A Look at Threatened Species

A Report on Some Animals of the Middle East and Southern Asia which are Threatened with Extermination

The International Union for Conservation of Nature and Natural Resources

Survival Service Field Mission of 1955 and subsequent inquiries

By

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A LOOK AT THREATENED SPECIES

ILLUSTRATIONS AND MAPS

FOREWORD

To preserve the last surviving remnants of gravely endangered species of fauna and flora from total extinction becomes more urgent every day, as the spread of civilization takes over their native habitat. In 1931, when the American Committee for International Wild Life Protection was established, it focused attention on the need for gathering information about gravely endangered species of mammals and birds. The Committee raised funds to support research on this subject, which culminated in the publication of *Extinct and Vanishing Mammals of the Western Hemisphere* by Glover M. Allen in 1942, *Extinct and Vanishing Mammals of the Old World* by Francis Harper in 1945, and *Extinct and Vanishing Birds of the World* by James C. Greenway, Jr., in 1958. These volumes furnish a base line of knowledge to assist future efforts in the protection of endangered species.

When the International Union for the Protection of Nature, or Union for the Conservation of Nature and Natural Resources, as it is now called, was founded at Fontainebleau in 1948, with the assistance of UNESCO, the problem of the fate of endangered species was recognized as a principal interest of the Union. It was at the International Technical Conference on the Protection of Nature, at Lake Success in 1949, that the first official list of gravely endangered species was drawn up. Thus the groundwork was laid for the establishment of the Union's Survival Service, whose primary function was to centralize information on endangered species, to keep the existing records up to date, and to focus world attention and seek governmental action in dealing with this problem.

In 1954, the Survival Service Commission was fortunate in obtaining the services of the young Californian ecologist, Lee M. Talbot, who undertook to make an on-the-spot survey of Middle East and Southern Asia countries in order to look into the status of selected species, many of which were on the official list of gravely endangered species. Talbot's mission was made possible by a generous grant from Mr. Russell Arundel, of Warrenton, Virginia. I, as Commission Chairman at that time, felt that we were particularly fortunate in the selection of Mr. Talbot for this assignment. He gathered a large amount of valuable information on the status of eight endangered species

with which the Commission was particularly concerned. He also established for the Union closer relations with governments, organizations, and individuals interested in the subject of conservation, and he served as a goodwill ambassador leaving a lasting favorable impression in the countries which he visited. The success of his mission, as he indicates, depended a great deal on co-operation from many governments and individuals, for which we are most grateful.

Since returning from his mission in 1955, Mr. Talbot has enlarged his knowledge of the areas and species which he studied through bibliographic research and correspondence. This final report sets forth the scientific results of his field work and subsequent research in a semi-popular manner. I have no hesitation in concluding that the important contribution made to our knowledge of threatened species, as a result of his first-hand investigation of their habitat and of his consultation with local observers, gives us unique information not previously available. The story he tells is further enhanced by his excellent photographs, as well as the carefully prepared drawing and maps by Mr. Christman.

The findings set forth in this publication indicate the need of further investigations of the ecology of the three Asian rhinoceros, the Indian Lion, the Arabian Oryx, and the Syrian Wild Ass. Let us hope that this report will encourage further work in this field, and will also encourage governments to take further steps to enforce the laws protecting the species which the author has described, as well as permanently assuring the integrity of parks and reserves which include the native habitat of the endangered species.

We are grateful to the Fauna Preservation Society for the publication of this report and to the following for the financial aid which made its publication possible : Mr. Russell M. Arundel, Mr. Suydam Cutting, the American Committee for International Wild Life Protection.

HAROLD J. COOLIDGE,
Vice-President,
International Union for Conservation of Nature and Natural Resources.

13th October, 1959.
WASHINGTON, D.C.

ACKNOWLEDGEMENTS

The Survival Service project which resulted in this publication was made possible by Mr. Russell M. Arundel. Endless details of preparation and correspondence were handled by the Secretariat of the International Union for the Conservation of Nature and most especially by Madame Marguerite Caram and Miss Jocelyn Arundel. Mr. Harold Coolidge was the guiding spirit behind the project from its conception.

