological influence.

While the first part reveals the extent of the problem, the second part provides an ecological explanation for it.

A naturally distributed bear population is not the same as a randomly distributed one. There is implicit in the general statement that Yellowstone's grizzly bears are "spread out naturally across the park" (a common way of expressing natural distribution for a popular audience) the notion that the bears are to be found more or less uniformly spaced, here and there, throughout the area. It is this misconception that may lead many people to underestimate the impact a given area can have on the bear population because they assume that only a few bears can be affected by activity in any one portion of the park. The closures of major park dumps, which had been bear "ecocenters" for decades, in 1970 and 1971, in all likelihood heightened this misconception; no longer did large numbers of bears congregate in known locations. But, as research has shown, even without the dumps of the old days, bears still concentrate where they can find the most of what they need. In spring there are concentrations of bears feeding on large mammal carcasses in the major elk and bison wintering areas. Congregations around the cutthroat spawning streams at Yellowstone Lake are common during the summer. Both fish and carcasses attract and hold grizzlies and are considered "natural" ecocenters.

Bears are most likely to be found in areas that provide an abundance of food and cover. Their food sources are for the most part either vegetation or animals that are feeding on vegetation. Vegetation is dependent upon a whole suite of factors: soil fertility, climate, season length, elevation, and so on. The influence of a developed area such as Fishing Bridge will be largely dependent upon how close it is to grizzly bear food resources, and those resources will be most directly measured in terms of vegetation.

The influence of a developed area, it should be said, is not always to reduce food availability. Some bears may be driven away from an area because of human habitation and activity, but others will be attracted by garbage or cooking odors. The complex effects of a development on native plants and animals has been addressed earlier in this report. What is significant, in principle, is not whether a development promotes or suppresses a specific element of the natural setting; what is significant is the degree to which the development causes a departure from the

natural setting. The following presentation demonstrates that grizzly bears are experiencing a radical and alarming departure from their natural state in the Fishing Bridge area.

PART ONE. HUMAN - BEAR CONFLICTS IN THE FISHING BRIDGE AREA

Grizzly Bear-Caused Injuries. No form of wilderness mishap in Yellowstone approaches the grizzly bear-caused injury for public attention and controversy, though several other forms of accidental injury are much more common. Nor could it be said that grizzly maulings receive more attention simply because more people care about grizzly bears. Grizzly bear attacks are spectacular in the minds of many people partly because such attacks are so rare that they are both novel and sensational. However, the statistical evidence shows that they are least rare in the Fishing Bridge area.

The present data-gathering system for bear management was developed in 1966-1968. These data are used in the following discussion because they are internally consistent.

Grizzly bear-caused injuries in the park from 1968 to 1983 are summarized in Tables 5 - 9, and are further displayed in Figures 23 - 26. Of the categories tabulated, Fishing Bridge dominates three of the four, and accounts for more than half of all grizzly bear-caused injuries in Yellowstone Park during the period 1968-1983.

Appendix D is a case-by-case listing of the injuries.

Though it is gratifying to note a decline in grizzly bear-caused injuries in and near developed areas since 1976, this decline should not be used to suggest that Fishing Bridge has been freed from human-bear problems permanently. As will be shown in the section "Bear Observations", there is substantial evidence that increasing levels of human use in the Fishing Bridge/Pelican Valley area caused grizzly bears to be displaced from that area after 1977. Furthermore, by 1976, the portion of the Yellowstone grizzly bear population that was habituated to human foods had dropped as more bears subsisted on natural foods. Thus, after 1976, fewer bears were visiting the developed areas out of habit.

Likewise, as will be shown, management actions and numbers of bears removed have decreased since the mid-1970's for the same reasons. These decreases were expected as the management program divorced the bear population from human food and related conflicts.

These decreases are, however, not cause to believe that the grizzly bear management program has adequately solved the problems of human - bear conflicts. The tenuous status of the grizzly bear population allows far less margin of mortality than may have

Table 5. Human injuries caused by grizzly bears, 1968-83.

| Year | Total number parkwide | Developed area | Backcountry less than one mile from developed area | Backcountry more than one mile from developed area | Backcountry total injuries |
|---|---|---|---|---|---|
| 1968 | 2 | 0 | 1 | 1 | 2 |
| 1969 | 6 | 6 | 0 | 0 | 0 |
| 1970 | 3 | 2 | 0 | 1 | 1 |
| 1971 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 3 | 1 | 1[a] | 1 | 2 |
| 1973 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 2 | 0 | 0 | 2 | 2 |
| 1976 | 4 | 2 | 2 | 0 | 2 |
| 1977 | 1 | 0 | 0 | 1 | 1 |
| 1978 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 2 | 0 | 0 | 2 | 2 |
| 1980 | 1 | 0 | 0 | 1 | 1 |
| 1981 | 2 | 0 | 0 | 2 | 2 |
| 1982 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 1 | 0 | 1 | 0 | 1 |
| Total | 27 | 11 | 5 | 11 | 16 |

[a]Fatality

Table 6. Human injuries caused by grizzly bears in developed areas, 1968-83.

| | N | Percent |
|---|---|---|
| Fishing Bridge | 6 | 54.5 |
| Grant Village | 3 | 27.3 |
| Bridge Bay | 1 | 9.1 |
| Canyon Village | 1 | 9.1 |
| Total | 11 | |

Table 7. Human injuries caused by grizzly bears in developed areas plus an area within a radius of one mile, 1968-83.

| | N | Percent |
|---|---|---|
| Fishing Bridge | 10 | 62.5 |
| Grant Village | 3 | 18.7 |
| Bridge Bay | 1 | 6.2 |
| Canyon Village | 1 | 6.2 |
| Old Faithful | 1 | 6.2 |
| Total | 16 | |

Table 8. Human injuries caused by grizzly bears in backcountry areas of Yellowstone, 1968-83.

| | N | Percent |
|---|---|---|
| Fishing Bridge/ Pelican area | 4 | 25 |
| Gallatins | 3 | 18 |
| Old Faithful | 1 | 6 |
| Mallard Creek | 1 | 6 |
| Mystic Falls | 2 | 12 |
| Washburn/Antelope | 2 | 12 |
| Grebe Pit | 1 | 6 |
| Sepulcher/ Snow Pass | 2 | 12 |
| Total | 16 | |

Table 9. Human injuries caused by grizzly bears in Yellowstone backcountry over one mile from a developed area, 1968-83

| | N | Percent |
|---|---|---|
| Sepulcher/Snow Pass | 2 | 18.2 |
| Gallatins | 3 | 27.3 |
| Mystic Falls | 2 | 18.2 |
| Mallard Creek | 1 | 9.1 |
| Washburn/Antelope | 2 | 18.2 |
| Grebe Pit | 1 | 9.1 |
| Total | 11 | |

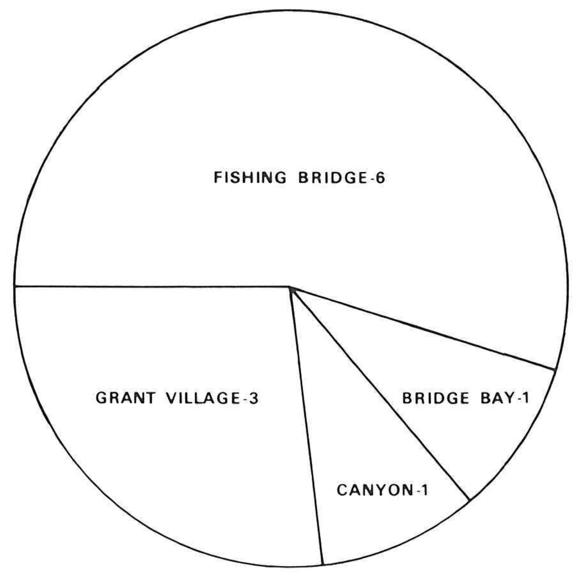


FIGURE 23

HUMAN INJURIES CAUSED BY GRIZZLY BEARS IN DEVELOPED AREAS (TOTAL INJURIES = 11) 1968-83

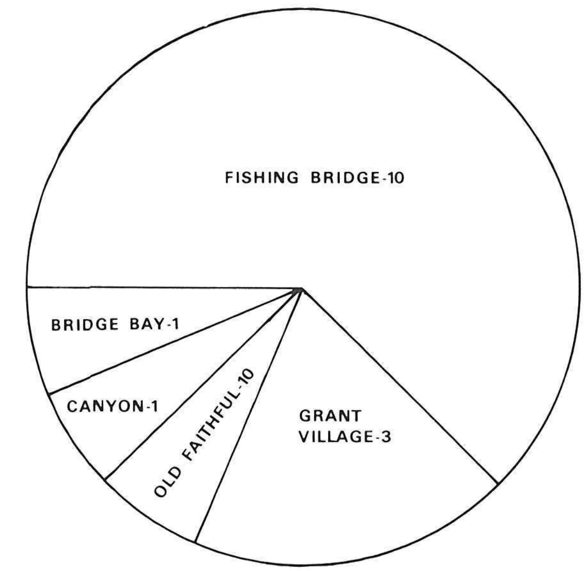


FIGURE 24

HUMAN INJURIES CAUSED BY GRIZZLY BEARS IN DEVELOPED AREAS PLUS AN AREA WITHIN A RADIUS OF ONE MILE (TOTAL INJURIES = 16) 1968-83

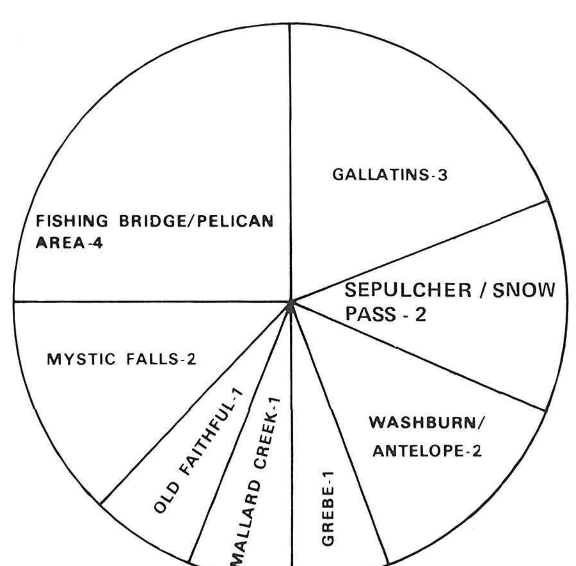


FIGURE 25

HUMAN INJURIES CAUSED BY GRIZZLY BEARS IN THE YELLOWSTONE BACKCOUNTRY (TOTAL INJURIES = 16) 1968-83

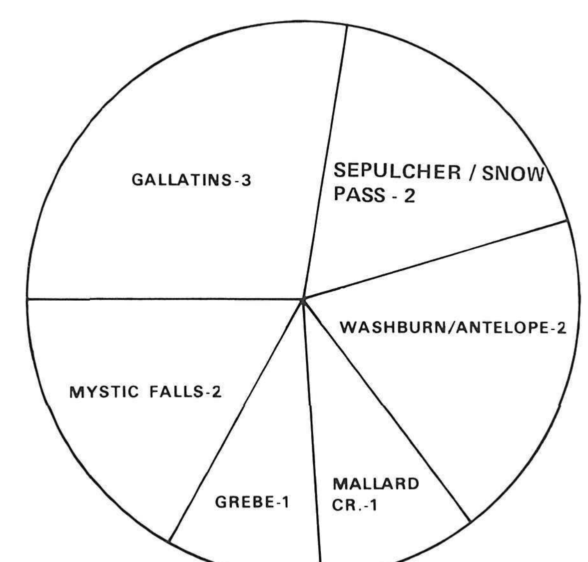


FIGURE 26

HUMAN INJURIES CAUSED BY GRIZZLY BEARS IN THE YELLOWSTONE BACKCOUNTRY MINUS AN AREA WITHIN ONE MILE OF A DEVELOPED AREA (TOTAL INJURIES = 11) 1968-83

# GRIZZLY BEAR-CAUSED HUMAN INJURIES / 1968-83

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seemed acceptable 20 years ago. Thus, though the numbers of bear-caused injuries, management actions, and bears removed have declined, each one of those events is now of critical significance to the welfare of the bear population. As will be shown in "Part II, Ecological Influences of the Fishing Bridge Area on Yellowstone Grizzly Bears," Fishing Bridge has the highest natural ability to generate these harmful events.

Management Actions. Records since 1968 indicate that, while total management actions (primarily transplanting of bears from developed areas) have declined parkwide, the proportion of such actions taken at Fishing Bridge has dramatically increased.

Total grizzly bears transplanted between 1968 and 1983 are shown in Table 10.

Open pit garbage dumps were closed between 1968 and 1970 and an intensive management program was instituted where incorrigible bears were removed. There followed a transition period to natural foods for other bears between 1971 and 1975. After 1976, the bears with prior knowledge of human food appeared to be gone or at least weaned to natural foods (Table 11).

The number of bears transplanted from each major developed area is shown in Table 12 for the years 1968-1983, and in Table 13 by the three time periods mentioned above.

Figure 27 graphically portrays the total transplants by area for the period 1968-1983. It shows the high level of management activity necessary at Fishing Bridge throughout the period.

Figures 28, 29, and 30 are more revealing of current trends. Though the Fishing Bridge area did not have the highest proportion of management actions in the earliest time period (1968-1970), it has assumed an ever larger proportion since then, more than twice as many as any other development in recent years. What occurred during the period 1968-1983, is that as the dumps were closed other developments, particularly Canyon Village, lost some of their attraction to grizzly bears and ceased to be the "bear crossroads" they were earlier. As all grizzly bears were compelled to seek natural food sources Fishing Bridge assumed its true proportion of influence as a crossroads.

Though it has for some years been assumed that grizzly bears have essentially redistributed themselves in some naturally-occurring order in Yellowstone Park, Fishing Bridge continues to be an area of great attraction and concentration for them. As will be shown in Part Two of this presentation, such attraction is predictable based upon the area's natural attributes. Of greater urgency, however, is the effect of this attraction on the population's mortality rate.

Table 10. The total number of grizzly bears transplanted by year, 1968-83.

| Year | N |
|---|---|
| 1968 | 54[a] |
| 1969 | 47[a] |
| 1970 | 50 |
| 1971 | 35 |
| 1972 | 25 |
| 1973 | 10 |
| 1974 | 12 |
| 1975 | 0 |
| 1976 | 14 |
| 1977 | 8 (+1[b]) |
| 1978 | 0 |
| 1979 | 1 |
| 1980 | 4 |
| 1981 | 7 (+1[c]) |
| 1982 | 4 (+1[b]) |
| 1983 | 1 (+1[c]) |

[a]Number agrees with Cole (1971a). Number of transplants at Grant Village varies with different sources (14 or 16), total of 54 uses 14.

[b]Nonmanagement trapping.

[c]Problem bears handled in park after brought in from Cooke City.

Table 11. The total number and percent of grizzly bears transplanted, by period, 1968-1983.

| Year | N | Percent |
|---|---|---|
| 1968-1970 | 151 | 56 |
| 1971-1975 | 82 | 30 |
| 1976-1983 | 39 | 14 |
| Total | 272 | |

Table 12. Management actions (transplants) by year and area, 1968-83.

| Year | Lake | | Fishing Bridge[a] | | Outlet[b] | | Bridge Bay | | Canyon | | Grant Village | | Old Faithful | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % | N | % | N | % | N | % |
| 1968 | 1 | 2 | 12 | 22 | 13 | 24 | 8 | 15 | 14 | 26 | 19 | 35 | 0 | 0 |
| 1969 | 12 | 26 | 8 | 17 | 20 | 43 | 9 | 19 | 12 | 26 | 4 | 9 | 0 | 0 |
| 1970 | 5 | 10 | 3 | 6 | 8 | 16 | 0 | 0 | 8 | 16 | 6 | 12 | 19 | 38 |
| 1971 | 0 | 0 | 19 | 54 | 19 | 54 | 0 | 0 | 9 | 26 | 5 | 14 | 2 | 6 |
| 1972 | 0 | 0 | 13 | 52 | 13 | 52 | 0 | 0 | 8 | 32 | 0 | 0 | 0 | 0 |
| 1973 | 4 | 40 | 0 | 0 | 4 | 40 | 3 | 30 | 3 | 30 | 0 | 0 | 0 | 0 |
| 1974 | 4 | 33 | 0 | 0 | 4 | 33 | 2 | 17 | 5 | 42 | 0 | 0 | 1 | 8 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 10 | 71 | 10 | 71 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 21 |
| 1977 | 0 | 0 | 2 | 25 | 2 | 25 | 2 | 25 | 1 | 13 | 0 | 0 | 3 | 38 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 100 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 50 | 0 | 0 | 0 | 0 |
| 1981 | 5 | 71 | 0 | 0 | 5 | 71 | 0 | 0 | 1 | 14 | [c] | 0 | 0 | 0 |
| 1982 | 0 | 0 | 3 | 75 | 3 | 75 | 1 | 25 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 1 | 100 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | [c] | 0 |

[a]Fishing Bridge, Indian Pond, and Pelican area.
[b]Fishing Bridge, Indian Pond, Pelican and Lake areas.
[c]Problem bears previously brought into park from Cooke City, Montana, not counted.

Table 13. Management actions (transplants) by period and area, 1968-83.

| Year | Lake | | Fishing Bridge[a] | | Outlet[b] | | Bridge Bay | | Canyon | | Grant Village | | Old Faithful | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % | N | % | N | % | N | % |
| 68-70 | 18 | 12 | 23 | 15 | 41 | 27 | 17 | 11 | 34 | 23 | 29 | 19 | 19 | 13 |
| Mean | 6 | 13 | 7.7 | 15 | 13.7 | 28 | 5.7 | 11 | 11.3 | 23 | 9.7 | 19 | 6.3 | 13 |
| 71-75 | 8 | 10 | 32 | 39 | 40 | 49 | 5 | 6 | 25 | 30 | 5 | 6 | 3 | 4 |
| Mean | 1.6 | 17 | 6.4 | 21 | 8 | 36 | 1 | 9 | 5 | 26 | 1 | 3 | .6 | 3 |
| 76-83 | 5 | 13 | 16 | 41 | 21 | 54 | 3 | 8 | 4 | 10 | 0 | 0 | 7 | 18 |
| Mean | .6 | 9 | 2 | 34 | 2.6 | 43 | .4 | 6 | .5 | 10 | 0 | 0 | .9 | 20 |
| 68-83 total | 31 | 11 | 71 | 26 | 102 | 38 | 25 | 9 | 63 | 23 | 34 | 13 | 29 | 11 |
| Mean | 1.9 | 11 | 4.4 | 26 | 6.4 | 38 | 1.6 | 8 | 3.9 | 17 | 2.1 | 4 | 1.8 | 13 |

[a]Fishing Bridge, Indian Pond, and Pelican area.
[b]Fishing Bridge, Indian Pond, Pelican, and Lake areas.

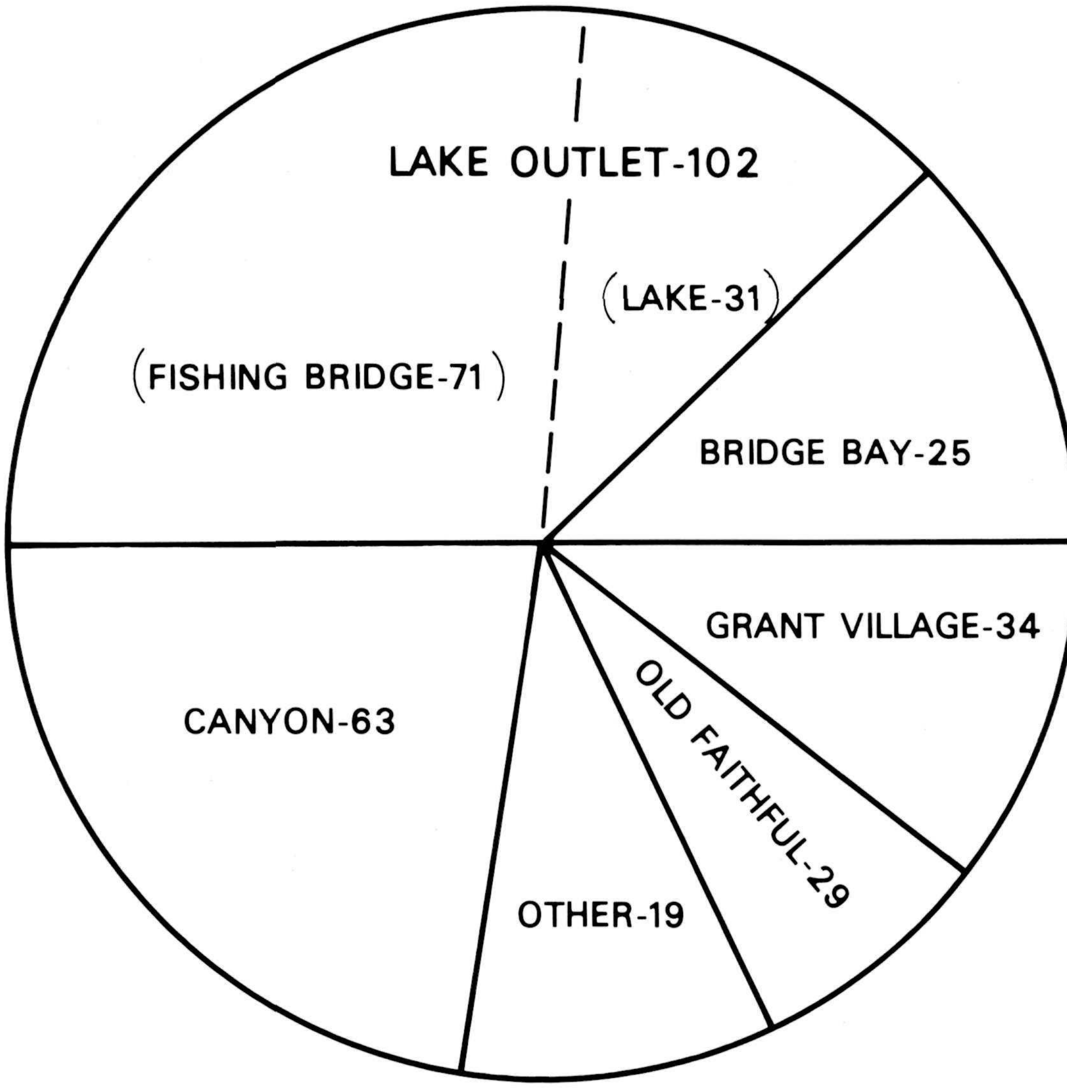


**FIGURE 27: TOTAL NUMBER (272) OF GRIZZLY BEARS TRANSPLANTED 1968—83**

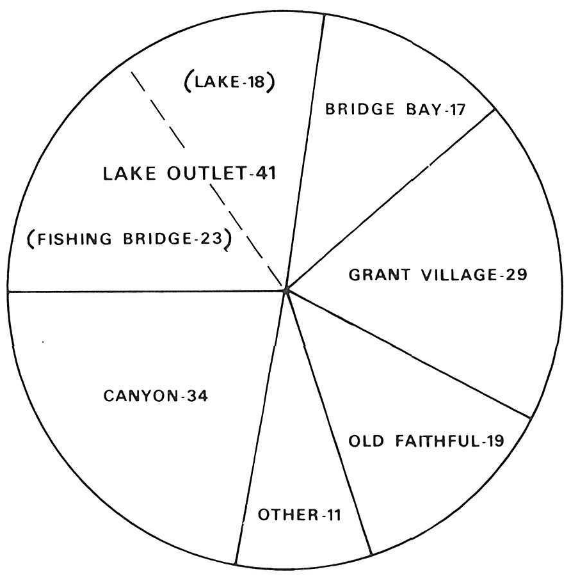


FIGURE 28

TOTAL NUMBER OF GRIZZLY BEARS TRANSPLANTED (TOTAL = 151) 1968-70

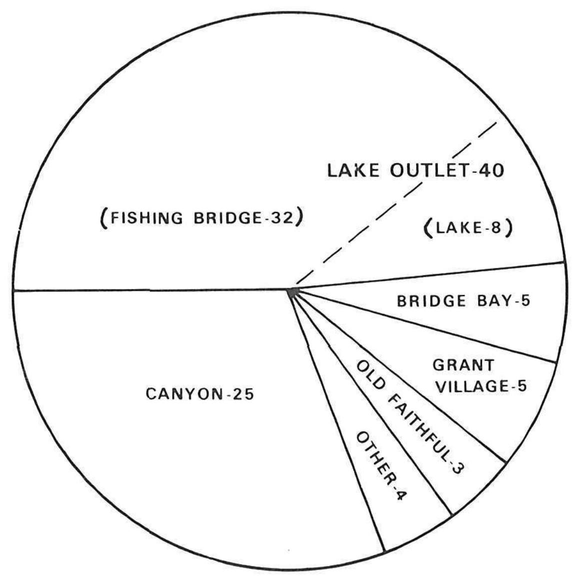


FIGURE 29

TOTAL NUMBER OF GRIZZLY BEARS TRANSPLANTED (TOTAL = 82) 1971-75

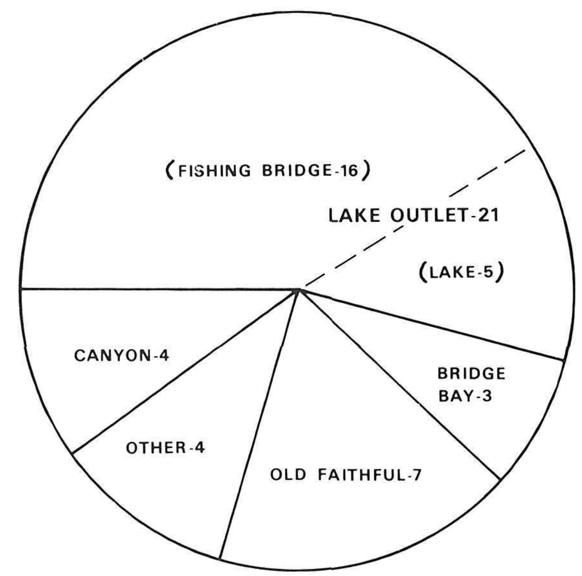


FIGURE 30

TOTAL NUMBER OF GRIZZLY BEARS TRANSPLANTED (TOTAL = 39) 1976-83

# TRANSPLANTED GRIZZLY BEARS / 1968-83 (TOTAL=272)

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Management Removals. The most direct evidence of an area's negative influence on grizzly bears is bear deaths and other removals from the population. Table 14 presents an area-by-area breakdown of where and when grizzly bears have been removed (killed intentionally or by accident, or sent to zoos) from the park in the period 1968-1983. Again, Fishing Bridge leads all developed areas.

