D. A. MacLulich

VOLUME 4 JUNE, 1927 NUMBER 2

Roosevelt Wild Life Bulletin

OF THE

Roosevelt Wild Life Forest Experiment Station

OF

THE NEW YORK STATE COLLEGE OF FORESTRY
AT SYRACUSE UNIVERSITY

PREDATORY AND FUR-BEARING ANIMALS OF YELLOWSTONE PARK

CONTENTS OF ROOSEVELT WILD LIFE BULLETIN

(To obtain these publications see announcement on back of title page.)

Syracuse Univ. Bull. JUNE, 1927 Vol. 24, No. 27

Roosevelt Wild Life Bulletin

VOLUME 4, NUMBER 2

OF THE

Roosevelt Wild Life Forest Experiment Station

OF

THE NEW YORK STATE COLLEGE OF FORESTRY
AT SYRACUSE UNIVERSITY

ANNOUNCEMENT

The serial publications of the Roosevelt Wild Life Forest Experiment Station consist of the following:

1. **Roosevelt Wild Life Bulletin.**
2. **Roosevelt Wild Life Annals.**

The *Bulletin* is intended to include papers of general and popular interest on the various phases of forest wild life, and the *Annals* those of a more technical nature or having a less widespread interest.

These publications are edited in cooperation with the College Committee on Publications.

The editions of these publications are limited and do not permit of general free distribution. Exchanges are invited. The subscription price of the *Bulletin* is $4.00 per volume of four numbers, or $1.00 per single number. The price of the *Annals* is $5.00 per volume of four numbers, or $1.25 per single number. All communications concerning publications should be addressed to

The Director,
Roosevelt Wild Life Forest Experiment Station,
Syracuse, New York.

Entered at the Post Office at Syracuse, N. Y., as second-class matter

TRUSTEES OF
THE NEW YORK STATE COLLEGE OF FORESTRY

Ex Officio

Dr. Charles W. Flint, *Chancellor*	Syracuse University
Dr. Frank P. Graves, *Commissioner of Education*	Albany, N. Y.
Hon. Alexander Macdonald, *Conservation Comm'er*	Albany, N. Y.
Hon. Seymour Lowman, *Lieutenant-Governor*	Albany, N. Y.

Appointed by the Governor

Hon. Alexander T. Brown	Syracuse, N. Y.
Hon. John R. Clancy	Syracuse, N. Y.
Hon. Harold D. Cornwall	Glenfield, N. Y.
Hon. George W. Driscoll	Syracuse, N. Y.
Hon. Louis Marshall	New York City
Hon. William H. Kelley	Syracuse, N. Y.
Hon. Edward H. O'Hara	Syracuse, N. Y.
Hon. Charles A. Upson	Lockport, N. Y.
Hon. J. Henry Walters	New York City

Officers of the Board

Hon. Louis Marshall	*President*
Hon. John R. Clancy	*Vice-President*

HONORARY ADVISORY COUNCIL OF THE ROOSEVELT WILD LIFE STATION

American Members

Mrs. Corinne Roosevelt Robinson	New York City
Hon. Theodore Roosevelt	New York City
Mr. Kermit Roosevelt	New York City
Dr. George Bird Grinnell	New York City
Hon. Gifford Pinchot	Harrisburg, Pa.
Mr. Chauncey J. Hamlin	Buffalo, N. Y.
Dr. George Shiras, 3rd	Washington, D. C.
Dr. Frank M. Chapman	New York City
Dean Henry S. Graves	New Haven, Conn.

European Members

Viscount Grey	Fallodon, England
Sir Harry H. Johnston	Arundel, England

ROOSEVELT WILD LIFE STATION STAFF

Franklin Moon, M. F. ..... Dean of the College

Charles E. Johnson, Ph.D. ..... Acting Director of the Station
Alvin G. Whitney, A. B. ..... Assistant Director
Wilford A. Dence, B. S. ..... Assistant Ichthyologist

Temporary Appointments†

Thomas L. Hankinson, B.S. ..... Field Ichthyologist*
Perley M. Silloway, M.S. ..... Field Ornithologist
Aretas A. Saunders, Ph.B. ..... Field Ornithologist
Bradford A. Scudder ..... Game Naturalist
Alfred O. Gross, Ph.D. ..... Field Ornithologist
Robert T. Hatt, A.M. ..... Field Naturalist
Clinton G. Weymouth, A.B. ..... Field Ornithologist
Victor H. Cahalane, M.F. ..... Field Naturalist

Collaborators†

Charles C. Adams, Ph.D., Sc.D. ..... Animal Ecologist**
William Converse Kendall, A.M., M.D. ..... Ichthyologist
Edward R. Warren, B.S. ..... Field Naturalist
Richard A. Muttkowski, Ph.D. ..... Field Naturalist
Milton P. Skinner, B.S. ..... Field Naturalist
Gilbert M. Smith, Ph.D. ..... Field Naturalist

---

* Resigned as Station Ichthyologist October 1, 1921.
** Resigned as Station Director May 1, 1926.
† Including only those who have made field investigations and whose reports are now in preparation.

CONTENTS

ILLUSTRATIONS

FIGURES

All figures are from photographs taken in Yellowstone Park by the author. Figures 23, 28, 31, 41, are from his *Yellowstone Nature Book;* figures 34, 39, 40, are from his *Bears in the Yellowstone.*

MAPS

NATIONAL PARKS POLICY AND WILD LIFE

"The service thus established shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations hereinafter specified by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life 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."

An act to establish a National Park Service, and for other purposes. Public — No. 235 — 64th Congress, (H. R. 15522): 1916.

"For the information of the public an outline of the administrative policy to which the new Service will adhere may now be announced. This policy is based on three broad principles:

'*first*, that the national parks must be maintained in absolutely unimpaired form for the use of future generations as well as those of our own time;

'*second*, that they are set apart for the use, observation, health, and pleasure of the people; and

'*third*, that the national interest must dictate all decisions affecting public or private enterprise in the parks.'"

FRANKLIN K. LANE,
Third Annual Report, U. S. National Park Service, p. 361; 1919.

THE FIELD-NATURALIST'S WORK

The average field-naturalist tends to become a collector of specimens, rather than an investigator of the ways of animal life. His ambition is to collect the specimens as soon as he can, and as many as he can; and fearing lest each specimen shall escape him and be lost, he neglects the opportunity to observe it in life and to learn something about its habits and its ways. Often he takes this attitude from the institution for which he is working. It desires a great series of specimens which he feels he must secure. Yet the collecting of a large series of specimens, and the bringing them home in satisfactory shape, should be only a small portion of the field-naturalist's work. Skins and skulls are useful, but skins and skulls and measurements and proportions tell us only a little about the living animal. Most of us wish to learn something about its ways of life.

George Bird Grinnell,
Foreword, Roosevelt Wild Life Bulletin,
Vol. 1, No. 1, p. 9; 1921.

Courtesy A. C. McClurg & Co.

Fig. 23. A coyote hunting on upland prairie. Near Gallatin River, Yellowstone Park, Oct. 10, 1922.

D. A. MacLulich

THE PREDATORY AND FUR-BEARING ANIMALS OF THE YELLOWSTONE NATIONAL PARK*

By Milton P. Skinner

Field Naturalist, Roosevelt Wild Life Forest Experiment Station, Syracuse, New York

Formerly Park Naturalist, Yellowstone National Park

CONTENTS

*An abstract of this paper was read at the Sixth Annual Meeting, American Society of Mammalogists, held at Cambridge, Mass., April 15-17, 1924.

INTRODUCTION

The original predatory and fur-bearing animals of North America were so prolific as to be an unending source of amazement when they first became known to Europe. Perhaps the French and Canadians were more quickly appreciative than the English colonies; probably because the New Englanders and the settlers of the Atlantic coast to the south were farmers, while the French were descended from a race noted for its love of luxuries and consequently more appreciative of fine furs. Although the Spaniards of the south and southwest were also a beauty-loving race, they were too busy following the lure of gold to give a thought to humbler products of their country. That the warmer climate of their colonies produced less valuable furs undoubtedly had its effect also.

Although the French of the Canadas were the first to develop the fur trade, the English of the more southern Atlantic seaboard were not long in following their lead. With characteristic Yankee thoroughness they soon outstripped their northern competitors. As a consequence, Canada has still a good supply of furs to draw upon, but the American trappers have reduced what was once the richest of fur countries to a point where we must conserve and augment our remaining animals in every possible way.

In another way, our settlers and farmers were antagonistic to the carnivorous animals. On the farms, man's domestic animals are penned up and peculiarly subject to the attacks of the wild predators; and the destruction that follows is often very serious, indeed. For the farmer destroys the carnivorous animals whenever he can to protect his domestic stock. Furthermore the farmers unwittingly aggravate the attacks on their animals by killing off the rodents that would otherwise furnish food to the predators. In the National Parks in general, and in the Yellowstone Park in particular, there is no obligation to defend livestock; but it has been thought proper without a thorough investigation to kill the carnivorous species in order to have a greater increase of other forms of wild life, apparently considered more important by those who have the authority to order the killing.

It has not been appreciated that we need these predatory and fur-bearing animals alive and living their normal lives, that the situation in the Parks where we believed these animals were preserved is not satisfactory, and that we are slowly losing a valuable possession there. Nevertheless, the Yellowstone National Park is a most logical

place to preserve our native animals. It is one of our largest Parks; it has a strong and continuing protector; it has large areas of wild land; and it is better stocked with a representative colony of wild life in an environment approaching primitive, natural conditions. In spite of these favorable factors, there has been little, or nothing, said about the situation and almost nothing has been written to show how unscientific, how careless, we have been in the Yellowstone National Park in the past. There have been no wholly adequate studies made and very little is positively known about the wild life in this Park and the interrelations of the various species of its wild plants and animals. Careful, minute investigations should be made, on which a wise general policy for the care of all wild life, and for such control as may be needed, can be based.

GENERAL DESCRIPTION OF YELLOWSTONE PARK CONDITIONS

Physical Character and Climate. The Yellowstone Park was the first National Park to be established and it is still our largest park, having an area of 3348 square miles. Much the larger part of it lies in Wyoming, with narrow strips in Montana and Idaho. In addition, it is proposed to add certain lands east and south of the present Park, including the Teton Mountains, and comprising about 1250 square miles. The enlarged Park will then contain some 4600 square miles, or about 3,000,000 acres,—practically all wild land in its original condition except for man's ravages amongst its wild animals, and the fire scars in its forests. The Park's lowest point, at the junction of the Gardiner and Yellowstone Rivers, is 5300 feet above sea level; its highest point at the present time is Electric Peak, 11,125 feet above sea level (Fig. 38). Curiously, the highest and the lowest points are only six miles distant from each other. A large share of the Park is a lofty plateau with an average elevation of about 8000 feet above the sea (Table 1; Map 1). This plateau has resulted from the outpouring of vast amounts of volcanic materials that have filled up an originally low valley between former high mountains, to the present level. The Yellowstone plateau presents much unevenness and diversity of surface, although the larger part of the rocks and soil are volcanic in origin. All the volcanic outbursts were prehistoric, and now there is no such activity except for the hot springs and geysers that remain as the last expiring remnants. So great a time has elapsed since they were active that even the outlines of the old volcanoes have been broken down and can no longer be easily recognized.

TABLE 1. AREAS AT DIFFERENT ELEVATIONS IN YELLOWSTONE NATIONAL PARK

Height above sea level, in feet	Square miles	Per cent of the Park
5300–6000	19	0.6
6000–6500	92	2.8
6500–7000	196	5.8
7000–7500	425	12.7
7500–8000	1120	33.4
8000–8500	824	24.6
8500–9000	428	12.8
9000–9500	153	4.6
Above 9500	91	2.7
Total	3,348	100.0

Naturally such a large elevated area is peculiarly adapted to attracting and catching moisture, ensuring an ample rain and snow fall. Since the rainfall is generous on the plateau and the streams descend to the bordering lowlands quite abruptly, there are waterfalls or tumultuous rapids on all. Yet the Yellowstone Park really lies in the dry belt and the air, except when it is actually storming, is dry and the climate almost desert-like. With such a set of conditions there is a striking difference in temperature between sunlight and shade, between noon and midnight, and between summer and winter. The summers are short and dry, yet the nights are cold enough on the plateau to have frosts every week in the year. August is almost always dry with scant rainfall. The autumns, springs and early summers are comparatively stormy. Winters are usually cold and bracing, but not so much snow falls as is usually the case in late autumn and early spring. Given such great daily variations, winds are frequent and sharp, and sometimes erratic, although usually light in the morning and stronger in the afternoon. The prevailing winds are from the southwest. Snow falls to an average depth of a foot at the northern entrance during the winter (see Figs. 26, 31, 49)—although seldom remaining long on the ground below 6000 feet elevation,—increases to many feet on the mountains, and declines to an average of four or five feet at the southern boundary. The average on the conifer-clad plateau is about four feet. There are no genuine glaciers actually within the Park and only a few perpetual snow-fields. This is probably due to the hot sunshine of the long summer days, and even more to the warm dry winds sweeping steadily across from the deserts of the southwest.

The Major Animal Habitats. The primary habitat areas in Yellowstone National Park are shown on Map 2 at the end of this

Bulletin. This map has been compiled from my notes made during about twenty of the thirty-one years that have elapsed since I first visited the Park in 1895. During the time I have been in the Park, both winter and summer, I have travelled all roads and trails and also much country where there were neither, again and again, probably 30,000 miles in all. Previous to this attempt, no data has been collected along this line. But now that we have this map, we can see a good many interesting things. Almost six per cent of the area is under water; twelve per cent is in open, grassy lands (Fig. 24); nearly eighty per cent is covered by forest; and the remaining area, a little over two per cent, comprises grassy and rocky areas above timber line. At the latitude of Yellowstone National Park, timber line is approximately 9500 feet above sea level. Of course, there is a good deal of grass amongst the trees in the forested areas, especially in those regions that have been fire-swept and are not yet completely reforested. Still, the typical Park forest is dark and heavily shaded so that there is comparatively little or no undergrowth on the needle-strewn ground. There is also a large area (20 square miles) where the forest has recently died, as the result of a spruce budworm infestation. For a time at least, this area (1½ per cent of the whole Park) should be subtracted from the forested area and added to the open, grassy lands. Over eight per cent of the forested lands is covered with aspens, willows, etc., and therefore available as browse for the elk, deer and moose. The remaining forests are coniferous with remarkably few species, not more than a dozen, all told. The lodgepole pine (Fig. 37) constitutes two-thirds of the forested area, or more than fifty per cent of the Park. Fortunately the region has never been extensively lumbered nor injured by the axe, although the dryness of the climate has permitted many severe forest fires. But the burnt-over lands are usually quickly reforested, especially by the lodgepole pine.

If there is any of the Sonoran Life Zone represented in the Park, it is by very limited areas. The Transition Zone is also comparatively limited. The great bulk of the Park lies within the Canadian Zone although an important part is Hudsonian. As indicated by Table 1, over two per cent of the Park lies above timber line and consequently in the Arctic-Alpine Life Zone (Fig. 36).

While some of the soil, notably in the grassy areas, is rich and of fine quality, much of Yellowstone National Park is a coarse, volcanic sand and therefore rather sterile. Yet the parks and meadows scattered through the forests are important grazing grounds. Many of them are due to silt caught in old-time ponds backed up by beaver

dams (Fig. 41) that may long ago have broken and rotted away, leaving no sign of their presence save the resulting meadows which have since naturally drained. I should judge that a very large part of the smaller Yellowstone meadows are thus due to beaver.

Classes of Animals. The animals of the Yellowstone National Park may be divided into three general classes on the basis of their environmental relations and practical administration: the so-called "big game animals," including those like the elk (Figs. 26, 50, 51), deer (Figs. 30, 31) and buffalo, that are very interesting to the tourists; the rodents (Figs. 28, 29, 43, 47) whose great place in nature, although many of them are of exceeding interest also, seems to be to turn vegetation into food for the predacious animals through the medium of their own bodies; and the predatory and fur-bearing animals,—of which two at least, namely the bear (Figs. 25, 34, 39, 40) and the beaver (Figs. 27, 42, 48), exceed all other Yellowstone animals in point of interest for the tourists,—whose preservation is most difficult of all.

The game animals live in all parts of the Park. Being largely grazing animals, their movements are based upon the presence of suitable forage. In summer, they are on the mountain pastures where the areas above timber line are important grazing grounds for elk, deer and mountain sheep (Figs. 36, 38); but in winter the snow drives them down to the grazing lands lowest in elevation (Figs. 44, 50), and they would naturally leave the Park altogether and go still lower if it were safe to do so.

Although a few rodents even have their homes above timber line, they are most numerous at the lowest elevations; but a few like the snowshoe rabbits and porcupines live normally in the forests on the plateau. In general the rodents either hibernate or else store up food for winter use, so that they are not out of doors much during the colder months. Of course, there are some exceptions, like the rabbits, which are about and active all winter.

The predatory and fur-bearing animals live in all parts of the Park, from the lowest elevation to the highest, and from the barest desert to the heaviest of forested lands. The terms "predatory animals" and "fur-bearing animals" mean almost the same species. All the predacious species are fur-bearers although one or two, like the bobcat, have pelts of comparatively little value. A few of the fur-bearers, such as the beaver and the muskrat, are not predatory. The bears and the skunks hibernate, and the badgers and beaver either live through the winter on stored food or enter a partial hibernation.

But the great bulk of the predatory animals are as active in winter as in summer, and this is the direct cause of the pressing problem connected with them. Their natural food, the rodents, are safe under ground, or at least under the snow and ice. Then the carnivores are obliged to turn to other food, and unfortunately the only available supply is the rabbits and the game animals. But the game animals cannot retreat to the plains for safety as they normally would, and are unable to withstand this concentrated and more or less unnatural attack upon them. Consequently, although the carnivorous animals attract little adverse criticism in summer while they are preying on their natural food, in winter they become conspicuous because of the animals they kill.

The various classes of animals are so interrelated, and each one is such an important part of the whole balance, that we should study carefully the probable results before we interfere. After having once disturbed nature, we should be still more careful before we try to rectify the first interference with another unconsidered disturbance. Darwin's classic example of the relationship between house cats and clover is well known!

In the Yellowstone National Park, the coyotes (Figs. 23, 32, 33) are the most prominent of the predatory animals, yet they are important checks on the increase of ground squirrels (Fig. 29), mice and rabbits. And these latter animals destroy much vegetation that is needed by the antelope, deer, elk and buffalo. It is reported that in Alaska the overabundance of rabbits which feed on the same food as the moose — willows, beech twigs and leaves, alder bush, aquatic plants, etc.,— is bringing starvation upon the moose ("An Alaskan," American Forestry, Vol. 29, 1924, p. 750).

HISTORICAL DEVELOPMENT OF THE YELLOWSTONE FAUNA

Original Conditions. When pioneers first entered the western plains and mountains they found there a wonderful aggregation of large animals, especially on the broad, wide open prairies and plains. In the mountains, all of the different species were represented by more scattered individuals, probably because the mountains did not contain such a superabundance of food so widely distributed. In later days wild life was more abundant in the mountains. But that this was not so originally, we find very evident from a careful perusal of Lewis and Clark's journals. While they were on the plains, and right up to the time they entered the mountains, these

explorers were able to supply themselves with an abundance of fresh meat. But after they entered the mountains, game practically ceased; and when they met the Shoshoni Indians on the headwaters of the Jefferson River even the Indians had only salmon and berry cakes to trade to them (Wheeler, '04, Vol. 2, p. 57). A little later, on Sept. 12, Lewis and Clark speak of the "scantiness of game" and relate that the Indians had to peel the pine trees "to procure the inner bark for food" (l.c., p. 81). On Sept. 14 they "killed a colt, on which they made a hearty supper" (l.c., p. 91). And after that, Lewis and Clark were forced to depend on horses secured of the Indians, and even on dogs purchased from the same source, for their only food supply.

And this condition was prevalent all through the mountains; traveller after traveller speaks of the abundance on the buffalo plains and contrasts that abundance with the comparatively gameless mountains in those early and primitive days.

At a later date, when the hunters and settlers worked steadily west of the Missouri, the larger "game" animals were forced to retreat towards the mountains. "Under these conditions not less than 90 per cent of all the big game remaining between the Mississippi Valley and the Pacific Coast has been forced to retreat to the mountains traversing that vast region. There among the rugged peaks and forest-covered slopes which characterize our remaining wilderness are sheltered the survivors of the wonderful hosts of big game animals which once graced so large a part of the continent." (Nelson, '17, p. 139.)

From these general conditions, the Yellowstone National Park was not at all exempt: "As a game country in those early days, it could not compare with the lower surrounding valleys" (Chittenden, '18, p. 11). When the discovery party led by Washburn, Langford, and Doane explored the then unknown headwaters of the Yellowstone, they found very few animals present. They speak of an antelope killed in the Blacktail valley and that they had plenty of venison in camp that night, but there was no more game killed during their remaining four weeks of travel through what is now the finest of the Yellowstone game regions (cf. Langford, '05, pp. 15, 19). In fact, it is really astonishing how few animals this party did see. A black bear was seen near the Mt. Washburn Hot Springs (l.c., p. 23); tracks of grizzlies, etc., were seen near Crystal Falls (l.c., p. 28); tracks of a herd of elk were seen near Park Point and of another herd south of Yellowstone Lake (l.c., pp. 57, 62);

Fig. 24. View of Lamar and Soda Butte valleys, showing the lowland grassy area, aspen in center foreground, coniferous forest on lower slopes of Druid Peak (at left), and The Thunderer with its peak above timber line (in distance). Yellowstone Park, Nov. 1, 1917.

Fig. 25. Black bears are common, and of intense interest to visitors, who never fail to see them in the Yellowstone National Park. September, 1922.

Courtesy of "Natural History."

Fig. 26. Elk bulls in coniferous forest (limber pine). The one in the foreground has just shed his horns while the one at right still retains his antlers. Near Mammoth, Yellowstone Park, March 19, 1920.

and a grizzly bear and cubs were seen south of Yellowstone Lake (l.c., p. 67). In addition, Mr. Langford speaks several times of the panthers' screams heard during the night. But these are remarkably few animals to see in the wilderness during a five weeks' trip. So few, indeed, that I do not wonder that rations were short south of Yellowstone Lake and throughout the remainder of the trip (l.c., p. 83).

The government Hayden Survey of 1871 saw even fewer animals. Although they had professional hunters with them, employed especially to keep the Survey supplied with meat, Dr. Hayden says: "Our hunters returned, after diligent search for two and a half days [from their camp at South Arm, Yellowstone Lake] with only a black-tailed deer, which, though poor, was a most important addition to our larder" (Hayden, '72, p. 131). And this is the only animal recorded in this report.

The party conducted by Capts. Barlow and Heap, army engineers, that same year of 1871, had better success. This party of fifteen men were in the Park about five weeks and evidently recorded every animal seen. Capt. Barlow's official report for July 23, 1871, says: "One of the men killed a large brown bear and three cubs. The latter were brought in and served our mess with delicious steak for several meals" (Barlow, '71, p. 11). Three days later, Capt. Barlow saw three elk at the foot of the southern slope of Mt. Washburn (l.c., p. 14). On Aug. 12, one member of the party killed a deer near Mt. Sheridan (l.c., p. 35), and four days later they "encountered a large grizzly bear and cub" near Bridger Lake (l.c., p. 37). It is not recorded that they shot this grizzly and cub. Evidently they did not, for the next day "provisions were just exhausted." "Several elk and deer" were seen on Mirror Plateau on Aug. 25 (l.c., p. 40). But just as soon as they came down off the Park plateau and were on lower ground, they saw "numerous bands of antelope" in the upper Lamar Valley. The next day, still nearer Mammoth Hot Springs, they killed an elk and a deer (l.c., pp. 40–41). Although I have recorded all the animals seen on an extensive trip, the number is very meagre indeed. Most eloquent of the paucity of game animals is the fact that a party of fifteen all armed, and some at least expert shots, allowed their supplies to become "just exhausted" eight days before the end of the trip so that they had to send back for more food! Yet this party covered a good deal of territory never before visited by a white man, so far as we know.

Dr. F. V. Hayden led another government exploring party into the new Yellowstone National Park (set aside as such March 1,

1872) in 1872 and this time they had naturalists attached to the party. Yet these experts record only wolverine, skunk, red squirrel, chipmunk, 2 species of mice, Baird's rabbit, and 3 species of bats, collected; and there is no mention of either other mammals or game anywhere in the report (Hayden, '73, pp. 662-669). But Dr. John M. Coulter, botanist of Mr. Stevenson's section of this party, has written an interesting letter, dated April 28, 1924, saying: "One of the very definite recollections, however, is of a trip I made to the edge of the geyser basin with the professional hunter whose business it was to keep us in fresh meat, when we ran into a tremendous herd of elk; in fact, it was so large a herd that the hunter, who had spent all his life in the west, was surprised at it. An occasional moose came into our camp at night and investigated our tents."

In 1873, Capt. William A. Jones, army engineer, led a party of thirty-one men into the Park and remained thirty-one days visiting many new and remote sections. Yet this party, also, had trouble finding game and were soon so short of rations, they had to send a party post haste to Fort Ellis, a hundred miles away, for a pack train load. On the east side of the Park, near what is now Pahaska Teepee, "a mule deer was killed" and furthermore the report says that "elk, deer, and trout are abundant" (Jones, '74, p. 19). But this territory is on the outside of the Park, and easily accessible from the plains where the animals were then. "Two bears came down to witness our passage" through Jones Pass on Aug. 2, 1873 (l.c., p. 21). On the same page it is recorded that an elk was killed near Yellowstone Lake the next day. A week later, the report says: "Provisions are getting low" (l.c., p. 27). And from that time until Sept. 2 the party was unable to secure any game, and did not even see any, although they went around Yellowstone Lake and up the Upper Yellowstone Valley, a very fine wild animal range at the present time.

Another party visited the Park in 1873 and left us some interesting records. It was led by Theo. B. Comstock, a noted geologist who was also interested in animals. In fact, he was the first to advocate the desirability of the Yellowstone as a wild animal reserve, but he speaks of the necessity of *introducing* and preserving animals! He mentions no animals as then in the Park except: "mule deer which is occasionally met in this region" (Comstock, '74, p. 75), and "the order Rodentia is well represented in this section" (l.c., p. 164).