A field mission such as this is absolutely dependent on the goodwill and co-operation of a great number of people. There were so many people involved in the success of this project that it is not possible to list them individually here. Particular gratitude is due to the representatives of my host governments, the Heads of State, Ministers, Administrative Officials, Parks, Forestry, and Game Departments, whose active co-operation was so essential. Other organizations also helped me greatly. Among them were the UNESCO Science Co-operation Offices, the UNESCO Technical Assistance Board, the American National Parks Association, the Lebanese Society of the Friends of the Trees, the Indian Board for Wild Life, the Bombay Natural History Society, the American International Co-operation Administration field staff, and the Arabian American Oil Company. The personnel of the Museums, Universities, Zoological Gardens and Experiment Stations visited, during both Part I and II, were most generous with their help and information. Indeed, the hospitality and help I received throughout this mission will remain one of my warmest memories.

The maps and drawings are by Mr. Gene Christman, Staff Illustrator of the Museum of Vertebrate Zoology, University of California, at Berkeley, and their accuracy is the result of long and careful work. Finally my thanks are due to those who reviewed and provided advice on parts of this work, and to Mrs. Jean Packard who edited and proofed the rough draft.

INTRODUCTION

The International Union for the Conservation of Nature established its Survival Service in 1949. As the name implies, the concern of this service is the survival of species threatened with extinction, and one of its duties is to collect information about these species and their status. This information serves three chief functions :

1. It is available to the governments or agencies concerned with the management or protection of these threatened species.

2. It can be used by IUCN as a basis for further action.

3. It is a source for workers on the problem of vanishing species.

Another duty of the Service is keeping a list of animals in imminent danger of extinction. This list focuses international attention on the problem, particularly when the listed species are large and spectacular—animals which capture the imagination of the public.

Between 1949 and 1954 the Survival Service collected information on threatened species of animals through library research and correspondence conducted by the IUCN Secretariat at Brussels and by Mr. Jean Jacques Petter of the Museum of Natural History in Paris. Much important information was gathered by this method, but the limitations of any method that relied entirely on published documents and correspondence soon became evident. In most cases very little was known about the animals themselves for the species involved had retreated to the most remote corners of their former ranges, so that even under peaceful conditions, information regarding their status was scarce and hard to obtain. This inherent difficulty was increased by the Second World War and its aftermath. Habitats of many of the species had been the scene of fighting and in the early 1950s these habitats—or the areas of access to them—were still involved in military activities or unsettled civil conditions. The only sure way to obtain information on many of the species was for scientists to survey the areas involved in order to collect information on the spot. Such a program was tentatively planned, but was not financially feasible until 1954 when it was made possible through a generous grant to the Survival Service by Mr. Russell Arundel, an American conservationist deeply concerned with the plight of endangered

species. I had the privilege and good fortune to be asked to carry out this program.

The Mission.—The principal aims of the mission were :

1. To survey the present status of certain threatened species of large mammals.

2. To determine the ways in which IUCN might co-operate most effectively with the local authorities, institutions, or persons concerned with the conservation of these mammals.

3. To collect other information about threatened species in particular, and about conservation in general, in the more remote areas visited.

The mission was divided into two parts.