Figure 31 presents these statistics graphically, and Table 15 elaborates on management removals in the Yellowstone Lake area.

The removal of a bear may not be entirely the result of its activities in the developed area from which it was removed. A bear may have been previously moved from another developed area where it first became a problem. Thus we might consider that other area the "cause", in a manner of speaking, of the bear's eventual demise.

For this reason, the records do not truly reflect the full contribution of Fishing Bridge to grizzly bear mortality unless the entire trapping history of each bear is examined. For example, the records do not show that a grizzly bear was destroyed at Fishing Bridge in 1976, yet the Fishing Bridge development can be directly blamed for the loss of four grizzlies that year. A female with three cubs of the year first became a problem there, though after multiple transplantings she was eventually destroyed at Bridge Bay. All of the cubs subsequently died.

Figure 32 is a correlation of developed areas with bear deaths that may in this sense be attributed to them. It differs somewhat from the simpler compilation of number of bears removed from each area, and more fully reflects the impact of the Fishing Bridge development. Note that of 67 bears removed from the park between 1966 and 1983, 31, or nearly half, can be attributed to problems that began at Fishing Bridge. Note also that Fishing Bridge has continued to cost the park grizzly bears as recently as 1983, when most other major park developments have not cost the park any grizzly bears since the early 1970s. Grant Village, of great interest in the current discussions over Fishing Bridge, has not caused the removal of a grizzly bear for fourteen years.

It must be noted that the term "removal" is not a euphemism for "bear death". At various times grizzly bears have been sent to zoos or to other grizzly bear ranges. Though these removals reduced the bear population as surely as if the bears were killed, the bears were not killed, and in the interest of accuracy should not be described as so.

Population Consequences of Female Mortalities. There is currently great concern over the stability of the Yellowstone grizzly bear population, concern often centered on the number and welfare of females of breeding age. This segment of the population can be

Table 14. Direct management removals of grizzly bears by areas, 1968-83 (management removals include intentional removals, bears sent to zoos, and overdoses).

| Year | Park Totals | Fishing Bridge | Lake | Bridge Bay | Canyon | Grant Village | Old Faithful | Lake Backcountry | Lewis Lake Campground | Madison Campground | Slough Creek Campground | Tower |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1968 | 6 | 3 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 10 | 4 | 1 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 20 | 3 | 0 | 0 | 1 | 9 | 3 | 0 | 0 | 1 | 2 | 1 |
| 1971 | 6 | 1 | 0 | 1 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 1972 | 9 | 2 | 0 | 3 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 2 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 2 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Totals | 61 | 15 | 2 | 7 | 12 | 11 | 6 | 2 | 1 | 2 | 2 | 1 |

FIGURE 31

# GRIZZLY BEAR MANAGEMENT REMOVALS 1968-83

**TOTAL – 61**

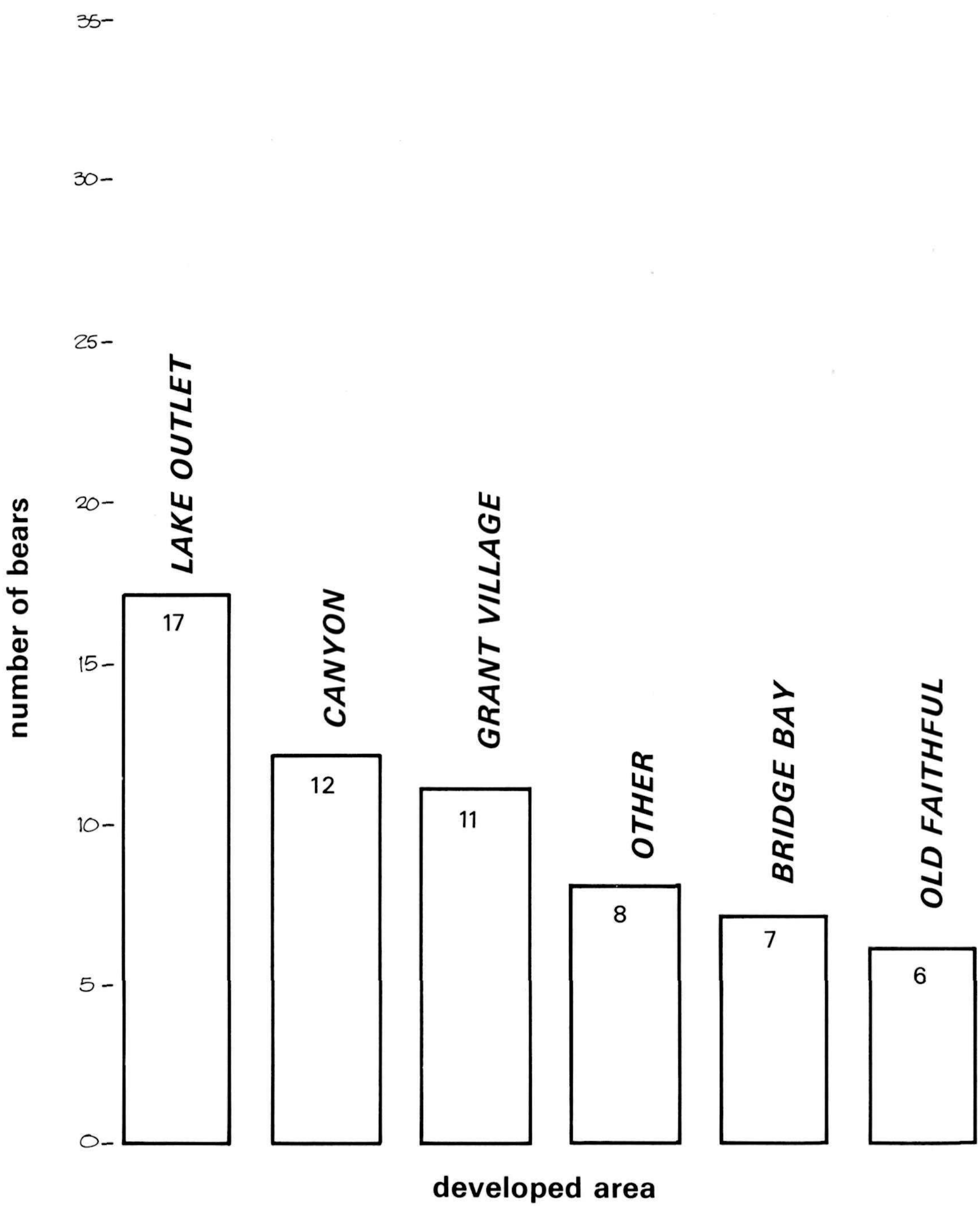


Table 15. Direct management removals in the Yellowstone Lake area, 1966-83 (management removals include intentional removals, bears sent to zoos, and overdoses). These figures reflect the area from which the bear was removed and do not reflect the bear's history.

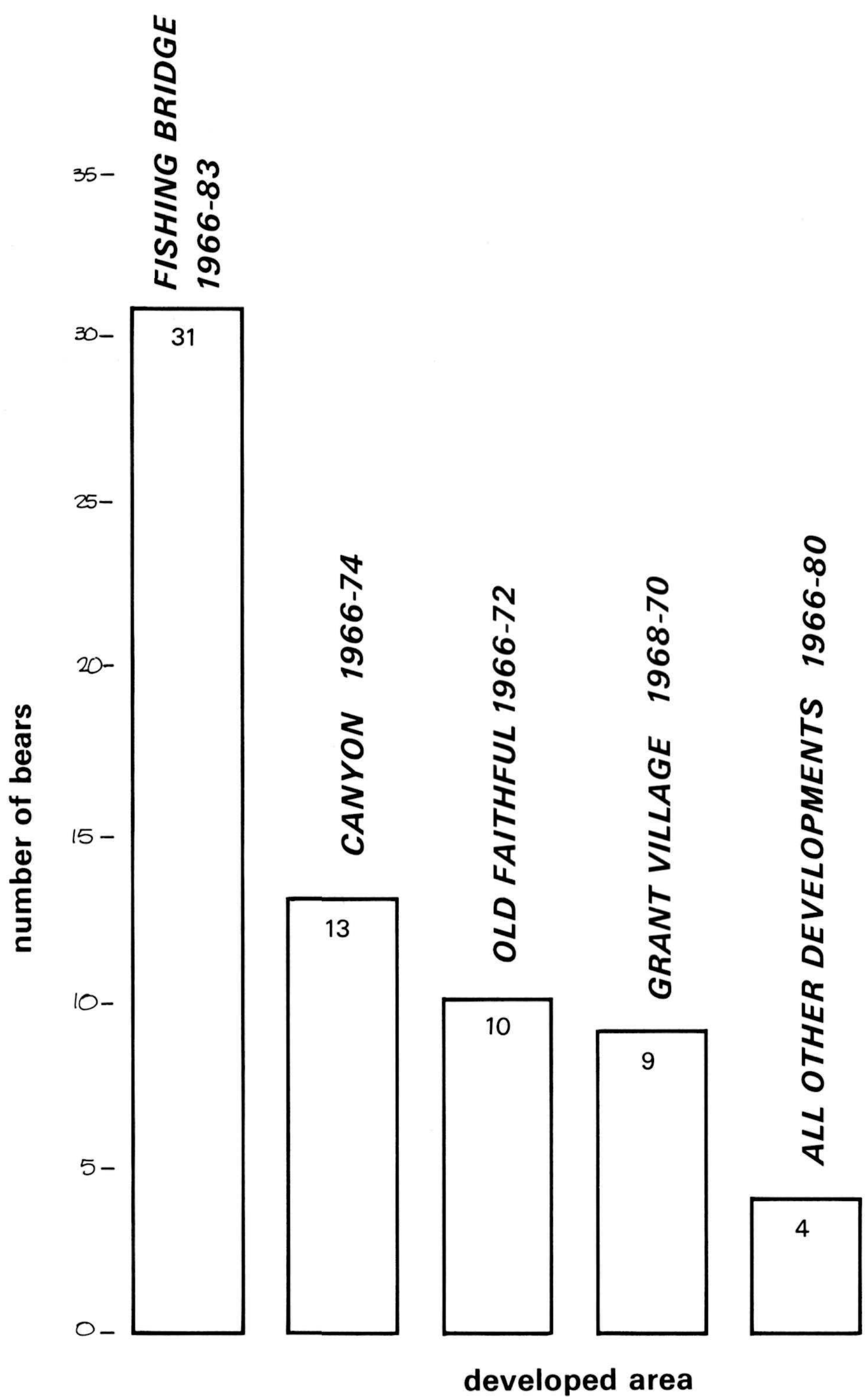
| Year | Park Total | Lake Total | Fishing Bridge | Bridge Bay | Grant Village | West Thumb | Lake | Pelican Campground | Other Areas |
|---|---|---|---|---|---|---|---|---|---|
| 1966 | 3 | - | - | - | - | - | - | - | - |
| 1967 | 4 | 1 | 1 | - | - | - | - | - | - |
| 1968 | 6 | 5 | 2 | - | 1 | - | 1 | 1 | - |
| 1969 | 10 | 6 | 4 | - | 1 | - | 1 | - | - |
| 1970 | 20 | 12 | 3 | - | 7 | 2 | - | - | - |
| 1971 | 6 | 3 | 1 | 1 | - | - | - | - | 1[a] |
| 1972 | 9 | 6 | 2 | 3 | - | - | - | - | 1[b] |
| 1973 | - | - | - | - | - | - | - | - | - |
| 1974 | 2 | 1 | 1 | - | - | - | - | - | - |
| 1975 | - | - | - | - | - | - | - | - | - |
| 1976 | 1 | 1 | 1 | - | - | - | - | - | - |
| 1977 | 1 | 1 | - | 1 | - | - | - | - | - |
| 1978 | 2 | 1 | - | 1 | - | - | - | - | - |
| 1979 | - | - | - | - | - | - | - | - | - |
| 1980 | 1 | - | - | - | - | - | - | - | - |
| 1981 | - | - | - | - | - | - | - | - | - |
| 1982 | 2 | 1 | - | - | - | - | 1 | - | - |
| 1983 | 1 | - | - | - | - | - | - | - | - |

[a]Clear Creek.
[b]Plover Point.

FIGURE 32

## GRIZZLY BEAR LOSSES FROM THE YELLOWSTONE ECOSYSTEM RELATED TO THE DEVELOPED AREA IN WHICH THE BEAR FIRST BECAME A HUMAN-BEAR PROBLEM 1966-83

**TOTAL LOSS WITHIN THE ECOSYSTEM-67 BEARS**



reviewed in light of mortality figures since 1966. This gives us yet another way of looking at the effects of the Fishing Bridge area on the grizzly bear population, and permits some cautious projection of ongoing influences.

Table 16 is a tabular breakout of bear mortality related to Fishing Bridge. It includes losses from management kills, drug overdose or other handling problems, bears sent to zoos, and two natural deaths of yearlings orphaned as cubs of the year. It also includes any bears removed from other locations if those bears got their start as "problem bears" in the Fishing Bridge/Lake/Pelican Creek area.

Table 16 reveals that 9 female grizzly bears have been removed from the population as a result of activities originating at Fishing Bridge. A calculation based on known life histories of female grizzly bears can be made to determine how many more females these bears would have contributed to the population.

One adult female was 11 years old when removed from the population. An 11-year-old female has an average life expectancy in the Yellowstone area of 2.86 years. Taking this times one-half the reproductive rate (0.558) gives us the number of females she should have produced before natural death (it is multiplied by one-half because only one-half of her cubs would be expected to be female).

The procedure follows:

$$2.86\ (0.558/2) = 0.8 \text{ females}$$

Three other adult females, for which there are no age records, were removed. If we are conservative and assume they were all 11 years old, and extrapolate from the calculation for the known-age 11-year-old, we would arrive at 2.4 additional female cubs produced by these 3. Reality would probably be closer to three or four.

The remaining five females were subadults and yearlings, which would not begin producing cubs until six years of age, and so it would be appropriate to base the calculation on life expectancy at that age. The life expectancy of a 6-year-old female grizzly bear in the Yellowstone Ecosystem is 5.48 years, so that the calculation proceeds as follows:

$$5.48\ (0.558/2) \times 5 = 7.6 \text{ females}$$

Thus the total projected loss of females from those bears that were removed is conservatively estimated to be ten individuals. This calculation could be projected out to future generations based on the potential productivity of the ten lost females, but it would quickly lose contact with reality and become purely

Table 16. Grizzly bear mortality related to the Fishing Bridge development, 1966-83.

| Years | Bears | Total | Yearly rate |
|---|---|---|---|
| 1966-67 | 1 - Adult, sex? | 1 | .50 |
| 1968-69 | 7 - Adult males | 9 | 4.50 |
| | 1 - Adult female | | |
| | 1 - Subadult, sex? | | |
| 1970-72 | 5 - Adult males | 13 | 4.33 |
| | 2 - Adult females | | |
| | 1 - Adult, sex? | | |
| | 1 - Subadult male | | |
| | 2 - Subadult females | | |
| | 1 - Yearling female | | |
| | 1 - Cub, sex? | | |
| 1973-83 | | 8 | .73 |
| 1973 | - | | |
| 1974 | 1 - Subadult female | | |
| 1975 | - | | |
| 1976 | 1 - Adult female | | |
| 1977 | 3 - Yearlings, 2 males, 1 female | | |
| 1978 | 1 - Subadult male | | |
| 1979 | - | | |
| 1980 | - | | |
| 1981 | - | | |
| 1982 | 1 - Subadult male | | |
| 1983 | 1 - Adult male | | |
| Total | 31 bears, 9 females | | Rate not meaningful |

conjectural. It should also be noted that the above calculations do not incorporate projected natural mortality losses among the female bears under consideration. Even with some natural mortality loss the number would be significant. It should be noted that if man-caused mortality of grizzly bears continues to be reduced, as it has the last two years, the life expectancy of an adult female will be longer and the production of cubs greater than the above calculations indicate. Thus the above 9.3 individuals would represent a further underestimate of natural production.

This is a minimum figure. It reflects only the history of bears whose fate is known. It does not reflect the fate of several other problem bears - or potential problem bears - for which the long term outlook is not encouraging. Nor does it reflect the fate of several other transplanted bears whose known history suggests they are confirmed campground problems. But even as it stands, the minimum figure is very important.

Knight and Eberhardt (1984, in press) estimate that a very small number of additional females in the population would stop or reverse their calculated downward trends:

> We believe adult female mortality is the key issue in maintaining the grizzly bear population of Yellowstone National Park. In fact, the likely difference between earlier years, when the population was stable, or possibly increasing, and the present situation amounts to an added mortality of about two fully adult females per year.

In another analysis, Knight and Eberhardt estimated the increase in female survival rate that would be needed to stop a population decline:

> Considering the average population of about 40 independent females, this increase of 0.02 in survival is less than one death per year. In other words, saving one adult female per year is roughly equivalent to shifting litter size from the present value to that prevailing when the garbage dumps were available as a supplementary food supply (Knight and Eberhardt in press).

It is clear from these estimations that the number of females lost at Fishing Bridge alone since 1968 - either females destroyed or females not produced - may have in itself been sufficient to maintain the population at a constant size had those animals not been lost. Though we cannot precisely estimate the magnitude of this loss, we can safely say that all scientists and other observers currently involved in studying and managing the Yellowstone grizzly bear would be considerably more at ease about the population's welfare if these females had not been lost.

Additional Comments on Bear Mortality. According to Table 16, Fishing Bridge has cost the Yellowstone area 31 known grizzly bears since 1966. It has also cost the grizzly bear population dearly in lost females and in potential production of additional females. But it is not enough to establish known bear mortalities resulting from the Fishing Bridge area, or even known and suspected bear mortalities resulting from the Fishing Bridge area. The true picture of the influence of this development on bear mortality is rather more complex than those lists would allow. For example, whatever happens to bears because of Fishing Bridge is only part of the larger arena of bear actions in other nearby developments. The female grizzly bear with three cubs is an example of this. There is a cumulative impact that is greater than that measured at any one development.

Additionally, the entire Yellowstone Ecosystem is experiencing human use increases far beyond levels that occurred twenty years ago. Recreational use has increased both in and near the park, both in numbers and in distribution. Negative effects on the grizzly bear through mortality and habitat change (or loss) have escalated. The removal of problem bears now, because of the Fishing Bridge development, has a population impact that did not occur twenty years ago.

At some point, the population cannot compensate for these losses. Current research data, some of which is presented later, suggest we may be near or at a critical time if we are to retain what has already become a biological island population of grizzly bears in the Yellowstone Ecosystem.

## PART TWO. ECOLOGICAL INFLUENCES OF THE FISHING BRIDGE AREA ON YELLOWSTONE GRIZZLY BEARS

The array of data that has been gathered on grizzly bear habits and movements permits us to examine the worth of the Fishing Bridge area to grizzly bears, as well as the effects of current development on that worth, in several ways. The following discussion evaluates grizzly bear use of the Fishing Bridge area in terms of habitat analysis, bear observations, and population influences. Because information exists on so many elements of grizzly bear life, we can evaluate many aspects of that life. Though any specific aspect may not in itself be conclusively revealing, the cumulative interpretations of the several aspects are.

Habitat Analysis: Fishing Bridge and Surrounding Areas. For the purposes of this analysis, a study area has been delineated according to the "analysis areas" shown in Figure 33. This combination of analysis areas has as its center a "Core Area", with the Fishing Bridge development in the middle. The Core Area is a circle with a radius of 4.8 kilometers. It is included within Area 1, an 8.8 kilometer-radius "circle" that includes the

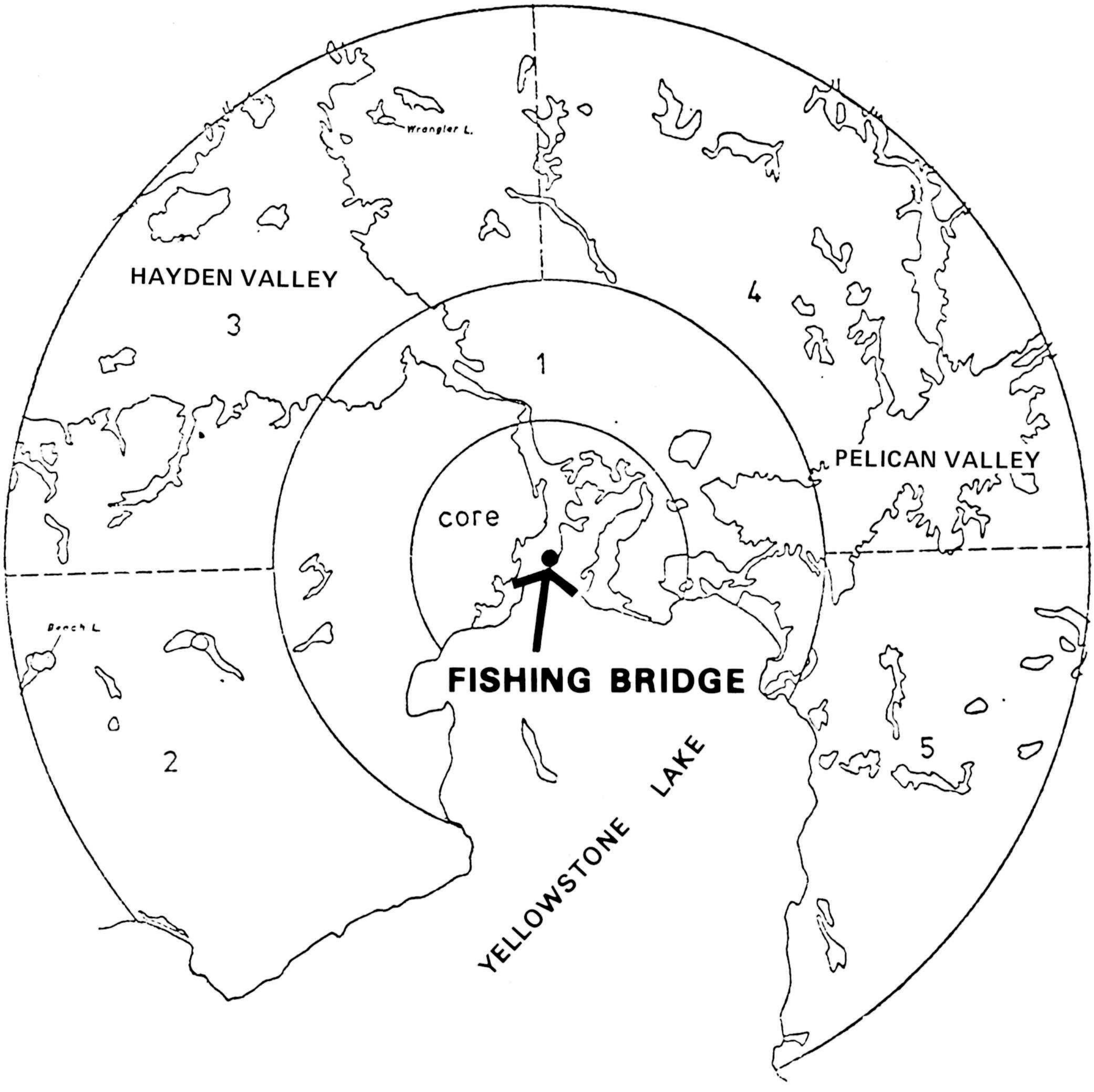



**FIGURE 33: FISHING BRIDGE HABITAT ANALYSIS AREA**

Core Area. Four additional analysis areas, Areas 2, 3, 4, and 5, encircle Area 1, each occupying a quadrant between 8.8 and 16.9 kilometers from the center of the Core Area.