In many ways, a party of visitors in 1874, led by the Earl of Dunraven, has left a still more interesting record, because all its

members, except the cook, were experienced hunters. Near Mammoth Hot Springs they killed five antelope to take along as a supply of meat (Dunraven, '22, p. 289). On the south side of Mt. Washburn, the party "found wapiti close to camp, and Campbell fired at but missed a stag. Jack killed one later in the day" (l.c., p. 192). An old bull elk, too poor to eat, was killed near the Yellowstone River between Canyon and Hayden Valley (l.c., p. 204). But a few days later: "meat had been growing very scarce for the last few days. We had scraped clean the bones of the antelope we packed with us from Gardiner's River." So they halted and all hands hunted two days in the upper end of Hayden Valley, where thousands of elk summer now. But Dunraven says: "not a single fresh track and nothing whatever eatable to be seen" (l.c., p. 219). Two men stayed at this place longer to hunt, while the others visited the Geysers and then returned to find the two "hard up for food, for the country had produced no game [p. 247], . . . we had counted upon getting plenty of game . . . not an atom of fresh meat had we tasted for days" (l.c., p. 288). During the return of the Dunraven party, they encountered antelope (15 individuals in all) on the Blacktail, and hunted all the way to Mammoth but secured nothing whatever (l.c., pp. 289–295).

Capt. Ludlow made a rapid surveying reconnaissance into the Park in 1875 with a party of twenty-two persons, including George Bird Grinnell as naturalist, and was in the Park only two weeks. Just before reaching Tower Creek "two deer were seen, the only game animals we encountered in the park" (Ludlow, '76, p. 30). In addition, a cougar was seen on the Yellowstone River near Alum Creek (l.c., p. 63). Dr. Grinnell reports there were considerable numbers of elk and bighorn, and that moose and mountain buffalo were abundant (l.c., pp. 69–71). But this would seem to be based on information from other sources, especially in view of Capt. Ludlow's statement that two deer were the only game animals seen.

The report of the Hayden Survey of 1878 does not mention any mammals at all except to say that the Falls River Basin "is one of the few remaining haunts of the moose in the Northwest" (Hayden, '83, Vol. 2, p. 468).

The Immigration of Large Mammals. It becomes evident however from Grinnell's information that game animals were becoming more abundant, and by 1878 this was noted by several parties. As the period 1870-1878 coincides with the last great killing on the plains, it seems quite likely that the surviving animals retreated more

and more into the mountains, especially in the summer, to escape the slaughter. For a time, probably until a large part of the lowland outside the Park was taken up and fenced, these animals that summered in the Park were driven by snow each winter to the plains and lower valleys outside.

Visitors to the Park since 1878 usually speak of the large number of animals. Capt. F. A. Boutelle, Acting Superintendent, speaks of the increasing number of animals in his report for 1889 (Boutelle, '89, p. 22). Mr. Arnold Hague gives a fascinating picture. "The Park supplies what is really needed—a zoological reservation where big game may roam unmolested by the intrusion of man, rather than a zoological garden inclosed by fences, and the game fed or sustained more or less by artificial methods. . . . All the large game animals of the northern Rocky Mountains are known in the Park except the white goat (*Mazama montana*) and the caribou (*Rangifer tarandus*) . . . Elk, moose, deer, antelope, mountain sheep, buffalo and bears are found . . . For elk, the park is an ideal country.[1] They frequent the alpine meadows and grassy terraces, passing freely from one to the other of the open uplands. Where streams flow through these openings, or ponds occupy shallow depressions, the elk resort to them in large numbers during summer and autumn" (Hague, '93, pp. 252-254).

The rodents—mice, gophers, squirrels, rabbits, woodchucks, etc., —have always been abundant in this region so far as we know. In fact, Theo. B. Comstock speaks of them in 1873 as "well represented" in the quotation already given (Comstock, '74, p. 164). Still, it seems likely that the ground squirrel (*Citellus armatus* Kennicott) has increased in number and enlarged its range within the Park in recent years.

Beaver (*Castor canadensis canadensis* Kuhl) have always been quite common in Yellowstone National Park, and, although fluctuations are noticed at times, the actual number present remains about the same throughout a course of years.

Since this paper bears on the status of the predatory and fur-bearing animals, it may appear strange that I have not mentioned them so far in this chapter. But the whole life and habits of the carnivorous animals depend directly upon the presence, or absence, of the other classes. Game animals are grazers and browsers, living on various forage plants; and the rodents are largely eaters of grasses and herbs. On the other hand, the carnivores must neces-

[1] Mr. Hague evidently overlooked the lack of adequate winter forage, a condition that had not made itself manifest at the time he wrote.

sarily depend on the bodies of other animals for food. This means that before predacious forms can thrive in a certain section, there must be a fair supply of other animals already established. Hence the necessity, in any animal problem, of determining first the food supply available. "Throughout the animal world we find that not only is the abundance of the higher predatory animals dependent upon the abundance of the lower forms upon which they prey, or which may indirectly affect their food supply, but this dependence may result in remarkable periodic fluctuations in the numbers of the predatory forms" (Hewitt, '21, p. 213).

Naturally the small meat-eaters prey on the smaller animals, especially the rodents. Since the rodents were originally common, it is quite probable that the carnivores that pursued them were common also. Yet their total number has never been great; and it is very small now, as may be seen from Table 2, page 180; indeed some of the species are dangerously near the vanishing point. While we have no early reports as to their actual abundance, it seems quite likely that most of the smaller fur-bearers have maintained their former numbers. An exception is the pine marten (*Martes americana caurina* Merriam) which seems to have declined during the last ten years, possibly because of heavy trapping in the forests surrounding the Yellowstone National Park.

In addition to the smaller meat-eaters, the mountain lion (*Felis hippolestes* Merriam) has always been reported rather common in the Yellowstone although subject to great fluctuations in numbers present at any one time.

The bears, both black bears (*Ursus americanus* Pallas) and grizzlies (*Ursus horribilis* Ord), are carnivorous at times. Still, they eat so much food other than meat—being able, indeed, to do without meat altogether—that their depredations on animals other than mice, ground squirrels and woodchucks, are negligible. While they have always been common and still are, for that matter, in the regions under consideration, they have no special bearing on the wild animal population except to maintain a check on the three rodents just named.

The coyote or prairie wolf (*Canis latrans* Say), was, as the latter name indicates, primarily a prairie or plains animal and very seldom penetrated the mountains, and still less often actually lived there. Dr. George Bird Grinnell who visited the Park in 1875 and whose

opinion I value highly, has just written me: "It has always been my impression that wolves and coyotes in old times were not often seen in the park. They were animals of the open country rather than of the forest as I recall it" (Grinnell, in letter dated March 4, 1924). That is, they stayed down on the plains where the carcasses of larger game animals as well as rodents could be secured for food. With the destruction of the game animals on the plains, the settlement of the lower country, and the intensive killing of the coyotes' preferred food—rodents—through trap and poison, large numbers of the canines retreated to the mountains just as so many game animals had done. Here in the Yellowstone National Park they found rodents abundant and they remained and established themselves. Furthermore, it seemed as if the coyotes were as quick to appreciate the advantages of protection as the game animals had been, and just as ready to take advantage of it. Hewitt has expressed it particularly well: "The creation on any extensive scale of wild life reserves will inevitably result in an increase within, and the attraction to such reserves of predatory mammals such as wolves and coyotes, and of birds such as eagles, great horned owls, and such noxious hawks as the goshawk, Cooper's, and sharp-shinned hawks,[2] owing to the fact that these reserves will not only contain a larger number of the animals and their young which predatory animals destroy, but as the reserves afford sanctuary to such animals they will tend to contain a much greater abundance of wild life than neighbouring territory. Following the general rule in nature that predatory species collect where the species on which they subsist occur in unusual abundance, an increase in game and other animals will bring about an increase in their enemies, especially when the latter are harassed elsewhere" (Hewitt, '21, p. 193). Later on, Hewitt says: "When we study these phenomena as they occur in our wild life, the dependence of the larger animals upon the abundance of the smaller is very marked, and we discover the significance of the well-known periodical increase and decrease in the prevalence of many of the well-known members of our wild life" (Hewitt, '21, p. 214).

So long as they confined their attacks to the mice, gophers, and ground squirrels, the coyotes had a safe home. But these animals

[2] As far as the Yellowstone is concerned, the birds named have not increased appreciably.

were to be had only in summer. When winter came the coyotes were reluctant to leave the protection they had found, and preyed upon the only animals to be had—the game. This in turn roused the Park authorities who began killing the coyotes to save the game animals assumed by them to be more valuable.

In Dr. Grinnell's words, the timber wolf (*Canis nubilus* Say) was an "animal of the open country," and "not often seen in the park." It is likely that an occasional one wandered in. Howard Eaton told me he saw them within the boundaries as early as 1890. Thereafter, they were occasionally reported, one or two each year. In 1912, I saw four near the Lamar Valley. After that, signs of their presence increased and I believed they were coming in faster. I had no proof of this, however, until Sept. 7, 1914, when I found an extraordinarily bold pack of eleven big fellows in the Pelican Valley. That winter of 1914–1915 two or three packs harried the elk on the lower, open valleys of the Park. There the elk and other animals were at a disadvantage in the snow, especially when it was crusted, the lighter-weight wolves being able to run over snow that would not support their heavier prey. As the wolves found abundant food and ample, secure breeding dens, they, also, were able to establish themselves and remain in spite of every effort to kill and dislodge them from the region.

Summing up, we have now in the Yellowstone National Park a section where small fur-bearers are native and not too numerous; where rodents are abundant; where game animals were not common originally but are now able to maintain a precarious existence on ground unsuitable to them in winter, and against foes not so much handicapped; and where coyotes and wolves were not common denizens there originally, but have increased and now prey on the rodents in summer and on the game animals in winter.

Present Numbers of Predatory and Fur-bearing Animals. Because of their elusive and mobile character, wild animals are difficult to enumerate under natural conditions. Particularly the carnivora, hunters and hunted as they are, are extremely hard to estimate with any degree of accuracy. In Table 2 I have listed the predacious and fur-bearing mammals now existing in Yellowstone Park, and have given as close an estimate of their numbers as I could.

TABLE 2. PREDATORY AND FUR-BEARING ANIMALS NOW LIVING IN THE YELLOWSTONE PARK

Kind of animal.	Estimated number.	Relative status.
Grizzly Bear	40	Decreasing.
Black Bear	150	Stationary.
Gray wolf	20	Decreasing.
Coyote	400 (in the autumn)	A yearly kill of possibly 150 necessary to check undue increase.
Red Fox	12	Stationary.
Marten	200	Decreasing.
Fisher	Doubtful if any are present.	Always was rare.
Wolverine	6–8	Decreasing.
Weasels	200	Stationary.
Mink	150	Decreasing.
Northern Skunk	100	Stationary.
Badger	200	Increasing.
Otter	60	Decreasing.
Mountain Lion	12	Stationary.
Canada Lynx	10	Stationary.
Bobcat	6–8	Stationary.
Muskrat	No data for an estimate	Stationary.
Beaver	About 10,000	Stationary.

The figures comprising this table have been compiled from a mass of field notes gathered from 1914 to 1925 inclusive, except for a short period during the war. The ten years previous also contributed to the final result by making me more familar with the ground to be covered and the animals likely to be found, a very necessary apprenticeship to a careful check-up. During the first mentioned period, I travelled Yellowstone National Park from end to end on foot, on horseback, and by automobile, and much of it was covered in winter when deep snow permitted only travel on skis. Whenever I saw an animal or a track, I noted it down in my note book at once and later plotted it on a map, or rather a series of maps. These maps soon showed where these animals lived and how many, approximately, to each "township" area. After these figures had been secured for each township, it was easy to add them together to get the whole predatory population. Such a table, based on only one year's experience would have been little more than an interesting guess, but twelve such years checked one against the others has given a result that should be approximately correct, although subject to fluctuations from year to year.

Fig. 27. Beaver living in a pond where they have flooded a typical willow growth. The male in the center is peeling a willow switch and eating the bark. At the extreme left the head of a second beaver shows as he swims away. Near Lava Creek, Yellowstone Park, Oct. 5, 1922.

Courtesy A. C. McClurg & Co.

Fig. 28. The woodchuck is the most prominent of the rodents. This one had his burrow under the log on the left. Yellowstone Park, Sept. 1, 1922.

Fig. 29. The mantled ground squirrel resembles a large chipmunk and is an important element of the rodent population. This one has his cheek pouches filled with oats spilled by horses.

NOTES ON THE PREDATORY AND FUR-BEARING ANIMALS IN YELLOWSTONE PARK

Grizzly Bear; Silvertip. *Ursus horribilis* Ord.—This bear (Fig. 34) has been well known in Yellowstone National Park ever since the first authentic exploration in 1870 by the Washburn-Doane Expedition which recorded seeing grizzly bears in the forested wilderness south of Yellowstone Lake. Although it is estimated that they number 40 in the Park at the present time, it is probable that this figure is not a greatly reduced one from the original population. It is not likely that the grizzly was ever as numerous here as in some other parts of its range. The grizzly ranges largely in the forested sections but I have seen it in the open Lamar Valley, on the upland prairie called Hayden Valley, and on the bald ridges above timber line.

The food of this animal is largely vegetable in character—grass, leaves, berries, bulbs, roots and mushrooms. It is an important destroyer of mice, gophers and ground squirrels. While I have seen it kill young elk and buffalo, I have never considered that it killed the larger animals to any appreciable extent. In the Yellowstone National Park the grizzly feeds somewhat on the garbage from hotels and camps, but not to the extent that the black bear does.

The grizzly here has an inoffensive disposition, seeking only to avoid trouble. Although accidents have occurred, and even human lives have been lost, in every case without exception it has been proved that a person was at fault, or that the bear had reason to think so, at least.

A grizzly breeds every third year, sometimes every second year, and normally raises two or three cubs at a time. The total number is decreasing because they are being trapped and shot outside the Park, and all about the boundaries. Their status is not satisfactory because the total number of breeding grizzlies is so small.

They are of great importance to the Park and of intense interest to the visitors. While the writer was in charge of the Yellowstone's Government Information Bureau, he asked a long series of visitors what they found most interesting in the Park, and 42 per cent answered: "Bears." Probably the grizzly shares equally with the black bear in this interest, for while not so often seen, he is invested with a greater interest perhaps because of the greater quantity of literature about him. His rôle in Yellowstone National Park is that of an inoffensive animal, strictly minding his own

business. He is a check on the mice, ground squirrels and woodchucks, and an active agent in scattering and planting tree and berry seeds.

In the Park, grizzlies must be absolutely protected; their capture for outside museums and zoos should be discontinued; and they should be better protected in the surrounding States.

Black Bear. *Ursus americanus* Pallas.—The brown bears, the cinnamons, and the yellowish bears are only color varieties of the black bear (Figs. 25, 39, 40). Frequently the black bear has a white breast patch, or varied marking.

This bear has been a member of the fauna ever since the Park's discovery. At the present time, there are estimated to be about 150 individuals present,—less than there were twenty years ago and probably less than there were originally. These bears roam about a good deal and many are trapped and shot after they cross the Park boundaries, on all sides.

They frequent all parts of the Park although they prefer the coniferous forests of the plateau to the lower, unforested sections. Still, they are actually out on the open hills and valleys at times.

Their food is largely vegetable, and great quantities of grass, leaves, bark, berries and roots are devoured. But they also devour large numbers of insects, mice and ground squirrels, and they interfere with the larger animals only to a limited extent. Most of the regular bear inhabitants of the Park sooner or later discover the garbage thrown out for them, and during July and August garbage is a considerable item of their food. In September and October they do a good deal of damage to food supplies and to the camps and storehouses in which food is kept.

Black bears are disposed to attend to their own business, but the tourists and the concessioners' employees seem possessed to feed and pet them, especially the cubs. For a time, there is no special harm in this. But it has the effect of making the bears too familiar with mankind, so that when they become larger they lose their fear and grow destructive. Being very treacherous and strong, it is never safe to allow one of these half-tamed bears to approach closely. The attempt to feed bears from the hands is highly dangerous.

Black bears breed every third year, in some cases every second year. The average number of cubs is two, although as many as four have been seen with one mother. The total number of bears in the Park is slowly decreasing, due to the fact that they wander a good deal, especially in fall, and are shot or trapped soon after crossing

the Park boundary. The practice of catching and shipping out bears to any public park or zoo, especially when breeding females are caught, is further depleting the supply.

These bears share with the grizzlies the keen interest that a bear has for all visitors. It would be as great a calamity to Yellowstone National Park to lose the bears as to have Old Faithful geyser stop playing, or the Yellowstone Falls run dry! Not only do the bears amuse and instruct the Park visitors, but their pictures form an essential part of all the Yellowstone moving picture films that are circulating over not only this nation, but over Europe and all foreign countries as well. As an educational and as an advertising feature, bears are well-nigh priceless to the Yellowstone.

The rôle of the black bear in nature is that of a scavenger, and as a check on mice, ground squirrels and other rodents. He is an important destroyer of forest insects and grubs; and he is of value in the destruction of old logs, and in the planting of trees, shrubs and berries. He does no damage except to storehouses containing food and to people who get too familiar with him.

No control methods are needed for the black bear, but the people should be prevented from feeding and molesting the bears. Better protection is needed in the surrounding States, and trapping for menageries should be discontinued within the Park itself.

Gray or Timber Wolf. *Canis nubilis* Say.—A large proportion of the wolves in Yellowstone National Park, possibly as much as 40 per cent, are black, and the remainder are gray. Originally the wolf was a rare animal here, but it is likely that a few wandered in from time to time. They began to increase about 1914, soon numbered about sixty, and maintained themselves until severe hunting by the Park Rangers has again reduced their numbers to the point of extermination.

Wolves range throughout the more open parts of the Park, usually following the elk herds to and fro in their spring and autumn migrations. Localities where I have seen them, range from 6000 feet up to timber line at 9500 feet, and while most of them were in open valleys, some wolves were in the forest. My records are mostly for the northern and eastern sections of the Park, possibly because there is not enough food in the southern and western sections where the game animals do not go in so large numbers.

In summer, they catch small prey, such as mice, woodchucks, rabbits and squirrels, and attract very little attention. In winter they kill elk and deer, and even antelope and mountain sheep, and cause

considerable damage; but even so, it is likely they kill mostly the old, the diseased, and the unfit. Probably as many as two or three elk were killed every day during the winter, a few years ago, but this was counterbalanced somewhat by the good the wolves did in devouring dead animals and carrion.

While the wolves in the Yellowstone National Park are bolder than they are outside, they are still wilder and more wary than other Park animals.

Wolves' dens are apt to be in natural caves or cavities among th. rocks and glacial débris. They breed every year, one litter a year of from three to six pups. Other authorities give a higher figure elsewhere. Three lots of pups that I knew of were born about March 1, but did not leave the dens for some time after that date. A pair of wolves keep together throughout all seasons and probably mate for life. The rate of increase without artificial control and where food is plentiful is about 60 per cent of all wolves present.

Probably there is no danger to people in the Yellowstone because of these wolves. Possibly a man might be in danger in winter if he encountered a pack of wolves made aggressive by poor hunting. It is possibly just as well to keep them in awe of man by more or less steady hunting. These wolves are too seldom seen to be of any value to visitors although all are interested to know they are present.

The wolf is of positive value as a scavenger and as a killer of weak and diseased wild stock. There is little doubt but that they played their part in developing speed and cunning among many forms of animals and in preventing epidemics.

Coyote. *Canis latrans* Say.—The coyote (Figs. 23, 32, 33) was not probably originally native to the Park but came in after persecution began in the lower country; or perhaps it followed the grazing animals in. It is said that both the wolf and the coyote followed the sheep herds when they were first brought to the Park boundaries, or driven in to the slaughterhouse. I have placed the number of coyotes in the Park in the autumn as 400. At that time the Rangers begin their annual campaign and gradually reduce the number to 200 coyotes or less by spring. The usual winter kill is from 150 to 250, but the yearly increase just about averages this number.

Coyotes are common in all parts of Yellowstone National Park and at all elevations. Vernon Bailey's notes would indicate that they were partial to the lower open country. It is probable that the coyote originally lived in the open altogether, but many are now living in the forested places, sometimes in the densest parts. Nor are

they merely passing through the forest, for they live there steadily. But even these forest animals hunt the meadows and open parks for mice and other rodents. It has got to the point, I believe, that there are fully as many in the forest as in the open, especially in summer. They are as frequent about habitations as elsewhere; at times, more so. Many, if not all, of the forest-dwelling coyotes remain there even in winter although food then becomes very scarce. A trapper, Mr. Musser, operating about Old Faithful in the heavy lodgepole pine forest, caught from fifteen to twenty every winter.

Since all parts of the Park are lived in, all kinds of habitats are frequented. Coyotes are in the open and sagebrush lands far from any forests; in the brushy areas; along streams under the cottonwoods, willows and alders; in the lowest forests where groves of aspen and Douglas fir alternate with open parks; in the aspen, Douglas fir, limber pine, cedar, lodgepole pine, spruce, white-bark pine, and the stunted timber line forests; even above timber line at times and out on the bald summits, and in high mountain hollows and meadows. At times, coyotes are even in the canyons, on slide rock, and in rocky gulches. Also in the burnt-over land, and in tangled windfalls. I frequently see them on the hot spring and geyser formations, probably in search of the rodents and other small animals and birds that frequent such sites.

In summer, when the females are tied to a den of pups, and the males to their mates, for they are exemplary family animals, I doubt if the individual goes more than two or three miles from its home. In winter they may follow game animals to the winter ranges, but many do not. Those that stay at home, and those that go to the game ranges and establish a home there, seldom range out more than four or five miles from the den.

I have observed no periodic movement except that mentioned above. Yet coyotes evidently appreciate the protection given in the Park and have moved in from the outside. Similarly, if severely hunted by the Park Rangers, they may leave their accustomed ranges altogether.

I believe the most common item of the coyote menu is mice of various kinds, with ground squirrels and rabbits closely competing in weight of meat furnished, if not in actual numbers. I often see them hunting mice and grasshoppers in summer, and even more often in September and October. On October 10, 1922, I found one on a small meadow so engrossed he paid no attention to me but allowed me a full view of his operations. The grass was not high,

but what there was of it had matted down and afforded some cover for the mice. When the coyote heard, or perhaps smelt them, he "pointed" them for a few minutes (see Figs. 23, 32, 33) and then by a sudden spring he had them under his paws. Only two or three bites to a mouse. On this occasion the coyote caught a mouse about every four minutes. On March 27, 1914, I saw a coyote find and jump a rabbit in the same way, but in this case the prey was quick enough to get away, probably having received some warning before the coyote leaped.

I frequently see coyotes near water and I assume they get frogs, snakes, and small birds there in addition to mice. I know they frequently get small ducklings, and even the adults, for I have found the remains of mallards and Barrow golden-eyes that had been caught and eaten. I have seen coyotes sneaking upon ducks on Twin Ponds and on Swan Lake and along Yellowstone River. I have seen a rather unsophisticated one try to catch a goose; and they occasionally catch and eat the white pelican of Yellowstone Lake.

While coyotes occasionally come to the garbage piles, they are more timid and allow the bears to monopolize them most of the time. But they will eat any scraps they can find, either there or about camps. I have seen them nosing about old camp sites. On May 15, 1915, after a snowy night, I found their tracks all about my tent and even within two feet of the canvas. After the summer is well started they find a good many lunches and scraps along the road, and for two or three months they haunt the roadways, especially at night. For this reason they are often seen when the automobile headlights flash on them.

In winter, when the rodents are hibernating or underground, the coyotes combine in packs and hunt the larger animals. It is always difficult to tell when coyotes have actually killed animals, because they almost always find a carcass and their tracks may obscure that of the real killer. I do not believe coyotes kill a third of the animals charged against them. In many cases they find a dead or dying animal. But they do sometimes kill quite large animals. I have seen coyotes chasing antelope and deer (Feb. 11, 1915). On Nov. 5, 1919, I found a case where a five-months-old elk had evidently been killed by a pack of coyotes. I was going along Slough Creek canyon on the trail. My notes read: "For some time I followed tracks of four coyotes in the trail, and then suddenly ran on to eight magpies and a coyote at the carcass of a fresh-killed elk calf. Evidently the coyotes had secured their prey by suddenly springing on it. The entrails had been eaten, the meat not yet disturbed."

Coyotes are noted scavengers, finding a carcass as soon as dead and returning to it time after time as long as a shred of anything eatable remains. For this reason, among others, they are valuable to mankind.

Here in Yellowstone National Park where they are seldom shot at, considering the number of people they see, they often become astonishingly tame, especially in late summer and fall. On July 11, 1917, I met with a coyote on Mary Mountain trail so tame he only turned out a hundred feet to pass me. On Oct. 10, 1922, one allowed me to drive up to within a hundred feet or so. On Oct. 27, 1914, a coyote on the open flat with no bushes or grass to conceal him crouched flat and let me pass 150 yards away. On Oct. 22, 1917, a coyote ran across the road ahead of me but so tame he stopped behind a screen of aspens to watch me pass. But a very wild one was seen only two days later.

During the late fall and winter, they are apt to be wild, for they are hunted steadily then by Rangers detailed for that purpose. Yet even in the spring some are astonishingly tame. My notes read: "A very tame coyote in Snow Pass," July 16, 1917. "A very tame coyote near the road near the 7-mile pond," April 16, 1921. "A coyote came so close, near Geode Creek, he almost ran into me," May 24, 1921.

The puppies are very playful. Even the adults are commonly seen at it. Sometimes I see them playing in the water, and on Oct. 27, 1914, I noted: "Two coyotes played with each other like puppies. One would spring at the other while the second one would crouch or jump away." Once (Sept. 22, 1917) we had a banjoist in camp in the evening, and all the time he played the coyotes were in full chorus all about us.

I have seen coyotes on the hills watch me pass by below, evidently with much curiosity. At night they have prowled around and through my camp either from curiosity or because they were looking for scraps of food. On the morning of Oct. 12, 1919, I saw one on the opposite side of the river watching me very intently and curiously, as I groomed my horses near the old Basin Station. On Oct. 18, 1917, on arrival at Wisdom's camp at Crystal Creek, I found two coyotes squatted in front of it, about 200 feet away, and watching the smoke coming over the intervening knoll.

With these animals mating is supposed to last for life, some writers even going so far as to say a coyote mourns for a lost mate. Personally, I should say a new mate is found before long.

Coyotes dig regular dens in soft soil on a dry location, or in sand. Usually these dens are deep, often five feet or more under ground.

In winter they serve as protection for the adults; in summer as natal dens for the pups. Most of the dens I have found were near Mammoth at 6000 feet elevation, but on July 17, 1919, I found a den near Sour Creek, 7800 feet above sea level. There are usually four to six pups to a litter, born between April and June. Three young coyotes were seen at the mouth of their den on Sour Creek, and later I saw the mother hunting just above the falls, July 17, 1919. Sometimes the female is with the pups and sometimes the father only, but both parents assist in taking care of them. As I have noted already, apparently an average yearly kill of 150 by the Rangers just about balances the increase.

The visitors are more interested in the coyote than in a good many animals but probably not more so than in the deer, elk, mountain sheep and antelope. They are not so much thought of as the bear, beaver and wolf.

We must not overlook the great service this animal does for us and for our health by removing dead carcasses that might otherwise be offensive and even dangerous. The coyotes will return time and again to a well-picked skeleton perhaps a year or two old to remove any last bit of flesh that may remain.

In the past it has been the custom to detail certain Rangers to kill and trap the coyotes wherever they can. Since 1907 we have definite figures for coyotes poisoned, trapped and shot (see Table 3).