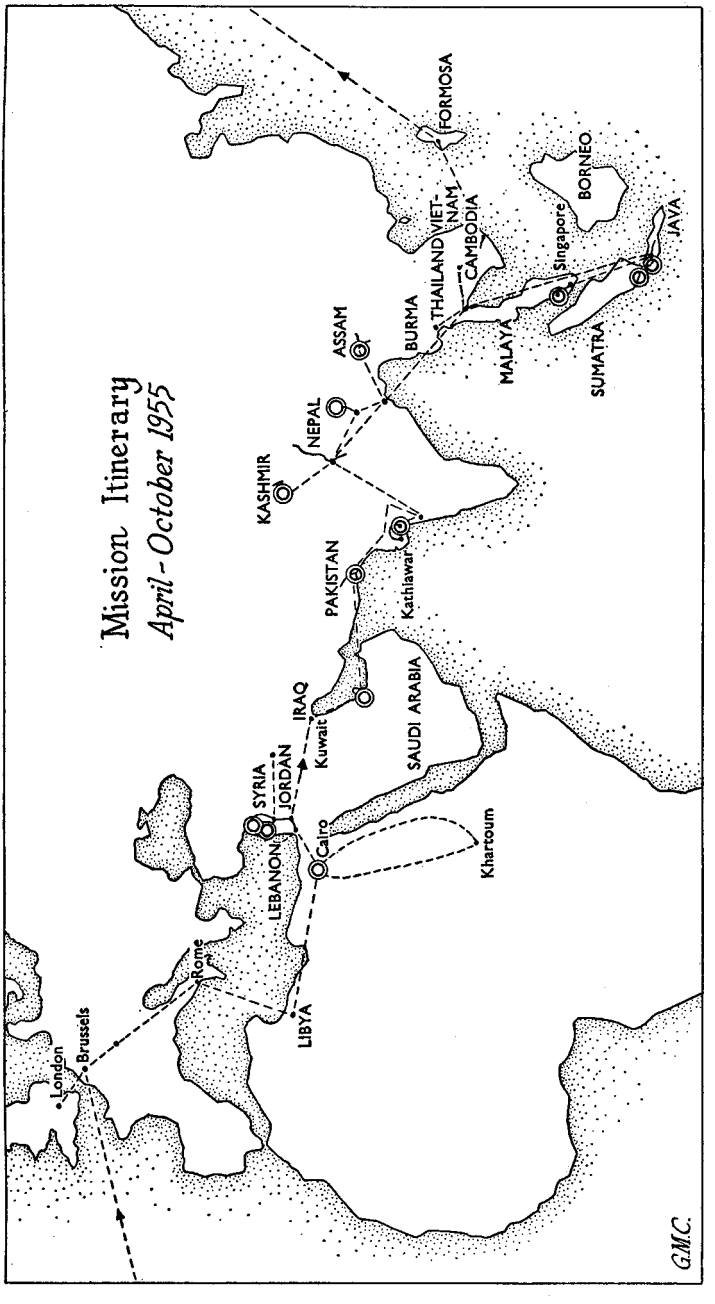
Part I was the period from December, 1954, until April, 1955. I spent part of the time at the Brussels office of IUCN getting accustomed to the Union and its operations. Then I travelled to England, Scotland, Germany, Holland, France and Denmark to consult experts in various fields affected, particularly ecology, getting the background and making contacts for the countries to be visited during Part II. During December, 1954, I carried out a similar program in the United States.

Part II began on 11th April, 1955. After leaving Brussels, I travelled, mostly by air, through about thirty countries on a six month journey of 42,000 miles. My itinerary was as follows :

Belgium, Libya, Egypt, Sudan, Egypt, Lebanon, Syria, Jordan, Iraq, Kuwait, Saudi Arabia, Pakistan, India, Nepal, Thailand, Indonesia, Singapore, Malaya, Burma, Cambodia, Viet Nam, Philippines, Japan, Hawaii, United States, Belgium.

Before leaving Brussels I had of course made contact with people I hoped to meet during my journey, and in each country I enlarged my contact list for the countries still to come. The UNESCO Science Co-operation Offices were very helpful with this. They furnished many facilities, aided with transport, visas, information and contacts, and actively co-operated in every way. The American International Co-operation Administration (Point 4), especially through its branches in forestry, range management, and disease control, provided a great deal of additional aid, transport and information.

Although each local situation differed and required a slightly different approach, the general procedure in all countries was the same :



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1. On arrival in a country I was met by a person previously contacted.

2. I consulted Government officials to gain their interest and approval for the project. These officials ranged from the heads of state, such as Prime Minister Nehru in India, or the ministers most directly concerned with conservation, to local administrators and forest guards.

3. Wherever possible, I met the scientific personnel most concerned.

4. Where possible, I visited the remote habitats of the animals in question, or areas of outstanding conservation or of ecological interest. My expeditions were arranged with the co-operation of the local authorities. All told, they involved some 10,000 miles of travel by 37 different kinds of field transport and included :

The Eastern Desert of Egypt, the Wadi Rishrash, formerly an Ibex reserve.

North Lebanon, at 6,000 to 10,000 feet elevation in the Kammouha district where isolation and tribal difficulties have allowed a remnant of the Middle East's once extensive forest cover to remain.

A similar area in north-western Syria north and east of Latakia.