Thus, Area 2 is southwest of Fishing Bridge; Area 3 is northwest of Fishing Bridge and includes most of Hayden Valley; Area 4 is northeast of Fishing Bridge and includes most of Pelican Creek Valley; and Area 5 is southeast of Fishing Bridge. Areas 2 and 5 have smaller land acreage than the other two outer quadrants because of Yellowstone Lake.

By establishing a study area that extends beyond the geographical bounds of the immediate Fishing Bridge area, opportunities are provided for comparison of nearby conditions, as well as for noting population influences not directly associated with the Fishing Bridge development.

In the following discussions of the analysis areas, data on observed bears and on habitat were gathered from 1973 through 1983. Data on movements and habitat of radio-instrumented bears were gathered from 1975 through 1983. The original data are available in the annual reports and publications of the Interagency Grizzly Bear Study Team (see Knight et al. 1983, and earlier annual reports).

Grizzly bear preference for habitat types as measured by feeding activity has been summarized in Table 17. A system of deriving a "Preference Value" for various habitats (the system is explained in the notes to Table 17) permits comparison of grizzly bear preferences in feeding activities. The numerical values derived to represent the Preference Value are listed in the table.

The primary grizzly bear feeding activities in the Fishing Bridge area are:

- digging for pocket gophers and voles
- digging up squirrel middens for pine nuts
- feeding on large mammals (elk, bison, moose), especially as winter kills
- grazing grasses and sedges
- digging yampa roots
- grazing clover
- grazing thistle

Of these, the first four are the most important. Either the quality of food items obtained through these most important activities is high, or diet quantity during some season is critically significant.

Table 17 becomes most useful in associating grizzly bear food preferences with habitat types. The most important feeding activities listed above are associated with habitat types as follows:

Table 17. Preference value for grizzly bear feeding activity by habitat type. An explanation of methods for deriving these values appears in Appendix B.

| Habitat type (scientific name in parentheses) | Feeding Activity | | | | | | |
|---|---|---|---|---|---|---|---|
| | Gophers | Pine nuts | Ungulates | Grazing | Yampa | Clover | Thistle |
| Subalpine fir/grouse whortleberry (*Abies lasiocarpa*/*Vaccinium scoparium*) | | 0.27 | 0.34 | | | | |
| Subalpine fir/grouse whortleberry-whitebark pine phase (*Abies lasiocarpa*/*Vaccinium scoparium* - *Pinus albicaulis*) | | 1.00 | | | | | |
| Subalpine fir/western meadowrue (*Abies lasiocarpa*/*Thalictrum occidentale*) | | 0.21 | 0.61 | | | | |
| Subalpine fir/globe huckleberry (*Abies lasiocarpa*/*Vaccinium globulare*) | | 0.20 | 0.23 | | | | |
| Subalpine fir/pinegrass (*Abies lasiocarpa*/*Calamagrostis rubescens*) | | | 0.57 | | | | |
| Lodgepole pine/elk sedge (*Pinus contorta*/*Carex geyeri*) | | 0.18 | | | | | |
| Whitebark pine/grouse whortleberry (*Pinus albicaulis*/*Vaccinium scoparium*) | | 0.34 | | | | | |
| Subalpine fir/bluejoint reedgrass (*Abies lasiocarpa*/*Calamagrostis canadensis*) | | 0.06 | 0.25 | | | | |
| Big sagebrush/blue bunchgrass (*Artemisia tridentata*/*Festuca idahoensis*) | 0.14 | | 0.23 | 0.50 | 0.46 | | |
| Silver sage/blue bunchgrass (*Artemisia cana*/*Festuca idahoensis*) | 0.54 | | | | 0.62 | 0.32 | |
| Shrubby cinquefoil/blue bunchgrass (*Potentilla fruticosa*/*Festuca idahoensis*) | 0.12 | | | 0.47 | 0.15 | 0.16 | 0.34 |

Table 17 (cont.)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Blue bunchgrass/tufted hairgrass (Festuca idahoensis/Deschampsia caespitosa) | | | | 0.53 | | 0.18 | 0.27 |
| Alpine timothy/bearded wheatgrass (Phelum alpinum/Agropyron caninum) | 0.55 | | 0.10 | 0.26 | 0.27 | 1.00 | 1.00 |
| Alpine timothy/small-winged sedge (Phelum alpinum/Carex microptera) | 0.32 | | | | | 0.23 | 0.45 |
| Alpine timothy/water sedge (Phelum alpinum/Carex aquitilis) | | | | | | 0.49 | |
| Wolf's willow/small-winged sedge (Salix wolfii/Carex microptera) | | | | | 0.90 | 0.63 | |
| Wolf's willow/water sedge (Salix wolfii/Carex aquitilis) | | | | | | 0.71 | |
| Silver sage/water sedge (Artemisia cana/Carex aquitilis) | | | | | 0.90 | 0.63 | |
| Bluejoint reedgrass/bluejoint reedgrass (Calamagrostis canadensis/ Calamagrostis canadensis) | | | | 1.00 | | | |
| Bluejoint reedgrass/arrowleaf groundsel (Calamagrostis canadensis/ Senecio triangularis) | | | | 0.59 | | | |
| Water sedge/elephant's head (Carex aquitilis/Pedicularis groenlandica) | 0.98 | | | | | | |
| Western springbeauty/glacier lily (Claytonia lanceolota/Erythronium grandiflorum) | 0.58 | | | | | | |

pocket gophers and voles: silver sage/blue bunchgrass; alpine timothy/bearded wheatgrass; water sedge/ elephant's head; and springbeauty/glacier lily
squirrel middens: subalpine fir/grouse whortleberry -whitebark pine phase
large mammals: subalpine fir/western meadowrue; and subalpine fir/pinegrass

Table 18 summarizes the amount of each important habitat type in each of the analysis areas. Notice that the subalpine fir/grouse whortleberry habitat type is the most widespread habitat type of interest to bears around Fishing Bridge. Next most widespread is the wet forest type, primarily of the subalpine fir/bluejoint reedgrass, bluejoint reedgrass/arrowleaf groundsel, and bluejoint reedgrass/bluejoint reedgrass habitat types. The important subalpine fir/grouse whortleberry-whitebark pine phase habitat type is present in significant amounts only in Areas 4 and 5, east of Fishing Bridge. On the other hand, significant amounts of habitat valuable for large mammals, pocket gophers, and voles are close to Fishing Bridge. Especially prominent among these valuable habitat types are subalpine fir/western meadowrue, subalpine fir/pinegrass, silver sage/blue bunchgrass, and alpine timothy/bearded wheatgrass.

Seasonally critical habitat, by percent of each area, is shown in Table 19. As can be seen in the table, the Core Area and Areas 1 and 3 have the highest proportion of seasonally critical habitat. Spring (March, April, and May) critical habitat is especially widespread in the Core Area and Area 1.

Based on Tables 17, 18, and 19, as well as on present knowledge of habitat types, bear feeding preferences, and related information, it is possible to evaluate the qualities of the analysis areas with reasonable accuracy.

The evaluation proceeds by calculations that assign numerical values to various qualities in the habitat. Table 20 presents calculations of several such numerical values. The table is explained as follows.

The first column on the left lists the analysis areas individually, followed by the "Outer" area, which consists of Areas 2, 3, 4, and 5, and by a "Total", which represents the overall average value of the combined analysis areas.

For the purposes of this narrative, a simplified explanation of the numerical values is sufficient. The manner of their derivation is formally explained in Appendix B. The numbers, for the purpose of the narrative, may be seen as numerical "grades" earned by each area based upon that area's qualities. The higher the number, the higher the quality. By comparing the various qualities, a more comprehensive portrait of the areas is possible.

Table 18. Habitat type and percent composition by analysis area.

| Habitat type | Area: Core | 1 | 2 | 3 | 4 | 5 | Total of all areas |
|---|---|---|---|---|---|---|---|
| Subalpine fir/grouse whortleberry (*Abies lasiocarpa*/*Vaccinium scoparium*) | 35 | 48 | 75 | 32 | 46 | 43 | 47 |
| Subalpine fir/grouse whortleberry -whitebark pine phase (*Abies lasiocarpa*/*Vaccinium scoparium* - *Pinus albicaulis*) | - | 0.2 | - | - | 6 | 16 | 4 |
| Subalpine fir/western meadowrue (*Abies lasiocarpa*/*Thalictrum occidentale*) | 2 | 6 | - | - | - | 1 | 2 |
| Subalpine fir/globe huckleberry (*Abies lasiocarpa*/*Vaccinium globulare*) | 13 | 8 | 0.7 | - | - | 1 | 3 |
| Subalpine fir/pinegrass (*Abies lasiocarpa*/*calamagrostis rubescens*) | 9 | 9 | 2 | 9 | 4 | - | 6 |
| Lodgepole pine/elk sedge (*Abies lasiocarpa*/*Carex geyeri*) | - | - | - | - | 0.7 | - | 0.2 |
| Whitebark pine/grouse whortleberry (*Pinus albicaulis*/*Vaccinium scoparium*) | - | - | - | - | - | 2 | 0.2 |
| Wet forest | 19 | 13 | 13 | 12 | 21 | 27 | 17 |
| Upland sagebrush/grass | 3 | 3 | - | 19 | 5 | 2 | 7 |
| Mesic sagebrush/grass | 8 | 4 | - | 8 | 3 | - | 4 |
| Mesic sedge-grass | 8 | 4 | 0.5 | 9 | 4 | 1 | 4 |
| Hydric | 7 | 4 | 0.5 | 8 | 9 | 2 | 5 |
| Shrubby cinquefoil/blue bunchgrass (*Potentilla fruticosa*/*Festuca idahoensis*) | - | - | - | 2 | - | - | 0.5 |
| High elevation meadow | - | - | - | - | - | 1 | 0.2 |
| Total nonforest | 26 | 15 | 1 | 46 | 21 | 6 | 20.7 |

Table 19. Percent of each analysis area regarded as seasonally critical habitat.

| Area | Spring | Fall |
|---|---|---|
| Core | 27 | - |
| 1 | 22 | - |
| 2 | 2 | - |
| 3 | 26 | - |
| 4 | 17 | 6 |
| 5 | 18 | 16 |

Table 20. Numeric evaluations of grizzly bear food score, habitat type diversity, habitat type juxtaposition, grizzly bear food importance value, and standardized food importance value. The method of deriving food score, habitat type diversity, and habitat type juxtaposition is found in Appendix B.

| Area | Food score | Habitat type diversity | Habitat type juxtaposition | Food importance value | Standardized food importance value |
|---|---|---|---|---|---|
| Core | 0.261 | 1.89 | 0.46 | 0.49 | 0.80 |
| 1 | 0.264 | 1.71 | 0.30 | 0.45 | 0.73 |
| 2 | 0.286 | 0.81 | 0.21 | 0.23 | 0.38 |
| 3 | 0.240 | 1.88 | 0.30 | 0.45 | 0.74 |
| 4 | 0.310 | 1.63 | 0.36 | 0.50 | 0.82 |
| 5 | 0.400 | 1.53 | 0.36 | 0.61 | 1.00 |
| Outer | 0.304 | 1.77 | 0.31 | 0.54 | 0.87 |
| Total | 0.300 | 1.84 | 0.31 | 0.55 | 0.90 |

The second column in Table 20 is "Food Score". Food Score incorporates information about grizzly bear feeding preferences, the proportion of useful feeding sites occurring in the area, and the relative value of the available food. A glance at Table 20 reveals that the Core Area is lowest in this category except for Area 3. Food Score values are highest for Areas 4 and 5, primarily because, as previously noted (in Table 15), those areas are highest in the important subalpine fir/grouse whortleberry-whitebark pine phase habitat type, as well as containing significant amounts of two other important habitat types: subalpine fir/globe huckleberry and subalpine fir/bluejoint reedgrass. The Core Area, Area 1, and Area 3 are open. They have many excellent grizzly bear foods. However, most characteristic plant food items used by grizzly bears in open areas have less nutritional value than the subalpine fir/grouse whortleberry-whitebark pine phase habitat type so common in areas 4 and 5.

By comparison with the analysis areas, whose average Food Score is .300, the average food score for the entire Yellowstone Park area is .262; this means that the analysis area average is well above the park average.

The third column in Table 20 is "Habitat Type Diversity". This is a measure of the number of habitat types in an area. It will be noted that the Core Area ranks highest in this case. The significance of this distinction will be explained momentarily.

The fourth column in Table 20 is a measure of "Habitat Type Juxtaposition". In simpler language this is called "edge diversity", and it is a measure of "boundaries" that occur between various habitat types. Edge diversity is important to grizzly bears, as explained in the following discussion.

While habitat diversity influences the number of food types in an area, edge diversity influences the ease and practicality of a bear's use of those food items. Grizzly bears are known to prefer cover types with fine scale "mosaics", meaning they prefer spending their time along the edges of different cover types. It is assumed that grizzly bears have similar preferences when it comes to habitat types. This means that grizzly bears are, as the old naturalists might have said, creatures of the edges. Thus, it is not enough for an area to merely be diverse in habitat types. In order for the area to be most hospitable to grizzly bears, its habitat types should be present in a complex patchwork of small sections closely bordered by contrasting sections. This gives it a high edge diversity.

And, as Table 20 shows, the Core Area and Areas 4 and 5 have the highest edge diversity of the analysis areas.

The fifth column in Table 20 is "Food Importance Value". This number is derived by multiplying two of the previous values, Food

Score and Habitat Type Diversity. It thus gives a more sophisticated measure of an area's worth, by combining two simpler measurements. Areas 4 and 5 are highest in Food Importance Value, followed by the Core Area. Food Importance Value in the Core Area is largely a reflection of that area's high diversity. In Areas 4 and 5, abutting or in the Absaroka Mountains, the high Food Importance Value is the result of high Food Scores and moderately high diversity. Area 2, by contrast, has a markedly low Food Importance Value, primarily because that area is characterized by low diversity.

The sixth column, "Standardized Food Importance Value", is simply another way of looking at the relative merits of the areas' Food Importance Values. All it does is use the highest Food Importance Value earned by any of the areas as a "standard" against which to compare the others. The highest Food Importance Value, it will be noted, was 0.61, earned by Area 5. As the sixth column shows, this 0.61 was given a Standardized Food Importance Value of 1.00, and all others in column 6 are just percentages of that standard. Thus, the Core Area has a Food Importance Value of 0.49. The Core Area's Standardized Food Importance Value is 0.80 because 0.49 is 80 percent of 0.61. It is merely a way of permitting a more convenient comparison of the analysis areas.

Additional Interpretations Based on Cover Type. The previous discussions have involved habitat potential for grizzly bear foods and feeding activity. Cover type analysis can further refine our understanding of grizzly bear activities in the analysis areas.

Nonforested areas are commonly preferred by grizzly bears throughout Yellowstone grizzly bear summer range, including the Fishing Bridge area. For example, in the area surrounding and north and east of Fishing Bridge, whitebark pine and nonforest cover types are significantly preferred; cover types where lodgepole pine is climax (or is a long persistent seral species) are significantly avoided.

Within the analysis areas, the whitebark pine cover type corresponds most often with the previously mentioned subalpine fir/grouse whortleberry-whitebark pine phase habitat type. It also corresponds to a lesser extent with the subalpine fir/grouse whortleberry habitat type. From that we infer that these habitat types receive the highest preferential use by grizzly bears.

On the other hand, the lodgepole pine/elk sedge and subalpine fir/elk sedge habitat types correspond well with climax or long persistent seral lodgepole pine cover types. We infer they will receive little use by grizzly bears.

Known Food Importance Values for forest habitat types coincide well with grizzly bear use or avoidance. The subalpine fir/grouse whortleberry habitat type, whitebark pine phase, has the highest

Food Importance Value of all habitat types assessed, and the lodgepole pine cover types have the lowest of all the forest habitat types. Grizzly bears prefer the former and avoid the latter because feeding opportunities dictate that they do so.

Of the analysis areas, the Core Area has the highest level of subalpine fir/elk sedge habitat type, one of the least desirable for bears. But it also has the second highest level of nonforest cover. Areas 3, 4, and 5 are favored with comparatively high nonforest cover, or with high subalpine fir/grouse whortleberry-whitebark pine phase habitat types, and so have correspondingly high levels of favorable grizzly bear cover.

It is evident from the information and interpretations made on the analysis areas that they are by various standards good grizzly bear habitat. This is particularly true of the Core Area and Areas 4 and 5 to the east of it. So far very little has been said about how Fishing Bridge compares with grizzly bear habitat elsewhere in Yellowstone, beyond the comparison of parkwide Food Score with the analysis areas. In order to establish the relative worth of the Fishing Bridge area to grizzly bears it is necessary to compare the Fishing Bridge area to the rest of Yellowstone. In that way the foregoing measurements may be seen in a broader context.

Habitat Analysis: Parkwide Comparisons. The following analysis is based on information and procedures used earlier in this report. To review that earlier presentation, a rectangle was delineated around the Fishing Bridge area to include the acreage considered to be most directly under the influence of the Fishing Bridge development. Then 22 other rectangles or comparison areas were randomly placed around the park area. Vegetation types were derived from the digitized vegetation data now available for the park. Please turn back to Figure 16, which is a map showing the locations of all comparison areas.

In order to apply this general information on park vegetation to the needs of the grizzly bear, the acreage of each vegetation type in each comparison area was obtained from digitized data. The acreage was then multiplied by a Food Value Index (see Appendix B for method of derivation of the Food Value Index) derived by the Interagency Grizzly Bear Study Team. When the acreages of every vegetation type in a given comparison area had been so multiplied, the resulting figures were then added together. The sum was then divided by the total acres in the comparison area (a constant for all comparison areas) to obtain a food value per acre rating for the comparison area. This was done for all 22 of the randomly chosen comparison areas as well as for Fishing Bridge, Grant Village, and Bridge Bay.

Any area is more valuable to the bear in the long run if it is more diverse; the importance of habitat diversity and cover

diversity were amply demonstrated earlier in this report. An area that has several different vegetation types would be more likely to produce food more often, and under a wider variety of environmental conditions, than would a less diverse area. The system outlined briefly in the previous paragraph is aimed at determining the relative significance of the various comparison areas to the bear.

In order to give the calculation further weight, the food value per acre was multiplied by the Shannon-Weiner diversity index to get a Food Habitat Value for each comparison area (Shannon and Weaver 1949).

Table 21 compares the Food Habitat Value of the 22 comparison areas to the Fishing Bridge comparison area. Because of their considerable importance to current discussions over Fishing Bridge, Grant Village, and Bridge Bay have also been included in this table.

Reference to Figure 16, the map with the comparison areas on it, will show which portions of the park are of the greatest significance to feeding grizzly bears. It is noted that the ratings for the Absaroka Mountains are consistently high, as are those of the areas north of Mount Washburn. Fishing Bridge, then, is midway between two areas containing much of the park's best bear feeding habitat.

The Fishing Bridge area itself is, by comparison, also excellent bear habitat. It falls in the top 25 percent of the rectangles. This would seem predictable based on what has already been shown about it as an unusually diverse area, one above average in Food Score.

An obvious question at this point might be, "if Fishing Bridge is so important to Yellowstone grizzly bears, why does it not rate at the very top according to this set of measurements?" The answer is that, though this comparison is necessary and useful, to a great extent it takes Fishing Bridge out of its most relevant context, that of a developed area. It is alone among those highest-ranking comparison areas in having a major development in it. It need not be the highest of all in order to have a major impact on grizzly bears. All it need be is reasonably high, with the <u>opportunity</u> to have such an impact. It <u>is</u> reasonably high, and the Fishing Bridge development is its opportunity.

Furthermore, as has already been suggested, measurements of habitat value may not fully reflect an area's worth. Fishing Bridge is a natural crossroads of travel routes along the lakeshore and in the rich riparian zones of the Yellowstone River and Pelican Creek. Also, as will be shown, reseach to date has not fully evaluted the potential food productivity of this area. Already, though, the Fishing Bridge area has been established as an area of importance to grizzly bears.

Table 21. Grizzly bear food-habitat value for 22 comparison areas and three developed areas. A discussion of the derivation of these values is found in Appendix B.

| Comparison area | Value | Fishing Bridge | Grant Village | Bridge Bay |
|---|---|---|---|---|
| KA | 380 | | | |
| | | | | 463 |
| JA | 471 | | | |
| KB | 476 | | | |
| JB | 536 | | | |
| DC | 603 | | | |
| | | | 666 | |
| AC | 710 | | | |
| AA | 718 | | | |
| DA | 744 | | | |
| AB | 808 | | | |
| DB | 817 | | | |
| BC | 856 | | | |
| BA | 925 | | | |
| EA | 948 | | | |
| EB | 978 | | | |
| | | 999 | | |
| BB | 1,007 | | | |
| GA | 1,045 | | | |
| IB | 1,216 | | | |
| IA | 1,222 | | | |
| FA | 1,267 | | | |
| CB | 1,297 | | | |
| CA | 1,301 | | | |
| HA | 1,310 | | | |

For this reason, the Fishing Bridge development will always be a place where bears will want to live. As long as the development exists it will always be in the way of bears wanting to use the area, and will always cause conflicts between bears and people. It is simply too nice a place, by grizzly bear standards, for them not to continue to go there and continue to be removed from the population when they get into trouble.

Scat Analysis Interpretations: Parkwide Comparisons. Scat analysis shows yearly as well as seasonal proportionate diet volume. Because there are greater amounts of data for the total Yellowstone area than for Fishing Bridge, analysis of the Yellowstone area in general is more finely resolved than analysis of Fishing Bridge. Figure 34 gives a comparison of scat content through the season in the Fishing Bridge area with a corresponding scat content for the Yellowstone area. Notice that in most particulars there is a rough proportionate similarity between the two.

According to Figure 34, large mammals constitute a much smaller portion of the spring diet around Fishing Bridge than they do parkwide. It can be seen, however, that pocket gophers and various rodent caches supplant large mammals in the Fishing Bridge area. This is especially true in April and May when they may be the predominant diet items. According to Interagency Grizzly Bear Study Team data, pine nuts and large mammals serve only to supplement rodent caches during this period.

As Figure 35 shows, this diet difference has nutritional consequences. Protein is proportionately lower in the Fishing Bridge diet than in the greater Yellowstone area. As a consequence, spring grizzly bear health is very likely affected in the Fishing Bridge area, though the increased proportion of fat due to feeding on pine nuts may compensate to a limited extent.

As Figure 36 shows, grizzly bear use of open habitats for feeding is greater in the vicinity of Fishing Bridge than in the greater Yellowstone area. This increased proportionate use is almost wholly the result of increased availability of nonforest habitat; they use it more because there is more of it to use. However, grizzly bears probably do spend a higher percentage of feeding time out in open areas around Fishing Bridge than they do, on the average, in the Yellowstone area in general. This being the case, their feeding habits may be more frequently altered by the visible presence (distant or near) of humans than would be the feeding habits of grizzly bears in less open habitats.