Table 3. Numbers of Coyotes Destroyed in Yellowstone Park, 1907–1926.

Figures taken from the Park Superintendent's reports, for fiscal years ending June 30.

Year	Number killed	Year	Number killed
1907	99	1917	100
1908	97	1918	190
1909	60	1919	227
1910	40	1920	107
1911	129	1921	140
1912	270	1922	130
1913	154	1923	221
1914	155	1924	226
1915	100	1925	180
1916	180	1926	243
Total for 20 years			3048

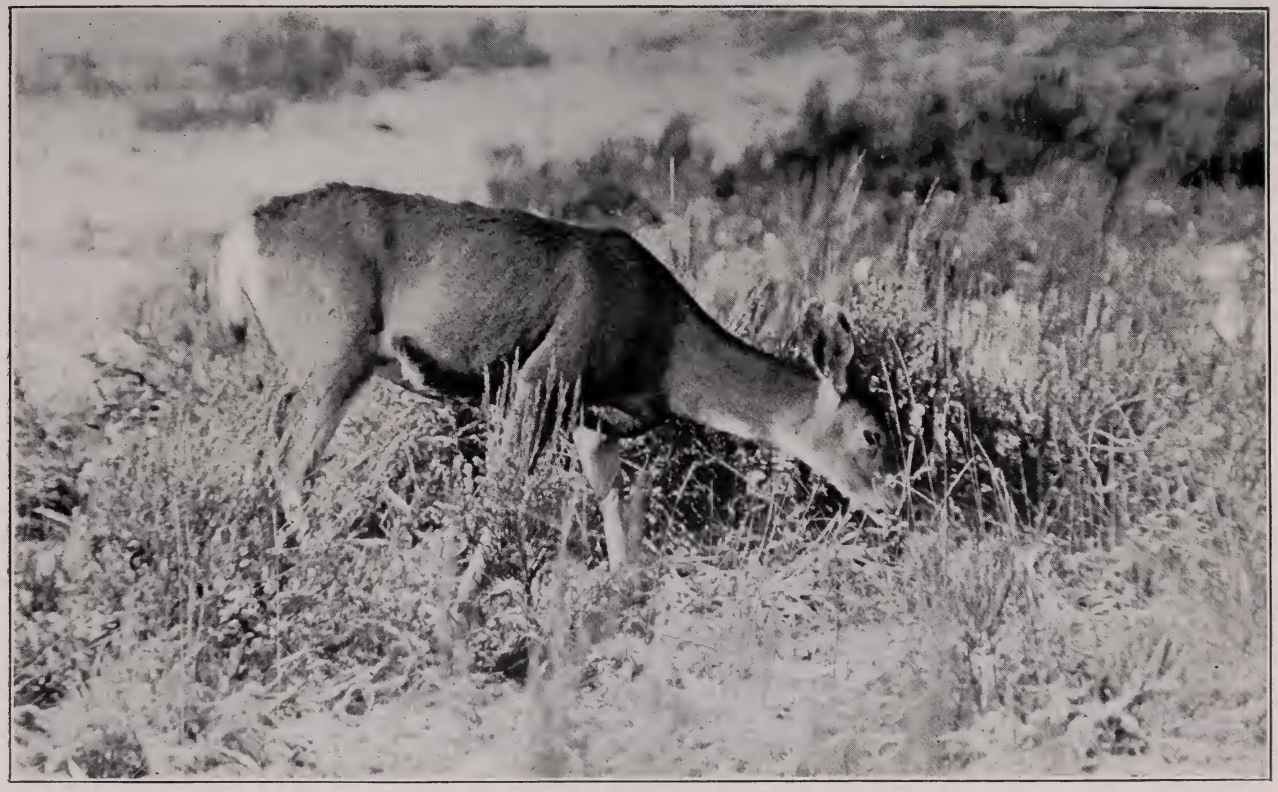

Fig. 30. A female mule deer feeding amongst the sagebrush, typical of the open areas below 7500 feet. Note the white tail with its black tip,—the best field mark for this deer and distinguishing it from both the eastern deer and the Columbian blacktail. Near Mammoth, Yellowstone Park, Nov. 1, 1914.

Courtesy A. C. McClurg & Co.

This is an average of 152 coyotes killed per year. And still the stock seems to maintain its numbers! But the question should be carefully studied in all its ramifications immediately and a definite policy adopted. The idea that it would be wise to exterminate this, or any other animal in a National Park, is antiquated and should be abandoned (cf. Grinnell, '25, p. 437; Adams, '25, '25a).

Mountain Red Fox. *Vulpes fulva macroura* Baird.—Probably this was always a rare animal in this section. My only notes in ten years are: "A red fox seen near the Trail down the north side of Mt. Washburn" (Aug. 18, 1919.) "A silver fox seen in the road to Canyon Junction five miles from Lake" (Nov., 1922). Probably the estimate of a dozen in the Park is liberal. Although one is now and then killed or poisoned in mistake for a coyote, they are maintaining their number. They are generally distributed over the northern and eastern sections of the Park, where they hunt mice, ground squirrels and rabbits. Occasionally they eat carrion. Foxes are not social and do not hunt in packs, at most a pair or family party together. Even at that the pups soon separate after leaving the den and hunt for themselves. Here, where most animals lose their fear of man, the fox is a notable exception. Their breeding habits here are similar to what they are elsewhere and they increase only fast enough to maintain their numbers. Because of their rarity, they concern the Park visitors but little. What little effect their presence has on the Park, is good. They destroy rodents and they scavenge, causing no damage of any kind that I know of. No control, nor even interference, is needed.

Marten. *Martes americana caurina* (Merriam).—So far as I can determine martens have always been rather common in Yellowstone National Park, especially in the forested sections. They range from the lowest Douglas fir forest to the highest white-bark pine forest near timber line. At the present time I estimate their number at 200 indivduals and steadily decreasing. This decrease has been going on for ten years at least and is probably due to excessive trapping in the regions surrounding the Park.

The food of the marten is largely mice and squirrels, although it also eats birds, rabbits, chipmunks, reptiles, fish, and frogs. It also devours carrion to some extent, especially in winter. While no one can doubt that this animal is a weasel, it lacks the wholesale destructiveness of that animal. It is wary and largely nocturnal in the Park.

They begin breeding when only a year old. Their mating habits are unknown although believed to be promiscuous. The pair do

not live together after mating. The young usually number three or four, and there is probably only one litter a year. If all the females bred every year, this would mean a 50 per cent increase each year; but it is believed that the females breed only when food is plenty, but not too abundant.

Martens are pretty and attractive when seen running about, but the visitors see so few they are of little general value. In unseen ways, they are of economic value. They are important checks on several species of rodents, clean up some carrion, and do little or no damage. They should be absolutely protected in the Park. Further than that, it is evident that they need more protection in the surrounding National Forests. Like the protection and care of a good many other animals, the situation in the Park and the surrounding National Forests should be handled as a whole after it is determined how many martens can safely be spared each year in the Forests.

FISHER. *Martes pennanti pennanti* (Erxleben).—This animal is so rare that it is doubtful if there are any in Yellowstone National Park at the present time. Even the one record for the Park of a skin taken by General Anderson from a poacher is open to the objection that it might have been caught outside the Park.

WOLVERINE. *Gulo luscus luscus* (Linnæus).—Probably this animal has always been present in limited numbers. Our estimate of six or eight individuals seems like very few in such a large territory. Still, the wolverine is never much more numerous than that anywhere. The Yellowstone National Park is apparently a peculiarly favorable habitat and they were twice as abundant twenty years ago as they are now.

They occur in all the forested parts of the Park but are apparently most numerous in the northeastern and eastern sections. Their food consists almost altogether of rodents, sick and crippled animals, and carrion. While their strength and courage would enable a 25-pound wolverine to kill practically any American animal except the cougar and bear, they are slow and clumsy animals at best and ill-suited to the life of killers. They are sullen, gluttonous, and given to much wandering.

While they have no habits that would appeal to tourists or sight-seers, the wolverines are peculiarly valuable as scavengers,—probably the most industrious scavengers the Park contains. For this reason they should be absolutely protected in the surrounding National Forests as well as in the Park itself. "Trappers around the borders obtain more specimens than in any other part of the United States.

The park evidently serves as a breeding and recruiting ground which has kept this interesting and rare animal from local extermination." (Bailey, '20, p. 78.)

Arizona Weasel. *Mustela arizonensis* (Mearns).—Presumably these weasels have always been common residents of the Yellowstone National Park. At the present time there are probably 200 individuals present and that number seems to be more or less stationary.

They are common about Mammoth and down to Gardiner. On Dec. 10, 1914, I saw one in Golden Gate; in Oct., 1912, one on the Upper Yellowstone meadows; on Oct. 31, 1920, one near Fountain Ranger Station; on Sept. 6, 1917, one near Lone Star Geyser; on Aug. 18, Aug. 29, and Sept. 8, 1922, near the Canyon. While not numerous on the Park Plateau they appear well distributed throughout the lodgepole forests between 7000 feet and 8500 feet above sea level. They live in lodgepole pine forest, in meadows, in swamps, and on the geyser and hot spring "formations" apparently wherever they can find prey.

They are indefatigable and bloody hunters, killing all animals smaller than themselves and some that are larger. Rodents are their special prey. When following up such small prey they insinuate themselves into every crack and under every ledge. Notwithstanding such thoroughness, the weasel while hunting is very quick and active. It is their relentlessness, however, that is their chief characteristic as hunters. They progress over the ground, especially when there is snow on the ground, by a series of quick, long leaps. They are quite apt to stop occasionally and stretch up to their full height while standing securely on their hind feet.

Theirs is a well earned reputation for blood-thirstiness and ferocity out of all proportion to their size. Seemingly they kill for pure love of killing, even after they are well fed. I have seen no disposition to return to the carcasses they have left. At times they grow remarkably tame where they are permitted to do so.

They are promiscuous breeders and their litters of young come regularly every year that there is an abundant food supply. Apparently the food supply is the limiting factor, for the females are not so fertile when the hunting is poor.

The visitors are interested in this animal whenever they see it, but that is not often enough to be of any importance. They form one of the most important checks we have on several kinds of rodents, especially mice and ground squirrels. For that reason it is

proper to afford them complete protection. At the present time no control measures are necessary.

Least Weasel. *Mustela cicognanii lepta* (Merriam).—This smaller species of weasel is occasionally seen in Yellowstone National Park and has all the characteristics already noted for the Arizona weasel. Because it is the deadliest enemy of the various species of mice no control should be attempted until after a thorough study of its influence has been made.

Mink. *Lutreola lutreocephala* (Harlan).—The mink was probably present originally in Yellowstone National Park, yet it has always been a rather uncommon animal here. I have seen mink as follows: first, on April 15, 1915, one near Junction Butte; second, on May 22, 1915, one ran past the Riverside Geyser; third, on June 27, 1916, one was seen in the grass beside Yellowstone River just above Canyon Junction; fourth, during the winter of 1919–1920 one staid about the Boat Company dock near the Lake Outlet and was frequently seen until May; fifth, one near Gardiner River where it crosses the Montana State Line. One of the above records is at 5500 feet, one at 6300 feet, and the other three at 7300 to 7800 feet. Hence my experience is somewhat different from Bailey's who found them "especially at the lower levels." At the present time, I believe there are about 150 individuals, a decrease from the number present ten years ago.

Although on December 3, 1922, I found the remains of a Barrow golden-eye probably killed and eaten by a mink, this animal lives to a large extent on trout which it is very expert at catching. Probably it eats a good many frogs and mice also. Birds at times fall a prey to the mink.

Although the mink is a close relative of the weasel, it has not the other's blood-thirst and destructiveness. At times, a mink becomes used to people and is remarkably tame.

Little is known of the breeding habits, but it is believed that one litter of four or five kittens a season is the usual family for a mink. The males and females do not remain paired.

Occasionally these little animals are seen by the tourists, and always arouse keen interest among the ladies, especially if they know what the animal is. The mink causes no damage in the Park, for the fish consumed can be easily spared. On the other hand he does some positive good as a check on rodents and by consuming some carrion and dead fish. Mink should be absolutely protected in the Park, and be given better protection in the surrounding National

Forests to prevent the steady drain on the Park animals which are slowly decreasing in numbers.

Northern Skunk. *Mephitis hudsonica* Richardson.—Probably the skunk has always been present in Yellowstone National Park. Although not common, it is generally distributed throughout. It occurs in aspen groves and lodgepole pine forests. Often out in the meadows and open parks and almost always near water. As my records are of skunks observed at elevations from 6300 to 7800 feet above sea level, it is evident they live on both the lowlands and the Park plateau.

A skunk's menu consists largely of grasshoppers, crickets, and mice. At times a few birds' eggs and even birds, if caught. They hunt a great deal along banks of streams, especially in spring, but I could not tell what food attracted them. Col. Wirt Robinson says that on July 23, 1907, a skunk came into his tent at the Lake Camp and ate some butter and then lapped up some cream from a small pitcher "just as a cat does," and then "it withdrew quietly." Three days later he passed in the rear of the Lake Hotel and "in the cellar saw a skunk walking slowly about and sniffing at some crates."

The skunk has absolute confidence in its "smell-gun." And rightly so, for very few animals will face it. This gives this fur-bearer a bearing of self-assurance at all times, and it makes no effort to escape. Ordinarily they pay no attention to a man passing, or approaching, until within fifty feet, then they turn and face the intruder. Although I sometimes find the odor strong, I am convinced that this animal never actually uses his weapon until he is forced to by some enemy.

They breed once a year and have from three to seven kittens at a time. It is difficult to see why they do not increase more rapidly, but their fertility is probably limited by the available food supply.

The Park visitors always like to see these pretty little black and white animals. They cause no damage whatever although the Park employees do not like to have them about because of the dire effects when one is molested. They are of value as a check on mice and ground squirrels and dispose of some carrion. They should be absolutely protected, as there are only a hundred of them according to my estimate and they are not increasing.

Badger. *Taxidea taxus taxus* (Schreber).—These animals have probably always been present. With the increase of the ground squirrels during the last few years, the badgers have increased also.

My estimate of 200 individuals at the present time is very conservative.

I have frequently seen these animals in all parts of the lower sections below the forests. I have also seen them twice, once in 1907 and again June 7, 1917, at Swan Lake Basin; and once on Specimen Ridge at 7300 feet altitude. That I have not seen them also on the open sections in the higher parts of the Park is probably due to their being most numerous where their prey is common. Seton records one in Upper Yellowstone Valley at 7800 feet.

They prey almost exclusively on the ground squirrels, which they can catch by fairly outdigging them, a considerable feat in itself. What a rapid digger this animal is! I have seen them fairly sink out of sight in soft ground, throwing the dirt perpendicularly behind them in a fountain ten feet high. Col. Wirt Robinson says: "I heard the gophers [ground squirrels] and chipmunks on a nearby hillside making a great racket and at first thought that their scolding was directed at me, but on looking across I saw a tawny, clumsy animal lumbering along with the heavy run of a woodchuck and I recognized it as a badger."

Sometimes they are quite tame here in Yellowstone National Park. They live a lonely life and seem sullen and ugly, yet they form strange friendships with other animals and can be tamed by man.

Not much is known of the breeding habits. Apparently the two badgers mate and remain together, and have one litter a year of two to four youngsters who remain with the parents throughout the first year. As with most other carnivores, badgers tend to increase in times of plenty.

Badgers are not of special interest to Park visitors because so seldom seen. As a check on the ground squirrels, this animal is the most important one present, and absolute protection should be granted it.

Otter. *Lutra canadensis canadensis* Schreber.—Apparently otters have always been dwellers in the larger lakes and streams of the Yellowstone and Snake River systems, but not originally along other streams because of insufficient fish for food. At the present time I should rate the otter as locally abundant in a few places. I believe there are only about sixty of the animals in the Park, and the number is decreasing because of overtrapping on the National Forests surrounding the Park.

Col. Wirt Robinson found an old and much weathered skull of an otter on a gravel bank of the Gardiner River. On May 11, 1914, I saw a large otter run across the meadow near lower cabin, Slough Creek; on June 20, 1915, one in the water at Willow Park beaver dam; on Oct. 15, 1920, one near Obsidian Creek, 14 miles from Mammoth; on Jan. 11, 1915, one near Virginia Cascades; on Sept. 21, 1917, in Gibbon Canyon; on Oct. 23 and 26, 1920, fresh tracks were seen near Riverside Geyser; on Oct. 26, 1920, two otter crossed the northern Mallard Lake Trail; during the winter of 1919-1920, one was frequently seen near Lake Outlet and on June 1, 1920, it was seen again in openings in the ice just west of the Fish Hatchery; on May 28, 1915, I saw four on Yellowstone Lake near Wolf Point; and on Oct. 26, 1920, I saw a fresh track near the Lake Outlet.

The above data would indicate that otter are to be found at all elevations between 5500 feet and 8000 feet and quite common near the Upper Geyser Basin, Gibbon River, and about Yellowstone Lake. Naturally, I have seen otter only in or near water; sometimes about beaver ponds.

Probably 90 per cent of the otters' food is fish which they catch by diving and outswimming their prey. The otters are so far superior to all other Yellowstone swimming mammals as to be in a swimming and diving class by themselves. Only the beautiful, dashing trout can rival them in expertness and speed. They can swim long distances, too, without fatigue. Probably they would eat other animal food if forced to it by hunger but they are not known to eat vegetable food ever.

Here in Yellowstone National Park they are comparatively tame and unsuspicious. Although a member of the same group as the weasel, I see in them no evidence whatever of the blood-thirst and ferociousness of that animal. Although a brave and courageous fighter when necessary, the otter lives in peace with the other animals. I see otter often about beaver ponds, but have observed no sign of animosity between otter and beaver. It is probable that the otter in these haunts are after trout that are often very numerous in beaver ponds.

Otters are very playful animals. On Jan. 11, 1915, I found an otter and his slide beside the Gibbon River just above Virginia Cascades. The slide was down a steep bank about twelve feet high and ended in a shallow pool of the River. The otter slid down flat on his belly with forepaws and legs stretched out in front. On May 28, 1915, four came swimming past my camp on the shore of Yellow-

stone Lake. Part of the time they were under water, but mostly on the surface rolling, diving, and playing together as they swam along, much as I have seen puppies do.

Otter breed once a year and have from one to three kittens at a time. The mother is devoted to them, but I am not sure that the father is ever with his family after the birth of the young. This is rather a slow-breeding animal, not likely to increase greatly.

Although not often seen by tourists, they share with other wild animals the interest shown these days in all wild life. While the otter does no damage whatever, further studies are needed to show his full economic value. Undoubtedly he has his value in keeping fish development up to the mark, and in preventing epidemics among them, by killing the unfit and the diseased. Absolute protection is rightly given in the Park. The protection in the surrounding regions should be strengthened and improved to prevent the present overtrapping there.

Mountain Lion; Cougar. *Felis hippolestes* Merriam.—The very first animal records we have of the Park speak of the presence of cougars. So numerous are the records that we must conclude that the animals were rather common; that is, for this species. But they have been so hunted and harried by the Rangers that comparatively few remain—not more than a dozen at the present time. They range throughout all parts of the Park, especially where the animals they prey on are to be found. In winter they are more numerous in the northern section than elsewhere.

In summer, the mountain lion lives mostly on small animals and then kills large numbers of rabbits and woodchucks. Colonel Roosevelt says they also kill gophers and mice. But in winter, they are apt to transfer their attention to deer, mountain sheep, elk calves, and even antelope, and thus invite the animosity of the Park authorities. It is said that they also kill coyotes and wolves but I cannot substantiate this from my own experience. Possibly a mountain lion may eat carrion, but as a rule it kills more than it really needs for itself, then makes a fresh kill when it is again hungry.

A cougar is naturally ferocious and destructive, but also rather cowardly. It shares with the weasel its reputation for killing more than it needs whenever opportunity offers.

Cougars breed once in two years, giving birth to from one to three kittens, and are therefore rather slow breeders and not apt to increase rapidly in any one district. But they roam about a great deal and a plentiful supply of prey will attract them a long distance.

Fig. 32. A coyote hunting mice in a small meadow. Gallatin Valley, Yellowstone Park, Oct. 10, 1922.

Fig. 33. When a coyote hears, or smells, a mouse in the grass, he "points" it for a few seconds much as a bird-dog points a game bird. Gallatin Valley, Yellowstone Park, Oct. 10, 1922.

Courtesy A. C. McClurg & Co.

Fig. 34. Grizzly bears foraging at the edge of the lodgepole pine forest near Canyon Junction. In the Yellowstone Park, grizzlies are inoffensive and actually seek to avoid trouble, unless provoked.

As this is the hardest of all animals to see and observe, it is of no great value from the tourist standpoint although serving as the source of thrilling tales. Although there are authenticated cases of attacks in the United States on persons, and especially on children, the fact is so rare that its danger can be disregarded in such a territory as the Yellowstone National Park. The cougar is of some value here as a destroyer of rodent pests, and of sick and diseased animals. Its numbers will doubtless have to be limited, but it is already so near extermination that further killing should be prohibited, pending the carrying out of a careful and unprejudiced study of its relations to the other animals. Perhaps in the future the cougar will receive special protection in the Yellowstone, for it should be noted well that there are but few areas in the country where it can be preserved at all (cf. Heller, '24, pp. 433–434).

Canada Lynx. *Lynx canadensis canadensis* Kerr.—Probably this cat has always existed in limited numbers in the Park, where it frequents the forests of the plateau region. I believe there are about ten individuals present and that the number has not changed materially for years.

Its food consists largely of snowshoe rabbits, and possibly other rodents. It has been said to destroy young deer, elk, and mountain sheep, but the number in Yellowstone National Park is so few that the damage done cannot amount to much. Like all the cats this is an inveterate hunter, but without the relentlessness of the weasel and cougar.

A pair of lynxes have but one litter a year of from one to three kittens. Like so many other carnivorous animals, the fertility of the females seems to depend to a large extent on the food supply.

Because of their limited number in the Park, they are of small value to the tourists, who never see them. If they do any damage at all, it is probably more than balanced by the number of rodents killed. Therefore they should be protected and not molested.

Bobcat. *Lynx uinta* Merriam.—What the lynx is to the higher, forested regions of the Park, the bobcat is to the lower, rough country of the northern section. Natural to their smaller size, they prey mainly on rodents and to a limited extent on birds, and are not even accused of killing "game animals." They are very few in number, not more than two or three pairs. Their place in the Park fauna is almost wholly as a check on the rodents. In the Yellowstone, bobcats should be given complete protection.

Muskrat. *Fiber zibethicus osoyoosensis* Lord.—Muskrats have always existed in Yellowstone National Park so far as we know. They are quite generally distributed over the Park except on the highest elevations, the altitude variation of their range being from 5300 feet to 8300 feet above sea level.

Usually their homes are in still waters that are not too deep, but they seem to prefer waters not subject to floods or very low stages. Yet I have often seen them on "reedy pond" which has no outlet and where the fluctuations of water level are correspondingly great. They seem fond of some alkaline ponds, especially those lined with reeds and tules. Muskrats are common in Yellowstone River in Hayden Valley where the current is not strong. On the other hand, I have seen them in the Gardiner River where the water is rapid and tumultuous, but they may have been only using that river as a water route. Usually they live about more or less warm and stagnant waters, but beside Sylvan Lake on July 17, 1921, I noticed one on the shore of this cold, clear, spring and snow-fed lake.

The food of the muskrat is almost wholly vegetable, although occasionally a little animal food is eaten. Usually they come ashore to eat or climb out on a rock in midstream, and sometimes on the edge of the shore ice. On May 9, 1923, I found one out on the meadow well away from "reedy pond" eating the fresh grass.

Sometimes they are quite tame but normally rather more suspicious than most of the Park animals. They frequently live in beaver ponds, even erecting their houses in the ponds still inhabited by the larger animal. I see no signs that the two are unfriendly or that the muskrat is parasitical on the beaver beyond merely taking advantage of the deep, still water provided by the other's industry.

The Park visitors are interested in these animals as part of the normal Park fauna. Since they do no damage, they are rightly given complete protection. Probably the Park serves as a source of supply of muskrats to the surrounding country.

Beaver. *Castor canadensis canadensis* Kuhl.—Beaver (Figs. 27, 42, 48) probably always have existed in the Park. Caches of beaver traps have been found in the Park that were of a type used by the fur companies in the earlier half of the nineteenth century, and there were a few other indications that beaver trappers roamed the region before the Park was established in 1872.

Beaver occur in practically every stream and pond (where there is suitable food) in the Park. The only extensive watercourses where I have not noted them are those of the Pelican Creek system

and I believe they are there also, at least along the lower part of Pelican Creek. They live about all streams and ponds, and along the shores of Yellowstone Lake in a few favorable localities. They are even to be found in the warm streams and mineral waters. Their habitat depends on food,—and the favorite foods seem to be the bark of the following trees, in the order named: aspen, cottonwood, willow, alder, birch, and Douglas fir; and on Aug. 4, 1917, I found one had cut a lodgepole pine apparently for food. They also eat other vegetable food such as sedges, flags, cow parsnips, and other plants.

Presumably the total number of beaver in Yellowstone National Park has always been about the same although fluctuating in certain localities. The normal increase leaves the Park and goes down the various streams to be caught or lost in the surrounding territory. I have estimated the beaver population of Yellowstone National Park at about 10,000, but believe that figure to be very conservative.

In the primitive wilderness it is likely that the beaver lived and worked during the cooler parts of the day as well as by night. When hunted and trapped, they become strictly nocturnal. Here in Yellowstone National Park, where they find themselves protected and secure from man, they gradually come out earlier and earlier until it is not uncommon to see them out as early as 5 p. m. on warm days, and at all hours on cooler days. Even so, they still continue to do their building and repairing of dams, canals and houses at night.

The beaver colonies seem to be patriarchal in form. So far as I know the original couple remain mated and are the leaders of their colony. The younger members emigrate whenever the home quarters become too crowded but I do not know as there is any regularity or sequence to the movement. Several kittens are born each year and the species increases rapidly in any favorable section.

Next to the bears the beavers are the most interesting and the most sought after of all the Park animals. As they are entirely harmless, except for minor interference with man's engineering, they are rightly given complete protection except that now and then a family is trapped and presented to some public zoological garden. The Park serves as a nursery for beaver for all the surrounding country. When food grows scarce, they emigrate. On Oct. 11, 1922, I found a pair in the Gallatin River and thirty miles north of the Park. Evidently they had come down that river.

THE VALUE OF PREDATORY ANIMALS, AND WHERE TO PRESERVE THEM

"As the settlement of the country progresses and the original aspect of nature is altered, the national parks will probably be the only areas remaining unspoiled for scientific study, and this is of the more significance when we consider how far the scientific methods of investigating nature then obtaining will be in advance of those now applied to the same study." (Grinnell and Storer, '16, p. 10.)