The Gir Forest, Asian lion habitat, in Saurashtra, India.

The Himalayas (to 13,000 feet elevation) in Kashmir, via horse and foot, in search of the Kashmir Stag.

Lower Assam, India, into Kaziranga Indian rhinoceros sanctuary, via elephant.

Kingdom of Nepal, the Rapti Valley, another habitat of the Indian rhinoceros.

South-west Sumatra, searching for the Sumatran rhinoceros, through the trackless jungle mountains.

Udjon Kulon Reserve, western Java ; two weeks observing the Javan rhinoceros and other marvellous wildlife of the area.

This list does not include the many one- or two-day automobile or jeep observation trips in virtually every area visited. Most notable of these, perhaps, were in Saudi Arabia, Jordan, Pakistan, and parts of western India and Java.

5. Before leaving each area I made arrangements to be kept up to date on matters affecting the status of the animals considered and on general conservation.

My mission was as a field investigator gathering information for the Union, not as a visiting expert adviser. Some of the

people I met seemed rather pleased that here was a foreigner who did not come to advise them on how to run their lives. I also stressed that no long-term studies of any animal or area were being attempted; rather, that the aim was an extensive reconnaissance.

Method of Presentation of this Report.

Part I.—Since the ranges of the animals investigated do not follow political boundaries, I have organized the information on the principal animals by species, rather than by country. Within each chapter, information is given under the headings of: "Description", "Distribution and Status", and "Ecological Notes".

Distribution and Status is presented country by country, with sections on "Former" and "Present". Much of the data on former distribution is drawn from Harper's *Extinct and Vanishing Mammals of the Old World* (New York, 1945). This publication is the finest existing compendium on Old World threatened species. I have made frequent references to it, mentioning it in the text without making formal acknowledgement.

The distribution maps drawn by Mr. Gene Christman, are the result of long and careful study. "Former Distribution" has been dated both to increase accuracy and to point out the rapid acceleration of extermination. Where there is doubt about the former range at a given time, this is indicated on the map. Under "Present Distribution" distinction is drawn between reports that are verified and those that are unverified, but which seem probable in the light of my investigations.

Under "Ecological Notes" I have included a variety of information under such headings as: History and Causes of Extermination, Habitat, Other Animals, and Conclusion and Recommendations. So little is known about these animals that, in many cases, what relatively little I was able to learn seems worthy of presentation. Such details also help to present the reader with a balanced picture of the animal's status.

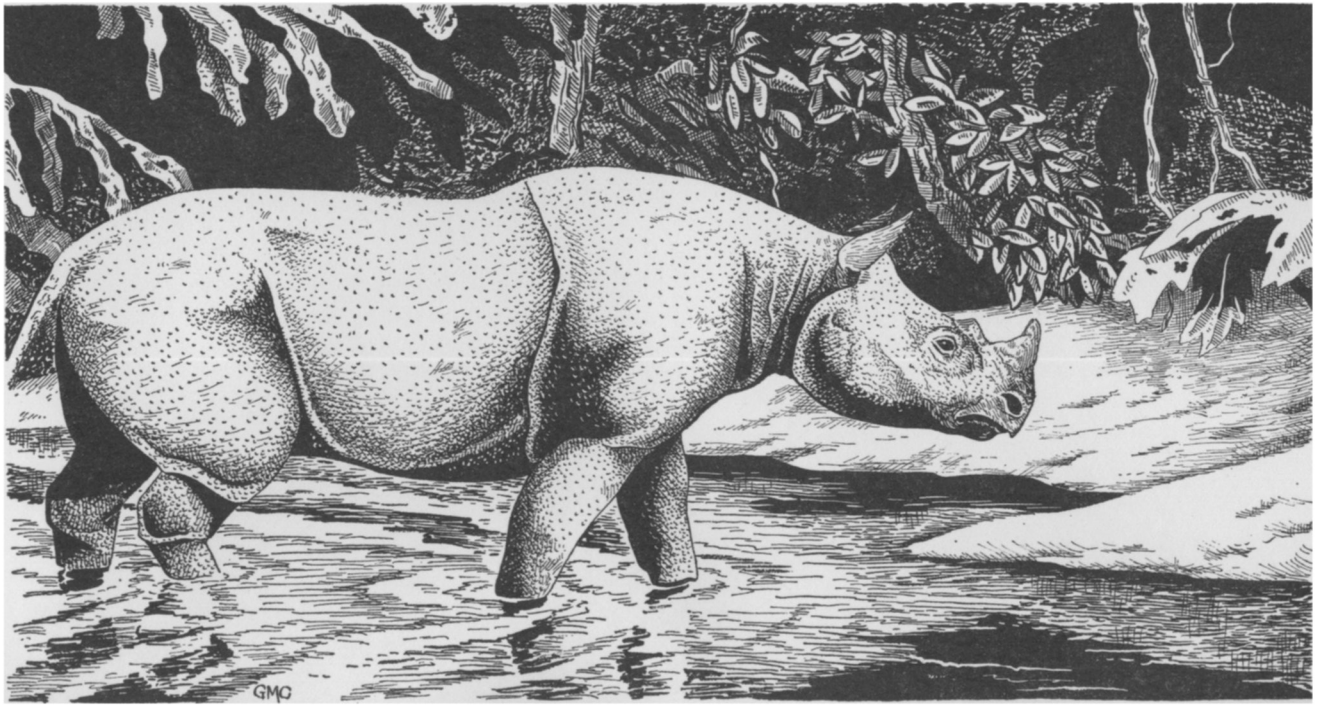
Part II.—During my rather brief visits to each country there was neither time nor opportunity to get a full and balanced picture of conservation in general, and this section does not claim to present such a picture. Instead, it contains a variety of information of interest to conservationists—highlights of conservation in each area. The information is divided into "General" and "Wild Life" sections. General land use, national parks and reserves, and conservation attitudes are the