Some Comments on the Limitations of Scat Analysis. The preceeding scat analysis, though it is the best currently available evidence, underestimates two important food sources and their use by grizzly bears in the Pelican Valley/Fishing Bridge area. One of these is spawning fish, which has been discussed in detail in the previous

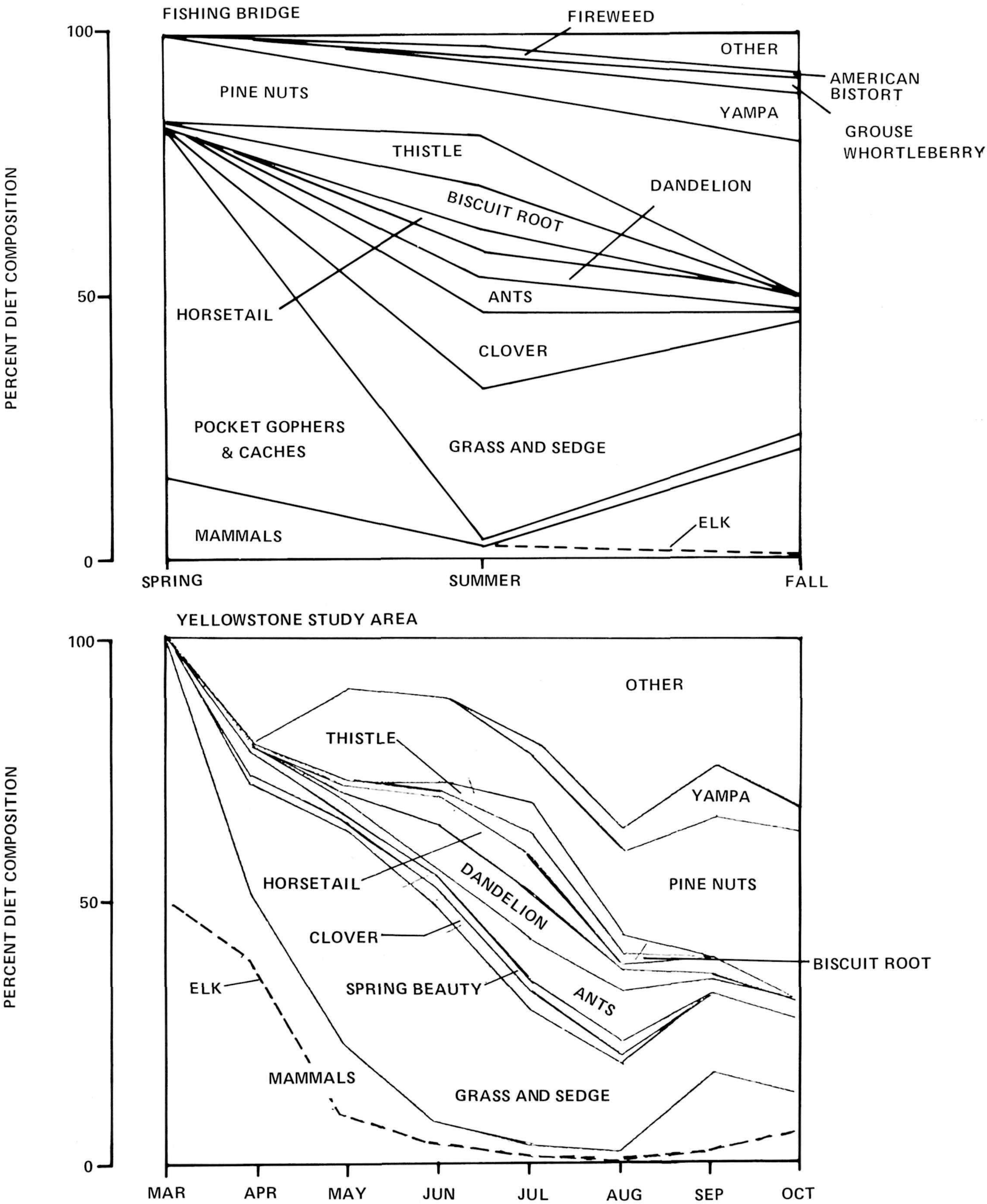



**FIGURE 34: SEASONAL PERCENT DIET-ITEM COMPOSITION OF GRIZZLY BEARS IN THE FISHING BRIDGE VICINITY COMPARED TO THE ENTIRE YELLOWSTONE STUDY AREA**

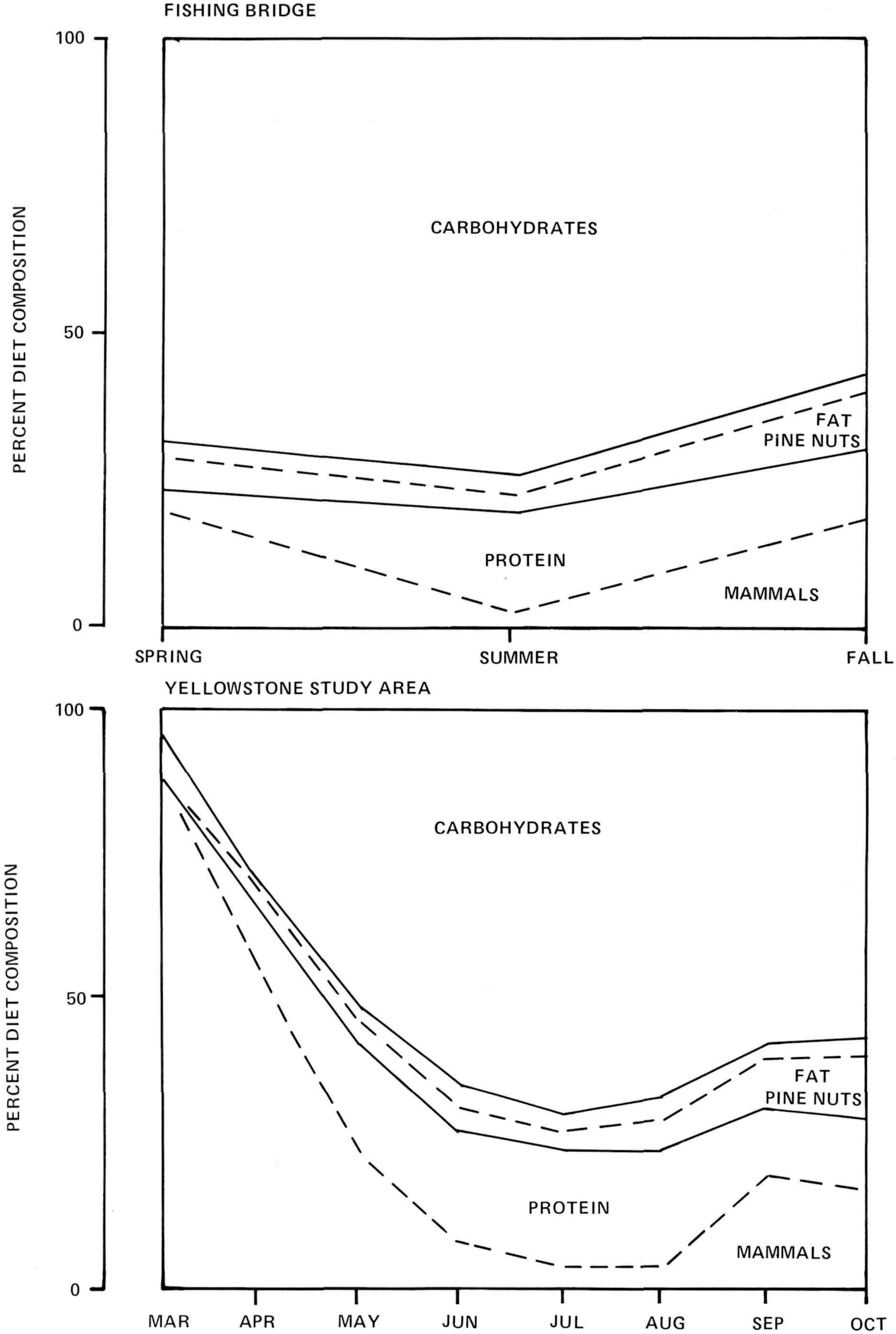



**FIGURE 35: SEASONAL PERCENT DIET NUTRITIONAL ELEMENT COMPOSITION FOR GRIZZLY BEARS IN THE FISHING BRIDGE VICINITY COMPARED TO THE ENTIRE YELLOWSTONE STUDY AREA**

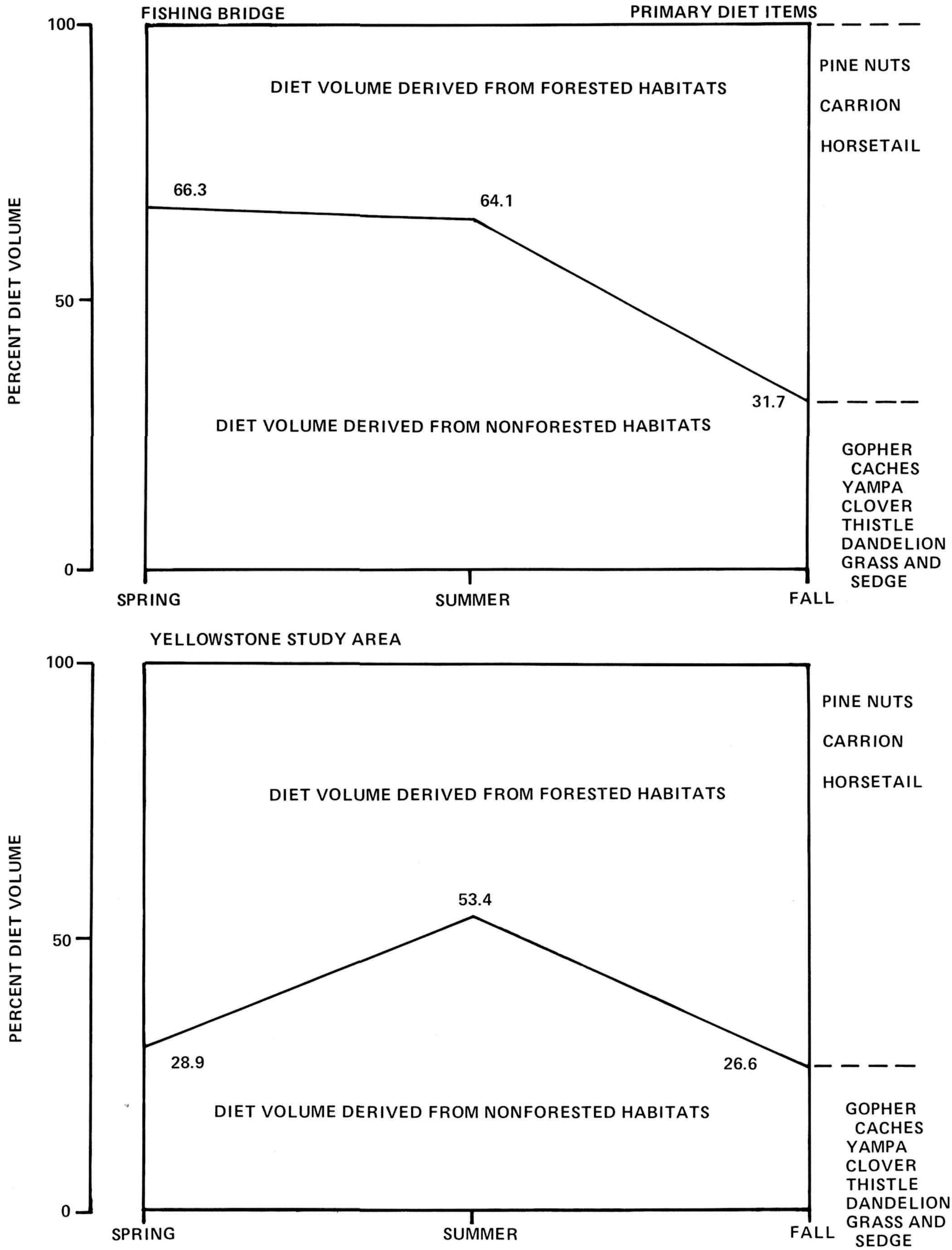



**FIGURE 36: SEASONAL PERCENT DIET VOLUME DERIVED FROM FORESTED AND NONFORESTED HABITAT TYPES FOR GRIZZLY BEARS IN THE FISHING BRIDGE VICINITY AND THE ENTIRE YELLOWSTONE STUDY AREA**

section of this report and in Table 4 (from Mealey 1975). Grizzly bear use of spawning fish is apparently not near its natural potential; thus, the previous scat analysis cannot reflect the full potential of fish for enriching grizzly bear diet in the Fishing Bridge area. Furthermore, scat analysis might underrepresent fish use in the Pelican Valley even if such use were heavy because scat containing fish would tend to be lost in high water more often than some other types of scat.

A more easily demonstrated shortcoming of the preceeding scat analysis involves grizzly bear use of large mammal carcasses in the spring. Like fish, the use of carcasses could increase the apparent lower level of spring protein intake in Pelican Valley as compared to the rest of the park. The following discussion evaluates current levels of carcass use by bears in Pelican Valley, using data collected in the spring of 1982 as an example year.

Mortality records kept as part of ongoing bison population research (Meagher unpubl. data) provide information on bear use of carcasses. Most available carcasses are bison, particularly in spring/summer as a result of winterkill. The Pelican Valley winter bison population is in a dynamic equilibrium, with the number of available carcasses in any given year correlated with the severity of the winter preceeding.

The winter of 1981-1982 was slightly above average in severity, but it followed two very mild winters. A mortality total of 66 bison was recorded, 57 of which were sexed and aged. Repetitive aerial counts suggest that a total actual mortality of 200-250 occurred. The sex and age records are biased by the mortality that occurred near the lakeshore from Lake to Lake Butte; this mortality is more easily recorded because of accessibility. This lakeshore mortality occurs almost entirely among mature and aged wintering bulls. It is most heavily represented in the record also because lakeshore carcasses are not as heavily utilized by scavengers as are other carcasses farther from roads and developed areas. Also, adult male carcasses are the longest-persisting and are more likely to be located because of size, thus further biasing the adult male category. The larger field sample from the Mary Mountain population (237 carcasses) suggests that actual mortality was perhaps 40 percent among yearlings (the previous year's calves), 14 percent unknowns, and the remaining 46 percent divided equally among mature to old animals of both sexes (with a slight chance of more males than females dying).

Extensive surveys by horseback in the Pelican Valley area revealed that the 47 carcasses not along the lakeshore (19 were along the lakeshore) were all utilized to some extent by bears. Use was attributed to bears based on the presence of bear scat, breakage of major long bones, "casing" of hide on legs, and major dismemberment, coupled with overall extent of utilization and

movement of large parts from site of death. Judgement was aided by familiarity with types of scavenging evidence left by other scavengers. An estimated one-half of the lakeshore carcasses were also used by bears. Thus an estimated 190-240 bison carcasses may have been used to some extent by bears in the Pelican Valley area in the spring of 1982 if we apply the percentage of use of examined carcasses to the total number of bison assumed or known to have died.

Extrapolation from Mary Mountain field data suggests that the number of carcasses would be as follows:

| | |
|---|---|
| last year's calves | 76-96 |
| unknown | 27-34 |
| females | 47-55 |
| males | 47-55 |

An estimate of total biomass available to scavengers would be made as follows:

| | |
|---|---|
| last year's calves | 250 pounds each x 76 = 19,000 pounds |
| unknown | 500 pounds each x 27 = 13,500 pounds |
| females | 800 pounds each x 47 = 37,600 pounds |
| males | 1500 pounds each x 47 = 70,500 pounds |

This would give a minimum total available biomass in bison carcasses alone of 140,600 pounds for the spring/summer of 1982. Some years the total would be considerably smaller, perhaps a quarter or less of this amount following a mild winter.

There are several reasons this carcass use is underestimated in current scat analysis. Because of extremely wet conditions and high water, field surveys are often not possible until mid-July, by which time evidence of smaller carcasses may disappear entirely. Scavengers consume and disperse carcass evidence, sedges and grasses grow and obscure evidence, and high water in June washes away both carcass materials and bear scat from mesic bottoms where many bison die. Until a way is found to more accurately measure the magnitude of this carcass use, estimates of the spring/summer food sources of Pelican Valley will likely underestimate available protein. The results of carcass analysis to date indicate that scat analysis data should be seen as a most conservative and underestimated measure of protein availability in Pelican Valley. The area is probably considerably more useful to bears in spring than we already know it to be.

Bear Observations. An examination of verified bear observations in and near the Fishing Bridge area provides a startling perspective on grizzly bear presence near that development. The following discussion is based on sighting data from the Interagency Grizzly Bear Study.

A rectangular area that includes the Fishing Bridge development and Pelican Valley is used to plot bear observations between 1973 and 1983. As Figure 37 shows, most of the observations are associated with open habitats in Pelican Valley. As previously noted, these habitats occur in this area in greater proportion than average for the Yellowstone area, and are more important to grizzly bears here than are similar habitats elsewhere.

Table 22 summarizes observations by year. The total of 57 flight observations and the total of 150 for all verified observations are fairly high for such a small area. The high proportion of open habitat and its importance to the bear undoubtedly contribute to these numbers being high.

Table 22 is equally interesting for what it says about the pattern of observations over the period 1973-1983. Note the sharp dropoff in sightings after 1977. This change is portrayed graphically in Figures 38 and 39. Figure 38 shows all observations for the period 1973-1977. Figure 39 shows all observations for the period 1978-1983. Eighty-nine percent of flight observations and 92 percent of all observations were made during the 1973-1977 period. The annual mean number of bears observed for the 1973-1977 period was 10.2 and 27.6 for flights and all observations respectively. The same respective annual mean numbers for the 1978-1983 period were 1 and 2.

This precipitous drop in observations cannot be meaningfully correlated with known mortalities or with control actions. It is not readily explainable in terms of changing habitat conditions. The most likely remaining variable is increased competition from visitor use. It seems possible that the grizzly bears' threshold of tolerance for human intrusion (overnight and day use combined) was reached in 1977 or 1978.

Table 23 offers evidence to buttress the suggestion that a threshold of tolerance was reached in about 1978 in the Pelican Valley. It shows an increase in visitor use nights in Pelican Valley of 83.6 percent between 1973 and 1979. But it does not fully reflect increases in use in this area during this period. The number of outfitters using the park has quadrupled in the past 10 years (S. Fowler pers. comm.), and the number of stock nights in the Pelican Valley has increased dramatically as well. Neither increase is fully reflected in the statistics for visitor use nights. Nor is increased backcountry presence by park personnel involved in monitoring increased visitor use.

As was pointed out in the section, "Current Levels of Human Use in the Fishing Bridge Area", ceilings on potential use of Pelican Valley by visitors and outfitters are twice present levels. If, as appears possible, current levels (Figure 40) are sufficient to reduce bear use of the valley's key habitat areas, increased levels in the future could only further reduce that use.

Table 22. Grizzly bear observations in the Fishing Bridge Area (as delineated in Figure 37), 1973-83.

| Year | Bears Observed | |
|---|---|---|
| | Flights | All verified |
| 1973 | 16 | 39 |
| 1974 | 18 | 30 |
| 1975 | 5 | 10 |
| 1976 | 11 | 36 |
| 1977 | 1 | 23 |
| 1978 | 0 | 1 |
| 1979 | 2 | 3 |
| 1980 | 3 | 4 |
| 1981 | 0 | 0 |
| 1982 | 1 | 1 |
| 1983 | 0 | 3 |

Table 23. Overnight visitor use of Pelican Valley, 1973-83 (values for the entire season).

| Year | Number of visitor use nights | Percent of 1973 level |
|---|---|---|
| 1973 | 1,308 | (100%) |
| 1974 | 1,405 | 107.4 |
| 1975 | 1,470 | 112.4 |
| 1976 | 1,485 | 113.5 |
| 1977 | 1,614 | 124.4 |
| 1978 | 1,833 | 140.1 |
| 1979 | 2,401 | 183.6 |
| 1980 | 2,070 | 158.3 |
| 1981 | 1,386 | 106.0 |
| 1982 | 1,338 | 102.3 |
| 1983 | 1,646 | 125.8 |

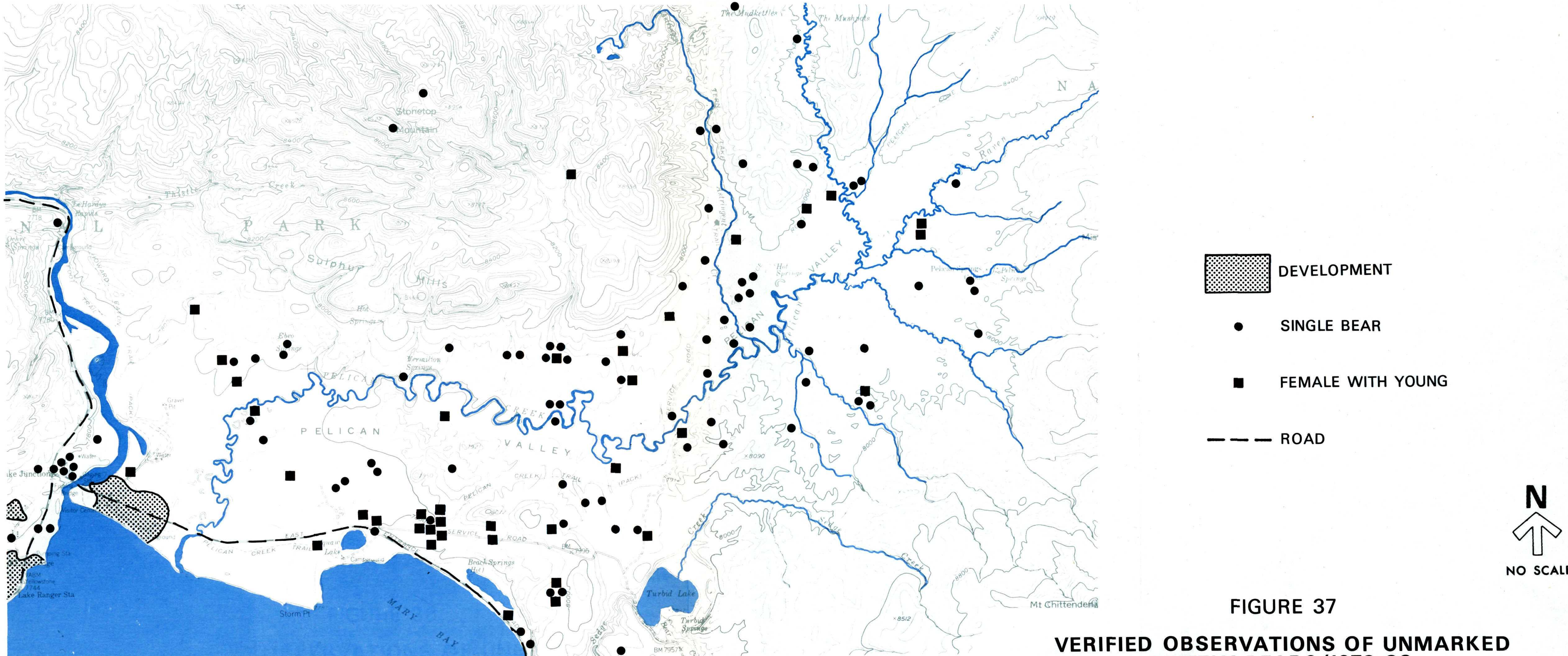



FIGURE 37

## VERIFIED OBSERVATIONS OF UNMARKED GRIZZLY BEARS/1973-83

YELLOWSTONE NATIONAL PARK
WYOMING/MONTANA/IDAHO
UNITED STATES DEPARTMENT OF THE INTERIOR-NATIONAL PARK SERVICE

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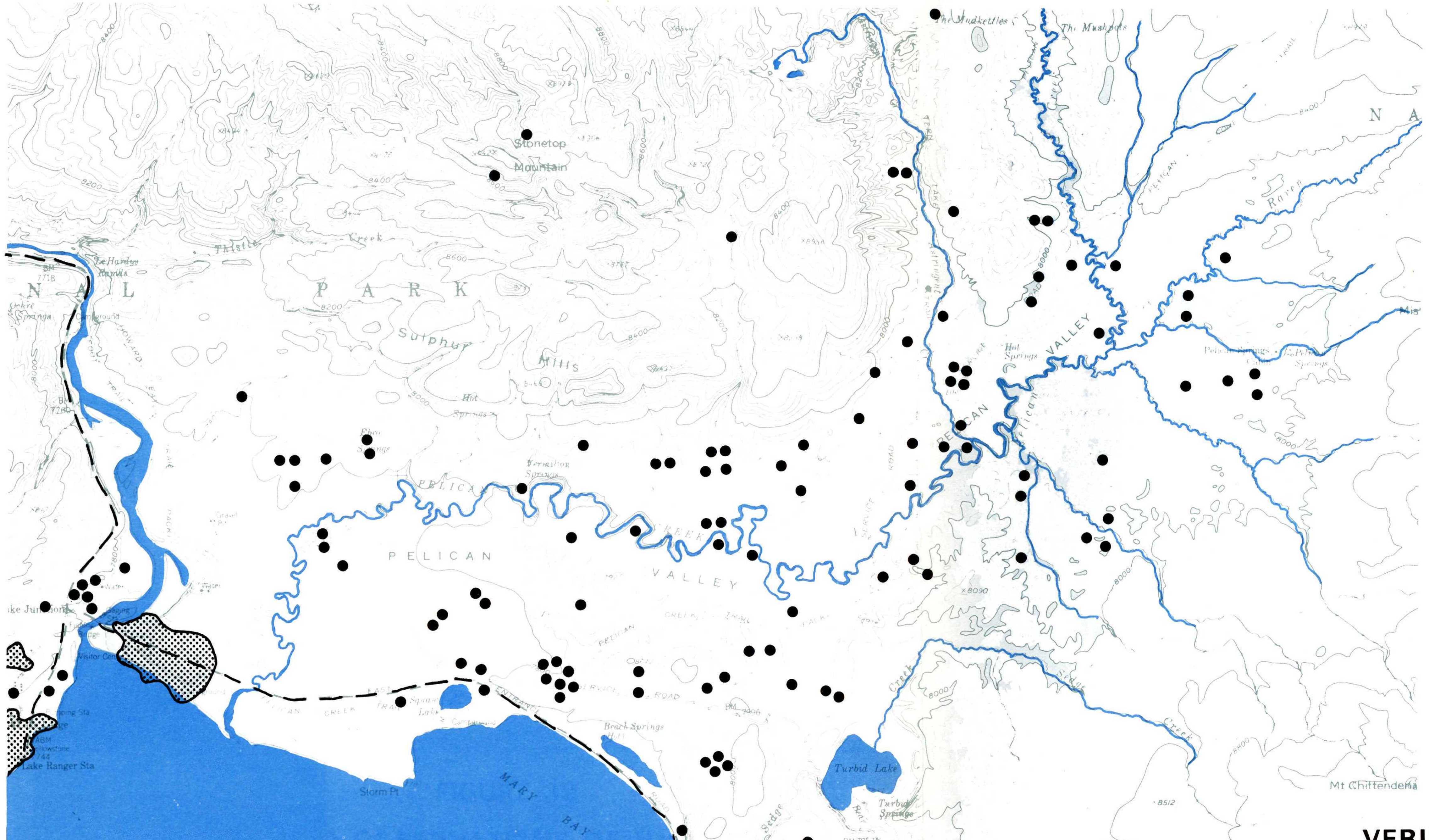