Economic and Educational Values of the Predators. That the coyotes, wolves, and their near relatives are exceedingly interesting animals cannot be denied by anyone who has read Ernest Thompson Seton's entertaining stories. And by this, I mean interesting to the unscientific as well as to the naturalists. To the naturalist every animal is keenly interesting—especially ones as highly developed and as diversified in habits as the predatory animals are. It is only by study that we can really know an animal and find out what it eats; whether it is detrimental to man's interests and should be kept under control; or whether the good it does (for every animal does *some* good) overbalances the evil it may do. If it does more good than harm, it obviously should be protected. The animals must be preserved somewhere if we are to study them, and the National Parks are logical places for that preservation. Undoubtedly in a careful study of the predators we are going to find them most instructive as well as entertaining. "You have all read your Darwin carefully enough to know that neither camels, horses, nor deer would have evolved as they did except for the stimulus given to their limb and speed development by the contemporaneous evolution of their enemies in the dog family." (Osborn, '14, p. 354.)

In another way, wild life is benefited by predacious animals which serve us well by removing weak and sickly animals, thus keeping the breeding stock vigorous and free from epidemics. On the grouse moors of Scotland, "birds of prey and small mammals—so-called 'vermin'—are killed off in order to preserve the grouse, yet this interference seems in part to defeat itself by making the survival of weak and diseased birds unnaturally easy, and epidemics of grouse-disease on this account the more prevalent." (Thomson, '96, p. 27.)

Mr. A. A. Saunders, also, is impressed by this view of their influence on bird life. "The wild enemies of birds weed out from their ranks the weaker individuals, those less fitted for the struggle

for existence. If through destruction of these enemies, the weaker ones increase, disease or parasitic enemies may start, and spread from weaker to stronger and do far more to decrease bird life than other natural enemies ever would." (Saunders, '23, p. 243.)

Although I have used birds to illustrate my meaning, it is just as true of mammals that they require predatory enemies to keep them at the top-notch of efficiency. The bison of the tame herd in Yellowstone National Park are subject to hemorrhagic septicemia which breaks out at intervals with tragic results. Since the wild animals do not have the disease, we are beginning to wonder if a few predators would not normally have stopped the disease with the first weakened animal before it could spread to others. I know of an instance back in 1917 where I found a single mule deer infected with actinomycosis, or lumpy jaw. This deer avoided all natural enemies by living near Mammoth where the crowds of people scared off the coyotes that would otherwise have killed him during the early stages of his trouble. But as it was, this deer lingered on for two years more. From that date to 1921, I saw five different mule deer that were infected with this disease although I had never noted a case among them before. Unfortunately I was not able to trace the disease back from the five mule deer to the one first seen in 1917, but the presumptive evidence is very strong that they contracted it from the first deer.

Prominent among the predatory animals are the coyotes. Tell the average rancher outside the Park that you see a coyote out on his meadow, and he immediately rushes for his gun. He never gives a thought as to whether the coyote's usefulness overbalances the mischief he does. But that very coyote that the rancher would shoot, is, nine times out of ten, catching mice that are much greater enemies to the ranch, at that very time.

One careful investigator discusses the influence of the coyote as follows: "Due credit must also be given the coyote for destroying rodent pests, particularly ground squirrels. An examination of the stomach contents shows that ground squirrels form a large part of coyotes' diet at certain seasons of the year. The good that they thus do in destroying squirrels, is, of course, counterbalanced in greater or less proportion by their destruction of game birds and mammals. The fact remains that if we kill off all the coyotes, we must face the problem of ourselves accounting for the thousands of ground squirrels which these animals now annually destroy. In certain instances coyotes have actually been afforded protection by ranchers on the ground that they were proving beneficial through the catching of

gophers and other rodents when flooded out during the irrigation of alfalfa fields. *A coyote is not necessarily a bad citizen.*" (Dixon, '20, p. 381.)

And Lantz is another investigator who gives full credit to the coyotes for the good work that they sometimes do: "Among the mammals included in the food of the coyotes are many injurious species; and, so far as their food is confined to these, the animals are decidedly beneficial to the farming interests of the country. The destruction of rabbits, both large and small species, is of great advantage, especially on the plains and in the cultivated valleys, where their depredations are keenly felt by the settlers. The various species of jack rabbit have often been observed as included in the coyotes' fare, and the smaller rabbits are also habitually eaten. The coyotes usually catch the rabbits by lying in wait behind bushes and bunches of grass near their paths and pouncing upon them as they pass. Sometimes they have been known to hunt jack rabbits in company. While a single coyote would not be able to run down a jack rabbit, by hunting together, taking turns in the drive, and by taking advantage of the tendency of the hare to run in a circle, they are able to capture it. . . . Prairie dogs (*Cynomys ludovicianus* and other species) are also a staple coyote food. The coyote captures them by hiding behind clumps of weeds or bunches of grass at some distance from the burrows. When the unsuspecting rodent, in feeding, approaches near enough, a few leaps enable the coyote to secure it. . . . Besides rabbits and prairie dogs, the food of the coyote is known to include the following mammals: Rice rats (*Oryzomys*), kangaroo rats (*Dipodomys* and *Perodipus*), wood rats (*Neotoma*), ground squirrels (*Ammospermophilus, Callospermophilus,* and *Spermophilus*), woodchucks (*Marmota*), voles (*Microtus*), pocket gophers (*Thomomys*), chipmunks (*Eutamias*), and pocket mice (*Perognathus*). All of these are more or less harmful, and the coyote performs an important service in preying upon them. The service is not an occasional or a spasmodic one, but lasts throughout the year and throughout the life of the coyote. When the number of animals taking part in the work is considered, the enormous importance of its bearing in maintaining the 'balance of nature' becomes apparent. The coyote is useful also as a scavenger. In the prairie country, especially in winter, it comes into towns at night searching for garbage thrown into the alleys. Here it finds remnants of meat from the table, offal from game, and similar prizes. When hungry it will reject no animal food, not even carrion. The slaughterhouses near the towns are favorite feeding places, and the animals are often shot

there by moonlight. On the ranges they soon consume dead horses and cattle, leaving the bones clean." (Lantz, '05, pp. 12-13.) The value of the coyote as a scavenger is liable to be underestimated.

I have picked out the coyote for this argument because it is the carnivore against which the greatest outcry has been raised. All the other predacious animals are of more or less value along the same lines. Unquestionably the coyote causes damage at times, sometimes great damage, outside the National Parks. And so do the mink and the weasel cause damage in populated districts. We do not deny that frequently such an animal has fallen into evil ways from the point of view of our economy. What we contend is that each species should be studied on its own merits. If we had more time we would go even farther and say that each individual should be studied on his own merits, for we are beginning to realize more and more that individual animals differ in their ways just as men do. But such studies are too much to hope for yet, and so if the decision is against a species after we have weighed its merits against its demerits, by all means kill the animals individually responsible, but we should move very slowly indeed when it comes to declaring war against a whole species (cf. Grinnell, '25, p. 437).

If these coyotes are sometimes as valuable as this, they are worthy of careful study. To study them carefully, they should be preserved in great natural areas where they are free to develop naturally. In partially disturbed areas, and still more so in captivity, habits change; and, while a captive is very interesting, we can never be sure such an animal is showing the characteristics of a normal wild individual. Even the form and proportions of the bones change, as so clearly shown in Hollister's fine study of captive lions ('17, pp. 180-192). What is true of lions in this respect, is probably true of captive coyotes. And our whole argument based on coyotes, is just as true for all predatory and fur-bearing species. To have normal animals fit for our careful study they must be living in large, natural areas. For this our great National Parks are well suited.

Besides these economic and scientific values, predatory animals have an esthetic and educational value for all outdoors people that can scarcely be overstated. A few years ago, wild life and the wilderness-in-a-state-of-nature did not appeal so strongly to the average person. As Enos Mills has vividly expressed it: "Most people think that the wilderness is a supremely dangerous place for human beings. They carry through life a handicap of fear of the outdoors. These children learn that the wilds are not only friendly but hospitable; they

find ferocious animals only in storybooks, and ere long being out after dark or in the rain is fun.

"A well-known educator recently emphasized the fact that to have a sane and healthful view of life it is necessary to have correct fundamental information concerning natural history; and that this knowledge can be acquired only by intimate contact with nature.

"For two or three hours in a primeval forest we played that we were primitive people. The children had a glimpse of the childhood of our race; learned something of the diet of primitive people; why we have so many domesticated plants. All this started over seeing mushrooms and wondering whether they were poisonous.

"When out with nature the unexpected often happens. If we come upon something well worth while—like a mother bird leading her young from the nest, beavers at play, or a near view of mountain sheep—we remain and make the most of this opportunity." (Mills, '20, p. 168.)

But conditions are changing, people are becoming more addicted to cross-country travel, camping, and living in the open, all of which promotes an interest in wild nature. Our growing boys and girls are imbibing a knowledge even more worth while than in the old farm days, for they now have competent leaders and natural science instructors. The adults are becoming interested in what their youngsters find so absorbing. Since wild life has so largely disappeared elsewhere, we shall have to depend upon our National Parks more and more for this aspect of the primitive. "As has already been intimated, the animal life of the parks is among their best recreative assets. The birds and mammals, large and small, the butterflies and the numerous other insects, even the reptiles and amphibians, are of interest to the visitor. As a stimulant to the senses of far sight and far hearing, faculties largely or altogether neglected in the present scheme of civilization, they are of no less consequence than the scenery, the solitude and the trails. To the natural charm of the landscape they add the witchery of movement. As soon as the general surroundings lose their novelty for the observer, any moving object in the landscape will catch his eye and fix his attention. People will walk miles and climb thousands of feet to secure a good view of falling water, and this desire for movement is even more completely satisfied by the sight of animals in motion. The moving deer, passing within range of the stage-coach, rouses exclamations of surprise and delight. Eagles and pigeons in flight overhead readily claim the traveler's notice, and the smaller birds often mingle the fascination of sprightly movement with that of bright color and pleasing song. Con-

Fig 35. Looking down on the open prairies bordering the Lamar River; lodgepole pine and aspen in foreground; elevation about 6500 feet. The mountain in the distance is The Thunderer. Northeast corner of Yellowstone Park, Nov. 1, 1917.

Fig. 36. Scene above timber line near Sportsman Lake, at the beginning of the winter, November 8, 1917. The extensive dark pine forests of the plateau region in the distance. Note the forage in the foreground and the dark-colored gopher hill at edge of picture in front.

sidering the predilections of the average visitor, we should perhaps regard these last as the most indispensable creatures in the parks.

"The interest of moving objects depends upon a number of elements other than movement, among which their color, and especially their size, is important. The chipmunk is more attractive than the ground squirrel, primarily because its movements are more rapid, and secondly because of its more brightly colored markings. But when movement and color are equal the average observer's selection seems to have a quantitative basis, though the rarity of the object, and its romantic or other associations affect the equation. A bear or a deer will elicit more interest than a smaller mammal, even though the latter be of a rarer species. There are exceptional cases where an animal's extreme rarity will make it of exceptional interest in spite of its inferior size, but in general the larger species are the more rare, as they are the first to disappear before human invasion. They have therefore a double claim to consideration, and measures should be taken to prevent their numbers from diminishing. After the visitor's initial curiosity has been aroused and his powers of observation developed, he may be trusted to give a closer study to the smaller species." (Grinnell and Storer, '16, pp. 5–6.)

As a good illustration of this general rule, we can instance the bears of the Yellowstone. When they first began to come about the garbage piles, the Acting Superintendent thought they ought to be killed off! "I am more than ever convinced that the bear and puma do a great deal of mischief and ought to be reduced in numbers." (Boutelle, '90, p. 6.) Fortunately the tourists were not at all backward in making known their wishes in the matter, and a wiser view more favorable to the bears, prevailed. At the present time we know that these bears do very little damage compared with the interest they arouse among the Park visitors. Certainly, without its bears, the Yellowstone would lose a great part of its attractiveness. "One may have a preconceived idea that people who visit the Yellowstone National Park center their interest on the geysers that spout and play and fill them with awe by their wonderful hydraulic displays. Nothing, however, is farther from the truth. The summer tourist probably is most fascinated by the sight of the two species of Park bears. The black or brown bear is a friendly animal and is a never-ending source of wonder and amusement; and the shy but powerful grizzly expresses in every movement an alertness and a spirit of independence that instantly commands respect. The tourist's conversation follows the promptings of his heart, and bear talk flows from his lips far oftener than any regarding the geysers or other inanimate objects."

(Heller, '24, pp. 405–406.) Yet, with this striking illustration before him, Major James B. Hughes, Acting Superintendent of Sequoia and General Grant National Parks, advocated the killing of the bears in the two Parks under his jurisdiction. "Authority should be given to kill bears in the parks by certain authorized persons; so far as I have observed or have been able to learn the bear is absolutely useless as an ornament or for any good purpose." (Hughes, '12, p. 193.)

But bears are not the only predacious animals that the people want to see. In fact, I know of one instance where the tourists were intently watching the bears near the Canyon Hotel when a small weasel came running in and out along some piled logs. Instantly the attention of everyone was riveted on the weasel to the exclusion of the bears. Without being at all versed in nature lore, they recognized the greater rarity of the weasel (in the Yellowstone at any rate); and as such it occupied all thoughts as long as it remained in sight. Then again, I have been out with tourists who wanted to see coyotes. From the time they entered the Park until they left, they talked about coyotes and importuned me repeatedly to be sure to show them one whenever I saw it. As for mountain lions and wolves, I believe many of the guests would make a new trip to the Yellowstone National Park if they were sure they would see one of these animals. There is no doubt, then, of the tourists' interest in predatory and fur-bearing animals. "For the love of nature includes vastly more than the appreciation of natural scenery." (Sumner, '20, p. 238.)

But these lesser animals are hard to find and see for they are largely nocturnal animals, or at least much shyer than the bears. Indeed, it would be hard to gauge the full extent of the interest in the bears shown by the tourists to the Yellowstone National Park. As Mr. Heller says, they talk about bears incessantly and one would judge from their conversations that these bears were of primary importance. As it is now, Bruin is the one large animal that everybody can count upon seeing. This is not because it is hard for any one to find other animals but simply because the average visitor does not know how and when, and does not spare the time, to hunt up the other animals in their native haunts and at the right time of day. But the bears are accommodating, they come right down where the people are and show themselves off to the immense pleasure and satisfaction of everyone.

Second only to the bears, in point of interest, is the beaver. Perhaps to some people the beaver is of even more interest than the bear. Mr. E. R. Warren expresses this well when he says: "If I were to judge from my experience at Camp Roosevelt, in the north-

eastern part of the Yellowstone National Park, during the past summer, no animal except the bear arouses so much interest on the part of the park visitors as the beaver. Within fifteen minutes' walk from the camp, near the bridge over the Yellowstone River, and close beside the Cooke City road, is a fine series of small beaver ponds. Hardly an evening passed during the summer but anywhere from half a dozen to thirty people thought it well worth while to walk down there and spend an hour or more watching these fascinating animals, which are obliging enough to go about their usual activities almost oblivious to the interested observers lined up upon the bank beside the road. Here one can observe not only the ponds, dams, lodges and all stages of felled trees and stumps, but even the beavers themselves swimming about in the water, crawling over the dams, cutting aspen branches, and busily and audibly eating the bark. If one is careful, by refraining from making quick movements and unusual sounds, so as not to disturb the animals, the opportunities for observation are excellent. Indeed, there are few places in America, even in remote regions, where such opportunities are equalled." (Warren, '22, pp. 187–188.) It is the fact, so well brought out above, that when we see beaver we also see something of their strange life and works, that makes this animal so enticing as a subject of study.

The skunk holds a different interest for us. The first impression of an observer is expressed in the exclamation: "Oh! how pretty he is!" when a skunk is sighted. Next comes wonder at the intrepidity of an animal who goes along attending to his own business indifferent to an audience. But when that audience finds out just what this pretty little animal is, the interest changes to wonder in the skunk's terrible weapon. To those who know what that weapon is, the skunk achieves a new interest because of his absorption in his own business and his refusal to use his weapon unless actually teased into it. Somehow he seems even stranger than the bears "who refuse to go about hugging every luckless human being they can catch," as one woman expressed it.

As for the mink, the minute that word "mink" is spoken it brings to mind furs and beautiful fur coats beloved by all. Naturally, everybody, especially the feminine tourists, are keen to see what the animal that furnishes the fur looks like. I have seen mink in the geyser basins and have been greatly impressed to see the tourists turn away from one of the great, spouting geysers to watch a little mink running along the river shore. It showed as nothing else could how great is the interest in all animals, no matter how small. This is but

an instance of the great value of National Parks to nature students and the average visitor, so well expressed by Grinnell and Storer: "But national parks have other less generally recognized advantages, and among these we consider their potential uses as places for recreation and for the study of natural history, especially worthy of notice." (Grinnell and Storer, '16, p. 1.)

Implications of the Destruction of Natural Conditions. Elsewhere than in the National Parks and the remotest and most inaccessible regions natural conditions are being altered rapidly. Indeed, there are very few sections retaining their natural wealth of trees, flowers and animal life in anything like their original condition. Besides the shooting and trapping going on everywhere, forests are disappearing, brushland is being cleared, swamps are being drained, great areas of desert land are being irrigated, and on many areas valuable native plants are being destroyed for commercial purposes or through overgrazing.

"The splendid redwood forests of the northern California coast belt—perhaps the finest forests on the American continent—are falling before the axe and the saw of the 'lumber king' and the air for much of the year is hazy with the smoke of the burning brush and trees which have to be thus removed before the fallen giants can be cut up and dragged away for the market. The result is a scene of appalling desolation for years to come. When these forests are gone—as they will be, save for a few remnants—our fertile-brained inventors will discover quite acceptable substitutes for the redwood lumber, and the building business will continue 'as usual.' But we shall never find any acceptable substitutes for the redwood forests, which it took nature thousands of years to produce. It is true that in the case of this particular tree a second growth may reforest an area which has been logged over or damaged by fire. But this is a slow process, and we can not be sure that the same plant associations will establish themselves as existed previously.

"Even the desert, which has long furnished interesting problems to the naturalist, as well as inspiration to the poet and the painter, seems doomed to wholesale invasion and exploitation. To make the desert 'blossom as the rose' has for ages been looked upon as typical of man's conquest over nature, and the wonderful achievements in our own Southwest stand in the front rank of such efforts. But we can not overlook the tragic side of the picture. The limitless vistas of picturesque desolation lose much of their mystery when we find that they are threaded in all directions by automobile roads, and when the

eye is everywhere confronted by scattered rectangular clearings, due to the fruitless efforts of would-be desert farmers. The highly interesting and picturesque plant associations in the western portion of the Mojave Desert are being rapidly destroyed by so-called 'settlers' who are probably not getting enough out of the land, in most cases, to pay expenses. The weird and beautiful tree-yucca, a plant so typical of our California desert landscape, is now being largely used for various commercial purposes. I know of at least one company, organized with the particular object of exploiting these yucca products. As this is a tree of extremely slow growth, we may expect its practical extinction within large areas in the near future." (Sumner, '20, pp. 240–241.)

And Theo. B. Comstock brings the situation home to the Yellowstone National Park when he says: "I consider that the Yellowstone National Park can be made a really valuable laboratory and conservatory of science at little cost . . . Momentous questions are now agitating the scientific world, calling for experiment and observation which are daily becoming less possible, owing in a great measure to the obliterating influences of modern civilization. Thus it would almost seem that the present difficulties in the way of the solution of many questions, bearing upon the process of natural selection, will soon become insurmountable if some means are not employed to render more practicable the study of animals in a state of nature." (Comstock, '74, p. 72.) If this was true fifty years ago when we were still comparatively rich in many animal forms, it is still more true in this day of wholesale destruction.

In fact, there is a crying need for sections maintained as Nature made them: for the scientists and for millions of others also. Only wild lands, free from domestic stock, free from domestic crops, and free from foreign weeds will answer. Furthermore, there must be no imported products of any kind—neither fur, fin, nor feather, nor ornamental shrubs and trees. What is wanted is great areas of wild land with plants and animals living in a natural environment. A competent technical staff should decide what is natural and do their utmost to maintain it so. As we have seen, the balance has already been disturbed in the Yellowstone National Park so that what we require now is to maintain it at the present point, and that necessitates intensive study.

"The pleas against *extermination* of any species and against the introduction of exotic species of animals or plants into wild life preserves are points well taken and should have the widest publicity.

Our National and State parks and reservations are our only hope for the preservation of any part of the primaeval wilderness and all commercialism or destruction of Nature's balance within these areas must be prevented. Certain species may be 'pests' or 'vermin' on the farmer's acres and may have to be killed there to allow some other species of commercial value to increase abnormally, but in the wilderness where the aim is to preserve primaeval conditions all species are on the same footing and nature who has always taken care of their interrelations can be trusted to govern them without man's interference." (Stone, '23, p. 552.)

In the National Parks, especially, we must not destroy, we must not exterminate, for we cannot reproduce that which we may at one time consider a menace, or a nuisance, just as in the case of bears, as related on page 213.

"These animals were not made in a day, nor in a thousand years, nor in a million years. As said the first Greek philosopher, Empedocles, who 560 B. C. adumbrated the 'survival of the fittest' theory of Darwin, they are the result of ceaseless trials of nature." (Osborn, '14, p. 353.) Dr. E. W. Nelson puts the case even stronger when he says: "The splendid mammals which possessed the earth until man interfered were the ultimate product of Nature working through the ages that have elapsed since the dawn of life. . . . The wanton destruction of any of these species thus deprives the world of a marvelous organism which no human power can ever restore." (Nelson, '16, pp. 401–402.)

At the present time, fur-bearing animals are rapidly being driven out of the country as a whole; and soon we must domesticate some of them outside the Parks and raise furs for market, just as we do chickens. In fact, this is being done now in the case of a few species. But before we can domesticate them and breed them successfully we must know much more about them, we must study them in their wilderness environment. And wild animals cannot be preserved in menageries or zoos; there they lose their wild habits, their stamina, their intelligence, and even their form. (Hollister, '17, pp. 177–193.)

"The need for prompt and drastic action to save our native fauna, especially the birds and mammals, has been ably and forcibly set forth by various recent writers. It is scarcely necessary for me to rehearse the gloomy chronicle of extinct and vanishing species which has been recorded by Hornaday ['13, pp. 1–411] and others. Let us not, however, focus our attention too exclusively upon these relatively few examples which are so conspicuous—the mammals and birds

which are sought for as sources of food or feathers or fur. . . . Large tracts of land, representing every type of physiography and of plant association, ought to be set aside as permanent preserves, and properly protected against fire, and against every type of depredation." (Sumner, '20, pp. 239, 241.) And in the same article Mr. Sumner speaks of the National Park Service and its care of the Parks as playgrounds, and hopes that they will also undertake "the permanent preservation of the native fauna and flora by reason of their value to science, and to the higher interests of generations to come." It cannot be too strongly emphasized that the predatory fur-bearers and other carnivores, as part of the natural fauna, are quite as valuable for preservation as the herbivorous animals that usually constitute their prey.

In the National Parks, we have only to consider the reactions of the animals on each other or on the wild plants. We must not think of any one species there as of more interest than another. The Yellowstone National Park was created for everybody, not for any one class; neither the sportsman, nor the fisherman, nor the botanist, nor the nature-student, nor the rancher, nor the irrigation enthusiast has a predominant interest in this great Park. Therefore the only way to preserve it for everybody is to preserve it as Nature made it, as nearly as we can. "It should be borne in mind that the mountains are for the whole people, not for certain classes; and no one doubts that the presence of wild animals adds greatly to the allurement of the woods." (Barnes, '22, p. 8.)

National Parks as Suitable Areas for Preserving Flesh-eaters and Fur-bearers. Since these animals are being destroyed outside the National Parks because of their destruction of domestic animals, we must preserve them inside the National Parks. The Yellowstone National Park being the largest and most isolated from farms and ranches, here is the place where we must preserve predatory animals if at all. In fact, this has been realized for a long time. Indeed, the earliest article on Yellowstone animals that I can find, specifically advocates the protection of cougars, wolves, coyotes, weasels, ermine, otter, skunks, and bears. (Comstock, '74, p. 75.)

Natural areas are as important to the tired tourist seeking diversion and recreation as to the naturalist and the nature student. Among the factors that make these National Parks so fascinating is the chance of seeing wild life. As a part of that wild life, the predatory and fur-bearing animals take an important part in this respect; the bears, weasels, mink, coyotes, mountain lions, and wolves espe-

cially. Perhaps these animals are not primarily responsible for bringing the people to the Yellowstone National Park; but after the people do reach the Park, wild life plays an important part in diverting and amusing the otherwise idle sojourner. Physicians tell us it is of the first importance to the tired or run-down system, that it be interested and amused. Nothing aids more in the rejuvenation of the summer tourist than to be drawn out of himself to the forgetfulness of his ordinary troubles. In this the animals take the most important part because they are something diverting, something alive. And we are all so constituted that amusing, living things are more interesting than dead and inert ones, at least to the majority of people. "The interest of the visitors to the Yellowstone in its game animals evidences the strength of the attraction which wild life has for all. Despite the scenic beauties and natural wonders of this park, the presence of thousands of game animals in their native haunts is widely advertised as one of its most notable features. There is scarcely a well-informed man, woman or child in this country who does not know something of the Yellowstone bears and their free and easy manners." (Nelson, '17, p. 144.) Of the animals that amuse and divert the visitors in the Yellowstone National Park, the bears and their kindred easily take first place. But the other carnivorous animals are no less valuable from the point of view of science and education. There can be no reasonable excuse for permitting the extermination of a single one of the nearly twenty species of predatory mammals native to the Yellowstone wilderness.

We can no longer doubt the great value of predatory and fur-bearing animals living as free, unhampered parts of a normal environment. The Boone and Crockett Club has put itself squarely upon record as favoring the protection of predacious and fur-bearing animals. "The Game Committee believes that the time has come when the same public interest should be aroused in the protection of fur-bearing animals as in the protection of insectivorous game birds and game . . . Their preservation is an asset of the highest value to the nation and a boon to civilization." (Boone and Crockett Club, '12, p. 23.)

I know that the naturalists are not in favor of unstudied attempts to rectify fancied faults in nature by the extermination of any animal, or even by the partial extermination. As Grinnell and Storer have said: "Thus far we have laid chief stress on the importance of the national parks to recreation, and have shown the necessity, in

Fig. 37. Upland prairie, covered with sagebrush in the foreground; in the center, a little aspen surrounded by the darker lodgepole pine forest. Near Glen Creek, Yellowstone Park, Nov. 15, 1917.

adapting them for this purpose, of retaining the original balance in plant and animal life. But the same necessity attaches to their adaptation for another end, hardly less important than recreation, namely, research in natural history." (Grinnell and Storer, '16, pp. 9–10.) Grinnell and Storer are even more concise and straight to the point where the carnivores are concerned. "As a rule predacious animals should be left unmolested and allowed to retain their primitive relation to the rest of the fauna." (l.c., '16, p. 8; see also Dixon, '25.) Another view of the case, but along the same lines, is that of Adams: "Naturalists are only beginning to awaken to the importance and seriousness of this matter. There is an urgent, acute need for careful, scientific study of the predatory animals in these parks (and elsewhere for that matter), because of the prevalence of a strong prejudice against the predatory animal. A sane, long look ahead is what is needed in this matter. It is only too easy to order out the trapper or hunter to kill these animals, without a previous and adequate study of the whole situation. The eagerness with which the uninformed public devours news items concerning the destruction of supposedly dangerous animals readily makes fuel for cheap politicians." (Adams, '24, p. 280.)