sort of thing that appears under " General ". These sections are arranged by countries. They provide perspective to aid in a better understanding of the status of the animals of Part I.

This report is of necessity a compromise between a scientific paper and a popular work. I have endeavoured to present the material in such a way that it is interesting, readable, and understandable to a non-technical person; while organizing it so that a serious worker has easy reference to the data he needs.

PART I

THE PRINCIPAL ANIMALS INVESTIGATED



THE SUMATRAN RHINOCEROS

SUMATRAN RHINOCEROS: ASIATIC TWO-HORNED RHINOCEROS

Didermocerus sumatrensis Fischer

Under " Sumatran Rhinoceros " I am including the Sumatran Rhinoceros of Borneo and Sumatra, *Didermocerus sumatrensis sumatrensis* (G. Fischer); the Chittagong or Hairy-eared Sumatran Rhinoceros of Bengal and Assam, *Didermocerus sumatrensis lasiotis* (Buckland), and the Malaccan Rhinoceros of Burma, Siam, the former French Indo-China, and the Malay States, *Didermocerus sumatrensis niger* (J. E. Gray).

I. Description

This is the smallest of the living rhinoceros. Height at the shoulder may be from 4 to 4½ feet; length from snout to root of tail, 8 to 9 feet. There are two horns, the anterior one generally under a foot long (there is one 19 inches long from Sarawak and a 32½ inch one in the British Museum of Natural History), the posterior 2 to 4 inches. The posterior horn is often quite small, especially in females, and from a distance it may appear to be missing entirely. This probably gives rise to the numerous reports of " one-horned rhinos " from areas outside the present range of either the Indian or the Javan rhinoceros. Unlike the Javan and Indian rhinos, whose skin appears to be made of armor plates, the Sumatran rhino's hide appears relatively smooth, with a conspicuous fold just behind the shoulder. On closer examination, the surface of the skin is seen to be quite rough and, in young animals at least, is thinly covered with short hair. The color and density of this hair varies with the geographic locality, Indonesian specimens being generally grayer and less densely covered with hair than those from the mainland. Judging from the few pictures of Sumatran rhinos that exist, their hair covering is not very conspicuous.

II. Economic Value of the Rhinoceros

(This section applies equally to all three Asian rhinoceroses.)