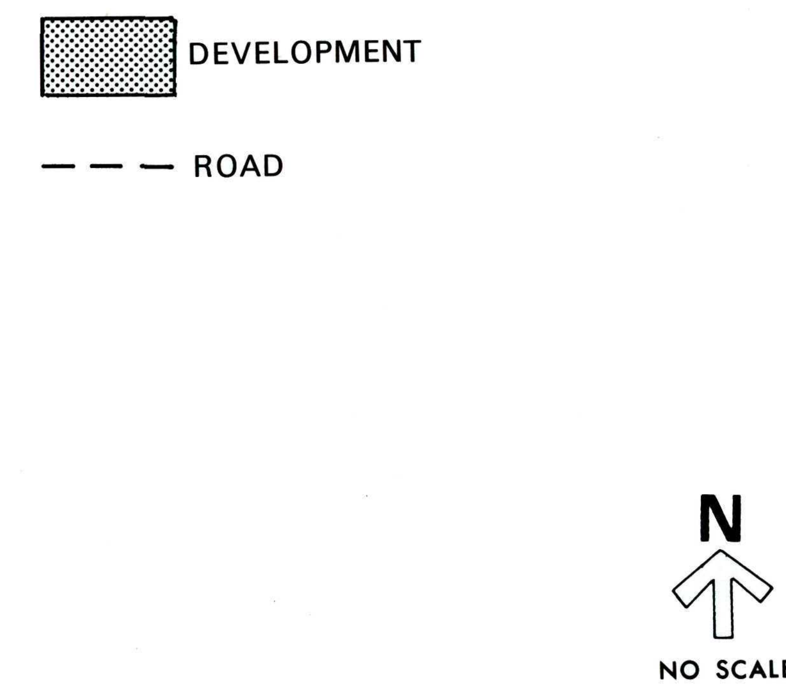


FIGURE 38

**VERIFIED OBSERVATIONS OF UNMARKED GRIZZLY BEARS/1973-77**

**YELLOWSTONE NATIONAL PARK**

**WYOMING/MONTANA/IDAHO**

UNITED STATES DEPARTMENT OF THE INTERIOR-NATIONAL PARK SERVICE

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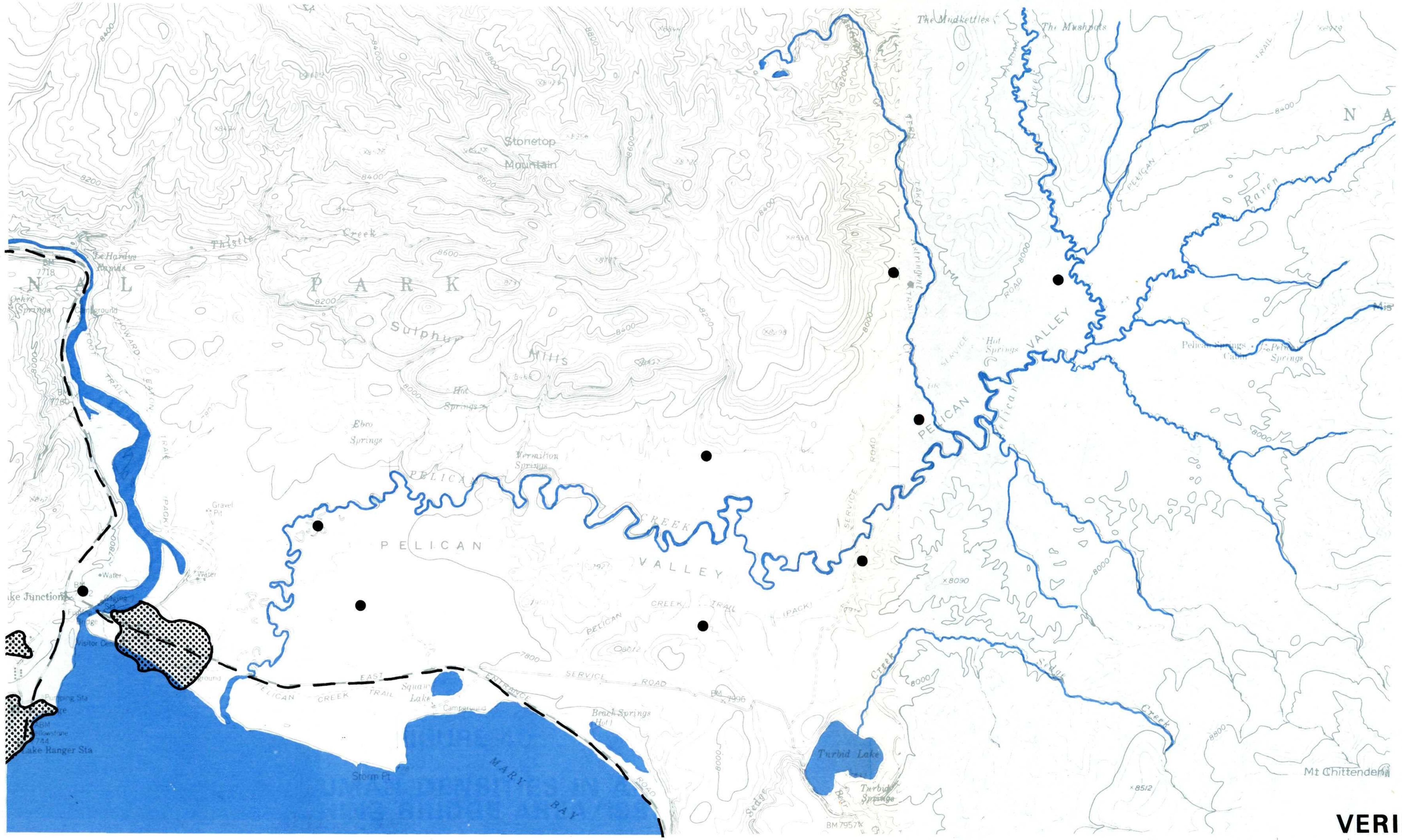


DEVELOPMENT

— — — ROAD

N

NO SCALE

FIGURE 39

**VERIFIED OBSERVATIONS OF UNMARKED GRIZZLY BEARS/1978-83**

**YELLOWSTONE NATIONAL PARK**

**WYOMING/MONTANA/IDAHO**

UNITED STATES DEPARTMENT OF THE INTERIOR-NATIONAL PARK SERVICE

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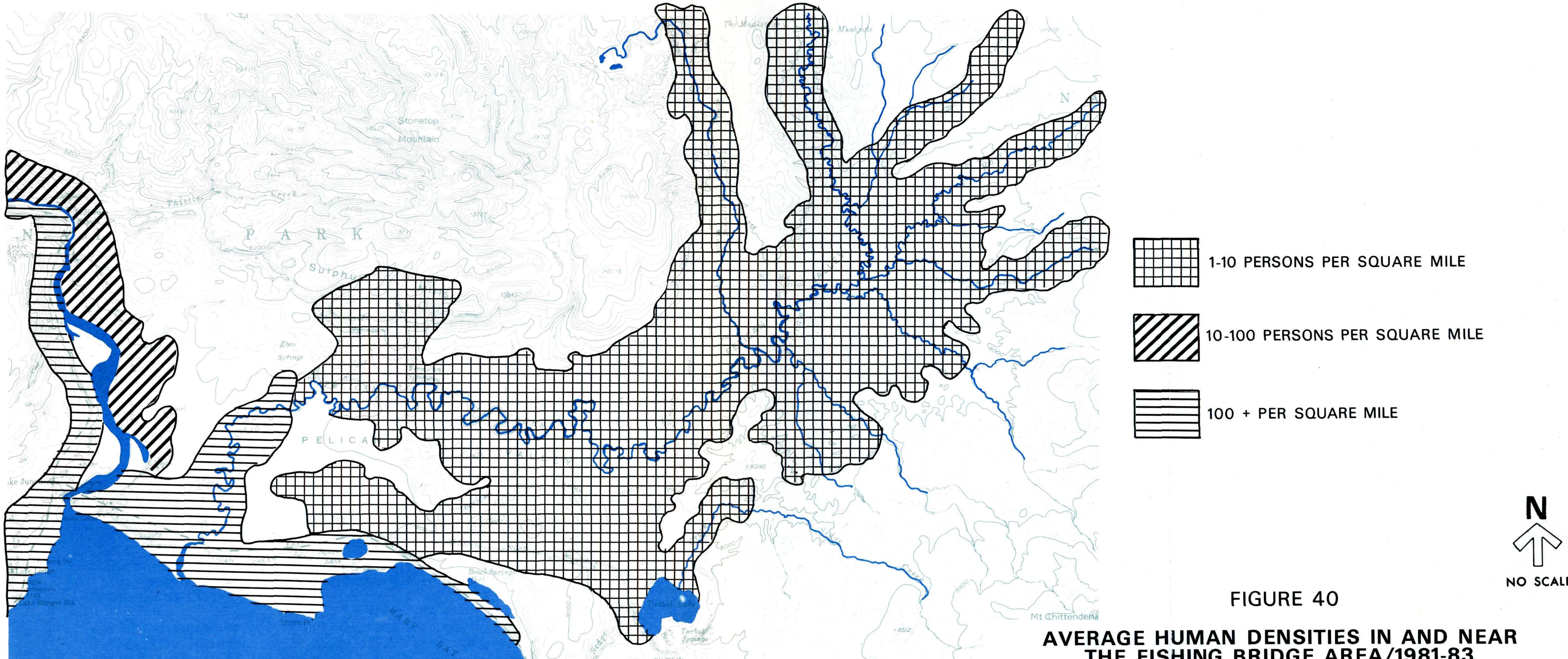


FIGURE 40

**AVERAGE HUMAN DENSITIES IN AND NEAR THE FISHING BRIDGE AREA/1981-83**

**YELLOWSTONE NATIONAL PARK**
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Little research has been done relating the effect of human presence on grizzly bears. One study in Glacier National Park (Jope 1982) showed three different responses of bears to the intrusion of humans. These responses were flight, neutrality, and agression. Each of these responses are apparently dependent on several things including individual temperament of the bear, frequency of contact, and training by the mother bear.

Data from two different studies in Yellowstone relating to this subject became available just as this report was going to press. These data show not only that human activities do displace some bears in the Yellowstone ecosystem, but also that some levels of activity may not seriously affect activity of some bears.

For several years certain restrictions have been in effect to modify human activity in the Pelican Valley area to accommodate grizzly bears. In brief these restrictions have involved closing the area to use until July 4 (recall the previous discussion on ungulate carrion and spawning fish). However, because of a bear-caused fatality in late July 1984, the Pelican Valley area was again closed to human use on August 1.

As part of a study to assess the effects of human use adjustment areas in the park, an observer was placed on the fire lookout at Pelican Cone to gather and correlate sightings of bears and humans. The data he gathered, which involves bear and human use of the meadows of Pelican Valley, strongly support the idea that increasing human use displaces bears from their preferred meadow habitats in Pelican Valley.

Because of the sequence of events with the opening and closing of Pelican Valley in the summer of 1984, it is possible to compare bear activity as it related to observations of people. Figure 41 presents this comparison.

The first period, June 19 - July 4, the area was closed, but a low level of human use was observed (0.45 people per day). The average number of bear observations per day was 2.52.

During the second period, July 4 - July 14, human use increased to 16.3 people per day and the average number of bear observations decreased slightly to 2.3.

Fishing season opened on July 15, and through July 31, human use radically increased to 36.2 per day. Bear observations dropped simultaneously to 1.2 per day.

The entire valley was closed on August 1, and the observer departed on August 14. During this period human use dropped to 3.2 people per day and use of the valley by bears climbed to 3.9.

These observations involve only meadow areas. Both humans and bears use forested portions of the valley, of course, and so it is

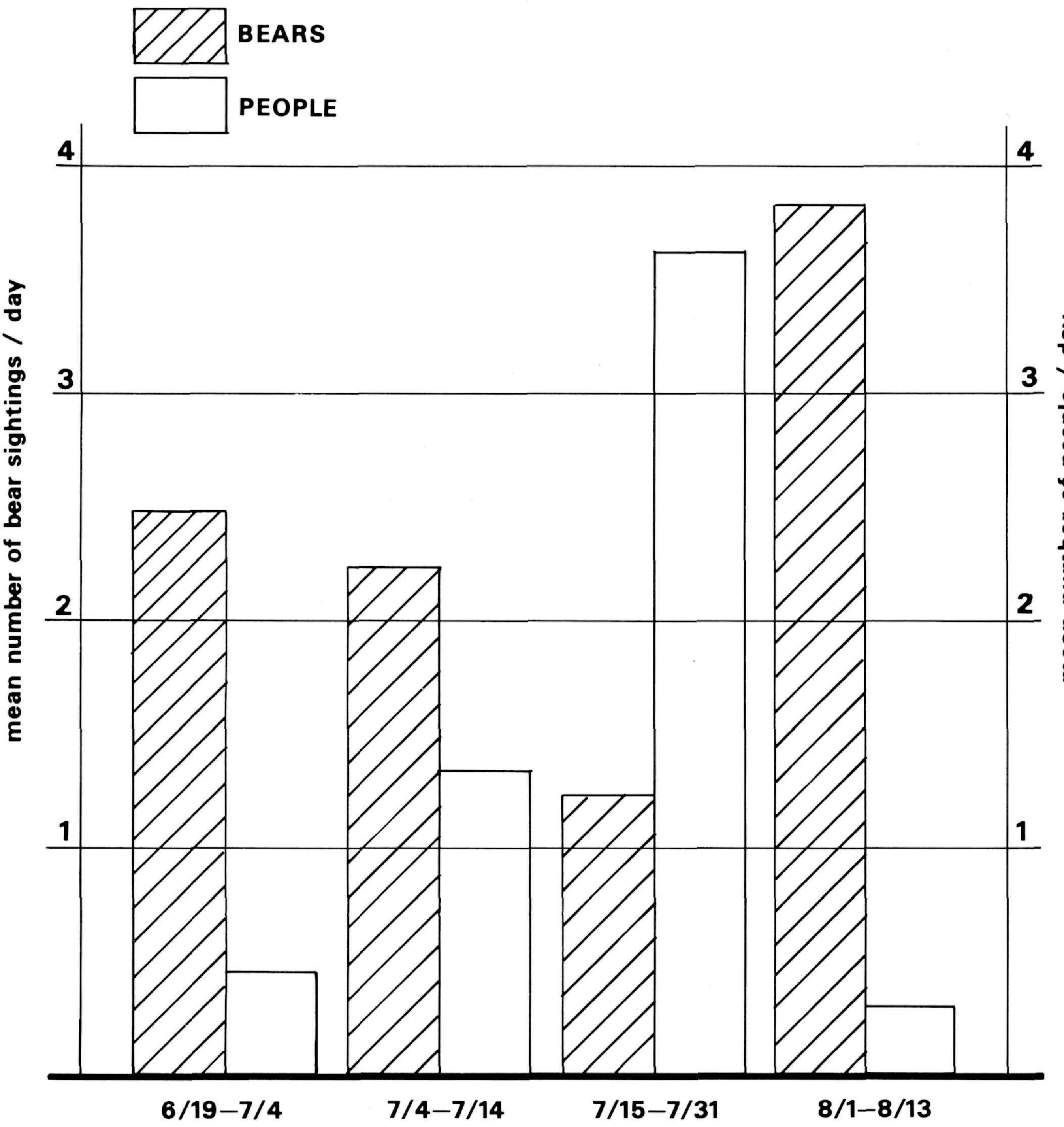



**FIGURE 41: HUMAN USE LEVELS AND GRIZZLY BEAR ACTIVITY IN THE MEADOW AREAS OF PELICAN VALLEY, 1984**

not yet possible to measure how far grizzly bears were displaced from the meadows. It is not known if they "left the neighborhood" or merely retreated to the cover of nearby trees. In either case, their use of preferred habitat was drastically curtailed.

Another recent study (Schleyer et al. 1984) has shown similar results. By intensive monitoring of some radio-collared grizzly bears the researchers were able to determine when a bear began to move because of a hikers presence, even though the bear could not be seen. This allowed them to study the effects of human activity on the movements of bears as a result of human intrusion and activity. It was found that the bears would most often move away from the researchers when they came within about 400 yards of where the bear was resting during the day. The bears would then move rapidly off for a distance of about a mile and a half before settling down again. On the other hand, a few of the bears studied did not seem to be affected by the presence of the researchers as close as 200 yards or less.

Though these recent studies show that humans can displace grizzly bears from an area, they also provide some data suggesting that there are levels of compatibility (both displacement and compatibility are generally recognized). The need to host both wildlife and humans is Yellowstone's greatest challenge in ecological management, and has been summed up by Houston (1982).

> The management conflicts facing park managers are, in essence, best defined as problems of managing man. This view, while essentially correct, is also a bit trite and risks missing the other side of the coin. The unique assemblage of species on the northern range is a source of immeasurable interest and pleasure to park visitors. Perhaps the greatest revelation to me was that maintenance of reasonably intact natural ecosystems was, in fact, possible in the presence of large numbers of visitors - the mere presence of man had to be distinguished from his significant ecological effects. The northern range, indeed the entire park, is tangible proof that this can be done.

It appears, based on the correlation presented in Figure 41, that Fishing Bridge-Pelican Valley grizzly bears and humans have provided us with additional tangible proof that they can indeed share a national park.

Bear observations can also be used to compare levels of bear activity in the Fishing Bridge area with those in other portions of the Yellowstone Ecosystem. Data compiled and presented by Basile (1982) reinforces previous interpretations of the Fishing Bridge area as one of great importance to grizzly bears.

Basile presented composite maps which placed the Yellowstone Ecosystem study area (as defined by the Interagency Grizzly Bear Study Team) on a grid, and reported numbers of sightings in each grid square. Basile (Figure 42) broke the information down into various categories, including verified sightings, unverified sightings, sign, and certain population segments. For the purposes of the present discussion, the composite of all grizzly bear sightings and sign, verified and unverified, for the period 1973-1979 is a reasonable approximation of the relative distribution of grizzly bears in the Yellowstone Ecosystem.

Certain biases are acknowledged in these data: bear sightings are in part a function of the observer effort, which is in part a function of the proximity of roads and developments; radio relocations are not necessarily reflections of uniform tracking effort in all parts of the park, but may concentrate on relocating bears known to inhabit a certain area. Other variations and biases are suggested by Basile (1982). Nonetheless, there is sufficient data to suggest a highly disproportionate concentration of grizzly bears in the vicinity of Fishing Bridge, not only compared to the Yellowstone Ecosystem in general but to the park's other major developed areas in particular.

The total of sightings for the square that includes Fishing Bridge is 141, a number half again as large as the number in any other square. This is all the more impressive because a considerable portion of the Fishing Bridge square is occupied by Yellowstone Lake. Moreover, the square directly east of the Fishing Bridge square, though it contains no developments, is itself unusually high. The average number of sightings for the 109 squares that are all or partly within Yellowstone Park is 19.14 per square; the square containing Fishing Bridge is more than seven times that average.

Fishing Bridge's concentration of sightings and sign is even more impressive when we consider that, as Table 22 showed, after 1977 the Fishing Bridge area was suffering a radical decline in bear sightings. Considering this, as well as the disadvantage of being in part occupied by Yellowstone Lake, the number of sightings in the Fishing Bridge square is little short of extraordinary. It again points up the area's ability to attract bears and generate bear problems.

<u>Geographical Extent of the Influences of Fishing Bridge on the Grizzly Bear Population.</u> A further measure of the worth of the Fishing Bridge area to grizzly bears can be obtained by determining the geographical extent of the influence of this development. Any area of good habitat has the potential of influencing the bear population over a much wider area than its immediate vicinity. A graphic example of that was provided by the Craighead study (1959-1970) in Yellowstone, which demonstrated the great distances that bears would travel in order to use the garbage dumps (Craighead 1980).