Strongest of all arguments for natural areas, because representative of so many different men and different interests, is the policy of the "Council on National Parks, Forests and Wild Life" which says: "A further land requirement is the maintenance of a part of the natural flora and fauna undisturbed by outside agencies, for education and scientific research. This calls for the setting aside and preservation of certain areas, selected so as to represent the more important types of plant and animal life, and so far as may be, the maintaining of the balance of nature on these areas. The need for such areas in the prosecution of the sciences on which human welfare depends, notably agriculture, has long been recognized by scientists, but it is as yet only dimly realized by the general public. Furthermore, such lands will be of value in education as actual examples of original America." (*A policy for National and State Parks, Forests, and Game Refuges,* Oct. 25, 1923, p. 8.)

The study of predatory and fur-bearing animals needs an ample territory abundantly stocked with these animals in as nearly a natural environment as possible, for we must remember that these animals have developed in such a natural state, and it seems quite probable that such a natural condition is the one best suited to them now. At any rate, before we can improve their habitat and method of liv-

ing, we must know more about them. And we must acquire that knowledge from animals living freely and naturally, for a changed habitat and changed habits may result in an animal not at all typical of the species. Furthermore, with extermination of several species more or less imminent, we must have a safe reserve for the supply of breeding stock. Since these must be natural, healthy animals to start with, it necessarily restricts the choice to animals from large and natural wild lands if possible. This is where our National Parks —and especially the largest, most natural, and best stocked of all, the Yellowstone National Park—will be of incalculable value.

RELATION OF THE YELLOWSTONE ANIMALS TO PARK POLICIES

In my treatment of the historical development of the present predacious fauna, I have already discussed the changes that have taken place in the original stock of animals. In that discussion we have seen how comparatively few game animals and predacious animals were a constituent part of the original fauna in Yellowstone Park.

The First Civilian Regime. Let us see what the Park policy has been and upon what basis it rests. When the Yellowstone National Park was set aside on March 1, 1872, absolute protection of the wild life was not intended. The Act of Dedication does not mention animals or natural conditions specifically, although it does "provide against the wanton destruction of fish and game." Indeed we know that in those days animals of all kinds were so abundant elsewhere, especially on the plains, that only the most far-seeing men of the times ever gave it a thought but to deem the supply inexhaustible. The first Superintendent, Mr. Nathaniel P. Langford, did the best he could to protect the animals of the Park, but having no funds for expenses and not even able to live in the Park, he could accomplish little. But he did suggest in his first report that "wild game of all kinds be protected by law," and that trapping be prohibited. From this suggestion came the first regulations: "All hunting, fishing, or trapping within the limits of the Park, except for purposes of recreation, or to supply food for visitors or actual residents, is strictly prohibited."

On April 18, 1877, Mr. Philetus W. Norris succeeded Mr. Langford, and soon after that the first appropriation was made. "He [Norris] strongly recommended game protection, but not the prohibition of hunting." (Anderson, '95, p. 381.) In fact, Norris' forces of workmen "lived upon game, which was hunted only in season,

and preserved, or jerked, for a supply for the remainder of the year" (l.c., p. 382). After Norris left in 1881, a series of civilians were appointed to the office of Park Superintendent, but they did little to protect wild life. The regulations, already quoted, were very liberal, and "even these extremely wide-open rules were not enforced; it rather seems to have been the policy of the superintendents and their assistants to beg (!) the shooters to be moderate in their activities." (Cf. Skinner, '22, p. 93.) Even scant protection resulted, as Capt. Boutelle said later, in making the Park a game preserve: "From what I can learn, the Park until recent years was considered by many living in the neighborhood little else than a fine hunting-ground. I think most of those who were in the habit of hunting in the Park have now a feeling of proprietary interest and recognize that the protection afforded the game makes it a safe breeding-ground, and that there will be more game in the adjacent country if the animals while in the Park are not disturbed." (Boutelle, '89, p. 22.)

Meanwhile, in 1882, there was formed a strong corporation known as the "Yellowstone Park Improvement Company" whose policy it was to grab everything in sight. Among other things, "the company tried to give out a contract for twenty thousand pounds of wild meat at five cents a pound, for the boarding houses for their laborers and mechanics." (Grinnell, '13, pp. 445–446.) Fortunately this contract was never consummated, for practically all of this meat would have been killed within the Park; but the incident shows well the difficulty of protecting the wild life. Especially as it required the united efforts of all the Park's strongest friends for ten years to defeat this company and its many and varied nefarious ramifications. Indeed, this company was so powerful and so greedy, it went far beyond utilizing the wild life as it chose and threatened the very existence of the Park itself; and until it was defeated, the defenders had little time to devote to other questions. "The dangers which threatened were very real, and continued for a dozen years." (L. C., '13, p. 447.)

The Military Regime. During the early life of the Improvement Company, the Park administration was so inefficient and even corrupt that it became a scandal. But such a state of affairs could not last. Congress finally refused to appropriate money for a protection that did not protect, and the Secretary of the Interior was forced to ask for a detail of troops to care for and protect the Park. Major Moses Harris was the first military Acting Superintendent ("Act-

ing" because the military was looked upon as a temporary expedient, although it was actually to endure for 32 years). He arrived in the Park with one troop of the First Cavalry on August 17, 1886, and assumed control on August 20th. "He made splendid efforts to prevent fires, to protect game." (Grinnell, '13, p. 449.) Better yet, all hunting and shooting was stopped and wild life began to recover. This was the beginning of real protection for which "Major Harris was an ideal selection, and he came none too soon. Austere, correct, unyielding, he was a terror to the evil doers." (Anderson, '95, p. 387.)

It was a marked change for the better. While friends were fighting in Washington, in both houses of Congress, for the life of the Park against commercial seizure, the military were in the Park enforcing the laws already on the books, without fear or favor. "From this time on things assumed a different aspect. He [Major Harris] had the assistance of a disciplined troop of cavalry, and he used it with energy and discretion. It very soon became unsafe to trespass in the Park, winter or summer, and load upon load of confiscated property testified to the number of his captures. . . . He speaks of the 'immense herds of elk that have passed the winter along the traveled road from Gardiner to Cooke City,' and he goes on to say that 'but little efficient protection can be afforded to this species of game except upon the Yellowstone and its tributaries.' He remained in charge until June 1, 1889, when he transferred his duties to Captain F. A. Boutelle, and in the three years of his rule he inaugurated and put in motion most of the protective measures now in use. Captain Boutelle, in succession to [Major] Harris, continued his methods, and protection prospered. Meantime, in 1889, an additional troop of cavalry was detailed for duty in the Park in the summer, and had station at the Lower Geyser Basin." (Anderson, '95, pp. 383–384.)

To get the best idea of the protective measures in force at this period, I give the following quotations from General George S. Anderson who was the next Acting Superintendent, and probably one of the best that the Yellowstone National Park ever had. He has described these methods so well that I could not hope to better them. "In protecting the beauties and wonders of the Park from vandalism, the main things to be contended against were the propensities of women to gather 'specimens,' and of men to advertise their folly by writing their names on everything beautiful within their reach. Small squads of soldiers were put on guard at each of the geyser

basins, and at other points where protection was needful, with orders to arrest and threaten with expulsion anyone found breaking off or gathering specimens. Only a few examples were needed to materially diminish this evil. . . .

"The protection of the forests—perhaps of more material importance than any other form of Park protection—became a subject of study, care and attention. As a rule, fires originated in one of three ways: by carelessly left camp fires, by lightning, or by the rubbing together of two trees swayed by the wind. There is no way of preventing the last two forms of ignition; the only thing to be done is to keep a ceaseless watch, and, so far as practicable, prevent the fire from spreading. The extensive areas burned over in days evidently prior to the advent of white men make it very apparent that these two agencies of destruction were then at work, as it is certain they have been since. Camping parties are many of them from cities, and they know little, and care less, about the devastation a forest fire may create. They leave a small and apparently harmless bunch of coals where their camp fire was; after they have passed on, a wind springs up, fans the embers into flame, the dry pine needles are kindled, and at once the forest is ablaze, and no power on earth can put it out. When once the flame reaches the tree tops, if the wind be strong, a man on horseback can scarce escape before it. As the wind ceases the fire quiets down, only to spring up again next day on the appearance of the afternoon breeze. The only time to fight the fire is when the wind has gone down and the flames have ceased. Then water poured on smouldering logs, earth thrown on unextinguished stumps, and the clearing of a path before the line of fire in the carpet of pine needles are the effective means of extinguishment. After a fire is once got under control it is no unusual thing for it to reappear 500 yards from any of its previous lines, carried there as a spark through the air, and dropped in the resinous tinder ever ready to receive and spread it. . . .

"A fire in pine woods may be successfully fought so long as it is kept confined to the ground, but once it gets a start in the tree tops no power on earth can cope with it; no effort is of the slightest avail. Campers who leave their fires unextinguished often make the excuse that they did not believe any damage could result, as the coals were nearly dead. Although such might be the case at the hour of their leaving, in the still air of morning, the afternoon wind is quite capable of blowing them into dangerous and destructive life. My rule has been to insist on the rigorous enforcement of the regula-

tions requiring expulsion from the Park in such cases. One or two expulsions each year serve as healthy warnings, and these, backed by a system of numerous and vigilant patrols, have brought about the particularly good results of which we can boast. . . .

"As a last heading of my subject I shall touch on the protection of the game. This was never seriously attempted until Major Harris came to the Park, in 1886; but he attacked it with an earnestness and a fearlessness that has left a lasting impress. It is not probable that the Park is the natural home of bison, elk or deer,[3] yet the last remnant of the first and great numbers of the last two are found here. The high altitude, great cold and extreme depth of snow make it a forbidding habitat for the ruminants. They remain here simply because they are protected. Protection was given by a system of scouting extended over the best game ranges, and throughout the season of probable game destruction." (Anderson, '95, pp. 388–389, 390–391, 393, 394.)

This scouting was a peculiar system in itself, requiring the utmost hardihood, knowledge of woodcraft, resourcefulness, and energy. Naturally even the best troopers, untrained to the work and unacquainted with the Park, could accomplish very little. Now and then a soldier did have the qualities necessary and slowly acquired a knowledge of the Park. But the usual short residence of each group of soldiers would soon remove these men and a new lot had to be used. This led to the employing of from one to three civilian "scouts" who were mountaineers familiar with such work and hardships and who remained year after year. These scouts did the wilderness work and looked after the wild life, especially guarding against infraction of the hunting and fishing regulations, while the soldiers patrolled the roads and more prominent trails, guarded the formations, and prevented the infraction of the rules by the tourists.

The protection was absolute for a time and included all animals. Soon the idea that the "game animals" were more valuable began to be entertained. In his report for 1889, p. 22, Capt. F. A. Boutelle, then Acting Superintendent, says: "The carnivora of the Park have, in common with other animals, increased until, I believe, something should be done for their extermination." In his report for 1898, Capt. Erwin, Acting Superintendent says: "*Coyotes*—Very numerous in certain sections. They do some damage to the young elk, but the young deer and antelope are their particular prey. Efforts

[3] Further researches since General Anderson's time have shown that a small band of mountain buffalo and a few elk and deer have probably always lived in the Park.

are made in winter to keep their number down by poisoning carcasses of dead animals, and to a certain extent it has been successful." This poisoning campaign was kept up and probably a hundred coyotes were destroyed every year. From 1907 to 1926, inclusive, there are definite records to show 3048 coyotes poisoned, trapped, and otherwise killed; or an average of 152 coyotes per year. Although the campaign against the coyotes has been most effective and sustained, mountain lions and gray wolves have been killed also whenever opportunity offered. A detailed list of the reported killings will be found on page 239.

The Park Protective Act. Even though the military authorities had been in charge since 1886, and were succeeding in protecting the Park, there were actually no laws under which they could punish offenders beyond ejecting them from the Park. In March, 1894, a poacher, Howell, killed seven buffalo on Astringent Creek in the Pelican Valley. Through a series of fortunate happenings this calamity became widely known and was used effectively in getting from Congress a code of laws, the Park Protective Act, signed by President Cleveland, May 7, 1894, and designed to punish offenses Yellowstone National Park. Under this Act, "the preservation of elk, deer, antelope, and the carnivora is assured. Their numbers elsewhere, their wide distribution within the Park, their relatively small commercial value, added to the danger attendant on killing them within the Park, is a sufficient protection." (Anderson, '95, p. 400.) This quotation is very important because General Anderson was Acting Superintendent in 1894 and the above quotation indicates that the act was intended (although it only says "birds and animals") to protect predatory animals and was so understood at the time. Unluckily, as we have just seen, this view did not prevail for long and the killing of predators was begun.

After the passage of the Act of 1894, it was not long before the results of real animal protection began to show. To our great naturalist-president, the Hon. Theodore Roosevelt, it was particularly evident in April, 1903, when he visited the Yellowstone National Park. "To any lover of nature it could not help being a delightful thing to see the wild and timid creatures of the wilderness rendered so tame; and their tameness in the immediate neighborhood of Gardiner, on the very edge of the Park, spoke volumes for the patriotic good sense of the citizens of Montana. Major Pitcher informed me that both the Montana and Wyoming people were co-operating with him in zealous fashion to preserve the game and put a stop to

poaching. For their attitude in this regard they deserve the cordial thanks of all Americans interested in these great popular playgrounds, where bits of the old wilderness scenery and the old wilderness life are to be kept unspoiled for the benefit of our children's children." (Roosevelt, '14a, pp. 44–45.)

Generally, the wild life protection under the military regime was good and effective, but there were some abuses. Among so many men recruited for military duty, there were some not at all in sympathy with duty in Yellowstone Park and in its protection of wild life. Several soldiers were actually caught trapping and poaching on the very animals they were supposed to be guarding. Naturally, the officers were very conscientious in their work and most of them took keen delight in their tour of duty in the Park. During the war years of 1917-1918 there was a relapse on their part, due probably to an inferior grade of men obtaining commissions. At that time, the officers failed to instruct and impress their men with their protective duty. Many of the troopers actually thought they could kill game for their own use. Some animals *were* killed, and the officers proved very negligent in inflicting punishment. Fortunately the soldiers were withdrawn before the end of the war and the military regime ended.

The very fact that patrolling and guarding the Park was not military duty, that the soldiers did not stay long enough to become used to their duties, and that they had no natural inclination for Park work, had been used often as a reason why a force of permanent Park Rangers recruited from men with natural aptitude should be formed. At the time the military took charge of the Park the preceding administration had already become inefficient and corrupt, and a strong, disciplined force was necessary to rescue and restore the Park. This the army accomplished. For the time and the work they had to do, soldiers were necessary, and they did their work quickly and well. But the emergency having passed, Yellowstone Park under the more or less settled conditions now prevailing, is much better cared for by a force of civilian Rangers without a trace of military training.

The National Park Service and Its Wild Life Policy. The Act of Congress of August 25, 1916 (39 Stats., 535), had created the necessary administrative machinery for the organization. And when the Deficiency Appropriation Act of April 17, 1917 (Public No. 2, 65th Congress) provided the necessary funds, the National Park Service was immediately organized as the ninth bureau of the

Courtesy A. C. McClurg & Co.

Fig. 39. A black bear industriously digging out a ground squirrel. A bit of the lodgepole pine forest in the background. Yellowstone Park, Sept., 1922.

Courtesy A. C. McClurg & Co.

Fig. 40. A black bear travelling along one of his paths. Bears are noted for stepping in each other's tracks. Here can be seen a distinct trail for each foot with the untrodden grass between. Yellowstone Park, Sept., 1922.

Courtesy A. C. McClurg & Co.

Fig. 41. A beaver house and pond. The trees in the background have been killed by being flooded when the beaver dam in the foreground first formed the pond. Near Lava Creek, Yellowstone Park, May 22, 1920.

Department of the Interior. A Director was appointed to carry out the provision of the Act which charged him with the supervision, management and control of the several national parks and monuments already under the control of the Department of the Interior. "A new ranger force, composed largely of members of the force developed in 1916 and disbanded last year, was organized . . . and is now engaged in protecting the park. Each one of these men has released four or five soldiers for war service without, in the slightest degree, reducing the patrolled area of the park. The military force necessarily had to maintain a semblance of army organization in the park, hence its outposts were garrisoned with squads of men, only one or two of whom regularly patrolled each district. Under the new organization, rangers are assigned in pairs to districts and each is required to do patrolling work. Thus the cost of protecting the park has been reduced enormously. The rangers are all hardy men of the mountains, skilled in forestry and woodcraft, accustomed to the hardships of the severe winters, trained in the use of snowshoes and skis, and thoroughly familiar, in most cases, with the entire park area. The soldiers formerly controlling the park were never sent there for a long tour of duty, and, consequently, never became thoroughly acquainted with the park or intensely interested in the performance of their duties." (Mather, '18, p. 39.)

The fundamental idea of the National Park Service was this replacement of the soldiers with Rangers. Their permanent force now comprises about thirty Rangers under a Chief Ranger, and each season from June 15 to September 20 it is reinforced by fifty to sixty temporary men. These Rangers perform the same general duties, in the same general way, as the soldiers did, with the addition of duties connected with checking and controlling automobiles. Two characteristic changes have been made. With cavalry in the Park, all summer patrol duty was performed on horseback; with Rangers, though trail patrols are still made on horseback, for the road patrols motorcycles have been substituted. Under military administration, all stations in the Park were occupied in winter as well as in summer; now, under a Chief Ranger, only a few stations in the interior of the Park, and all the boundary stations, are manned in winter by the permanent Rangers. This change was made on the principle that if all boundaries are patrolled and poachers prevented from entering the Park, there would be no need of Rangers in the interior. Of course, all persons entering the Park during the winter would leave behind unexplained tracks that would lead to their immediate investigation and possible arrest.

As late as it is possible in the fall, patrols are made along the trails just inside the Park boundaries, and intentionally paralleling them, on horseback. These patrols are made every day at the most important points and twice a week at the least important. When the snow becomes too deep for the horses, the same patrols are made on snowshoes (either "webs" or "skis" as each Ranger prefers). Not even a quite severe storm or intense cold is allowed to interfere with these duties. It is also a part of the Rangers' duties to keep track of all hunters and trappers just outside the boundaries and to maintain a record of all animals killed and captured.

Excellent as the formation of the National Park Service was, it has, if anything, further confused this question of the balance of nature, so far as the Yellowstone National Park is concerned. The Act of August 25, 1916, expresses the purpose of the National Parks in these words: "the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life 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." And this same idea is restated and emphasized as the National Park Service policy in a letter dated May 13, 1918, by Secretary Lane to Director Mather: "First, that the national parks must be maintained in absolutely unimpaired form for the use of future generations as well as those of our own time." And further says: "The educational, as well as the recreational, use of the national parks should be encouraged in every practicable way. University and high school classes in science will find special facilities for their vacation-period studies." (Lane. See Mather, '19, pp. 361–362.) The then Acting Director stated that: "The park is therefore the greatest wild-animal sanctuary in the world. We endeavor to refrain from calling it a game sanctuary because park animals are not game in the popular sense of the term." (Albright, '17, p. 35.) Yet the old idea still persists of a separation of the game animals from the predatory animals, in a different catagory, the one being legitimately conserved, the other "vermin," to be exterminated. As witness: "complete sanctuary they offer all the wild life, except predatory animals," (p. 23); "campaign of extermination waged against mountain lions and coyotes has shown beneficial results," (p. 64); "efforts are being made to exterminate them" [coyotes in Glacier National Park], (p. 156); "destroying predatory animals," (p. 170); and finally "The grey squirrels are numerous, and until they are ex-

terminated they will be a menace to bird life," (p. 177). These last five quotations are from Report of the Director, National Park Service, for 1923.

This seems far too drastic an attitude to take, both because it is not in harmony with the law and because no adequate study has yet been made in any one of the Parks. It really appears that each Park official has been trying out his own ideas; ideas that may be disastrous to the predatory and fur-bearing animals. And above all, we must remember that if we destroy these animals, we can never replace them. By all means, let this destruction be arrested *until we know what we are doing.*

In the opinion of many discriminating persons, our National Parks should not be conventionalized in any way. Grinnell and Storer have well said: "On the contrary, it is their chief function to prevent just that disfigurement of the face of nature by industrial machinery which is being carried on at such a disastrous rate in other localities. We mean rather that the ideal recreative conditions now to be found in them should be preserved, that all factors disturbing to these conditions should be excluded, and that the artificial elements required for the practical work of administration should be disguised or beautified past offense. Let us, however, take up these points in greater precision and detail. The first necessity in adapting the parks for recreative purposes is to preserve natural conditions." ('16, p. 4.) Fortunately, conditions in Yellowstone National Park have been changed only to a small extent as yet; still more fortunately, there are no privately owned lands within its borders to interfere with any plan adopted for readjusting life to a natural condition and maintaining it there.

I have already related how the military authorities developed their plan to protect "the game animals" without much regard to the damage they might do to the animals *they* considered harmful and that posterity might consider valuable. For we must not forget what Dr. Hornaday has written so well: "For educated, civilized Man to exterminate a valuable wild species of living things is a crime. It is a crime against his own children, and posterity.

"No man has a right, either moral or legal, to destroy or squander an inheritance of his children that he holds for them in trust. And man, the wasteful and greedy spendthrift that he is, has not created even the humblest of the species of birds, mammals and fishes that adorn and enrich this earth. 'The earth is THE LORD'S, and the fulness thereof!' With all his wisdom, man has not evolved and placed

here so much as a ground-squirrel, a sparrow or a clam. It is true that he has juggled with the wild horse and sheep, the goats and the swine, and produced some hardy breeds that can withstand his abuse without going down before it; but as for species, he has not yet created and placed here even so much as a protozoan.

"The wild things of this earth are *not* ours, to do with as we please. They have been given to us *in trust,* and we must account for them to the generations which will come after us and audit our accounts." (Hornaday, '13, p. 7.)

Of course, military men whose training and profession are to kill, cannot be blamed too much if they have not been shown the other side of the case. At first, the predatory animals in Yellowstone National Park ate rodents in summer, but they could not get them in winter, so they killed "big game" with disastrous effect because of the concentrated attack. And then, when summer came again the rodents increased too fast because there were not enough enemies to check them. Besides controlling the overabundance of any one prey, the predators help to keep the breeding stock of all animals healthy and vigorous, and tend to prevent the development of epidemics. They are of primary importance in developing the speed, cunning, and watchfulness of the animals preyed upon. If we kill off all their enemies, it seems reasonable to suppose that our "big game" will deteriorate.

Progressive Extermination of the Carnivorous Animals. As far as the predators are concerned, we can already see the handwriting on the wall, and it means gradual extermination. My data in the list on page 180 calls attention to the few otter, mink, marten, and wolverines still in the Park and to the fact that they are decreasing, probably because of excessive trapping in the lands around the Park. This has been known for some time. S. N. Leek of Jackson's Hole, just south of the Yellowstone National Park, reported before 1913: "wolverine and pine marten nearly all gone." (Hornaday, '13, p. 51.) In many places, the wolverine is looked upon as the acme of ruthless destruction; he is in truth the "Indian devil." Yet even he has his value in Nature's scheme and teaches us anew we must not jump to conclusions. "The wolverine forms one of the most interesting members of California's fauna and steps should be taken for its immediate protection. Its extermination, to me, seems a very serious crime in which man will be held to strict accountability. Furthermore, I believe that these animals have played an important part in helping to save the larger game animals during attacks of contagious diseases

by consuming as food the dead and sick animals, thus preventing spread of the contagion." (Fry, '23, p. 134.)

I have already given much evidence in defense of the coyote but he has other valuable qualities not heretofore touched upon. In the far West, rabbits are a pest; but the coyote is one of the best natural checks upon them. "In eastern Oregon, where the coyote has been hunted by federal officials for the past several years, the jackrabbit has grown so abundant that since 1911 it has taken at least 10 per cent of all the crops suited to its food habits. This applies, of course, to the sections along the stock growing belts where alfalfa is the chief forage crop. . . . Ground squirrels were nearly as numerous as the rabbits, but did not destroy as much because of the fact that they do not work all year. . . . The killing off of the rabbits by poisoning has been a total failure in the section where I took my notes, although it was tried several times. I am convinced that the best check is the coyote, which Nature has placed there to keep down just such pests." (Anthony, '23, pp. 111–112.)

Perhaps a still more just argument for the rational treatment of the coyote is that by Dr. E. W. Nelson: "The complete destruction of coyotes would, no doubt, upset the balance of nature in favor of rabbits, prarie-dogs, and other harmful rodents, and thus result in a very serious increase in the destruction of crops. The coyote supplies much interest and local color to many dreary landscapes and has become a prominent figure in the literature of the West. There it is usually symbolic of shifty cunning and fleetness of foot. Whatever his faults, the coyote is an amusing and interesting beast, and it is hoped that the day of his complete disappearance from our wild life may be far in the future." (Nelson, '16, p. 424.)

It will be noticed that in neither of the above quotations is there a desire to protect absolutely the coyote. It is admitted that the coyote causes damage in places. Dr. Nelson is, himself, the head of the greatest organization in the United States for the control of the predatory animals. That he has so much to say in the coyote's favor should be given double weight in any argument as to the good or ill that that animal does. From Canada comes similar testimony: "Any rational system of wild-life protection must take into account the control of the predatory species of mammals and birds. And while the complete extermination of such predatory species is not possible, desirable, or necessary, a degree of control must be exercised to prevent such an increase in numbers as would affect the abundance of the non-predatory species. In the treatment of predatory animals it is

necessary to determine whether the species concerned are responsible for more harm than good in a particular region." (Hewitt, '21, p. 193.)

As I have already shown in the chapter on historical development, conditions in the Yellowstone are unstable because man has already interfered with nature and made conditions too favorable to predatory animals of certain kinds. We cannot, therefore, allow them to increase indefinitely but must judiciously control them. *Control* is what is needed, not *extermination*. Furthermore, since there are no indispensable domestic flocks or herds in the Yellowstone Park, conditions are different there from elsewhere, and rational control should be suited to those conditions. But we know very little about all the interrelation of those conditions, and a special study is needed to determine just what the most beneficial control would be. Some thirty years ago, Mr. Samuel N. Rhoads stated that "concerning the subject of economic zoology as specially affecting the United States it may be said: (*a*) that, in general, experience has shown that the *extermination* of any native species on economic grounds is undesirable, but its *restriction*, temporary or continuous, may be a subject for wise legislation; (*b*) that the damage done by many so-called noxious species is offset in a degree beyond calculation by the fact that they form a large share of the food of beneficial or harmless species, which, if deprived of this source of supply, would be exterminated or become harmful by recourse to an unnatural diet; (*c*) that in the United States we have large areas so nearly in their virgin state that the balance of nature there existing may be taken as a criterion by which to restore the most natural order compatible with the changed conditions of populated districts; (*d*) that the unwise destruction of so-called noxious species in this country has not gone so far toward extermination that present-day reforms will fail to be a remedy, as is the case in Europe." (Rhoads, '98, p. 580.)