Belief in the medicinal, religious or magical value of the various parts and products of the rhinoceros is common to all peoples of south and east Asia, with the possible exception of a few hill tribes. Every part of the body is highly prized, from hide, hair and toenails to the blood and visceral organs. In

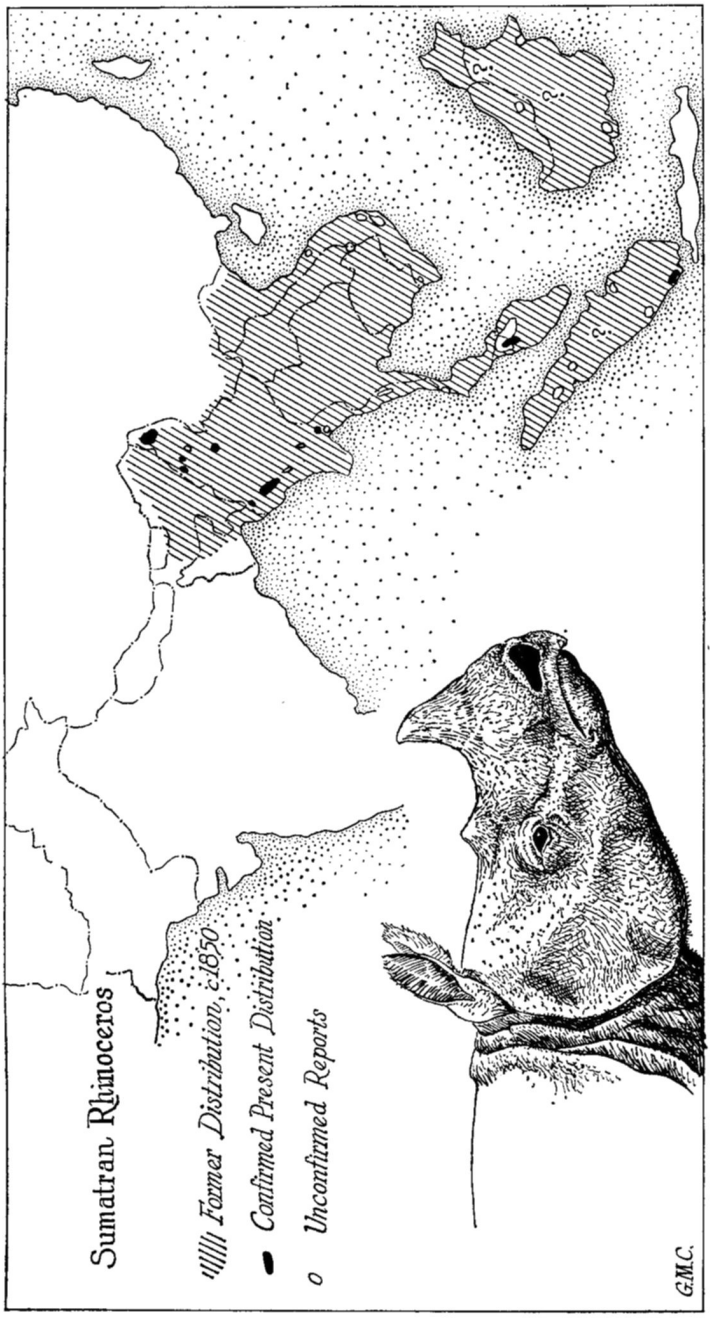
many cases the belief extends even to the urine and faeces of the animal. In 1955 tiny bamboo vials of urine, presumably from zoo rhinos, sold in Calcutta for 12 annas (about 15 cents).

The most valuable single part is the horn. In the past, rhino horn has been an important part of the export trade of all the south and south-east Asian countries. The greatest market was China. Even in Borneo, rhino horn was considered one of the three most important wild products in the trade with China (Harrisson, 1956).

Rhino horns were carved by the Chinese and others into a number of highly prized articles from buttons, belt-plaques and scabbards to knife handles, but probably the greater number ended up as cups. Most of these were libation cups, important in certain religious ceremonies. Others were kept, especially by rulers, because of the belief that they protected the user from poison. Such cups have been used in Asia up to recent times, but they also have been used by some British and European monarchs and popes.