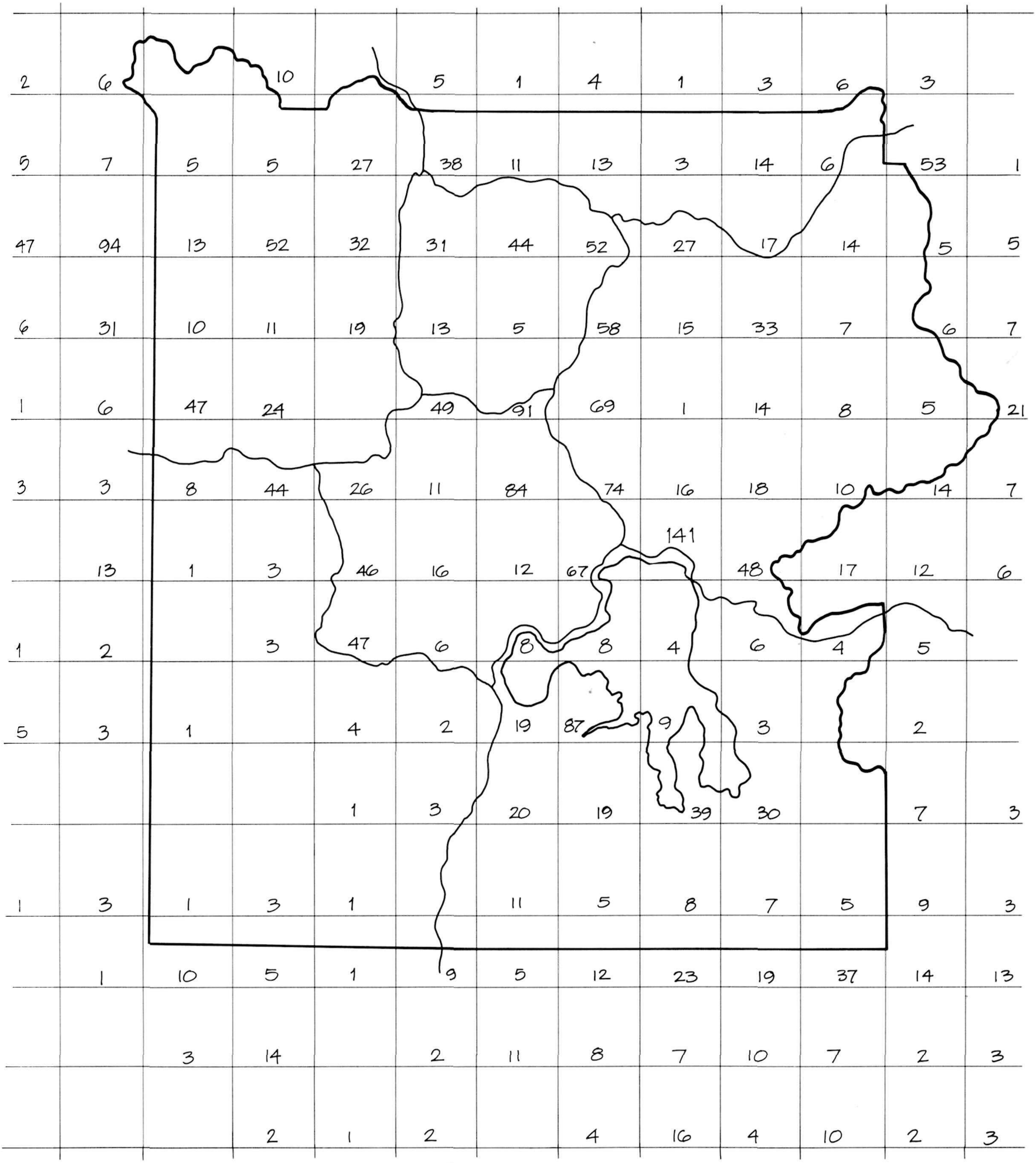



**FIGURE 42. COMPOSITE OF ALL GRIZZLY BEAR SIGHTINGS AND SIGN, VERIFIED AND UNVERIFIED, FOR THE YEARS 1973-79 (FROM BASILE 1982)**

Geographical extent of influence is defined, for the purposes of this discussion, as the area used by bears which are known to include Fishing Bridge in their range. The following procedure was used:

1. Radio-instrumented bears whose home ranges included the area delineated in Figure 37 were considered as influenced by that area.

2. Radio-relocations for all of these bears were then plotted.

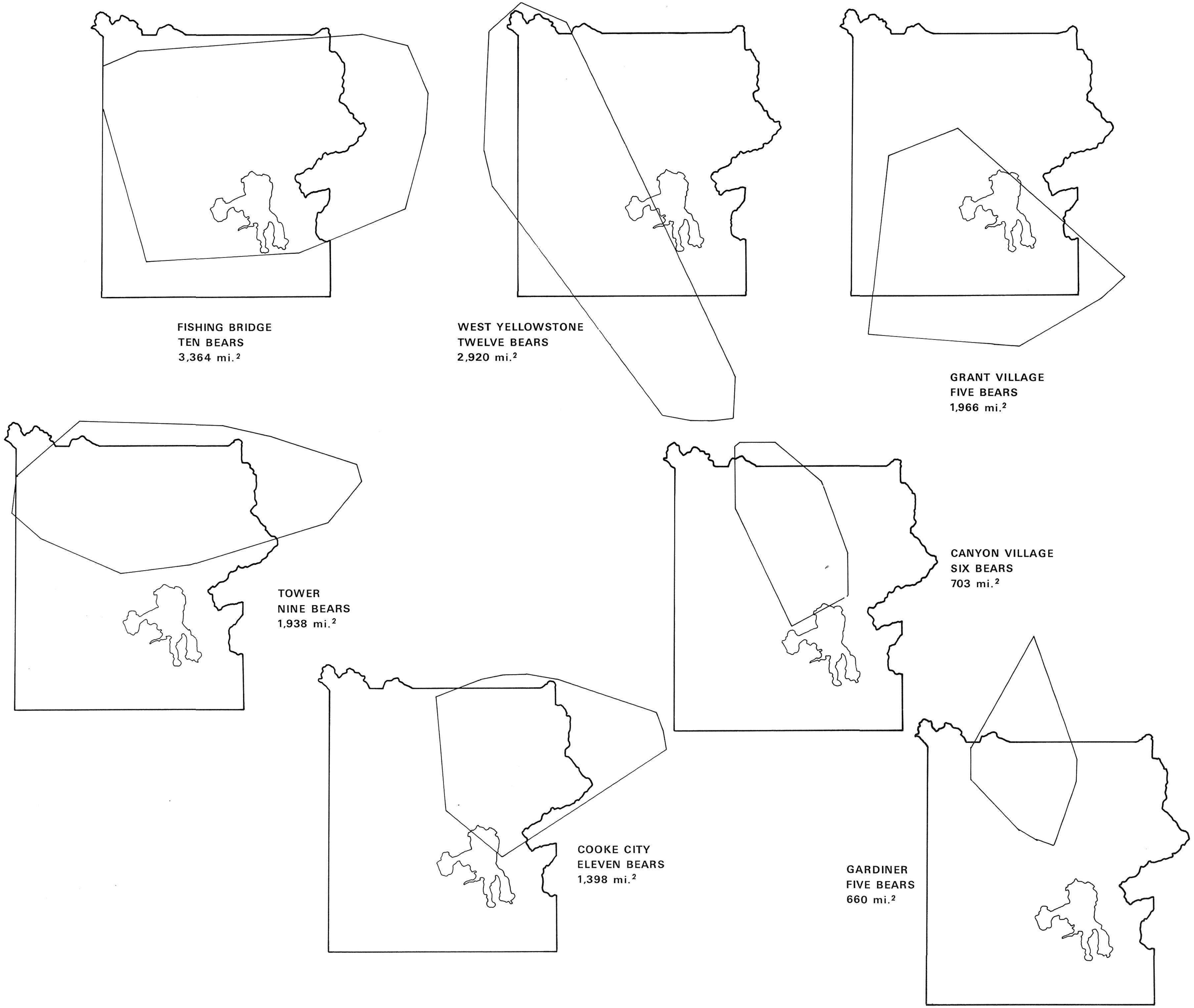
3. Radio-relocations that were associated with transplants were then deleted.

4. The area enclosed by the outermost points of the remaining radio-relocations were taken to be the area of potential influence of the Fishing Bridge area.

The results are shown in Figure 43. Ten instrumented bears included the area in their home ranges (as did of course an undetermined number of uninstrumented bears). The area enclosing all relocations and representing the population influence of the Fishing Bridge area is 3,364 square miles, which is equal to 99 percent of the area of Yellowstone National Park. Portions of two states (Wyoming and Montana) and two national forests (Gallatin and Shoshone) are included.

By comparison, geographical extent of influence was also calculated for Grant Village, using the same procedures. For Grant Village, five instrumented bears were involved, with a combined home range of 1,966 square miles. Two states were involved (Wyoming and Idaho) as were three national forests (Shoshone, Bridger-Teton, and Targhee). West Yellowstone had an area of influence of 2,920 square miles based on the movements of 12 bears. Canyon had an area of influence of 703 square miles based on instrumentation of 6 bears. Gardiner had an area of influence of 660 square miles for 5 instrumented bears. Cooke City had an area of influence of 1,398 square miles for 11 instrumented bears. Tower, had an area of influence of 1,938 square miles for 9 instrumented bears. Old Faithful had an area of influence of 1,943 square miles for 5 instrumented bears.

It could be argued that this measure of geographical extent of influence is a function in part of the number of bears instrumented; by this line of reasoning it would be expected that Fishing Bridge's influence would be larger than, say, Gardiner's, because twice as many bears were involved in the Fishing Bridge measurement than at Gardiner. To some extent this may be true, but in fact the area of influence of Fishing Bridge is more than four times that of Gardiner's. Also, Fishing Bridge's ten instrumented bears have a geographic range that is more than twice the size of the range of Cooke City's eleven bears, and is 400




# FIGURE 43: THE GEOGRAPHICAL EXTENT OF INFLUENCE USED BY RADIO-COLLARED BEARS - 1977-83

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square miles larger than the range of West Yellowstone's twelve bears. Fishing Bridge is, by this measurement, clearly in possession of an unusually large area of influence, the largest of any development in or near the park, and substantially larger than almost all other developments.

It must be kept in mind, however, that these are minimum estimates based only on that portion of the bear population that has been radio-instrumented. Undoubtedly the intensity, if not the gross size, of the true influence of Fishing Bridge is greater than these calculations reveal.

Conclusion. The Fishing Bridge development is influencing the grizzly bear population in many ways. Human injuries have been substantial, and in themselves are a serious problem, but they have a real, if difficult to precisely quantify, impact on the "public image" of the grizzly bear. Human injuries may work to the bear's disadvantage in a variety of social and political ways, just as they work to the disdvantage of an agency administering an area in which bears injure people.

Management actions aimed at controlling bear problems at Fishing Bridge are dangerous in several ways: to park personnel and bystanders who risk injury from the bear; to the bear that may be accidentally lost in one way or another during the management action; and to the bear that may become incurable as a campground raider. Ultimately management actions are dangerous just because they remove a certain number of bears from the population.

A wide variety of human influence, including the above as well as various visitor activities, may in the long run be even more harmful to the bear as they displace grizzly bears from preferred habitat.

The foregoing presentation demonstrates, by the use of many kinds of evidence and many perspectives, that all of these influences are now, and for some time have been, reducing the grizzly bear population as that population attempts to use the Fishing Bridge area.

Grizzly bears are marvelously adaptive omnivores. They are legend for their ability to remember the source of a good meal for many years. A single careless camper, much less a camper inclined to bait a bear in for closer viewing, may be responsible for the death of one or more grizzly bears. Not only is Fishing Bridge desirable to bears, the development itself is so located that even bears with no interest in human foods are "channeled" toward it along natural travel routes up the east bank of the Yellowstone River or along the north shore of Yellowstone Lake. In this way the natural setting conspires with the host of human influences already described, and grizzly bears are enticed into trouble.

Any development in the Yellowstone Ecosystem has potential for adverse effects on the grizzly bear. The mandate of the National Park Service requires that agency to make the park available for the use and enjoyment of the public as well as to preserve native life forms. There will, therefore, always be a certain sacrifice of grizzly bear habitat in Yellowstone Park, with a corresponding influence on the health of the grizzly bear population.

As has been amply demonstrated, Fishing Bridge is an outstanding instance of a developed area having an intolerably high impact on the grizzly bear. The National Park Service's responsibilities to the grizzly bear under the terms of the Endangered Species Act, as well as under the mandate of the National Park Service Act of 1916, are a matter of record. The Fishing Bridge development is seriously compromising current efforts by the National Park Service to fulfill these legal responsibilities.

The information presented in this report is useful in explaining why it is not likely that grizzly bears that have been attracted to the Fishing Bridge area will simply "go next door" to Bridge Bay should the Fishing Bridge development be removed. As Table 21 shows, the area around Bridge Bay is not high quality grizzly bear habitat; it is well below the park average. Nor is the area around Bridge Bay attractive to bears for other reasons; it is not known to be of interest as a travel route. There is a sharp dropoff in the quality of bear habitat west and south of Fishing Bridge, a clear delineation between the excellent habitat of the Fishing Bridge peninsula and Pelican Valley on the one hand and the relatively low diversity forested lands adjacent to the western lakeshore on the other. For this reason it is not expected that Bridge Bay Campground will experience a significant increase in bear problems; it has taken a combination of excellent habitat and poorly located development to cause the problems at Fishing Bridge. Such a combination does not exist at Bridge Bay.

The information presented also sheds light upon the agreement between the National Park Service and the U.S. Fish and Wildlife Service by which Grant Village was built with the understanding that the Fishing Bridge development would be removed (see Appendix E). Based on the relative potential influence of these two areas, as shown in Figures 42 and 43, and on the relative food value of the two areas, as shown in Table 21, it appears that ecologically this agreement is a good deal for the grizzly bear. Fishing Bridge, by these and other standards mentioned earlier, has considerably greater potential influence on the grizzly bear population than does Grant Village. It must be remembered, though, that most of these statistics are based on an unfinished development at Grant Village, and that even in that condition the Grant Village area had considerable impact on the grizzly bear. Now that it is nearing completion, Grant Village is exercising almost its full potential for detrimental impact on the grizzly bear population. Fishing Bridge continues to exercise its full

potential. The results are predictable and grave. If Fishing Bridge alone were able to seriously affect the grizzly bear in Yellowstone, Fishing Bridge operating in concert with Grant Village has a potential cumulative effect that is disastrous.

ACKNOWLEDGEMENTS

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The project was overseen by J. Varley. The report was organized, edited, and brought to its final narrative form by P. Schullery.

# APPENDIX A

## Habitat Types and Cover Types in Yellowstone National Park

# HABITAT TYPES OF YELLOWSTONE NATIONAL PARK

Compiled by Don G. Despain

The habitat type concept (Daubenmire 1968) makes use of the fact that plants are integrators of all the environmental factors affecting the area in which they live. Certain plants can be used to indicate the particular environmental complex of a site and the climax plant community to be expected in that area. Aside from the influence of the soils and climate of a site that determine the kinds of plants occurring there, the time since last disturbance, or successional stage, is also important. In forested communities, this is indicated by the cover type or stand structure. Knowing the vegetation type (habitat type plus cover type), it should be possible to predict within reasonable limits the existence and abundance of plant species of an area of interest.

Mapping of stands of the same vegetation type indicates the abundance and distribution of plant species of concern, such as those used as food by grizzly bears, and gives an indication of the vegetative value of an area to the grizzly bear.

Animal food sources are not as closely predicted by habitat type and cover type as are vegetal food sources.

## Forested Habitat Types

2LL Subalpine Fir/Grouse Whortleberry Habitat Type, Grouse Whortleberry Phase (Abies lasiocarpa/Vaccinium scoparium - V. scoparium)

Climax and late seral stages dominated by subalpine fir and engelmann spruce (Picea engelmannii) with grouse whortleberry dominating the forest floor. Other shrubs are absent or rare. Elk sedge (Carex geyeri), heartleaf arnica (Arnica cordifolia), one-sided wintergreen (Pyrola secunda), and a good cover of mosses and lichens common on the forest floor. Seral stages dominated by lodgepole pine (Pinus contorta). Engelmann spruce and subalpine fir are common in the understory. On rhyolite flows with rainfall less than 40 in/yr., this type becomes a lodgepole pine - whitebark pine (Pinus albicaulis) climax type with a very sparse understory and forest floor cover.

2LG Subalpine Fir/Grouse Whortleberry Habitat Type, Pinegrass Phase
(Abies lasiocarpa/Vaccinium scoparium - Calamagrostis rubescens)

Similar to 2LL but at lower, warmer sites where pinegrass becomes codominant on the forest floor. Seral stages often appear more

open with a sward of pinegrass obscuring in the grouse whortleberry. Early blue violets (Viola adunca) and sticky geranium (Geranium viscosissimum) are often common in these stands.

2L3 Subalpine Fir/Grouse Whortleberry Habitat Type, Whitebark Pine Phase
(Abies lasiocarpa/Vaccinium scoparium - Pinus albicaulis)

Upper timberline type with whitebark pine as a dominant or codominant seral species with lodgepole pine (Pinus contorta) and engelmann spruce (Picea engelmannii). These species also remain conspicuous in the late seral and climax stands. Grouse whortleberry may form nearly continuous cover. Showy aster (Aster conspicuus), engelmann's aster (Aster engelmannii), ross's sedge (Carex rossii), and fireweed (Epilobium angustifolium) are common.

2D0 Wet forests consisting of several habitat types.

The overstory and understory are dominated by subalpine fir (Abies lasiocarpa) and engelmann spruce (Picea engelmannii). The forest floor is usually wet, dominated by a variety of wet site species including horsetails (Equisetum spp.), bluejoint grass (Calamagrostis canadensis) trapper's tea (Ledum glandulosum), twisted-stalk (Streptopus amplexifolius), arrowleaf groundsel (Senecio triangularis), and a variety of wet site mosses. Seral stands usually have a good representation of engelmann spruce and lodgepole pine (Pinus contorta).

2F0 Subalpine Fir/Western Meadowrue Habitat Type (Abies lasiocarpa/Thalictrum occidentale)

Late seral and climax stands dominated by subalpine fir and engelmann spruce (Picea engelmannii). The forest floor usually has mountain sweetroot (Osmorhiza chilensis), heartleaf arnica (Arnica cordifolia), pinegrass (Calamagrostis rubescens), and fireweed (Epilobium angustifolium), along with western meadowrue. Alpine prickly current (Ribes montigenum) can be a common shrub. Seral stands dominated by lodgepole pine (Pinus contorta) with a lush forest floor cover.

2H0 Subalpine Fir/Elk Sedge Habitat Type (Abies lasiocarpa/ Carex geyeri)

Dry type related to 2LL. Englemann spruce (Picea engelmannii) and subalpine fir are slow growing but quite common in the understory of the later seral stages along with whitebark pine (Pinus albicaulis). Elk sedge dominates the forest floor. Heartleaf arnica (Arnica cordifolia) and silvery lupine (Lupinus argenteus) are also usually present. Lodgepole pine (Pinus contorta) forms the seral forest. Because of the slow growth of spruce and fir, nearly all stands are dominated by lodgepole pine.

2CL Subalpine Fir/Twinflower Habitat Type, Grouse Whortleberry Phase (Abies lasiocarpa/Linnaea borealis - Vaccinium scoparium)

Climax and late seral stages dominated by subalpine fir and engelmann spruce (Picea engelmannii). Lodgepole pine (Pinus contorta) forms the seral stages. The understory is dominated by engelmann spruce and subalpine fir. There is no shrub layer, but utah honeysuckle (Lonicera utahensis) is often scattered throughout. The forest floor is usually dominated by grouse whortleberry with twinflower conspicuous beneath the whortleberry. Heartleaf arnica (Arnica cordifolia), fireweed (Epilobium angustifolium), raceme pussy-toes (Antennaria racemosa), and one-sided wintergreen (Pyrola secunda are usually present.

2EE Subalpine Fir/Globe Huckleberry Habitat Type, Globe Huckleberry Phase (Abies lasiocarpa/Vaccinium globulare - V. globulare)

Late seral and climax stands dominated by engelmann spruce (Picea engelmannii) and subalpine fir. Lodgepole pine (Pinus contorta) is the seral forest species. The understory is dominated by engelmann spruce and subalpine fir. Globe huckleberry is well represented. Utah honeysuckle (Lonicera utahensis) and shiny-leaf spirea (Spiraea betulifolia) are also quite common. Cascade mountain-ash (Sorbus scopulina) is occasionally present. On the forest floor, pinegrass (Calamagrostis rubescens), elk sedge (Carex geyeri), ross's sedge (Carex rossii), heartleaf arnica (Arnica cordifolia), showy aster (Aster conspicuus), engelmann's aster (Aster engelmannii), and one-sided wintergreen (Pyrola secunda) are quite common.

2SO Subalpine Fir/Ross's Sedge Habitat Type (Abies lasiocarpa/ Carex rossii)

Late seral and climax stands dominated by lodgepole pine with a poor representation of subalpine fir. Engelmann spruce (Picea engelmannii) is rare or absent. Lodgepole pine (Pinus contorta) is the seral dominant. Trees are widely spaced and slow growing. Forest floor is also depauperate. With ross's sedge is western yarrow (Achillea millefolium), heartleaf arnica (Arnica cordifolia), and mountain sweetroot (Osmorhiza chilensis).

2GO Subalpine Fir/Pinegrass Habitat Type (Abies lasiocarpa/ Calamagrostis rubescens)

Late seral or climax stands dominated by subalpine fir with an occasional engelmann spruce (Picea engelmannii). Lodgepole pine (Pinus contorta) forms the pioneer stage and continues important in the late seral and climax stands. Douglas-fir (Pseudotsuga menziesii) can also be represented in the seral stages. The understory is dominated by subalpine fir with a representation of lodgepole pine and engelmann spruce. Shrubs are rare or sparse

with an occasional serviceberry (Amelanchier alnifolia) or mountain snowberry (Symphoricarpos oreophilus). The forest floor is often a sward of pinegrass with heartleaf arnica (Arnica cordifolia), early blue violets (Viola adunca), and white-flowered hawkweed (Hieracium albiflorum) scattered throughout.

4HO Lodgepole Pine/Elk Sedge Habitat Type (Pinus contorta/Carex geyeri)

A drier version of the 2HO type where conditions do not allow for the establishment of subalpine fir (Abies lasiocarpa). The forest floor is a sparse version of that under 2SO.

4PO Lodgepole Pine/Bitterbrush Habitat Type (Pinus contorta /Purshia tridentata)

Climax and seral stands dominated by lodgepole pine. A shrub layer of bitterbrush is present but the shrubs remain low, seldom reaching 60 cm in height. Also common on these sites is little ricegrass (Oryzopsis exigua).

5NO Douglas-fir/Snowberry Habitat Type (Pseudotsuga menziesii/ Symphoricarpos albus)

Both seral and climax stands dominated by douglas-fir. Lodgepole pine (Pinus contorta) may also be present in pioneer stands. A shrub layer exists, with common snowberry (Symphoricarpos albus) as dominant with serviceberry (Amelanchier alnifolia), chokecherry (Prunus virginiana), shiny-leaf spirea (Spiraea betulifolia), and creeping oregongrape (Mahonia repens) usually present. The forest floor usually has pinegrass (Calamagrostis rubescens), western yarrow (Achillea millefolium), and false solomon's seal (Smilacina racemosa).

5GO Douglas-fir/Pinegrass Habitat Type (Pseudotsuga menziesii/ Calamagrostis rubescens)

Both seral and climax stands are dominated by douglas-fir. Lodgepole pine (Pinus contorta) may also be present in the pioneer stands. There is only a sparse shrub layer with occasional shiny-leaf spirea (Spiraea betulifolia). The forest floor is a sward of pinegrass with western yarrow (Achillea millefolium), heartleaf arnica (Arnica cordifolia), woods strawberry (Frageria vesca), and sticky geranium (Geranium viscosissimum).

5JJ Douglas-fir/Shiny-leaf Spirea Habitat Type, Shiny-leaf Spirea Phase (Pseudotsuga menziesii/Spiraea betulifolia - S. betulifolia)

Late seral and climax stands usually quite open with douglas-fir forming both seral and climax stands. Shrubs are sparse. Shiny-leaf spirea may be joined by creeping oregongrape (Mahonia

repens). The forest floor usually has wheeler's bluegrass (Poa nervosa), western yarrow (Achillea millefolium), heartleaf arnica (Arnica cordifolia), and weedy milkvetch (Astragalus miser).

5MO Douglas-fir/Mallow Ninebark Habitat Type (Pseudotsuga menziesii/Physocarpus malvaceus)

Stands dominated by douglas-fir with a well developed shrub layer dominated by mallow ninebark. Shiny-leaf spirea (Spiraea betulifolia) and canada buffaloberry (Shepherdia canadensis) are also present in the shrub layer. The forest floor contains a sparse covering of heartleaf arnica (Arnica cordifolia), showy aster (Aster conspicuus), weedy milkvetch (Astragalus miser), and wild strawberry (Fragaria virginiana).

3LO Whitebark Pine/Grouse Whortleberry Habitat Type (Pinus albicaulis/Vaccinium scoparium)

Seral and climax stands dominated by whitebark pine. Grouse whortleberry dominates the forest floor with a scattering of other species.

3HO Whitebark Pine/Elk Sedge Habitat Type (Pinus albicaulis/ Carex geyeri)

Both seral and climax stands dominated by whitebark pine. The forest floor lacks grouse whortleberry (Vaccinium scoparium) but has elk sedge. Idaho fescue (Festuca idahoensis), western needlegrass (Stipa occidentalis), western yarrow (Achillea millefolium), heartleaf arnica (Arnica cordifolia), harebell (Campanula rotundifolia), fireweed (Epilobium angustifolium), and northern goldenrod (Solidago multiradiata) are commonly present.