In Table 4 are given the records from the Yellowstone Park administrative reports of the destruction of three of the predatory mammal species under the system of unregulated killing, or rather, attempted extermination. Doubtless more are destroyed than the official records show. In this connection see also the stated policy of extermination of predacious and certain other forms of wild life in the various National Parks, pages 253-265.

TABLE 4. OFFICIAL RECORD OF CERTAIN PREDATORY MAMMALS DESTROYED IN YELLOWSTONE NATIONAL PARK

From Superintendent's Annual Report For	Mountain Lions	Coyotes	Wolves
1904	15 } 62 in these three years.	.....	.....
1905	unknown	.....	.....
1906	unknown	.....	.....
1907	.....	99	.....
1908	1	97	.....
1909	.....	60	.....
1910	.....	40	.....
1911	.....	129	.....
1912	.....	270	.....
1913	.....	154	.....
1914	19	155	.....
1915	.....	100	several.
1916	4	180	14
1917	.....	100	4
1918	23	190	36
1919	11	227	6
1920	.....	107	28
1921	.....	140	12
1922	.....	130	24
1923	.....	221	8
1924	.....	226	.....
1925	1	180	.....
Total	121	2,805	132†

Alternative Policy: Preserving the Parks in Natural Condition. I have already touched upon the need of preserving our National Parks in their original natural condition so far as is humanly possible. Rarely some earnest critic sounds a deeper note of warning. "The whole problem with which we have to deal is, after all, one of relative values. What are the things that are most worth doing—and paying for? Our whole plea for the conservation of these considerable fragments of nature rests, of course, upon the *value of these to mankind*. What the wishes of the animals and plants are in this matter does not much concern us. But we must recognize the existence of various standards of value, and I believe that there are standards far higher than are generally recognized and applied to this question. . . .

"Again, it must be insisted that as things now go, our world is destined to be populated up to its capacity, within a comparatively brief period of time. In that day, if not before, we shall be faced with the problem of correlating the rate of reproduction with the means of subsistence under endurable conditions of life. Would it

not be equally possible, and vastly more desirable, that we should strike this equilibrium some time before the inhabitable land had all been occupied? I think there can be no difference of opinion as to which of these alternatives offers the greater prospect for future human happiness. This mad rush to fill up every nook and cranny of the world is prompted in a large degree by national ambition for power; partly also by the greed of the business promoter and the real-estate shark. These are the greatest foes of any movement toward leaving the world truly habitable for the future.

"I trust that I shall not be charged with voicing any general depreciation of what we call 'man's conquest of nature.' To a large extent this has been desirable; and in any case it has been the necessary price which we have had to pay for our advance beyond savagery. Many things in nature have had to be used, even though this use has destroyed their beauty and their interest as objects of scientific study. What we insist upon is a fuller recognition of the non-utilitarian motives, or, we should perhaps say, a broader conception of what constitutes *usefulness*." (Sumner, '20, pp. 242–244.)

Surely this great country of ours can afford to keep our great National Parks as natural areas. In them wild life of all kinds should be preserved in as natural a balance as possible. What we need are natural areas where we can see and study the rocks and soil, and study plants, trees, fish, reptiles, birds, and mammals in their natural environment, and living their lives naturally. At least, we should try to attain such an ideal. Nor am I making this plea from the scientific side alone. There is another great army of people who want to become acquainted with nature. For these, John Muir is the greatest and most eloquent advocate I know. Speaking of the Yellowstone, he says: "This is the coolest and highest of the parks. Frosts occur every month of the year. Nevertheless, the tenderest tourist finds it warm enough in summer. The air is electric and full of ozone, healing, reviving, exhilarating, kept pure by frost and fire, while the scenery is wild enough to awaken the dead. It is a glorious place to grow in and rest in; camping on the shores of the lakes, in the warm openings of the woods golden with sunflowers, on the banks of the streams, by the snowy waterfalls, beside the exciting wonders or away from them in the scallops of the mountain walls sheltered from every wind, on smooth silky lawns enameled with gentians, up in the fountain hollows of the ancient glaciers between the peaks, where cool pools and brooks and gardens of precious plants charmingly embowered are never wanting, and good

Fig. 42. A beaver eating bark from a willow switch that can be seen in his mouth, the peeled switch appearing as a short white streak against his cheek. Near Lava Creek, Yellowstone Park, Oct. 5, 1922.

Fig. 43. A woodchuck, such as are hunted at times by the coyotes and bears especially. Yellowstone Park, Sept. 1, 1922.

Fig. 44. A flower-bedecked meadow such as we expect everywhere under natural conditions. Near Gardiner River, Yellowstone Park; altitude 5500 ft. June 15, 1920.

rough rocks with every variety of cliff and scaur are invitingly near for outlooks and exercise." (Muir, '04, pp. 40–41.)

What a glorious picture this is to the nature student or the tired business man, especially if we assure them that in addition to nature's beauty we can also show them some of nature's children living natural lives in such a place. As Walter P. Taylor says: "Few subjects of study possess more absorbing interest than a living animal that can be seen in action. Both children and adults are naturally interested in tracks and tracking; in tracing the relationship of animals to each other and to plants; in observing the migration and movements of animals, their eating and drinking; in finding and examining their dens, nests, and shelters; and in watching their growth and development. Life history studies of the higher animals, at least, deal with materials already a part of the experience of many persons, and so make possible a strong educational appeal." (Taylor, '24, p. 46.)

Creating and maintaining the Yellowstone in a natural state, "just as nature made it," means of course that all exotic species should be kept out. There should be no exotic forms of either plants or animals, not only because they introduce a foreign element, whose effects cannot always be foreseen, but also because they are out of place (cf. Grinnell, '25, p. 438). Of the perniciousness of this, the familiar examples are the English sparrow and starling in the the United States, the mongoose in Jamaica, and the rabbit in Australia. Furthermore, the practice is dangerous, for even a seemingly harmless animal like the rabbit in Australia may disturb the natural balance by making the living conditions of the native species too onerous. "The introduction of exotic species may become a dangerous factor in disturbing the original balance, even to the extent of assuming economic proportions." (Korstian, '21, p. 281.) This is a very insidious danger, for there are many people who, under the guise of improving a seeming lack, are anxious to introduce strange plants and animals, or perhaps ones more familiar to them in another clime. Occasionally they are even indifferent to the fate of the native species if they can only introduce their favorites. As long ago as 1874, Theo. B. Comstock advocated the introduction of animals into Yellowstone National Park under the plea of "*the preservation* from extinction of at least the characteristic mammals and birds of the west, as far as they can be domiciled in this section." (Comstock, '74, p. 72.) As an antidote to this pernicious doctrine I offer a quotation found on pages 453–454 of the Boone and Crockett Club's

book, *American Big Game In Its Haunts.* The author, presumably George Bird Grinnell, had game and its shooting in mind, but his argument is just as good for all wild life. "There is a tendency in this country to avoid trouble, and to do those things which can be done most easily. From this it results that efforts are constantly being made to introduce into regions from which game has been exterminated various species of foreign game, which can be had, more or less domesticated, from the preserves of Europe. Thus red deer have been introduced in the Adirondack region, and it has been suggested that chamois might be brought from Europe and turned loose in certain localities in the United States, and there increase and furnish shooting. To many men it seems less trouble to contribute money for such a purpose as this than to buckle down and manufacture public sentiment in behalf of the protection of native game. This is a great mistake. From observations made in certain familiar localities, we know definitely that, provided there is a breeding stock, our native game, with absolute protection, will re-establish itself in an astonishingly short period of time. It would be far better for us to concentrate our efforts to renew the supply of our native game rather than to collect subscriptions to bring to America foreign game, which may or may not do well here, and may or may not furnish sport if it shall do well."

Unfortunately, introduction of foreign species into the Yellowstone National Park has already taken place in the case of fish. It would seem to have been better to have stocked the waters previously without fish, with the black-spotted trout, native to other waters in the Park. The introduction of foreign species above the falls in the Firehole and Gardiner Rivers has resulted in those fish becoming established in the lower parts of these rivers, where they are now driving out the native fish. These foreign fish were introduced at the instigation of Capt. F. A. Boutelle, then Acting Superintendent. "In passing through the Park I noticed with surprise the barrenness of most of the water of the Park. Besides the beautiful Shoshone and other smaller lakes there are hundreds of miles of as fine streams as any in existence without a fish of any kind. I have written Col. Marshall McDonald, U. S. Fish Commission, upon the subject, and have received letters from him manifesting a great interest. I hope through him to see all of these waters so stocked that the pleasure-seeker in the Park can enjoy fine fishing within a few rods of any hotel or camp. There are other reasons, too, to be considered in this connection. The stocking of these waters will add vastly to the breeding-grounds of the tributaries of the Missouri and Snake Rivers

and add immeasurably to the food supply obtained from those waters." (Boutelle, '89, pp. 22-23.) But this object could have been better accomplished by the spreading of the black-spotted trout to the fishless waters, if it is necessary to have fish in every water, which is very doubtful indeed in a wild preserve. As it is, the breeding-grounds and food supply in the Missouri and Snake Rivers have actually been depleted because of the competition by the foreign species.

Another unhappy result further tending to spoil the naturalness of the Park has come about by the establishment of the U. S. Fish Hatchery at Yellowstone Lake as advocated by Capt. Boutelle. The Hatchery people are now demanding the destruction, or at least serious reduction of the white pelican colony which so much enhances the original beauty of that lake. Any decrease in the number of these pelicans will threaten the welfare of the colony, because a weakened colony gives its natural enemies too great a chance to take excessive toll in accordance with the well known principle enunciated elsewhere in this paper. (Cf. Adams, '25, pp. 383–385.)

The bringing of buffalo from Montana and Texas into the Park has meant the introduction of a possible different variety of that animal. The large "tame herd" of buffalo that has resulted is now a menace to native wild life because of the forage it consumes and the great area of native grass that has to be cut on what might be winter range for wild animals, especially elk. Furthermore these buffalo are infected with *hemorrhagic septicemia,* which is a standing danger to the native wild buffalo that may contract it, and perhaps to other animals as well.

In other cases also, the authorities in charge are often the very people who wish to introduce these detrimental species. Major Jno. Pitcher, Acting Superintendent, advocated "that the capercailzie and blackcock, game birds of northern Europe, might be introduced in the park. The capercailzie is said to be the largest of grouse species, and is found in large numbers in Norway and Sweden. Its home is in the pine forests, and when the deep snows come it can live on the pine leaves. The blackcock is a fine game bird, and I believe it would also do well in many places in the park. If these birds could be successfully raised here they would spread into the neighboring country and soon afford fine bird shooting where there is little or none at present." (Pitcher, '02, p. 7.) In later years there have been many projects to introduce European chamois, white goats, caribou, and even eastern white pond-lilies. In the National Park Conference of 1911, Major B. Hughes offered a recommendation that: "Foreign and domestic game should be propagated in the

parks, and the necessary funds appropriated to purchase desirable species, also an appropriation for the extermination of certain predatory animals that prey upon the game." (Hughes, '12, p. 194.) Fortunately this was not adopted, and, so far as I know, has never been acted upon. But the danger is ever present and it is one that must be constantly watched. So evident was this danger to the American Association for the Advancement of Science that it passed the following resolutions at the Toronto meeting, December, 1921:

"*Whereas,* One of the primary duties of the National Park Service is to pass on to future generations for scientific study and education, natural areas on which the native flora and fauna may be found undisturbed by outside agencies; and

Whereas, the planting of non-native trees, shrubs or other plants, the stocking of waters with non-native fish, or the liberating of game animals not native to the region, impairs or destroys the natural conditions and native wilderness of the parks;

Be It Resolved, That the American Association for the Advancement of Science strongly opposes the introduction of non-native plants and animals into the national parks and all other unessential interference with natural conditions, and urges the National Park Service to prohibit all such introductions and interferences."

The Ecological Society of America, a leading organization of naturalists interested in outdoor natural history, has also passed similar resolutions (*Ecology,* Vol. 3, pp. 170–171).

In considering the introduction of exotic species it must be remembered that every introduced form will inevitably tend to crowd or even displace and destroy one or more native species. This applies to domestic stock, which in a sense are not so serious, if in small numbers, because they can be more readily gathered up and driven elsewhere than can wild animals. It is fortunate that in the Yellowstone stock grazing is now prohibited by law; and yet considerable numbers of milch cows and saddle horses are grazed within the Park by the concessioners, under the guise of "public necessity." The danger of permanent stock grazing in this Park is not yet past. Eternal vigilance is the price we must pay for the wild life and beauty of the Yellowstone. Only as recently as 1911, did Mr. R. B. Marshall, afterwards Superintendent of National Parks, advance his belief "that many thousand head of cattle could be pastured each season in the various national parks with no resulting damage. If given 5-year leases the cattlemen would be glad to pay a reasonable fee per head a month, which would create a large fund to be used in general improvement of the parks. The cattle would

keep the trails open and eat the underbrush. The interest of the cattlemen in conserving the feed for their cattle would induce them to become an organized fire-fighting ally." (Marshall, '12, p. 114.) Apparently from Mr. Marshall's viewpoint the destruction of the underbrush (and consequent extermination of certain shrubs and the brush-nesting birds) would be an advantage! If that is the view of the landscape engineers, and I do not believe it is, I hope our great National Parks will always be safe from the landscapers! We can only conclude that Mr. Marshall had not heard of the condition of Crater Lake National Park. Yet Crater Lake was under his care, as well as the other Parks. Of what use is it to have a central organization if the mistakes in one Park do not teach a lesson for all? Mr. Marshall even advocated the fencing in of certain of the Parks' areas for the grazing of domestic animals (Marshall, '12, p. 120). (Cf. Adams, '25b, pp. 571–574, on cattle grazing in Sequoia National Park.)

"Mr. Steel, to whom Mr. Mills referred, who was so long the supervisor of Crater Lake Park, and, as Mr. Harriman put it, 'the inventor of Crater Lake,' tells a story of the way the flowers disappeared from the rim of that beautiful body of water. When I was there this summer I commented upon the lack of wild flowers around the lake's edge, remarking how poorly the rim compared in that respect with the wonderfully flowered country at the foot of Mount Rainier. He told me the reason. He said that some 25 or 30 years ago, before the park was created, sheep were allowed to feed there, and, as the soil was almost entirely light volcanic ash, they destroyed all the vegetation. Previous to that time, he said, the country was carpeted beautifully with wild flowers; it was a perfect picture, just as fine as any one of those Alpine valleys of Rainier. In the 25 years that have passed since, those flowers have never come back, and unless some artificial method is used it may be another 50 years or so before they will again be in evidence." (Mather, '17, p. 49.)

Other National Parks have been subject to severe overgrazing by domestic stock. Mr. W. W. Crosby, formerly Superintendent of the Grand Canyon National Park, says: "Flowers in the Park below the rims of the canyon are extremely varied and beautiful in their successive seasons, but flowers on the rims are much scarcer than they should be because of the cattle grazing." (Crosby. See Mather, '23, p. 171.) After an examination in 1924, Adams ('25b, p. 569) pronounced the overgrazed condition on the canyon rims to be "exceedingly bad." He says: "This is a deplorable condition,

which influences the wild life, changes the character of the vegetation, favors the erosion of the soil and produces conditions directly the opposite of the intention of a National Park."

Bringing our discussion home once more to the Yellowstone National Park, and bearing in mind Crater Lake's experience which should have been a warning, we have here another fine illustration of the damage caused by grazing. In former days the Transportation Company was allowed to graze its horses in the Blacktail Valley, an important range for antelope and elk. Since the transportation people were not limited as to number of horses grazed, and since they had little or no interest in the future good of the range, they greatly overgrazed the area—putting horses on as early as possible each spring, keeping too many on the range all summer, and keeping them there until the very last spear of grass was gone in the autumn. For instance, these horses were brought over from the winter ranges early in May, a month before there was any use for them and nearly two months before any number were required. Although the tourist season closed September 15 the horses were kept on the Blacktail until the middle or end of October. Big motor-bus autos handled all tourists after 1916, yet the Transportation Company was permitted to bring in hundreds of horses to the Blacktail and allowed to graze them until after Oct. 25, 1917. The wild animals were disturbed by the horses, and actually driven out and fenced out by the Company's employees. Worse yet, the excessive overgrazing destroyed the natural forage,—a condition that is only now, after nine years' rest, beginning to remedy itself. Conditions were the same, only not so bad because of larger acreage per horse, on the Swan Lake Basin where the permanent camping companies grazed their horses, and in the Madison Valley, but within the Park, where the West Yellowstone Transportation Company grazed its horses. All three areas were important game ranges. Since the evacuation of the Blacktail range by the Transportation Company's horses, the antelope have re-established themselves there (Albright. See Mather, '21, p. 177) and the elk are slowly coming back to it once more.

STATUS OF WILD LIFE ADMINISTRATION IN OUR NATIONAL PARKS

Now that I have discussed rather fully the predatory and fur-bearing animals, their value, the danger they are in, and our own carelessness in advocating either extermination or control measures before we know what we are doing, it is time to see just what the

National Park Service is doing. In all that I have said already and in all that I am about to say there is no disposition to disparage the National Park Service for I firmly believe they are doing the best they can. But they have a multitude of troubles and cares and some of these points have never been brought forcibly to their attention.

Necessity of a Definite Protective Policy. What we lack more than all else is a definite policy — a real plan for the conservation of all wild life. Dr. E. W. Nelson has expressed a similar thought: "At present the lack of a definite general policy to safeguard our game supply and the resulting danger to our splendid native animals are deplorably in evidence." (Nelson, '16, p. 404.) Dr. Nelson was writing of the continent as a whole. Had he narrowed his remarks down to conditions in the National Parks, his words would have fitted those conditions exactly.

But I am hopeful that a good general policy can be evolved. The officers of the National Park Service are wide awake officials anxious to do their best for the good of their important reservations and for the increased pleasure and enjoyment of the people. They know that a good policy is the first step in efficient administration. With efficient protection, the Parks will acquire an army of effective friends. "If you can send a man back home after having visited Yellowstone Park, Yosemite Park, and the other parks and have him go back thoroughly satisfied with his trip and an enthusiastic admirer of the parks, you have accomplished more than could be accomplished by any general advertising campaign. . . . it behooves every one interested in our parks and resorts to see that they are so kept that the visitors will go away having had a pleasant and agreeable time and having seen the parks to the best possible advantage." (Fee, '12, pp. 11, 13.)

An analytical study of the Annual Reports of the Director of the National Park Service indicates uncertainty and confusion on the part of the various Superintendents, and a disposition to rashly experiment, and sometimes use extreme measures in dealing with the wild life entrusted to their care. The Director states the National Park policy to be that of preserving the Parks "unimpaired,"—although at times he seems to over-emphasize the importance of *big game* animals, whereas we believe he could improve his practice by making it cover *all wild life*. The fundamental policy of preservation of the National Parks "as nature made them" is all very fine on paper, but the subordinate officials find it very difficult in actual

practice. Unless they have a background of special training in natural science, they are unlikely to be cautious about applying drastic measures in dealing with delicately adjusted natural conditions, which in the case of wild life may result in irreparable damage. I find the Supervisor of Yosemite National Park, for example, hoping for "the complete elimination of the mountain lion from this section." (Lewis. See Albright, '17, p. 152.) He evidently considered the mountain lion of no value whatever. An extremely undesirable attitude for an official in charge of a *wild life* sanctuary. On page 176 of the same Report, the Supervisor of Mesa Verde National Park, says: "These animals [the mountain lions] should be killed off, as they prey upon the deer." Is it not possible for Mesa Verde to raise enough deer so that a few mountain lions can continue to exist? Again on page 186, I find the Chief Ranger in charge of Rocky Mountain National Park reporting: "A start was made last winter to exterminate predatory animals." Actual *extermination* is wanted there, not *control!* Of course, here is the conflict between extermination and control right out in the open. Which will win I do not know, but I hope I have said enough to show that the case for rational control, based on really adequate study in each Park, is a strong one, with many earnest advocates.

Fortunately the National Park Service policy has been plainly stated by the Hon. Franklin K. Lane: "The national parks must be maintained in absolutely unimpaired form for the use of future generations." Control, then, for animals *proved* detrimental to the general good, but not extermination, or we destroy that which we can never replace, and we certainly do not preserve the national parks " in absolutely unimpaired form." Speaking of the statement from which the above is quoted, Stephen T. Mather, Director of the National Park Service says: " This platform is destined to go down in national park history as one of its most important documents; it is not likely to be modified greatly in the future because the fundamental principles it enunciates govern the future care and use of all of these reservations, as well as the present protection and enjoyment of them." (Mather, '18, p. 11.) With these statements of principle from the high officials we are wholly in accord and our task is to urge that they be put in practice.

Director Mather is keenly alive to the importance of wild animals: "The National Park Service holds no one of its several public charges in greater reverence than the care, maintenance and development of the wild animals which live free and normal lives within its reserves. These animals are an exceedingly important part of what is left of that

Fig. 45. A mountain sheep, or bighorn. Such are some of the animals that are now preserved in our great National Parks. In Gardiner Canyon, Yellowstone Park, March 20, 1920.

Fig. 46. Mountain sheep, one of the finest of the "big game animals." Near Gardiner Canyon, Yellowstone Park, March 20, 1920.

vast heritage of wild life which the march of civilization and the ruthlessness of former generations have elsewhere destroyed." (Mather, '18, p. 22.) The total destruction of large predatory animals outside the Parks has been defended by some people on the ground that they are being adequately preserved in the National Parks. Mr. Mather says that Yellowstone Park is in the best condition so far as animal life is concerned; yet a glance at our list of predatory and fur-bearing animals on page 180 will show how near the danger point many of the Park's species are at this time. Of the eighteen species listed only the beaver and badger are in a satisfactory condition. The gray wolf and coyote are present in satisfactory numbers, but an unreasoned, unrestricted campaign of killing is being directed against them that may result in practical extermination at any time. The remaining fourteen species number only about one thousand individuals in an area of almost 3400 square miles; or each pair of these animals has about seven square miles to itself! Not one of the fourteen has a safe margin. The numbers of otter, mink, marten, black bear, and grizzly might be considered satisfactory if it were not that they are being hunted and trapped on all sides of the Park, even right up to the boundaries, and all are *decreasing in numbers* at the present time. The Canada lynx, bobcat, red fox, fisher, and wolverine are all below the danger mark now, and their extermination is imminent. The Superintendent of the Yellowstone Park in 1918, says: "I am of the opinion that there are not so many [coyotes and wolves] found among the game animals [inside the Park] as there are among domestic animals in farming communities outside." (Lindsley. See Mather, '18, p. 128.) If this view is accurate, then it is strongly confirmatory of my analysis that the predacious and fur-bearing mammals are not present in safe numbers inside the Park, for it is notorious that they are rapidly disappearing everywhere outside. Evidently, even in the Yellowstone, these animals are not yet safe from extinction. Can the other National Parks show any better conditions? Since the presence and welfare of the game animals and the rodents are closely bound up with the carnivorous animals, I shall mention them also under the respective Parks in the following summary from the government reports.

Remaining Wild Life and Its Management in the Parks. The Hot Springs National Park in Arkansas has but few animals other than mice, rats, cats, dogs, and horses, and has no predatory animal problem.

The Yosemite National Park in California has a good many mule deer, bear, gray squirrels, and small animals. On the floor of the

Valley, a comparatively small part of the Park, the elimination by poison of ground squirrels, mice, and gophers (Mather, '20, p. 242) has proceeded rather far but the rodents of the greater part of the Park have been undisturbed. The Superintendent has recommended the elimination of the cougar (Albright, '17, p. 152) but this Park has comparatively few predatory animals of any kind. A good feature is the prohibition of dogs in the Park.

The Sequoia and General Grant National Parks in California have some deer, bear, mountain sheep, perhaps a few elk, and some smaller animals. The ground squirrels are being poisoned with the idea of extermination (Mather, '19, p. 207). A campaign against the cougar and bobcat is advocated (Mather, '20, p. 265). In 1918, the killing of 2 cougars, 5 coyotes, 3 bobcats, and 6 foxes is reported (Mather, '18, p. 148); in 1924, 12 cougars were destroyed (Mather, '24, p. 109).

The Mt. Rainier National Park in western Washington has some deer, black bear, mountain goats, beaver and smaller animals. There are a normal number of rodents present. Reduction of the predatory animals—cougar, bobcat, lynx, coyote, and wolf—is recommended (Mather, '20, p. 273). A good feature and one that might well be adopted by the other Parks is the strict enforcement of the no-dog law (cf. Mather, '23, p. 139).

The Crater Lake National Park in Oregon has deer, bear, a few elk, and some small mammals. Efforts are being made to exterminate predatory animals,—cougar, lynx, bobcat, wolf, and coyote (Mather, '18, p. 159; '19, p. 217; '20, p. 279).

The Wind Cave National Park in South Dakota is a small park, or rather a fenced game preserve with buffalo, antelope and deer enclosed. Coyotes and bobcats are hunted down, and the extermination of all predatory animals is desired; indeed the deer is the *only wild animal protected* (see Mather, '18, p. 163). This seems rather a relapse from the "National Park idea" of protection for all wild life.

The Platt National Park in Oklahoma is only a small Park of a few hundred acres containing 9 deer, 3 buffalo, and 2 elk (Mather, '20, p. 288). The elk have since increased to 5. The badgers are the only predacious animals.

The Mesa Verde National Park in southwestern Colorado has deer, a few elk, cougars, and small animals. This is openly advocated as an advantageous fenced game preserve and it is desired that the predators be hunted out (cf. Mather, '18, p. 169). With such ideals

before it, Mesa Verde hardly deserves to rank as a National Park; a game preserve is most assuredly not a wild life sanctuary.

The Glacier National Park in northwestern Montana has many white goats, deer and mountain sheep; also some bears, elk, moose, and small animals. A campaign of extermination against the cougar was advocated (cf. Mather, '22, p. 139), and the extermination of both cougar and coyote planned (Mather, '23, p. 156).

The Rocky Mountain National Park in Colorado has many deer and mountain sheep, also some bear, elk, and smaller animals. This Park is rather intensive in its destruction of *all* predatory animals, as witness: 5 foxes and 7 martens killed (Albright, '17, p. 186); 9 foxes, 2 bobcats, 3 coyotes, and 16 martens killed (Mather, '18, p. 180); 15 coyotes and 7 bobcats killed (Mather, '19, p. 245); 6 cougars, 20 bobcats, 3 foxes, 2 badgers, 2 weasels, 8 coyotes, and 6 mink killed (Mather, '22, p. 144); 14 bobcats, 3 coyotes, 2 badgers, 1 red fox, destroyed (Mather, '24, p. 133).