As a protection against poison, the use of rhino horn varies by locality. In Sumatra, it should be drunk as a purgative if one feels the first signs of poisoning. In Burma, a belief exists that when one puts rhino horn shavings into a cup containing poison, they will bubble and smoke. In Nepal and parts of India, the belief is that if poison is placed in a rhino horn cup the poison will bubble, discolor or become harmless, or else the cup will slowly disintegrate or shatter. Interestingly enough, there may be some basis for this latter belief. Many of the old poisons were strong alkaloids, and the horn is what amounts to an agglutination of hair, closer in structure to toenails than to cattle horns or deer antlers. Such a structure would indeed be affected by a strong alkaloid, although the shattering and other dramatic behaviour is probably an embellishment. Because of their size, horns of the great Indian rhino are probably more used for cups than the smaller horns of Javan or Sumatran rhinos.

To-day, the greatest demand for rhino horn is based on its supposed value as an aphrodisiac and this widespread belief accounts for the greater part of its market value. China still provides the biggest market, with Singapore acting as the main collection point for horns, whether they come from Africa, India or South-East Asia. In each country, the local horn is regarded as the best, but any rhino horn is good. It seems to be somewhat a question of proximity, horns coming from Africa



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being the least valuable. The place of origin is said to be easy to determine on close examination of the horn.

Sumatrans call the front horn of the Sumatran rhino the " true horn " and the rear one the " false horn ". The front horn is the more valuable, and it is also usually the larger. Indonesians also recognize three kinds of local rhino horn—red, white and black. Black horns are the most common and the least valuable, white next, and red most prized, the white being about three-fifths the value of the red. I could find no explanation for the difference in horns ; no size differentiation was reported. If there is truly such a difference, it would be most interesting to know if it were one of condition, age, sex or species. It may be the last, in part at least. In 1933 Hazewinkel noted that in Sumatra the horn and hide of the Javan rhinoceros brought ten times that of the Sumatran rhino.

Usually the horn is ground to a powder and mixed with water or coconut oil. Among the cures this mixture is supposed to effect are the following : to remove a thorn from the palm of a hand, apply the horn oil to the back and the thorn will work right out ; to ease childbirth, the expectant mother should drink some of the mixture just before the baby is born ; to shrink lumps, stop infections, close cuts, sooth irritations or cause broken bones to heal properly, just apply the mixture to the nearby skin surface and rub well.

The horn may be sold in small pieces, in powder, in a coconut oil or other solution, or in combination with other parts of the rhino. In the latter case, a mixture is made of rhino horn, toenail, rib, foreleg and occasionally other parts of the rhino body, all mixed in coconut oil. This is placed in small bamboo vials and is sold by itinerant " medical men ". I saw a mimeographed paper giving the proportions of rhino in one mixture being sold by such a travelling druggist. The sheet described the parts of rhino included and the various ailments they were good for. I saw similar charts, along with large drawings of rhinos, in druggist shops in some of the larger cities of Indonesia.

When a travelling medical man arrives in an outlying village with some rhino medicine to sell, the word goes out and the village rhino experts assemble, along with most of the populace. The experts pass judgment on the man's products, and if they judge them *bona fide* the villagers buy. This judgment may consist of some test, such as rubbing nettles on an arm, then applying the alleged rhino horn potion and observing the results. These experts may be very highly esteemed in the village.

Even in an area where cash is not an important part of the economy, the medicinal value of rhino is great. The Kachin State Ministry (Burma) estimated that the value of a whole dead rhino to a northern hill tribe is the equivalent of $900.

As an item of export trade, rhinoceros horn has an official market value in some places, such as Kenya and India. As it becomes more and more difficult to meet the demand (due to the increasing rarity of the animals themselves and in some areas more effective protection of the few survivors) the value rises. In Saigon, traders told me they could get 100,000 piastres for a large horn. That was then the equivalent of $2,000. In Palembang a Chinese merchant was offering a new American car for a whole dead rhino. In Telukbetung, Sumatra, a Chinese trading group had a standing offer of 100,000 rupiah, then $2,500, for a large horn. I heard of this particular offer from a number of sources. These may be the exceptions, extraordinarily high prices offered by wealthy Chinese who considered their need desperate, although the Telukbetung offer was said to be for horns for export to Singapore. These present-day prices seem more reasonable when we consider past values. A horn brought half its weight in gold at Calcutta in 1935 (Shebbeare, 1935); its weight in gold in Siam in 1937 (Loch, 1937); "thousands of dollars", at 3·2 Sarawak dollars to 1 U.S. dollar in Borneo "in historic times" (Harrisson, 1956); and nearly 500 pounds sterling, $1,400 U.S. in Sumatra in 1933 (Hazewinkel, 1933). Apparently a rhino horn is worth about what the seller can get for it above the market price. As the supply becomes shorter the poaching pressure on the surviving rhinos in both Asia and Africa grows steadily greater. When a local merchant, villager or tribesman knows the whereabouts of a rhino, he is likely to keep the information to himself in the hopes of cashing in on it.