## Nonforested Habitat Types

AOM Bluebunch Wheatgrass/Sandberg's Bluegrass Habitat Type, Needle-and- Thread Phase (Agropyron spicatum/Poa sandbergii - Stipa comata)

Grassland dominated by bluebunch wheatgrass, junegrass (Koeleria cristata), and sandberg's bluegrass. In ours, the bluegrass is often found only in slightly moister areas and needle-and-thread grass is quite conspicuous. Fringed sagebrush (Artemisia frigida) and hood's phlox (Phlox hoodii) are very common with occasional common rabbitbrush (Chrysothamnus nauseosus).

MFM Mud Flow Mosaic
Grassland mosaic covering large mudflows near the north entrance. A patchwork of very wet swales with rushes (Juncus) and bulrushes (Scirpus), and as-yet-undescribed bluebunch wheatgrass/junegrass (Agropyron spicatum/Koelaria cristata) type and bluebunch wheatgrass/sandberg's bluegrass (Agropyron spicatum/Poa

sandbergii) habitat type.

FA Idaho Fescue/Bluebunch Wheatgrass Habitat Type (Festuca idahoensis/Agropyron spicatum)

Grassland of intermediate elevation dominated by both idaho fescue and bluebunch wheatgrass. Junegrass (Koelaria cristata), sandberg's bluegrass (Poa sandbergii), and western needlegrass (Stipa occidentalis) are usually present. Forbs usually present are western yarrow (Achillea millefolium), rosy pussy-toes (Antennaria microphylla), and capitate sandwort (Arenaria congesta). Common rabbitbrush (Chrysothamnus nauseosus) and big sagebrush (Artemisia tridentata) are occasionally found.

FN Idaho Fescue/Bearded Wheatgrass Habitat Type (Festuca idahoensis/Agropyron caninum)

Mesic forb-grassland of the subalpine zone dominated by idaho fescue, although bearded wheatgrass is always present. Other grasses include western needlegrass (Stipa occidentalis), timber oatgrass (Danthonia intermedia), and junegrass (Koelaria cristata). Forbs are a conspicuous part of this type and include prairie smoke (Geum triflorum), yarrow (Achillea millefolium), mountain-dandelion (Agoseris glauca), and harebell (Campanula rotundifolia).

FNG Idaho Fescue/Bearded Wheatgrass Habitat Type, Sticky Geranium Phase (Festuca idahoensis/Agropyron caninum - Geranium viscosissimum)

Moister phase of the FN type described above, with sticky geranium and graceful cinquefoil (Potentilla gracilis) usually present. Pocket gopher activity is often quite high in these meadows and occasionally places are found where idaho fescue is nearly absent and a number of taller forbs are common, such as western stickseed (Lappula redowskii), yampa (Perideridia gairdneri), giant frasera (Frasera speciosa), and goldenrod (Solidago missouriensis). California brome (Bromus carinatus), timber oatgrass (Danthonia intermedia), and raynold's sedge (Carex raynoldsii) are also common.

FR Idaho Fescue/Richardson's Needlegrass Habitat Type (Festuca idahoensis/Stipa richardsonii)

Grassland dominated by idaho fescue with a good representation of richardson's needlegrass. Western needlegrass (Stipa occidentalis) and sticky geranium (Geranium viscosissimum) are always present. Yarrow (Achillea millefolium), northern bedstraw (Galium boreale), graceful cinquefoil (Potentilla gracilis), and hairy golden-aster (Chrysopsis villosa) are common forbs.

FD Idaho Fescue/Tufted Hairgrass Habitat Type (Festuca idahoensis /Deschampsia cespitosa)

hleum alpinum), spiked woodrush (Luzula spicata), and sedges (Carex spp.). Forbs are numerous. American bistort (Polygonum bistortoides), clover (Trifolium spp.), silvery lupine (Lupinus argenteus), yarrow (achillea millefolium), and diverse-leaved cinquefoil (Potentilla diversifolia) are common.

DW Tufted Hairgrass/Sedge Habitat Type (Deschampsia cespitosa/ Carex spp.)

A grassland type on poorly drained soils commonly found in drainages where silts and organic matter have accumulated, often accompanied by sedge bogs. Tufted hairgrass shares dominance with various species of sedges such as black-and-white scaled sedge (Carex albonigra) and slenderbeaked sedge (C. athrostachya). American bistort (Polygonum bistortoides), meadow pussy-toes (Antennaria corymbosa), and graceful cinquefoil (Potentilla gracilis) are usually present.

WW Sedge Bogs and Other Very Wet Areas

Areas dominated by various species of sedges such as water sedge (Carex aquatilis) or inflated sedge (Carex vesicaria). Around the fringes of this type are usually DW, described above, and the wet forest described under 2DO.

TA Big Sagebrush/Bluebunch Wheatgrass Habitat Type (Artemisia tridentata/Agropyron spicatum)

Dry shrubland of big sagebrush with bluebunch wheatgrass interspersed. Elk grazing has kept most of the big sage small and hedged but, given protection, the sagebrush becomes dominant. Junegrass (Koeleria cristata), sandberg's bluegrass (Poa sandbergii), and needle-and-thread (Stipa comata) may also occur with bluebunch wheatgrass.

TF Big Sagebrush/Idaho Fescue Habitat Type (Artemisia tridentata /Festuca idahoensis)

Mesic shrubland of big sagebrush with idaho fescue interspersed. Together with its sticky geranium (Geranium viscosissimum) phase described below, it accounts for nearly all the vegetation dominated by sagebrush in the park. Junegrass (Koeleria cristata) and occasionally bluebunch wheatgrass (Agropyron spicatum) occur with idaho fescue. Common rabbitbrush (Chrysothamnus nauseosus) and fringed sagebrush (Artemisia frigida) are usually present along with prairie smoke (Geum triflorum).

TFG Big Sagebrush/Idaho Fescue Habitat Type, Sticky Geranium Phase (Artemisia tridentata/Festuca idahoensis - Geranium viscosissimum)

Moist phase of TF described above, having a greater standing crop of grasses and forbs. Timber oatgrass (Danthonia intermedia), California brome (Bromus carinatus), bearded wheatgrass (Agropyron caninum), and raynold's sedge (Carex raynoldsii) are common graminoids. Common forbs are sticky geranium (Geranium viscosissimum), rocky mountain helianthella (Helianthella uniflora), graceful cinquefoil (Potentilla gracilis), and sulfur buckwheat (Eriogonum umbellatum).

AT Alpine Tundra

A wide diversity of habitat types from thick closed mats of low growing alpine grasses and forbs to more open drier types.

TS Talus and rubble fields with very little vegetation other than lichens.

HS Hot springs deposits and warm ground with a much modified vegetation, usually very short.

IW Willow/Sedge Habitat Type

Typical willow flats. A wet type dominated by various species of willows with a wet understory of sedges (Carex spp.) and tufted hairgrass (Deschampsia cespitosa) with wet area forbs.

KF Silver Sage/Idaho Fescue Habitat Type (Artemisia cana/ Festuca idahoensis)

Wet area type dominated by silver sage and idaho fescue. Tufted hairgrass (Deschampsia cespitosa) and species of sedge (Carex spp.) are also common. This type tends to be associated with areas of high water table such as streambanks, seeps, or areas of perched water tables in old lake sediments.

PZ/D Shrubby Cinquefoil-Silver Sage/Tufted Hairgrass Habitat Type (Potentilla fruticosa - Artemisia cana/Deschampsia cespitosa)

A limited type occurring in Gardner's Hole where shrubby cinquefoil shares aspect dominance with silver sage and other wet site species.

PPX Pitchstone Plateau Complex

A mosaic occupying the upper portion of the Pitchstone Plateau. The plateau is one of the most recent lava flows in the area and still retains much of the original flow topography. The flow ridges are occupied by forested types 2L3, 3LO, and 3HO, while the intervening flat areas are occupied by a grassland type, mostly FD.

## Cover Types of Yellowstone National Park

These cover types represent stages in the successional process that occurs following a disturbance such as a forest fire. The lodgepole pine series is a series with two possible outcomes: 1) LP4 is a stage just under the spruce-fir climax stage. 2) LP3 is a climax or near climax stage where poor, dry soils prevent or severely limit the growth of either engelmann spruce or subalpine fir. Whitebarked pine often is codominant in older stands of this type.

ASP - Aspen (*Populus tremuloides*) stands.

DF - Stands dominated by douglas-fir (*Pseudotsuga menziesii*), often in scattered islands in a nonforest matrix.

DF1 - Even-aged douglas-fir (*Pseudotsuga menziesii*) stands where trees are younger and shorter than those of neighboring stands.

KH - Krumholtz stands consisting of dwarfed wind-shaped engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), and whitebarked pine (*Pinus albicaulis*) stands, usually islands interspersed in non-forest at upper tree line.

LP0 - Recently burned where reforestation has not yet produced a closed canopy. Approximately 0-40 years post fire.

LP1 - Closed canopy of usually dense lodgepole pine (*Pinus contorta*) where trees are younger and shorter than those of neighboring stands. On outwash at West Yellowstone, it is islands of short trees next to islands of larger trees. Approximately 40-100 years post fire.

LP2 - Closed canopy dominated by lodgepole pine (*Pinus contorta*). Overstory still largely intact. Understory usually small to medium engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) seedlings and saplings. Approximately 100-300 years post fire.

LP3 - Canopy dominated by lodgepole pine (*Pinus contorta*) beginning to break up. Understory of lodgepole pine and whitebarked pine (*Pinus albicaulis*). Stands usually on rhyolite and multi-aged. When not on rhyolite, then canopy ragged, dominated by lodgepole pine with an engelmann spruce - subalpine fir (*Picea engelmannii - Abies lasiocarpa*) understory. May be the result of past bark beetle attack. Three hundred plus years post fire.

LP4 - Canopy quite ragged, predominately of lodgepole pine (*Pinus contorta*) but containing some engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), and

whitebarked pine (Pinus albicaulis). Understory of small to large spruce and fir seedlings and saplings. Three hundred plus years post fire.

LPP - Lodgepole pine (Pinus contorta) pigmy forests found mostly on Madison Plateau. Multi-aged dwarfed lodgepole pine with a grass understory (height up to ten feet).

NF - All nonforested areas.

SF - Stands dominated by engelmann spruce (Picea engelmannii) and subalpine fir (Abies lasiocarpa) in both overstory and understory. Lodgepole pine (Pinus contorta) may still be a significant component. Whitebarked pine (Pinus albicaulis) may be a significant component at high elevations.

WB - Stands dominated by mature whitebarked pine (Pinus albicaulis). May also contain considerable engelmann spruce (Picea engelmannii), subalpine fir (Abies lasiocarpa), or lodgepole pine (Pinus contorta).

WB0 - Recently burned whitebarked pine (Pinus albicaulis) stands, usually near upper timberline.

WB1 - Even-aged whitebarked pine (Pinus albicaulis) stands where trees are younger and shorter than those of neighboring stands.

References:

Daubenmire, R. and J.B. Daubenmire. 1968. Forest vegetation of eastern Washington and northern Idaho. Tech. Bull. 60. Washington Ag. Exp. Sta.

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Steele, R., S.V. Cooper, D.M. Ondov, and R.D. Pfister. 1979. Forest Habitat types of eastern Idaho - western Wyoming. 182 p. USDA For. Ser. Intermountain For. and Range Expt. Sta., Ogden, UT.

# APPENDIX B

## Sample Computations for Several Comparison Areas

To obtain the per acre food value used to determine the vegetative value of an area, a complex process was used by the Interagency Grizzly Bear Study Team to obtain a numeric multiplier. This process made use of a wide variety of both estimated and measured values. Figure B1 gives a general overview of the process. A fuller explanation can be found in Interagency Grizzly Bear Study Team, "Habitat Relations of the Yellowstone Grizzly Bear" (in progress). For the analyses involving the comparison areas, this numeric multiplier was applied to the acres of each habitat type/cover type combination occurring in the comparison area. These products were then summed and divided by the total acres of the comparison area. This value was then multiplied by the Shannon-Weiner index of diversity to add weight reflecting the added value provided by the different feeding opportunities of all the different habitat types. The raw food score is the sum of all the acres multiplied by food importance value (FIV). Mean food score is the raw food score divided by the total acres and multiplied by 1,000 to give the value of 1,000 acres of that comparison area. Examples of these calculations are shown in Tables B1 - B5.

From these examples it can be seen that highly diverse rectangles of high value vegetative types produce much higher values than those with few types of low value.

Table B1. Vegetative food value calculations for Lake/Bridge Bay. HT=Habitat Type, CT=Cover Type, FIV=Food Importance Value, PCT=Percent of that vegetative type in the comparison area, LN(Pi)*Pi is used in calculation of the Shannon-Weiner index of diversity.

| HT | CT | ACRES | FIV | AC*FIV | PCT | LN(Pi)*Pi |
|---|---|---|---|---|---|---|
| 2DO | LP1 | 806 | 0.49 | 394.940 | 2.01% | -0.0785 |
| 2DO | LP2 | 1968 | 0.41 | 806.880 | 4.91% | -0.1479 |
| 2DO | LP3 | 523 | 0.13 | 67.990 | 1.30% | -0.0566 |
| 2DO | LP4 | 1043 | 0.41 | 427.630 | 2.60% | -0.0949 |
| 2DO | SF | 24 | 0.49 | 11.760 | 0.06% | -0.0044 |
| 2GO | LP4 | 21 | 0.23 | 4.830 | 0.05% | -0.0040 |
| 2GO | LP3 | 414 | 0.07 | 28.980 | 1.03% | -0.0472 |
| 2GO | LP2 | 1224 | 0.19 | 232.560 | 3.05% | -0.1065 |
| 2GO | LP1 | 726 | 0.30 | 217.800 | 1.81% | -0.0726 |
| 2HO | WB | 25 | 0.50 | 12.500 | 0.06% | -0.0046 |
| 2HO | LP3 | 1708 | 0.08 | 136.640 | 4.26% | -0.1344 |
| 2HO | LP2 | 1854 | 0.09 | 166.860 | 4.62% | -0.1421 |
| 2HO | LP1 | 631 | 0.09 | 56.790 | 1.57% | -0.0653 |
| 2LL | WB | 5 | 0.14 | 0.700 | 0.01% | -0.0011 |
| 2LL | LP1 | 4002 | 0.23 | 920.460 | 9.98% | -0.2299 |
| 2LL | LP2 | 10853 | 0.24 | 2604.720 | 27.05% | -0.3537 |
| 2LL | SF | 35 | 0.26 | 9.100 | 0.09% | -0.0061 |
| 2LL | LP4 | 1371 | 0.26 | 356.460 | 3.42% | -0.1154 |
| 2LL | LP3 | 11487 | 0.13 | 1493.310 | 28.63% | -0.3581 |
| 3HO | LP3 | 49 | | 0.000 | 0.12% | -0.0082 |
| DW | | 362 | 0.50 | 181.000 | 0.90% | -0.0425 |
| FN | | 77 | 0.30 | 23.100 | 0.19% | -0.0120 |
| TF | | 412 | 0.30 | 123.600 | 1.03% | -0.0470 |
| TFG | | 199 | 0.42 | 83.580 | 0.50% | -0.0263 |
| WW | | 300 | 0.30 | 90.000 | 0.75% | -0.0366 |
| TOTALS | | 40119 | | 8452.19 | 1 | -2.1959 |
| | | DIVERSITY INDEX | | 2.196 | | |
| | | RAW FOOD SCORE | | 18559.904 | | |
| | | MEAN FOOD SCORE | | 463 | | |

Table B2. Vegetative food value calculations for Fishing Bridge. HT=Habitat Type, CT=Cover Type, FIV=Food Importance Value, PCT=Percent of that vegetative type in the comparison area, LN(Pi)*Pi is used in calculation of the Shannon-Weiner index of diversity.

| HT | CT | ACRES | FIV | AC*FIV | PCT | LN(Pi)*Pi |
|---|---|---|---|---|---|---|
| 2LL | LP0 | 2537 | 0.210 | 532.770 | 6.46% | -0.1769 |
| 2LL | LP1 | 3452 | 0.230 | 793.960 | 8.79% | -0.2137 |
| 2LL | LP2 | 2768 | 0.240 | 664.320 | 7.05% | -0.1869 |
| 2LL | LP3 | 2633 | 0.130 | 342.290 | 6.70% | -0.1811 |
| 2LL | LP4 | 4264 | 0.260 | 1108.640 | 10.85% | -0.2410 |
| 2LL | SF | 1082 | 0.260 | 281.320 | 2.75% | -0.0989 |
| 2EE | LP1 | 79 | 0.540 | 42.660 | 0.20% | -0.0125 |
| 2EE | LP2 | 55 | 0.570 | 31.350 | 0.14% | -0.0092 |
| 2EE | LP4 | 305 | 0.610 | 186.050 | 0.78% | -0.0377 |
| 2EE | SF | 66 | 0.610 | 40.260 | 0.17% | -0.0107 |
| 2GO | LP0 | 22 | 0.230 | 5.060 | 0.06% | -0.0042 |
| 2GO | LP1 | 317 | 0.300 | 95.100 | 0.81% | -0.0389 |
| 2GO | LP2 | 580 | 0.230 | 133.400 | 1.48% | -0.0622 |
| 2GO | LP3 | 6 | 0.130 | 0.780 | 0.02% | -0.0013 |
| 2GO | LP4 | 191 | 0.230 | 43.930 | 0.49% | -0.0259 |
| 2DO | LP0 | 972 | 0.410 | 398.520 | 2.47% | -0.0915 |
| 2DO | LP1 | 917 | 0.490 | 449.330 | 2.33% | -0.0877 |
| 2DO | LP2 | 1010 | 0.410 | 414.100 | 2.57% | -0.0941 |
| 2DO | LP3 | 341 | 0.130 | 44.330 | 0.87% | -0.0412 |
| 2DO | LP4 | 2227 | 0.410 | 913.070 | 5.67% | -0.1627 |
| 2DO | SF | 1492 | 0.490 | 731.080 | 3.80% | -0.1242 |
| 2DO | WB | 15 | 0.620 | 9.300 | 0.04% | -0.0030 |
| 2FO | LP0 | 206 | 0.170 | 35.020 | 0.52% | -0.0275 |
| 2FO | LP1 | 630 | 0.180 | 113.400 | 1.60% | -0.0663 |
| 2FO | LP2 | 189 | 0.190 | 35.910 | 0.48% | -0.0257 |
| 2FO | LP4 | 836 | 0.210 | 175.560 | 2.13% | -0.0819 |
| 2FO | SF | 286 | 0.210 | 60.060 | 0.73% | -0.0358 |
| 4HO | LP1 | 80 | 0.090 | 7.200 | 0.20% | -0.0126 |
| 4HO | LP2 | 66 | 0.090 | 5.940 | 0.17% | -0.0107 |
| 4HO | LP3 | 28 | 0.090 | 2.520 | 0.07% | -0.0052 |
| 4HO | LP4 | 37 | 0.090 | 3.330 | 0.09% | -0.0066 |
| 2L3 | LP2 | 23 | 0.340 | 7.820 | 0.06% | -0.0044 |
| 2L3 | LP4 | 532 | 0.360 | 191.520 | 1.35% | -0.0583 |
| 2L3 | SF | 291 | 0.620 | 180.420 | 0.74% | -0.0363 |
| 2L3 | WB | 17 | 0.620 | 10.540 | 0.04% | -0.0034 |
| 3LO | LP2 | 8 | 0.240 | 1.920 | 0.02% | -0.0017 |
| 3LO | WB | 79 | 0.260 | 20.540 | 0.20% | -0.0125 |
| 2CL | LP4 | 8 | 0.310 | 2.480 | 0.02% | -0.0017 |
| 2CL | SF | 332 | 0.310 | 102.920 | 0.85% | -0.0403 |
| DW | | 2060 | 0.500 | 1030.000 | 5.24% | -0.1546 |
| WW | | 1250 | 0.300 | 375.000 | 3.18% | -0.1097 |
| KF | | 5633 | 0.500 | 2816.500 | 14.34% | -0.2785 |
| HS | | 387 | 0.290 | 112.230 | 0.99% | -0.0455 |

| | | | | | |
|---|---|---|---|---|---|
| TF | 141 | 0.300 | 42.300 | 0.36% | -0.0202 |
| TFG | 532 | 0.420 | 223.440 | 1.35% | -0.0583 |
| FN | 239 | 0.300 | 71.700 | 0.61% | -0.0310 |
| FNG | 3 | 0.500 | 1.500 | 0.01% | -0.0007 |
| TS | 63 | 0.001 | 0.063 | 0.16% | -0.0103 |
| TOTALS | 39287 | | 12891.453 | 100.00% | -3.0455 |
| | DIVERSITY INDEX | | 3.045 | | |
| | RAW FOOD SCORE | | 39260.848 | | |
| | MEAN FOOD SCORE | | 999 | | |

Table B3. Vegetative food value calculations for Grant Village. HT=Habitat Type, CT=Cover Type, FIV=Food Importance Value, PCT=Percent of that vegetative type in the comparison area, LN(Pi)*Pi is used in calculation of the Shannon-Weiner index of diversity.

| HT | CT | ACRES | FIV | AC*FIV | PCT | LN(Pi)*Pi |
|---|---|---|---|---|---|---|
| 2LL | LP0 | 1822 | 0.21 | 382.620 | 4.49% | -0.1393 |
| 2LL | LP1 | 5074 | 0.23 | 1167.020 | 12.49% | -0.2599 |
| 2LL | LP2 | 8393 | 0.24 | 2014.320 | 20.67% | -0.3258 |
| 2LL | LP3 | 295 | 0.13 | 38.350 | 0.73% | -0.0358 |
| 2LL | LP4 | 8049 | 0.26 | 2092.740 | 19.82% | -0.3208 |
| 2LL | SF | 98 | 0.26 | 25.480 | 0.24% | -0.0145 |
| 2DO | LP0 | 981 | 0.41 | 402.210 | 2.42% | -0.0899 |
| 2DO | LP1 | 2234 | 0.49 | 1094.660 | 5.50% | -0.1595 |
| 2DO | LP2 | 5903 | 0.41 | 2420.230 | 14.54% | -0.2803 |
| 2DO | LP3 | 23 | 0.13 | 2.990 | 0.06% | -0.0042 |
| 2DO | LP4 | 5626 | 0.41 | 2306.660 | 13.85% | -0.2738 |
| 2DO | SF | 95 | 0.49 | 46.550 | 0.23% | -0.0142 |
| 2L3 | LP1 | 214 | 0.32 | 68.480 | 0.53% | -0.0276 |
| 2L3 | LP2 | 63 | 0.34 | 21.420 | 0.16% | -0.0100 |
| 2L3 | LP3 | 21 | 0.50 | 10.500 | 0.05% | -0.0039 |
| 2L3 | LP4 | 48 | 0.36 | 17.280 | 0.12% | -0.0080 |
| 2L3 | SF | 7 | 0.62 | 4.340 | 0.02% | -0.0015 |
| 2GO | LP1 | 2 | 0.19 | 0.380 | 0.00% | -0.0005 |
| 2GO | LP2 | 135 | 0.19 | 25.650 | 0.33% | -0.0190 |
| 2GO | LP4 | 137 | 0.23 | 31.510 | 0.34% | -0.0192 |
| 2HO | LP0 | 47 | 0.07 | 3.290 | 0.12% | -0.0078 |
| 2HO | LP1 | 301 | 0.07 | 21.070 | 0.74% | -0.0364 |
| 2HO | LP2 | 49 | 0.07 | 3.430 | 0.12% | -0.0081 |
| 3HO | LP3 | 85 | 0.21 | 17.850 | 0.21% | -0.0129 |
| DW | | 449 | 0.50 | 224.500 | 1.11% | -0.0498 |
| HS | | 13 | 0.15 | 1.950 | 0.03% | -0.0026 |
| TS | | 57 | 0.00 | 0.057 | 0.14% | -0.0092 |
| WW | | 388 | 0.30 | 116.400 | 0.96% | -0.0444 |
| TOTALS | | 40609 | | 12561.937 | 1 | -2.1791 |
| | | DIVERSITY INDEX | | 2.179 | | |
| | | RAW FOOD SCORE | | 27373.948 | | |
| | | MEAN FOOD SCORE | | 674 | | |

Table B4. Vegetative food value calculations for comparison area EB. HT=Habitat Type, CT=Cover Type, FIV=Food Importance Value, PCT=Percent of that vegetative type in the comparison area, LN(Pi)*Pi is used in calculation of the Shannon-Weiner index of diversity.