The Sullys Hill National Park in North Dakota is a small Park of 780 acres and has 5 elk, 5 deer, and 13 buffalo, but no predators are reported.

The Lafayette National Park in Maine has some deer, beaver, and smaller animals. There are probably some small predacious animals present but I have received no reports of them.

The Zion National Park in Utah has some deer and smaller animals. Its reports list coyotes, wildcats, porcupines, skunks, badgers, and gray squirrels under "predatory animals" (cf. Mather, '20, p. 318), and advocate the extermination of gray squirrels (Mather, '23, p. 177).

The Grand Canyon National Park in Arizona has many deer, mountain sheep, and cougars; also some antelope and smaller animals. It kills its coyotes, bobcats, and cougars (Mather, '23, p. 170; also Mather, '24, p. 143).

The Mt. McKinley National Park in Alaska is a new Park that has many mountain sheep and caribou, and some moose, bear, and smaller animals. As yet there has been no mention of predatory animals in the reports.

The Hawaii National Park is such a new member of the family that no mention has been made of the animals to be found there.

The Lassen Volcanic National Park in California is another new Park. As very little work has been done there and no reports made, we know very little about its wild life.

Analyzing this data it appears that the Yellowstone National Park is by far the most important so far as the carnivorous animals are

concerned, and that only Yosemite, Mesa Verde, Glacier, Rocky Mountain, Grand Canyon, and Mt. McKinley National Parks will rank as of any importance at all even with a modern, enlightened policy. Since we have already found the situation in the Yellowstone far from ideal, it would appear that the future of the carnivorous wild life in the National Parks is rather discouraging.

Especially so when we observe how many of the Parks are planning campaigns of reduction, and even extermination, against some of the predatory and fur-bearing animals. Although the annual Report for 1917 was gloomy enough for us, we find little hope in the Report for 1918, for we observe that some of the Superintendents were still planning extermination. On page 148, the Superintendent of Sequoia and General Grant National Parks reports that: "A campaign for their destruction" was organized and "2 large lions, 5 coyotes, 3 lynx, and 6 foxes were killed." By the term lynx, the California wildcat was probably meant, for Grinnell and Dixon say that the Canada lynx (*Lynx canadensis* Kerr) does not occur so far south ('24, p. 339). It is too bad, to say the least, that wildcats and foxes should be persecuted in a National Park. Surely the small damage they do could be rectified in other ways (cf. Dixon, '25). On page 169, the Superintendent of Mesa Verde National Park speaks of the extermination of the mountain lions and favors the "game" as against the "predatory animals." On page 173, the Superintendent of the Glacier National Park speaks of "the campaign of extermination that is being inaugurated against the predatory animals," and of the "game" as distinct from other animals. It would seem as if our National Park Superintendents are all wrongfully imbued with the idea that the game animals are the only important part of the fauna. On page 180, the Superintendent of Rocky Mountain National Park, says that: "The following predatory animals have been killed by park officers; fox, 9; bobcat, 2; coyote, 3; marten, 16." Again the killing of foxes and bobcats; and worse yet, of marten. That item is particularly indefensible. To be sure, martens eat grouse, rabbits, and birds' eggs, but I will venture to assert that much the highest percentage of their food is mice. Is Rocky Mountain National Park so badly off that it cannot spare the few grouse, rabbits, and birds that the martens would kill? Furthermore, why were *any* of these "predatory animals" killed? In the same paragraph that gives the above list, it is recorded: "No game animals are known to have been killed, except one mountain sheep." Yet thirty fur-bearing animals were destroyed presumably because they kill "game" animals. Is this proportion warranted? I have been

assured that there are several hundred mountain sheep in Rocky Mountain Park. To my mind these thirty fur-bearing animals were as valuable as thirty mountain sheep where the latter are so abundant.

Can it be that each Superintendent of the National Park Service decides for himself what he will kill, and what he will not? It certainly looks that way, especially after a careful study of the next annual Report, that for 1919. On page 34, the Director says: "All [the National Parks] are refuges for wild animals, and some of them are among the finest preserves in the world," — although later he speaks of efforts to reduce predatory animals. On page 172, Horace M. Albright, Superintendent of Yellowstone National Park and also Field Assistant to the Director, says: "It is hardly practicable, even if desirable, to entirely exterminate these carnivorous animals." Yet, on page 230, the Superintendent of Mesa Verde National Park says: "They [the mountain lions] should be systematically hunted out," and reports "5 coyotes, 2 bobcats, and 13 foxes" trapped.

In his annual Report of the National Park Service for 1920, the Director says: "As the parks constitute sanctuary for all wild life, they will forever have their place as living museums for zoology students. In the larger parks there is hardly a trip that will not secure a glimpse of bears, deer, or other large game. In the Yellowstone more than 15,000 visitors during the month of July viewed and inquired about the tame buffalo herd located about a mile south of headquarters. In the major parks monthly bulletins supplement the information conveyed in the printed rules and regulations. The above gives a fascinating glimpse of some of the educational work that has been accomplished during the year, but serves to accentuate the tremendous possiblities for expansion and enlargement that this line of endeavor holds. Our national parks and monuments were established because of the primary importance of their great scenic and historical background, and naturally there are no localities that hold as rich promises of success to the student investigator and scientists in geology, botany, zoology, anthropology, and ethnology as do these remarkable areas that have been reserved from the public domain in their natural condition for all times for the enjoyment and knowledge of man. Particularly are these possibilities so fraught with tremendous benefit for our schools, colleges, and universities that I am firmly convinced that the Park Service should eventually have on its permanent staff during the park season paid scientists and scholars of established reputation, who can lecture and develop this field to its fullest extent for the benefit of the great traveling

public. . . . So far as possible, the natural resources of the parks are being developed, not only for recreation but are being made available for educational purposes for the benefit of those visitors who may wish to utilize them as outdoor laboratories for the study of wild life in the fields." (Mather, '20, pp. 58-59, 66.) So it is very evident that the Director is in some measure aware of the scientific value of his wonderful Parks and will afford every opportunity to scientific study. It is for nature students and scientists and all defenders of the Parks to impress him with the value of the predacious and fur-bearing animals as being fully equal to that of the hoofed game.

But again on pages 244, 273 and 279 of this 1920 Report, we find the Superintendents of Yosemite, Mt. Rainier, and Crater Lake National Parks drawing the distinction between game animals and predatory animals and advocating the extermination of the latter. On page 318, the Superintendent of Zion National Park lists "coyote, wild cat, porcupine, skunk, badger. . . . gray squirrel" all under "*Predatory Animals*"!

In the annual Report of the National Park Service for 1921, the Director says on page 33: "Each season the advantages which the parks offer in an educational way become increasingly apparent. Probably no other areas offer such fertile fields for natural history exploration. Here the results of nature's activities remain undisturbed. One interested in zoology can select no better spot to study wild life in its native setting. The animals are almost fearless, for hunting in no form is permitted." And again on page 37, the Director tells us: "The statement has been made by no less an authority than *Natural History*, the official organ of the American Museum of Natural History, that because of immediate destruction by man the period of the age of mammals as a whole will likely have closed by the middle of the present century, barely 30 years away. Such a prediction is conducive to serious reflection. How can such conditions be ameliorated? Unquestionably, *the only sound relief lies in a well-established and well-directed system of National and State game preserves in which wild life finds absolute sanctuary.** And good beginnings have already been made. It is in this particular niche of national and popular conservation that the national parks find one of their most satisfying opportunities. It is true that the parks comprise only one-third of 1 per cent of the country's area, but the complete and absolute protection afforded the wild life within their boundaries insures a supply that is subjected only to possible depletion by natural conditions." Yet on page 235 of the

* Italics mine.—M. P. S.

same Report, the Superintendnt of Mesa Verde speaks of his "efforts to eradicate" the coyotes. But on page 258, Mr. Barrington Moore, discussing the "Scientific Opportunities of the Lafayette National Park," writes: "With advancing civilization areas on which natural conditions still exist are rapidly diminishing, and one of the most important functions of the national parks is to preserve for scientific study parts of our flora and fauna undisturbed by outside agencies." With this I agree heartily, especially with the wish for native plants and animals undisturbed and in their natural condition.

In the annual Report of the National Park Service for 1922, the Director says on page 22: "The national parks and monuments play a very important part in the conservation of wild life, for in them all animals, with the exception of predatory ones, find safe refuge and complete protection, and live unhampered in natural environment." But though he does not advocate extermination, in the last few words he speaks of natural environment as if unaware that some predatory species belong in such an environment. On page 57 the Director differentiates the "game animals" from the "predatory animals," which we think is a step in the wrong direction, for we want to see protection for *all* wild life with a settled policy of control for those animals that prove they need it. "The greatest good for all classes of people" is the motto we would adopt. I am wholly in accord with Dr. Grinnell's "A Conservationist's Creed as to Wild-Life Administration," which I quote in full herewith.

"(1) I believe that the fullest use should be made of our country's wild life resources from the standpoint of human benefit—for beauty, education, scientific study, recreation, for sport, for food, for fur, etc. *All* these possible uses should be considered in the administration of wild life, not any one of them exclusively of the others. At the same time, any one use may be of more importance than the others in a given locality, so that such locality may be administered with that particular value most prominently in view.

"(2) I believe that that portion of our wild animal life known as 'game' belongs no more to the sportsman than to other classes of people who do not pursue it with shotgun and rifle. More and more the notebook, the field glass and the camera are being employed in the pursuit of game as well as other animals. The newer generation by hundreds of thousands is turning to nature-out-of-doors, for recreation, instruction and pleasure through such agencies as the national parks, summer camps, Boy Scouts, Girl Scouts and Camp Fire Girls. Indeed, these other claimants upon our 'game'

resources are probably reaching to numbers greater than those of active sportsmen; *their* rights certainly deserve at least equal consideration.

"(3) I believe it is unwise to attempt the absolute extermination of any native vertebrate species whatsoever. At the same time, it *is* perfectly proper to reduce or destroy any species in a given neighborhood where sound investigation shows it to be positively hurtful to the majority of interests. For example, coyotes, many rodents, jays, crows, magpies, house wrens, the screech owl and certain hawks may best be put under the ban locally.

"(4) I believe it is wrong to permit the general public to shoot crows or any other presumably injurious animals during the breeding season of our desirable species. It is dangerous to invite broadcast shooting of any so-called vermin during the regular closed season, when the successful reproduction of our valuable species is of primary importance and is easily interfered with.

"(5) I believe in the collecting of specimens of birds and vertebrates generally for educational and scientific purposes. The collector has no less right to kill non-game birds and mammals, in such places where he can do so consistently with other interests, than the sportsman has right to kill 'game' species. A bird killed, but preserved as a study-specimen, is of service far longer than the bird that is shot just for sport or for food.

"(6) I believe that it is wrong and even dangerous to introduce (that is, turn loose in the wild) alien species of either game or non-game birds and mammals. There is sound reason for believing that such introduction, if 'successful,' jeopardizes the continued existence of the native species in our fauna, with which competition is bound to occur.

"(7) I believe that the very best known way to 'conserve' animal life, in the interests of sportsman, scientist and nature-lover, alike, is to preserve conditions as nearly as possible favorable to our own native species. This can be done by the establishment and maintenance of numerous wild-life refuges, not only as comprised in private and public parks, but in national forests and elsewhere.

"(8) In the interests of game and wild life conservation generally, I believe in the wisdom of doing away with grazing by domestic stock, more especially sheep, on the greater part of our national forest territory. A further, and vital, interest bound up in this factor in the conservation of water.

"(9) I believe that the administration of our game and wild life resources should be kept as far as possible out of politics. The appertaining problems are essentially biological ones and are fraught

with many technical considerations not appreciated or understood by the average politician or sportsman. The resources in question should be handled as a national asset, administered with the advice of scientifically trained experts." (Grinnell, '25, pp. 437-438.)

On page 107 of the 1922 Report, the Superintendent of Yellowstone Park repeats this same division of animals into game and predatory groups. And again the extermination idea is brought up by the Superintendents of two out of the nineteen National Parks, on pages 135 and 139. Particularly disturbing is the report on page 144 of the Superintendent of the Rocky Mountain National Park that: "The following animals were killed in the park, or in territory immediately adjacent: Mountain lion, 6; bobcat, 20; fox, 3; badger, 2; weasel, 2; coyote, 8; mink, 6." We do not believe that foxes, badger, weasels, and mink can cause damage enough in a natural wild life preserve to warrant their destruction, especially where they are no more numerous than in Rocky Mountain National Park. We believe *that this question of what is an undesirable animal should be taken out of the hands of each individual Superintendent, and decided by a more judicial authority on the basis of scientific knowledge.*

A careful reading of the Report of the National Park Service for 1923 affords about the same analysis as the previous reports. But this time the Superintendent of Zion National Park, on page 177, actually advocates the extermination of "gray squirrels" on the ground that they destroy birds' eggs and drive the birds away. Have not these squirrels always been there and have they not always acted as they do now? Or have they been introduced? Or are they increasing because some other animal has been exterminated? In either of the last two cases even, our contention that a more judicious and scientific control of wild life is necessary, is strengthened.

The Report of the National Park Service for 1924 justifies the same analysis as previous reports. On page 10, Director Mather says: "All the national parks are absolute sanctuaries for wild animals except a few species of predatory ones which are annually reduced by the ranger forces on patrol." And again there is the differentiation of game animals from other wild life. A further bad feature of this report from the standpoint of those who like to see small wild life in natural surroundings, is the advocacy on page 24 of a policy of "cleaning up dead and down timber." This dead and down timber provides nesting places and safe retreats to several species of birds and small mammals (cf. Adams, '25, p. 573). Cleaning this up along the road will at least drive back the squirrels, chipmunks, woodpeckers, bluebirds and tree swallows and deprive the

roadsides of their services in fertilizing and improving the living trees there (cf. Grinnell, '23, pp. 137-149; '24, pp. 838-840). Another feature of this Report is the smaller amount of information furnished about the predatory animal destruction, but it is quite possible that this is due to the economic curtailing of the size of the Report as a whole.

The Report of the National Park Service for 1925 gives still less data on the predatory animals, not because there has been a change of policy but evidently due to disinclination to publish the information,—possibly due to a further curtailment of the size of the Report. On page 24, Director Mather again speaks approvingly of the roadside clean-up work, although according to my observations in 1925 it has already decreased the small mammal and bird life along the Park roads.

At many points in this article I have touched on the great value of the Yellowstone National Park to nature students and scientists. It is the stated purpose of the Director to encourage and develop these pursuits. But this is not exactly a new idea, for it has been recognized since its inception that this Park is peculiarly suited to such purposes. As long ago as 1874, Mr. Theo. B. Comstock wrote: "the earnest student of nature will always find an abundance of fresh matter for research in nearly every department of science. Here he will find ready to his hands a laboratory of physics in which he may observe on a large scale the action of the various forces of attraction and repulsion, and new illustrations of the correlation and conservation of energy cannot fail to attract his attention. He will find the laws of crystallization exemplified in forms novel and instructive, and will doubtless witness many new and varied phenomena of heat, light, and electricity. The chemist will interest himself in problems of analysis and synthesis, in the processes of evaporation, condensation and solution, and the chemical changes incident thereto. To the botanist and the vegetable physiologist, the field is open for observation and wide experimentation, but there exists, even at this great altitude, a storehouse of facts bearing upon the distribution and fertilization of plants, and the almost indefinite related subjects. The zoologists and the student of comparative anatomy may also hope for rich rewards, in but partially explored fields, and the meteorologist, astronomer, artist, and physican, may each find here full employment for his peculiar talent." (Comstock, '74, pp. 71-72.) But there is a wider, more general, interest than that voiced by Mr. Comstock. "In itself a sanctuary is a kind of wild 'zoo,' on a gigantic scale and under ideal conditions. As such, it appeals to

Fig. 47. A rock rabbit, or cony. A curious little rodent resembling a tiny rabbit in many ways, but hiding its home in crevices among loose rocks. Near Golden Gate, Yellowstone Park, Oct. 13, 1922.

Fig. 48. A pair of beaver, one swimming and one eating. Near Lava Creek, Yellowstone Park, Oct. 7, 1922.

Fig. 49. Sometimes, if the snow is not too heavy, the elk can remain higher than usual and get a little food (grass) through the snow. Near Mammoth, Yellowstone Park, Dec. 12, 1922.

everyone interested in animals, from the greatest zoologist to the mere holiday tourist. Before concluding I shall give facts to show how well worth while it would be to establish sanctuaries, even if there were no other people to enjoy the benefits. Yet the strongest of all arguments is that sanctuaries, far from conflicting with other interests, actually further them." (Wood, '11, p. 6.) "Men and women with minds weary from the constant turmoil of business will inhale the elixir of life in the parks; they will marvel at the rule of law in nature and apply scientific method to their daily life and activities. Whether we will or no, the scientific method and divine spirit must rule humanity in the future, and as a great source of training and inspiration the national parks will be a mighty asset, both scientific and spiritual, through the centuries." (Walcott, '17, p. 117.)

FUTURE WILD LIFE ADMINISTRATION IN YELLOWSTONE PARK

We must first know the animals in our Parks before we can make them known to others. Furthermore the ideal of the Yellowstone National Park is to maintain all animal life in a natural condition for "the benefit and enjoyment of the people." This has been reiterated by the Director of the National Park Service and some of his Superintendents. So far, so good. We have disturbed the original balance already, and to regain a new one requires further knowledge; but we are fearful of ill-advised experiments although the authorities are continuing to experiment, often rashly. As the Parks are now operated, each Superintendent decides what animals to kill; overburdened as he usually is with a mass of executive detail, he could not give this subject the careful and judicious care that it needs, even if he were trained to decide on such matters. He yields to the tendency to protect the "big game" at the expense of the other animals. But the right course is to protect *all wild life,* not excluding even those carnivores that may prey on the hoofed mammals. To many persons, a wolf or a coyote is as important as a deer; and surely a bear is as valuable as a rabbit. It is a fact that all are equal in value, else they would have disappeared in the struggle to exist. Therefore, we should do that which will benefit all wild life and not favor the hoofed game. To know exactly the consequences of what we are doing, we must know all about the animals and their interrelations. Most assuredly we do not know that now. "The interrelations between vertebrate animals and their environment are exceedingly

variable and far-reaching. To base any conclusion upon a contrary assumption has proven dangerous, for in specific cases such procedure has led people to expend effort and substance not only needlessly but definitely against their own best interests. An inference as to the relationships between some certain wild mammal and human affairs may at first thought look to be perfectly obvious and unquestionable. Extended examination, however, may show that many factors previously overlooked are concerned, and the comprehension of these may lead to an entirely different view." (Grinnell, '23, p. 137.) Each Park should have an adequate staff of experts to study each situation on its own merits and then have the authority to put their plans, based on knowledge, into effect. The staff should have this authority and be held accountable for results. This plan is not new nor is it original with the writer, except in a few of its details. The germ of the plan was suggested by Colonel William Wood, who declared in 1912: "This occasion should be taken to place the whole of the fauna under law; not only *game* but noxious and beneficial species of every kind. And here both local experts and trained zoologists ought to be consulted. Probably everyone would agree that flies, wolves and English sparrows are noxious. But the indiscriminate destruction of all mammals and birds of prey is not a good thing, as a general rule, any more than any other complete upsetting of the balance of nature." (Wood, '12, p. 7.) On page 17 of the same publication, Dr. Robert Bell, late Chief Geologist, Geological Survey of Canada, endorses Colonel Wood's plan and says: "The Sanctuary should be placed in charge of a committee of naturalists."

Grinnell and Storer have expanded the idea and applied it to our National Parks. "As a final requirement, we would urge that provision be made in every large national park for a trained resident naturalist who, as a member of the park staff, would look after the interests of the animal life of the region and aid in making it known to the public. His main duty would be to familiarize himself through intensive study with the natural conditions and interrelations of the park fauna, and to make practical recommendations for their maintenance. Plans to decrease the number of any of the predatory species would be carried out only with his sanction and under his direction. . . . His acquaintance with the local fauna would enable him to communicate matters of interest to the public in popularly styled illustrated leaflets and newspaper articles, on sign posts, and by lectures and demonstrations at central camps. He would help awaken people to a livelier interest in wild life, and to a healthy

and intelligent curiosity about things of nature. Our experience has persuaded us that the average camper in the mountains is hungry for information about the animal life he encounters. A few suggestions are usually sufficient to make him eager to acquire his natural history at first-hand, with the result that the recreative value of his few days or weeks in the open is greatly enhanced." (Grinnell and Storer, '16, pp. 10-11.) Dr. F. B. Sumner has added several ideas of value: "It is my belief that sooner or later its administration must be in the hands of men who are willing and able to make this their life work. Such men will probably be hard to find. The university biologist, however gifted otherwise, is commonly neither willing nor able to achieve success along these lines. On the other hand, a mere high-grade clerk, the counterpart of some of our bureau or division chiefs in the government service would probably make an even more lamentable failure. A broadly trained field naturalist, with a more than usual endowment of public spirit and administrative talent, would doubtless fill the bill. His salary should be commensurate with his great responsibilities. He should have a staff of expert assistants, giving much of their time to first-hand observations of the unequal struggle between man and nature, and to actual surveys of proposed reservations. Furthermore, this important official should have an adequate office force." (Sumner, '21, p. 41.) Finally Dr. Charles C. Adams says, in 1925: "Without doubt every such Park should not only have its Naturalist, but there should be in most cases several of them, as the field is too large for one man, however capable. It is only a question of time until all our most important parks must be fully equipped with a scientific and a technical staff, in addition to the administrative officials. So long as the Parks had few visitors, and were almost wholly wild, the administrative officers were able to handle the situation, but now with their thousands of visitors, they are rapidly becoming so congested as to be threatened with grave injury, a danger which only a technical staff, constantly on guard, can fully anticipate and ward off." (Adams, Roosevelt Wild Life Bull., Vol. 3, p. 192.)

Here we have the plan complete, except that I would suggest at least one expert on Park conditions on such a staff. He would not necessarily be a technical scientist but he should have had a broad and practical experience in Park affairs. Of course, such a staff necessitates an adequate fund for its financing, yet it would repay its cost many times in a short period. Had such a staff been functioning when the spruce bud-worm infestation started in the Yellowstone National Park, it would probably have prevented its further

spread and saved the ten thousand acres of Douglas fir that have since been destroyed. With congestion and its attendent danger, as stated by Dr. Adams, now menacing the Parks, it is false economy to delay longer in establishing such a staff. But in some of the Parks (notably Yellowstone, Yosemite, Glacier, and Mt. Rainier) Park Naturalists have been appointed, but for educational rather than administration work. Let us hope that their work will rapidly broaden out into such a technical, expert staff as I have advocated.

As I have said repeatedly, we do not know enough yet to lay out the details of future policy for the Yellowstone National Park. That would be for the expert staff to decide after making a thorough study of the situation. But we can indicate some points needing immediate attention and point out a general line of policy.

Since it is avowedly the settled policy of the National Park Service to maintain the National Parks in a state of nature, however much in actual practice it has fallen short of this ideal, it is evident that such a general policy can meet with only the highest praise from all the true friends of the Parks. It is unquestionably the only proper plan to pursue. Let the expert staff study that policy carefully, then decide after an adequate investigation just what constitutes this "state of nature" and just what "balance of nature" applies to the Park considered. For we must remember that the original natural condition has been changed and cannot now be regained. In the old days of the Yellowstone Park, the elk, deer, and antelope at least, made regular migrations each autumn to the plains—a thing that is no longer possible. After thorough investigation the staff would deliberately and carefully put their plans into operation. Their work would be wide-ranging and important; some of their problems have already been pointed out by Hewitt: "Compared with the rapacity of man, the destruction of our wild life by natural factors is slight, although it must demand our serious consideration. When animals become reduced in numbers through man's improvidence, then their natural enemies which have not suffered a like diminution take an unnatural and abnormal toll. The usual balance of nature is completely upset, and the remnant is exposed to excessive numbers of their enemies. The latter increase in numbers and become emboldened in their attacks. Predatory animals, such as wolves, harry the struggling bands whose former abundance enabled them to withstand the natural onslaughts of their enemies. Therefore, when an animal is reduced in numbers, the necessity of lessening the effects of natural reduction by predatory enemies becomes an important part of any policy of protection. In Canada forest fires constitute one of

the most serious dangers to animal life. Not only do such conflagrations destroy large numbers of mammals and birds, particularly young ones, but they destroy the haunts of such animals, and in consequence any replenishing or restocking of the devastated area is impeded for some time, and in any case the conditions are never as suitable or as attractive. It has already been pointed out that a species of animal must not be destroyed at a greater rate than it can increase. This axiom involves a number of fundamental requirements." (Hewitt, '21, p. 22.) The staff of naturalists has already at hand the machinery for the control of dangerous or exotic species in the Act of Aug. 25, 1916 (39 Stat. L., 535) which says: "He [The Secretary of the Interior] may also provide in his discretion for the destruction of such animals and of such plant life as may be detrimental to the use of any of said parks, monuments, or reservations."

A policy for the animals in general would have to be worked out. In most of its aspects this would have but simple modifications, where needed, of the plans now in force; but because they are simple changes does not mean that they are any the less important. But in one particular, at least, this general policy must be modified. We cannot sanction the increase of the grazing animals, or indeed any kind of wild life, beyond the capacity of the region to support it. A large proportion of the animals in Yellowstone National Park are not strictly native there, but they have been driven up from the plains and are now in a territory where such large numbers were not originally present. The Park is an ideal summer range for them but it is not a suitable winter range, because deep snows sometimes cover even the forage growing at the lowest elevations. Since we are holding them there—as is necessary because the lower valleys and plains are now settled with farms and ranches—on a range ill suited to them and not favorable in winter, they are not as strong, because of less feed, and hence fall easier prey to predatory animals. These predacious animals increase under protection also. The smaller rodents on which they prey normally are either hibernating or safe under the winter snow and ice. This gives the animals above ground added enemies which can usually run over the snow without sinking in. The increased number of large predators will then tend to harry the hoofed game unduly, necessitating their own limitation by man. It is apparent that until the Yellowstone can be enlarged, some compromise must be made with the ideal of leaving the wild life to work out its own balance again.

The very first problem to take up would be the question of forage

for the elk, especially on the wintering grounds. "Even the lower parts of the Yellowstone Park are so high above sea level that the winters are severe, and in exceptional seasons the snowfall is so deep that a large proportion of the animals are forced to seek grazing outside the park limits." (Nelson, '17a, p. 202.) An accurate survey of the available winter forage should be made, a reasonable margin allowed for safety, and then it should be determined just how many elk this range would support, and the herds held to that number, or below. The same question is still more urgent with regard to the few remaining antelope, although in their case a large share of the preliminary work and the survey has already been done (see Skinner, '22, pp. 82-105; '24a, pp. 1-32).

Artificial feeding of animals is always a poor substitute for natural food, naturally collected, and should only be resorted to as a temporary or emergency measure. The only way to augment the supply of food for winter grazing that holds hope of permanent success is to add more natural winter range to the Park, where natural food will be available at the time it is most needed. Plans for the acquisition of sufficient lands for this purpose along the Yellowstone River, north of the Park, are now being developed.

Another problem is suggested in the Report of the National Park Service, 1923, on page 119: "Some of the rodents, especially the Kennicott ground squirrels, are getting to be a distinct nuisance, and some measures may eventually have to be taken for their control." This would prove an intricate problem and well worthy of the expert staff suggested. The Report seems to indicate that the ground squirrels would have to be killed off. Perhaps it is not realized that that solution, simple as it seems is extremely ill-advised. As it is now, the ground squirrels are the main food of the badgers, and an important food of the bears, coyotes, foxes, weasels, and other fur-bearers. If the ground squirrels are killed off, or even have their numbers lessened to any material extent, all these flesh-eating animals are forced to eat other food. For a short time, the mice and rabbits might fill the gap, but eventually they, too, would fail and then the concentrated attack of the hungry smaller predators would fall on the birds, while the larger forms would harry the deer and antelope, perhaps even the young elk and mountain sheep. It would be much safer to await an expert examination before moving on the rodents. At most, it might be permissible to trap out a few ground squirrels at Camp Roosevelt, Mammoth, and other points where they are locally too abundant (poisoning has already been resorted to around buildings); but even this ought to be studied before being acted upon.

Fig. 50. The winter range for these elk is so limited that it is badly overgrazed. This band of elk is trying to exist on ground that is almost bare of vegetation. Near Gardiner, Montana, Jan. 20, 1920.

Fig. 51. If the snow gets too heavy, or becomes crusted, the elk may starve. The elk pictured here have had a hard time of it and are reduced to "mere skin and bones." Near Mammoth, Yellowstone Park, March, 1920.

Since we have destroyed the original natural balance by holding the larger herbivorous animals in an environment unfavorable to them in winter and favorable to their enemies, we must try to establish a new balance by regulating the number of predacious animals, but we must not decrease them below a limit that will allow a natural balance or we may invite unknown dangers. Meanwhile the hunting and trapping should be limited to a degree only necessary to prevent undue increase, until a settled policy can be developed. Even to decide upon this temporary estimate of numbers to be killed, requires far more careful investigation than has ever been made. In the study of the predatory and fur-bearing animals, their primary dependence on the rodents must not be underestimated. The rodents must be studied too, and any disturbance of the rodent population should be discouraged until their true importance has been established.

SUMMARY

1. The abundance of predacious and fur-bearing animals throughout this continent was astonishing when the first settlers landed. Since then the Americans have been more destructive of this valuable resource than either the Canadians or the Spanish. At the present time, the number of these animals is but a shadow of what it once was; extermination faces them everywhere, even in the National Parks, where we had thought they were safe.

2. In the Yellowstone Park the diverse topographical conditions and rugged climate are suited to varied and abundant animal life. Although this Park has far too small an area of winter grazing grounds (which condition may be remedied by certain additions at the lower altitudes), it is nevertheless the predominant National Park so far as wild life is concerned. There are three great classes of mammals there: the hoofed game, the predators and the rodents. The Park's mammal fauna has changed greatly since its discovery; the original natural balance was destroyed and has not been re-established.

3. Life history notes on the predatory animals in the Yellowstone show that they are an indispensable asset; and that even the outlawed coyote has much to be said in his favor.

4. With natural conditions outside the National Parks disappearing rapidly, we need these large areas maintained in their nearly original wild state. We must not exterminate any part of the wild life but guard it all carefully, for once destroyed we cannot bring it back. The predators should be preserved in the National Parks as a part of

the natural environment, and because of their scientific, educational and recreational interest.

5. The discussion of the history of the Yellowstone Park after its establishment in 1871, traces the development of protective policies for the wild life under methods used by the military regime and by the National Park Service.

6. A review of the existing conditions in the Yellowstone and other National Parks shows that the extermination of the carnivorous animals is threatened. The danger of introducing exotic plants and animals is shown to be serious. Grazing of domestic stock should be prohibited in all National Parks, in order to safeguard the wild animals and conserve the native vegetation.

7. Since the ideal policy would be to preserve the Yellowstone Park essentially as nature has evolved it, the extermination of any species of its wild life is indefensible. A certain amount of control is at times necessary, but this is a very delicate matter, requiring careful study by qualified naturalists whose sympathies are with the primary purpose of the National Parks.

8. A stable, forward-looking policy must be adopted, for it is dangerous to the maintenance of the native fauna to allow each Superintendent to experiment on his own account. All the wild life should be studied intensively and a policy evolved that will fully protect it. For this purpose a responsible technical staff is requisite in each Park to study conditions and control all activities affecting the wild life and its Park environment. This is the chief hope for the future of our highly prized Yellowstone animals.

LIST OF REFERENCES

ADAMS, CHARLES C.

1923. The Relation of Wild Life to the Public in National and State Parks. Proc. Second Nat. Conference on State Parks, 1922, pp. 129–147.

1924. A review of Hewitt's "The Conservation of the Wild Life of Canada." Science, N.S., Vol. 59, pp. 279–281.

1925. The Relation of Wild Life to the Public in National and State Parks. Roosevelt Wild Life Bull. Vol. 2, No. 4, pp. 371–402. (An amplification of paper of same title, 1923, above.)

1925a. The Conservation of Predatory Mammals. Jour. Mammalogy, Vol. 6, pp. 83–96.

1925b. Ecological Conditions in National Forests and in National Parks. Scientific Monthly, Vol. 20, pp. 561–593.

ALBRIGHT, HORACE M.

1917. Report of the Director of the National Park service for 1917. Pp. 1–258. Govt. Printing Office, Washington.

ANDERSON, GEORGE S.

1895. "Protection of the Yellowstone National Park." *In:* Hunting in Many Lands (The Book of the Boone and Crockett Club), pp. 377–402. New York.

ANTHONY, A. W.

1923. A Defense of the Coyote. Calif. Fish and Game, Vol. 9, pp. 111–112.

BAILEY, VERNON

1920. "Wild Animals." *In:* Rules and Regulations, Yellowstone National Park, 1920, pp. 70–80. Nat. Park Service, U. S. Dept. Interior.

BARLOW, J. W.

1871. Letter from the Secretary of War accompanying an Engineer report of a reconnaissance of the Yellowstone River in 1871. Senate Ex. Doc. No. 66, 42d Congress, 2d sess. Pp. 1–43.

BARNES, CLAUDE T.

1922. Mammals of Utah. Bull. Univ. of Utah, Vol. 12, No. 15, pp. 1–166.

BAYNES, ERNEST HAROLD

1923. Timber Wolves — Wild and Tame. Nature Magazine, Vol. 2, pp. 333–338.

BOONE AND CROCKETT CLUB

1912. Report of the Game Preservation Committee, 1912. Pp. 1–31.

BOUTELLE, F. A.

1889. Report of the Superintendent of the Yellowstone National Park to the Secretary of the Interior. Pp. 1–35.

1890. "Wild Animals." *In:* Report of the Superintendent of the Yellowstone National Park to the Secretary of the Interior, pp. 6–7.

BROWN, ARTHUR ERWIN

1914. "The Zoology of North American Big Game." *In:* American Big Game In Its Haunts (The Book of the Boone and Crocket Club), pp. 52–98. New York.

BRUNNER, JOSEPH

1912. Tracks and Tracking. Pp. 1–219. New York.

CHITTENDEN, HIRAM MARTIN

1918. The Yellowstone National Park. Pp. 1–350. Cincinnati.

COMSTOCK, THEO. B.

1874. The Yellowstone National Park. Amer. Naturalist, Vol. 8, pp. 65–79, 155–166.

DIXON, JOSEPH

1920. Control of the Coyote in California. Univ. of Calif. Publications, Bull. No. 320, pp. 379–397.

1925. Food Predilections of Predatory and Fur-bearing Mammals. Jour. Mammalogy, Vol. 6, pp. 34–46.

DUNRAVEN, LORD

1876. The Great Divide: Travels in the Upper Yellowstone in the Summer of 1874. Pp. 1–377. London.

1922. Hunting in the Yellowstone (a reprint of The Great Divide, Dunraven, 1876). Edited by Horace Kephart. Pp. 1–333. New York.

FEE, CHARLES S.

1912. "Remarks by Mr. Charles S. Fee." Proc. Nat. Parks Conference, 1911, pp. 11–13. Govt. Printing Office, Washington.

FRY, WALTER

1923. The Wolverine. Calif. Fish and Game, Vol. 9, pp. 129–134.

GRINNELL, GEORGE BIRD

1913. "Notes on Memories of a Bear Hunter." *In:* Hunting at High Altitudes (The Book of the Boone and Crockett Club), pp. 242–294. New York.

1914. "Wolves and Wolf Nature." *In:* Trail and Camp Fire (The Book of the Boone and Crockett Club), pp. 152–203. New York.

GRINNELL, JOSEPH

1923. The Burrowing Rodents of California as Agents in Soil Formation. Jour. Mammalogy, Vol. 4, pp. 137–149.

1924. Wild Animal Life as a Product and as a Necessity of National Forests. Jour. Forestry, Vol. 22, No. 8, pp. 837–845.

1925. A Conservationist's Creed as to Wild-life Administration. Science, N. S., Vol. 62, pp. 437–438.

GRINNELL, JOSEPH AND DIXON, JOSEPH

1924. Revision of the Genus Lynx in California. Publications in Zoology, Vol. 21, No. 13, pp. 339–354.

GRINNELL, JOSEPH AND STORER, TRACY I.

1916. Animal Life as an Asset of National Parks. Science, N. S., Vol. 44, pp. 375–380.

1921. "Some Mammals of Yosemite National Park." *In:* Handbook of Yosemite National Park, edited by Ansel F. Hall, pp. 155–173. New York.

HAGUE, ARNOLD

1893. "The Yellowstone Park as a Game Reservation." *In:* American Big-Game Hunting (The Book of the Boone and Crockett Club), pp. 240–270. New York.

HAHN, WALTER L.

1908. "The Mammals of Indiana." *In:* 33rd Ann. Rept., Dept. of Geology and Natural Resources of Indiana, pp. 418–663.

HAYDEN, F. V.

1872. Preliminary Report (1871), U. S. Geological Survey of Montana and Adjacent Territories. Pp. 1–538.

1873. Sixth Annual Report (1872), U. S. Geological Survey of the Territories. Pp. 1–844.

1883. Twelfth Annual Report (1878), U. S. Geological and Geographical Survey of the Territories. Vol. 1, pp. 1–809; Vol. 2, pp. 1–503.

HELLER, EDMUND

1924. The Big Game Animals of Yellowstone National Park. Roosevelt Wild Life Bull., Vol. 2, No. 4, pp. 404–467.

HEWITT, C. GORDON

1921. The Conservation of the Wild Life of Canada. Pp. 1–344. New York.

HOLLISTER, N.

1917. Some Effects of Environment and Habit on Captive Lions. Proc. U. S. Nat. Museum, pp. 177–193. (Sep. No. 2196.)

HORNADAY, WILLIAM T.

1913. Our Vanishing Wild Life. Pp. 1–411. N. Y. Zool. Society, New York.

HUGHES, JAMES B.

1912. General Park Administration. Proc. Nat. Parks Conference, 1911, pp. 190–194. Govt. Printing Office, Washington.

JONES, WM. A.

1874. Report upon the Reconnaissance of Northwestern Wyoming, Including the Yellowtone National Park, Made in the Summer of 1873. Pp. 1–120. Govt. Printing Office, Washington.

KORSTIAN, CLARENCE F.

1921. Grazing Practice on the National Forests and its Effects on Natural Conditions. Scientific Monthly, Vol. 13, pp. 275–281.

LANE, FRANKLIN K.

1919. "Statement of National Park Policy." *In:* Report of Director of Nat. Park Service for 1919, pp. 361–364.

LANGFORD, NATHANIEL PITT

1905. Diary of the Washburn Expedition to the Yellowstone and Firehole Rivers. Pp. 1–122. St. Paul, Minn.

LANTZ, DAVID E.

1905. Coyotes in their Economic Relations. U. S. Dept. Agri., Biol. Survey Bull. No. 20, pp. 1–28.

LUDLOW, WILLIAM

1876. Report of a Reconnaissance from Carroll, Montana Territory, on the Upper Missouri, to the Yellowstone National Park, and Return, made in the Summer of 1875. Pp. 1–155. Govt. Printing Office, Washington.

MARSHALL, R. B.

1912. Park Administration. Proc. Nat. Parks Conference, 1911, pp. 108–121. Govt. Printing Office, Washington.

MATHER, STEPHEN T.

1917. *In:* Proceedings of the National Parks Conference of 1917. Pp. 1–364. Govt. Printing Office, Washington.

1918. Report of the Director, National Park Service, for 1918. Pp. 1–284. Govt. Printing Office, Washington.

1919. Report of the Director, National Park Service, for 1919. Pp. 1–384. Govt. Printing Office, Washington.

1920. Report of the Director, National Park Service, for 1920. Pp. 1–423. Govt. Printing Office, Washington.

1921. Report of the Director, National Park Service, for 1921. Pp. 1–306. Govt, Printing Office, Washington.

MATHER, STEPHEN T.

1921a. "Ideals and Policy of the National Park Service." *In:* Handbook of Yosemite National Park, edited by Ansel F. Hall, pp. 77–86. New York.

1922. Report of the Director, National Park Service, for 1922. Pp. 1–173. Govt. Printing Office, Washington.

1923. Report of the Director, National Park Service, for 1923. Pp. 1–198. Govt. Printing Office, Washington.

1924. Report of the Director of the National Park Service for 1924. Pp. 1–165. Govt. Printing Office, Washington.

1925. Report of the Director of the National Park Service for 1925. Pp. 1–137. Govt. Printing Office, Washington.

MILLS, ENOS A.

1920. The Adventures of a Nature Guide. Pp. 1–271. Garden City, N. Y.

MUIR, JOHN

1904. Our National Parks. Pp. 1–370. New York.

NELSON, E. W.

1916. The Larger North American Mammals. Nat. Geogr. Magazine, Vol. 30, pp. 385–472.

1917. Conservation of Game in the National Forests and National Parks. Amer. Forestry, Vol. 23, pp. 139–145.

1917a. The Yellowstone and the Game Supply. Proc. Nat. Parks Conference, 1917, pp. 200-204. Govt. Printing Office, Washington.

OSBORN, HENRY FAIRFIELD

1914. "Preservation of the Wild Animals of North America." *In:* American Big Game In Its Haunts (The Book of the Boone and Crockett Club), pp. 349–373. New York.

PITCHER, JNO.

1902. Report of the Acting Superintendent of the Yellowstone National Park to the Secretary of the Interior. Pp. 1–22. Govt. Printing Office, Washington.

RHOADS, SAMUEL N.

1898. "Noxious" or "Beneficial"? False Premises in Economic Zoology. Amer. Naturalist, Vol. 32, pp. 571–581.

1903. The Mammals of Pennsylvania and New Jersey. Pp. 1–266. Phila.

ROOSEVELT, THEODORE

1914. "On the Little Missouri." *In:* Trail and Camp-Fire (The Book of the Boone and Crockett Club), pp. 204–222. New York.

1914a. "Wilderness Reserves." *In:* American Big Game In its Haunts (The Book of the Boone and Crockett Club), pp. 23–51. New York.

SAUNDERS, ARETAS A.

1923. The Summer Birds of the Allegany State Park. Roosevelt Wild Life Bull., Vol. 1, No. 3, pp. 239–354.

SCOTT, WILLIAM B.

1913. A History of Land Mammals in the Western Hemisphere. Pp. 1–693. New York.

SETON, ERNEST THOMPSON

1909. Life Histories of Northern Animals. Vol. 1, pp. 1–673; Vol. 2, pp. 674–1267. New York.

SKINNER, M. P.

1922. The Prong-horn. Jour. Mammalogy, Vol. 3, pp. 82–105.

1924. The Yellowstone Nature Book. Pp. 1–229. Chicago.

1924a. The American Antelope in Yellowstone Park. Pp. 1–32. (A revision of 1922, privately printed; Syracuse, N. Y.)

1925. Bears in the Yellowstone. Pp. 1–158. Chicago.

SUMNER, FRANCIS B.

1920. The Need for a More Serious Effort to Rescue a Few Fragments of Vanishing Nature. Scientific Monthly, Vol. 10, pp. 236–248.

1921. The Responsibility of the Biologist in the Matter of Preserving Natural Conditions. Science, N. S., Vol. 54, pp. 39–43.

STONE, WITMER

1923. Review of Adams' "Relation of Wild Life to the Public in National and State Parks." The Auk, Vol. 40, p. 552.

TAYLOR, WALTER P.

1924. The Basic Importance of Life History Studies. Jour. Mammalogy, Vol. 5, pp. 44–48.

THOMSON, J. ARTHUR

1896. The Study of Animal Life. Pp. 1–375. New York.

WALCOTT, CHARLES D.

1917. National Parks as a Scientific Asset. Proc. Nat. Parks Conference, 1917, pp. 113–117. Govt. Printing Office, Washington.

WARREN, EDWARD R.

1922. The Life of the Yellowstone Beaver. Roosevelt Wild Life Bull., Vol 1, No. 2, pp. 187–221.

1926. A Study of the Beaver in the Yancey Region of Yellowstone National Park. Roosevelt Wild Life Annals, Vol. 1, Nos. 1–2, pp. 1–191.

WHEELER, OLIN D.

1904. The Trail of Lewis and Clark. Vol. 1, pp. 1–377; Vol. 2, pp. 1–419. New York.

WHITNEY, CASPER W.

1895. "The Cougar." *In:* Hunting in Many Lands (The Book of the Boone and Crockett Club), pp. 238–254. New York.

WILLIAMS, ROGER D.

1895. "Wolf-Coursing." *In:* Hunting in Many Lands (The Book of the Boone and Crockett Club), pp. 318–357. New York.

WOOD, WILLIAM

1911. Animal Sanctuaries in Labrador. 2d Ann. Meeting, Canadian Comm. of Conservation, pp. 1–37.

1912. Supplement to "Animal Sanctuaries in Labrador." Pp. 1–38. Canadian Comm. of Conservation.

CURRENT STATION NOTES

By Charles C. Adams

THE PREDATORY MAMMAL PROBLEM

The problem of the best policy for the administration of predatory mammals,—the coyotes, wolves, cougars, and other predators, and fur-bearing mammals, in the National Parks, the National Forests and other similar lands, is one which every year becomes more urgent and insistant.

In the case of forests conducted for revenue, it seems at first sight a simple matter to decide that all predatory mammals which feed upon domestic animals, or desirable game, should be under strict control. But experience has shown that the problem is not as simple as it appears, because with the destruction of the larger predators the rodents tend to multiply unduly. Then their control must be undertaken and be followed up closely. As the larger animals are eliminated, the chances are that the smaller ones tend to take their place. Before long, also, we may expect some other form of control will demand similar attention. If the predatory animals were exterminated—ignoring the needs of the fur industry—other kinds of control measures would still persist, and the prospects are that they would be equally difficult or even more so to solve. Control is a permanent problem, and we are in the predatory stage in its development; so let us not endeavor to console ourselves with the idea that if we could exterminate predators in economic forests, our troubles would be over. Even the technique of control yet awaits satisfactory scientific study on the part of naturalists, although certain special studies of great value have been made toward this result.

In the case of the National Parks we have another standard. The professed ideal of the National Parks has been to pass on to future generations the natural resources of the Parks unimpaired, and this has generally been interpreted to mean in a wild or wilderness state. Field naturalists know something of the difficulties involved in such an undertaking in this changing world. In the Parks, as elsewhere, conditions change continually, necessitating adjustment as a part of a continuous series. The wise procedure in maintaining wild or wilderness conditions, is to interfere as little as possible with the course of Nature. The only safe starting point is to leave the animals alone, study them faithfully, and if conditions demand administrative attention, permit only the minimum rather than the maximum interference.

To attempt to prescribe in advance is worse than useless, because it only leads to confusion, when to determine what should be done can only be decided wisely by a close and careful study of the local conditions. Under such circumstances the most practical method of handling such a problem, is to put it in the hands of competent naturalists, allow them the time and facilities to familiarize themselves with the problem, protect them from interference, and give them authority to put their policies into practice.

I have elsewhere called attention to certain unsatisfactory and discouraging conditions in the Parks (this *Bulletin,* Vol. 2, pp. 371-402; *Journal of Mammalogy,* Vol. 6, pp. 83-96; *Scientific Monthly,* Vol. 20, pp. 561-593) which deserve serious attention on the part of friends of our National Parks. Even the *extermination* policy, for the large predatory mammals, by the Biological Survey of the United States Department of Agriculture, has been strongly challenged by a large number of our leading field naturalists. For National Park officials to borrow such a policy, in direct opposition to the proclaimed policy of protection of all animals in National Parks, is ample cause for serious concern. The paper by Mr. M. P. Skinner in this number of the *Bulletin* will be a startling revelation to a large number of the public. Mr. Skinner's familiarity with the Yellowstone Park gives his observations, opinions and recommendations great weight.

BORROWING NATIONAL PARK IDEALS FOR STATES

The wilderness ideal of the National Parks, when well practiced, leads to an abundance and tameness of wild life that is a chief attraction in the Parks. A visitor in the Yellowstone may, with slight or moderate effort, see black and grizzly bears, elk, beaver, and moose. A lifelong woodsman in the Adirondacks may get only a fleeting glance at a bear, and then only on rare occasions.

In those States where there are large State forests, would it not be wise to establish sanctuaries where all animals would be protected? Such areas might be located a safe distance within, and wholly surrounded by a large forest where the normal overflow might be used for hunting or trapping, and where any desirable control measures might be practiced when needed. Within this large central sanctuary, with complete protection wild life would become tame, similar to that seen in some of the National Parks. It would be much better to adopt National Park ideals and practice them in many States, than to attempt to establish National Parks in regions which clearly lack the supreme scenic and other features that should characterize National Parks.

THE ROOSEVELT WILD LIFE MEMORIAL

As a State Memorial

The State of New York is the trustee of this wild life Memorial to Theodore Roosevelt. The New York State College of Forestry at Syracuse is a State institution supported solely by State funds, and the Roosevelt Wild Life Forest Experiment Station is a part of this institution. The Trustees are State officials. A legislative mandate instructed them as follows:

"To establish and conduct an experimental station to be known as 'Roosevelt Wild Life Forest Experiment Station,' in which there shall be maintained rrecords of the results of the experiments and investigations made and research work accomplished; also a library of works, publications, papers and data having to do with wild life, together with means for practical illustration and demonstration, which library shall, at all reasonable hours, be open to the public." [Laws of New York, chapter 536. Became a law May 10, 1919.]

As a General Memorial

While this Memorial Station was founded by New York State, its functions are not limited solely to the State. The Trustees are further authorized to cooperate with other agencies, so that the work is by no means limited to the boundaries of the State or by State funds. Provision for this has been made by the law as follows:

"To enter into any contract necessary or appropriate for carrying out any of the purposes or objects of the College, including such as shall involve cooperation with any person, corporation or association or any department of the government of the State of New York or of the United States in laboratory, experimental, investigative or research work, and the acceptance from such person, corporation, association, or department of the State or Federal government of gifts or contributions of money, expert service, labor, materials, apparatus, appliances or other property in connection therewith." [Laws of New York, chapter 42. Became a law March 7, 1918.]

By these laws the Empire State has made provision to conduct forest wild life research upon a comprehensive basis, and on a plan as broad as that approved by Theodore Roosevelt himself.

Form of Bequest to the Roosevelt Wild Life Memorial

I hereby give and bequeath to the Roosevelt Wild Life Forest Experiment Station of The New York State College of Forestry at Syracuse, for wild life research, library, and for publication, the sum of ....., or the following books, lands, etc.

MAP 1. TOPOGRAPHIC MAP OF YELLOWSTONE NATIONAL PARK. FROM U. S. GEOLOGICAL SURVEY ATLAS SHEET, REVISION OF 1921, REDUCED ONE THIRD.

Map 2. The Major Animal Habitats of Yellowstone National Park

ROOSEVELT WILD LIFE BULLETIN, Vol. 2, No. 2. February, 1924.

1. Ecology of the Plankton Algae in the Palisades Interstate Park, Including the Relation of Control Methods to Fish Culture..... Dr. Gilbert M. Smith.

ROOSEVELT WILD LIFE BULLETIN, Vol. 2, No. 3. March, 1924.

1. The Status of Fish Culture in Our Inland Public Waters, and the Role of Investigation in the Maintenance of Fish Resources..... Dr. William C. Kendall.
2. Current Station Notes.....The Director and Editor.

ROOSEVELT WILD LIFE BULLETIN, Vol. 2, No. 4. February, 1925.

1. The Relation of Wild Life to the Public in National and State Parks.....Dr. Charles C. Adams.
2. The Big Game Animals of Yellowstone National Park..Edmund Heller.
3. The Food of Trout in Yellowstone National Park..... Dr. Richard A. Muttkowski.
4. Current Station Notes.....The Director and Editor.

ROOSEVELT WILD LIFE BULLETIN, Vol. 3, No. 1. February, 1925.

1. The Birds of the Yellowstone National Park.....Milton P. Skinner.
2. Current Station Notes.....The Director and Editor.

ROOSEVELT WILD LIFE BULLETIN, Vol. 3, No. 2. March, 1925.

1. The Muskrat in New York: Its Natural History and Economics..... Dr. Charles E. Johnson.
2. Current Station Notes.....The Director and Editor.

ROOSEVELT WILD LIFE BULLETIN, Vol. 3, No. 3. September, 1926.

1. The Summer Birds of Central New York Marshes.Aretas A. Saunders.
2. Additional Notes on the Summer Birds of Allegany State Park..... Aretas A. Saunders.
3. Current Station Notes.....The Director and Editor.

ROOSEVELT WILD LIFE BULLETIN, Vol. 3, No. 4. October, 1926.

1. The Economic and Social Importance of Animals in Forestry, with Special Reference to Wild Life.....Dr. Charles C. Adams.
2. The Land-Economic Survey in Michigan.....R. A. Smith.
3. Current Station Notes.....Dr. Charles C. Adams.

ROOSEVELT WILD LIFE BULLETIN, Vol. 4, No. 1. October, 1926.

1. The Relation of Birds to Woodlots in New York State..... Waldo L. McAtee.
2. Current Station Notes.....Dr. Charles C. Adams.

ROOSEVELT WILD LIFE BULLETIN, Vol. 4, No. 2. June, 1927.

1. The Predatory and Fur-bearing Animals of the Yellowstone National Park .....Milton P. Skinner.
2. Current Station Notes.....Dr. Charles C. Adams.