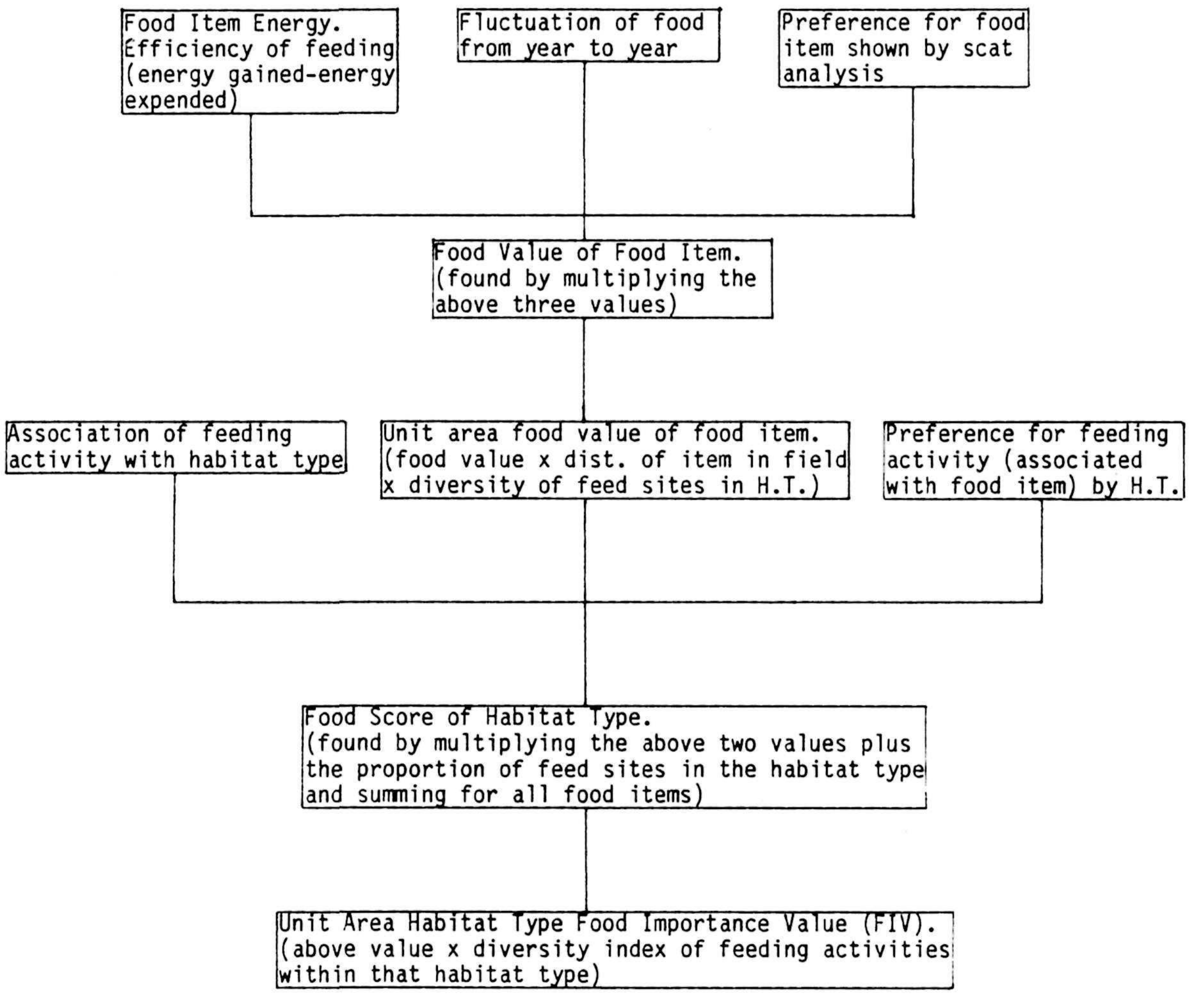
| HT | CT | ACRES | FIV | AC*FIV | PCT | LN(Pi)*Pi |
|---|---|---|---|---|---|---|
| 2LL | LP0 | 1654 | 0.21 | 347.340 | 4.24% | -0.1339 |
| 2LL | LP1 | 65 | 0.23 | 14.950 | 0.17% | -0.0106 |
| 2LL | LP2 | 3553 | 0.24 | 852.720 | 9.10% | -0.2181 |
| 2LL | LP3 | 496 | 0.13 | 64.480 | 1.27% | -0.0555 |
| 2LL | LP4 | 1242 | 0.26 | 322.920 | 3.18% | -0.1097 |
| 2LL | SF | 126 | 0.26 | 32.760 | 0.32% | -0.0185 |
| 2LL | WB | 64 | 0.14 | 8.960 | 0.16% | -0.0105 |
| 2LL | DF | 64 | 0.09 | 5.760 | 0.16% | -0.0105 |
| 5GO | LP2 | 11 | 0.57 | 6.270 | 0.03% | -0.0023 |
| 5GO | LP4 | 9 | 0.61 | 5.490 | 0.02% | -0.0019 |
| 5GO | WB | 79 | 0.62 | 48.980 | 0.20% | -0.0125 |
| 2DO | LP0 | 34 | 0.41 | 13.940 | 0.09% | -0.0061 |
| 2DO | LP2 | 213 | 0.41 | 87.330 | 0.55% | -0.0284 |
| 2DO | LP4 | 211 | 0.41 | 86.510 | 0.54% | -0.0282 |
| 2DO | SF | 47 | 0.49 | 23.030 | 0.12% | -0.0081 |
| 2CL | LP1 | 18 | 0.27 | 4.860 | 0.05% | -0.0035 |
| 2CL | LP2 | 1176 | 0.29 | 341.040 | 3.01% | -0.1055 |
| 2CL | LP4 | 83 | 0.31 | 25.730 | 0.21% | -0.0131 |
| 2CL | SF | 135 | 0.31 | 41.850 | 0.35% | -0.0196 |
| 2L3 | LP2 | 38 | 0.34 | 12.920 | 0.10% | -0.0067 |
| 2L3 | LP4 | 8 | 0.36 | 2.880 | 0.02% | -0.0017 |
| 2L3 | SF | 1361 | 0.62 | 843.820 | 3.49% | -0.1170 |
| 2L3 | WB | 3406 | 0.62 | 2111.720 | 8.72% | -0.2128 |
| 2L3 | KH | 17 | 0.50 | 8.500 | 0.04% | -0.0034 |
| 2FO | LP0 | 1460 | 0.17 | 248.200 | 3.74% | -0.1229 |
| 2FO | LP1 | 22 | 0.18 | 3.960 | 0.06% | -0.0042 |
| 2FO | LP2 | 2569 | 0.19 | 488.110 | 6.58% | -0.1790 |
| 2FO | LP3 | 229 | 0.07 | 16.030 | 0.59% | -0.0301 |
| 2FO | LP4 | 3230 | 0.21 | 678.300 | 8.27% | -0.2061 |
| 2FO | SF | 3178 | 0.21 | 667.380 | 8.14% | -0.2041 |
| 2FO | WBO | 24 | 0.10 | 2.400 | 0.06% | -0.0045 |
| 2FO | WB | 681 | 0.50 | 340.500 | 1.74% | -0.0706 |
| 2FO | DF | 5 | 0.10 | 0.500 | 0.01% | -0.0011 |
| 2HO | LP0 | 125 | 0.07 | 8.750 | 0.32% | -0.0184 |
| 2HO | LP1 | 3 | 0.09 | 0.270 | 0.01% | -0.0007 |
| 2HO | LP2 | 262 | 0.09 | 23.580 | 0.67% | -0.0336 |
| 2HO | LP4 | 17 | 0.10 | 1.700 | 0.04% | -0.0034 |
| 2HO | SF | 14 | 0.29 | 4.060 | 0.04% | -0.0028 |
| FNG | | 7230 | 0.50 | 3615.000 | 18.51% | -0.3123 |
| TFG | | 1814 | 0.42 | 761.880 | 4.65% | -0.1426 |
| DW | | 1080 | 0.50 | 540.000 | 2.77% | -0.0992 |
| WW | | 141 | 0.30 | 42.300 | 0.36% | -0.0203 |
| IW | | 166 | 0.30 | 49.800 | 0.43% | -0.0232 |

| | | | | | |
|---|---|---|---|---|---|
| TS | 941 | 0.00 | 0.941 | 2.41% | -0.0898 |
| AT | 306 | 0.00 | 0.306 | 0.78% | -0.0380 |
| FN | 249 | 0.30 | 74.700 | 0.64% | -0.0322 |
| FD | 1196 | 0.30 | 358.800 | 3.06% | -0.1068 |
| TOTALS | 39052 | | 13242.227 | 1 | -2.8843 |
| | DIVERSITY INDEX | | 2.884 | | |
| | RAW FOOD SCORE | | 38194.698 | | |
| | MEAN FOOD SCORE | | 978 | | |

Table B5. Vegetative food value calculations for comparison area KA. HT=Habitat Type, CT=Cover Type, FIV=Food Importance Value, PCT=Percent of that vegetative type in the comparison area, LN(Pi)*Pi is used in calculation of the Shannon-Weiner index of diversity.

| HT | CT | ACRES | FIV | AC*FIV | PCT | LN(Pi)*Pi |
|---|---|---|---|---|---|---|
| 2LL | LP0 | 522 | 0.21 | 109.620 | 1.55% | -0.0645 |
| 2LL | LP1 | 195 | 0.23 | 44.850 | 0.58% | -0.0298 |
| 2LL | LP2 | 2308 | 0.24 | 553.920 | 6.84% | -0.1835 |
| 2LL | LP3 | 1715 | 0.13 | 222.950 | 5.09% | -0.1515 |
| 2LL | LP4 | 669 | 0.26 | 173.940 | 1.98% | -0.0778 |
| 2LL | SF | 1017 | 0.26 | 264.420 | 3.02% | -0.1056 |
| 2GO | LP2 | 59 | 0.19 | 11.210 | 0.17% | -0.0111 |
| 2GO | LP3 | 2 | 0.07 | 0.140 | 0.01% | -0.0006 |
| 2GO | SF | 21 | 0.19 | 3.990 | 0.06% | -0.0046 |
| 2SO | LP1 | 7 | 0.09 | 0.630 | 0.02% | -0.0018 |
| 2SO | LP2 | 5 | 0.09 | 0.450 | 0.01% | -0.0013 |
| 2SO | LP4 | 8785 | 0.09 | 790.650 | 26.05% | -0.3504 |
| 2SO | SF | 158 | 0.06 | 9.480 | 0.47% | -0.0251 |
| 2DO | LP2 | 184 | 0.41 | 75.440 | 0.55% | -0.0284 |
| 2DO | LP3 | 57 | 0.13 | 7.410 | 0.17% | -0.0108 |
| 2DO | LP4 | 532 | 0.41 | 218.120 | 1.58% | -0.0655 |
| 2DO | SF | 296 | 0.49 | 145.040 | 0.88% | -0.0416 |
| 2HO | LP4 | 427 | 0.07 | 29.890 | 1.27% | -0.0553 |
| LPP | | 9739 | 0.06 | 584.340 | 28.88% | -0.3587 |
| FD | | 5136 | 0.42 | 2157.120 | 15.23% | -0.2866 |
| DW | | 1692 | 0.50 | 846.000 | 5.02% | -0.1501 |
| TS | | 54 | 0.00 | 0.054 | 0.16% | -0.0103 |
| TF | | 141 | 0.30 | 42.300 | 0.42% | -0.0229 |
| TOTALS | | 33721 | | 6291.964 | 1 | -2.0379 |
| | | DIVERSITY | | 2.038 | | |
| | | RAW FOOD SCORE | | 12822.218 | | |
| | | MEAN FOOD SCORE | | 380 | | |

METHOD OF CALCULATING THE MULTIPLIER OF FOOD IMPORTANCE VALUE (FIV)



APPENDIX C

A Comparison of Suitable Bird Habitat:

Fishing Bridge and Two Comparison Areas

Richard Follett

May 1984

## Methods

Based on known preferences of Yellowstone bird species for food, nesting sites, perching sites, availability of water, vegetational variety, and other habitat factors including elevation and access, a summary of bird species that may be expected in each of three areas has been prepared. Two areas are comparison areas HA and KA; the former has the highest diversity index, the latter one of the lowest, of the 22 comparison areas plotted at random in Figure 16. The third comparison area is Fishing Bridge.

## Discussion

Fishing Bridge lies at the hub of some of the most productive avian habitat within the boundaries of Yellowstone National Park. The combination of terrestrial and aquatic habitats within a ten-mile radius of Fishing Bridge is as diverse as any area in the park that is known to the author. Lying at the outlets of both Pelican Creek and the Yellowstone River, the development at Fishing Bridge inhibits, to some degree, the natural daily, seasonal, and annual movements of both birds and mammals that use the area as a thoroughfare and feeding source.

It must be noted that the following compilation represents a minimum list based on known bird preferences. Actual total based on sightings may be higher due to birds entering areas from bordering habitats, accidentals, and migrants only passing through.

Characteristic Species of Birds for Study Comparison Areas

| Bird Species | HA | Fishing Bridge | KA |
|---|---|---|---|
| white pelican | | x | |
| trumpeter swan | x | x | x |
| Canada goose | | x | |
| mallard | | x | |
| gadwall | | x | |
| pintail | | x | |
| green-winged teal | | x | |
| blue-winged teal | | x | |
| cinnamon teal | | x | |
| American widgeon | | x | |
| northern shoveler | | x | |
| ring-necked duck | | x | |
| lesser scaup | | x | |
| Barrow's goldeneye | x | x | x |
| bufflehead | | x | |
| harlequin duck | | x | |
| ruddy duck | | x | |
| common merganser | | x | |
| northern goshawk | x | x | x |
| red-tailed hawk | x | x | x |
| Swainson's hawk | x | x | x |
| rough-legged hawk | x | x | x |
| golden eagle | x | x | x |

| Bird Species | HA | Fishing Bridge | KA |
|---|---|---|---|
| bald eagle | | x | |
| marsh hawk | x | x | x |
| osprey | | x | |
| prairie falcon | x | x | x |
| American kestrel | | x | |
| blue grouse | x | x | x |
| ruffed grouse | x | | |
| sandhill crane | | x | |
| American coot | | x | |
| killdeer | | x | |
| common snipe | x | x | x |
| spotted sandpiper | x | x | x |
| Wilson's phalarope | | x | |
| California gull | | x | |
| Franklin's gull | | x | |
| mourning dove | | x | |
| great gray owl | x | x | x |
| belted kingfisher | | x | |
| northern flicker | x | x | x |
| Williamson's sapsucker | x | | |
| hairy woodpecker | x | x | x |
| black-backed woodpecker | x | x | x |
| three-toed woodpecker | x | x | x |

| Bird Species | HA | Fishing Bridge | KA |
| --- | --- | --- | --- |
| dusky flycatcher | x | x | |
| Hammond's flycatcher | x | x | x |
| olive-sided flycatcher | x | x | x |
| violet-green swallow | | x | |
| tree swallow | x | x | x |
| rough-winged swallow | | x | |
| barn swallow | | x | |
| cliff swallow | | x | |
| gray jay | x | x | x |
| Steller's jay | x | | |
| common raven | x | x | x |
| Clark's nutcracker | x | x | x |
| mountain chickadee | x | x | x |
| red-breasted nuthatch | x | x | x |
| American dipper | x | x | x |
| rock wren | x | | |
| sage thrasher | x | x | x |
| American robin | x | x | x |
| hermit thrush | x | x | x |
| Swainson's thrush | x | x | x |
| mountain bluebird | x | x | x |
| Townsend's solitaire | x | x | x |
| ruby-crowned kinglet | x | x | x |

| Bird Species | HA | Fishing Bridge | KA |
|---|---|---|---|
| water pipit | x | | x |
| yellow-rumped warbler | x | x | x |
| red-winged blackbird | x | x | x |
| Brewer's blackbird | | x | |
| western tanager | x | x | x |
| evening grosbeak | x | x | x |
| Cassin's finch | x | x | x |
| pine grosbeak | x | x | x |
| rosy finch | x | | |
| pine siskin | x | x | x |
| red crossbill | x | x | x |
| savannah sparrow | | x | |
| dark-eyed junco | x | x | x |
| chipping sparrow | | x | |
| white-crowned sparrow | x | x | x |
| Lincoln's sparrow | x | x | |
| TOTAL | 51 | 78 | 44 |

Factors contributing to variation in numbers of species characteristic of the three different habitats:

1) Habitat Types: Fishing Bridge obviously has a huge edge in waterfowl aquatic habitats (would also garner most migratory shorebirds).

2) Elevation: Many species, only a few of which are represented here, do not inhabit high elevations.

3) Open Areas: Pelican Valley and access to Hayden Valley, as opposed to relatively "closed in" KA and HA. (Birds are ecotonal creatures, more attracted to vegetational diversity than habitat diversity.)

4) Migrational Access: "The River" is literally a migrational freeway, and many species breed in relatively close proximity to it.

5) Food Sources: Again, the lake and the river are very big factors.

# APPENDIX D

## Human Injuries Caused by Grizzly Bears 1968 through 1983

## Human injuries caused by grizzly bears 1968 through 1983

| Year | No. | Date | Location/Details | Injury Description |
|---|---|---|---|---|
| 1968 | 2 | | | |
| | | 08/07/68 | Mallard Creek, William Seavey | Scratch on right foot |
| | | 08/04/68 | In swamp near Fishing Bridge, John Ketarkus, bear came out of bushes at him | Four-inch long scratch |
| 1969 | 6 | | | |
| | | 06/10/69 | Fishing Bridge Campground, Daphne Jax | Chest wound, collapsed lung, hospitalized several weeks |
| | | 06/27/69 | Canyon Campground, Patrick Lewis | Scratch and bite on back, minor |
| | | 07/09/69 | Fishing Bridge Campground, David Lou | Laceration, contusions to skull and thigh, minor |
| | | 07/09/69 | Fishing Bridge Campground, Michael Rock | Deep laceration, minor |
| | | 07/20/69 | Fishing Bridge R.V. Park, David Mickley | Bite on toe, minor |
| | | 09/04/69 | Grant Village, Denise Wilson | Lacerations, minor |
| 1970 | 3 | | | |
| | | 09/04/70 | Grant Village Campground, Michael Rinker | Lacerations, hopitalized |
| | | 09/04/70 | Grant Village Campground, Stanford Moist | Lacerations, puncture wounds, hospitalized |
| | | 06/27/70 | Mystic Falls Trail, Jim Freeman, sow with cub of year | Puncture wounds, abrasions & scratches, hospitalized |
| 1971 | 0 | | No injuries | |
| 1972 | 3 | | | |
| | | 06/25/72 | Near Old Faithful, Harry Walker | Fatal |
| | | 07/26/72 | Bridge Bay Campground, Joseph Keirnen | Skin broken, minor |
| | | 08/16/72 | Fawn Pass, Kenneth Bell, sow with cubs | Hospitalized, minor bites and scratches |
| 1973 | 0 | | No injuries | |
| 1974 | 0 | | No injuries | |

| | | | | |
|---|---|---|---|---|
| 1975 | 2 | | | |
| | | 08/20/75 | 7 miles east of Bighorn Pass trailhead, sow with two cubs | Bites, minor lacerations |
| | | 08/21/75 | Snow Pass, two adult bears | Bites, minor |
| 1976 | 4 | | | |
| | | 08/15/76 | 1/2 mile up Pelican Creek, sow with cub | Scratches, abrasions, bites, minor |
| | | 08/17/76 | Fishing Bridge Campgróund, Melvin Ford, sow with cubs | Severe injuries |
| | | 08/29/76 | Fishing Bridge Campground, sow with cubs | Minor injuries |
| 1977 | 1 | | | |
| | | 06/27/77 | Crowfoot Ridge, Barrie Gilbert, single bear | Severe injuries |
| 1978 | 0 | | No injuries | |
| 1979 | 2 | | | |
| | | 05/22/79 | Trail from Tower to Tower Falls Junction, sow with cubs | Minor bites |
| | | 09/16/79 | Canyon to Tower, Howard Eaton Trail | Hospitalized, bites, minor lacerations |
| 1980 | 1 | | | |
| | | 11/01/80 | Sepulcher Mountain Trail, sow with cubs and one bear | Minor, lacerations |
| 1981 | 2 | | | |
| | | 05/02/81 | Mystic Falls Trail, sow with cubs and carcass | Lacerations, bites, etc. hospitalized, minor |
| | | 07/11/81 | Grebe Lake pit, bear came out of drug | Bites, minor |
| 1982 | 0 | | No injuries | |
| 1983 | 1 | 06/21/83 | Fishing Bridge area, Branbel, near sewage lagoon, group of three bears | Bites, scratches, hospitalized, minor |

# APPENDIX E

Correspondence Pertinent to Section 7 Consultation, Threatened and Endangered Species Act of 1974

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

Billings Area Office
316 North 26th Street
Billings, Montana 59101

IN REPLY REFER TO:

SE

February 18, 1981

Mr. John A. Townsley, Superintendent
National Park Service
Yellowstone National Park, WY 82190

Dear Mr. Townsley:

This is in response to your January 26, 1981, letter regarding the Section 7 consultation on Grant Village.

Your comments and affirmation that the Park Service is indeed committed to the phaseout of facilities at Fishing Bridge are appreciated. The FWS supports your objectives and looks forward to their achievement. I am now satisfied that our respective Section 7 responsibilities for the Grant Village Development have been met.

Sincerely,

Wally Steucke

Wally Steucke
Area Manager

United States Department of the Interior

NATIONAL PARK SERVICE

YELLOWSTONE NATIONAL PARK

WYOMING 82190

IN REPLY REFER TO:
D18(RMR)PP

JAN 26 1981

Mr. Wally Steucke, Area Manager
U.S. Fish and Wildlife Service
Federal Building, Room 3035
316 North 26th Street
Billings, Montana 59101

Dear Mr. Steucke:

In response to your December 12 memorandum to Regional Director Mintzmyer, we would like to offer the following comments which conclude our formal Section 7 Consultation on Grant Village.

The National Park Service is committed to the phaseout of facilities at Fishing Bridge. The cabins which meet the age criteria for historic preservation, required formal review with the Wyoming State Historic Preservation Officer. After consultation on November 5, 1980, 138 rental units were burned between November 10 and November 19, 1980. This accounted for removal of 45% of the total rental units at Fishing Bridge.

At the present time, public use of overnight accommodations has been discontinued in the Fishing Bridge cabin area. Subsequent to fire safety issues, employee housing in the Lake Hotel and two dormitories were removed in the Lake area. Those displaced employees are now temporarily housed in cabins at Fishing Bridge. As funding permits, new employee housing will be constructed and employees will be removed from the Fishing Bridge area.

Specific timetables for replacement or rehabilitation of facilities at Fishing Bridge are dependent on public finance. A requested $7 million package for rehabilitation of facilities dealing with life safety issues was deleted by Congress. Yellowstone National Park's highest priority when money becomes available will be correction of those life safety issues. Subsequent to resolution of those problems will be the removal of facilities at Fishing Bridge. If we are not successful in getting money, exact timetables cannot be projected. However, it is our intent to adhere to the timetable presented.

At the park level we attempted to close Fishing Bridge Campground. National Park Service policy consideration beyond Yellowstone resulted in the campground remaining open. It is the park's objective to remove the campground prior to 1985. When removed, we believe the campground area will still have potential for a day-use picnic area.

The use of the recreational vehicle park in our judgment will exist for the next five years, which in long-term park objectives is not a long period of time. We agree that the recreational vehicle park is in the wrong area with

our present understanding of grizzly bear needs. We now recognize that the Pelican Valley delta area is crucial to the survival of the grizzly bear.

Evaluation of visitor use from the past year and next two seasons will give us a chance to examine future needs and possible locations for a recreational vehicle park. Several years ago, consideration was given to replacement of the RV park in the Grant Village area. If the RV park is replaced, a thorough evaluation of grizzly bear-human conflict will be undertaken. The recreational vehicle park will not be placed where there is a substantial potential for human-bear conflict.

Removal of facilities at Fishing Bridge must be in concert with overall operation of public facilities in Yellowstone National Park. It must be recognized that our intent to remove all facilities from Fishing Bridge must be politically and socially accepted.

Sincerely yours,

John A. Townsley

John A. Townsley
Superintendent

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