For the most part, the known Indian and Javan rhinos are well protected, so that in Asia most rhino hunting is Sumatra rhino hunting. In Sumatra itself even with the full support of an Indonesian government expedition in the best known rhino habitat, I never saw the animal, although on five occasions I did find fresh tracks, varying from a few minutes to two hours old.

One result of the increasing economic value of rhino products has been to make it extremely difficult to gather, in the field, any facts at all about the surviving Sumatran rhinoceros. More important, as the market value of the rhinos climbs higher and

higher, the difficulty of conserving them becomes greater and greater.

III. Distribution and Status

India and East Pakistan

Former.—Within the last century the Sumatran rhinoceros was found in parts of the former Bengal (Chittagong Hills and Tippera, now East Pakistan) and Assam (Lushai Hills, Manipur Hills, Cachar and the valley of the Brahmaputra). It was considered rare in Assam in 1900 and by 1936 was presumed extinct or on the verge of extinction.

Present.—I received no verified reports from India of the Sumatran rhino's occurrence since the war. Mr. E. P. Gee believes that if any exist, they are probably in the Tirap Frontier Tract, along the Dihung River. There are occasional reports of rhinos from the adjoining area in Burma. As these reports sometimes specify large, one-horned animals the rhinos to which they refer may not be Sumatran.

There is also some possibility of isolated survivors in the Chittagong Hill Tracts, partially in the Indian Lushai Hills and partially in East Pakistan.

Burma

Former.—In previous centuries the Sumatran rhinoceros was apparently the most common rhino in Burma. It was reported from one end of the country to the other.

Present.—The present reported range does not differ much from the former range in total area, but it does differ considerably in distribution within that range. The animals are reported from Putao in the extreme north to Victoria Point, Burma's southernmost tip.

I had no time to visit the rhino habitats in Burma, but in order that I could get first-hand accounts of the animals, U Tun Yin, Burma's foremost spokesman for wild life, arranged for me to meet forestry officers from every part of the country. I also got in touch with other possible sources of such information: Government officers, agricultural technicians, soldiers, hunters and traders. U Tun Yin himself had visited some of the areas and since his retirement from government service had devoted most of his energies to gathering information on Burma's wildlife and furthering its conservation. The estimated number

of the Sumatran rhinoceros in Burma as a result of this inquiry was :—

Area.	*Min.*	*Max.*
*Kachin State, near Tirap Border	4	6
Pegu Yoma	6	8
Uyu upper	3	3
Uyu lower	7	8
Arakan upper	4	6
Arakan lower	3	5
Kahilu	2	3
Tenasserim	2	2
Shwe-u-duang	4	5
TOTAL	35	46

* In October, 1955, a reliable report of about 30 Sumatran rhinoceroses in the Kamaing Sub-Division of Kachin State was received from the Assistant Resident Kamaing. U Tun Yin. *Journal B.N.H.S.*, Vol. 53, No. 4, August, 1956.

An occasional one-horned rhino is reported in Kachin State which might be the Great Indian Rhinoceros wandering in from Assam. These rhinos are said to be forced into the lowlands near Putao in the winter, if there is a particularly heavy snowfall in the surrounding hills. Forest and game laws in the Union of Burma do not apply in the Kachin State, but U Shan Lone, Secretary, Kachin State Ministry, has issued official warnings to the people that the rhinos are to be totally protected.

During the war rhinos were reported just west of Prome. A road was recently completed through that area and the rhinos, according to the engineer in charge, have retreated to an area " five days' march " to the north. As another road is contemplated through that way, the rhinos will gradually be forced farther and farther back into the Arakan Hills.

Two one-horned rhino are reported near the Kaletha Sanctuary. A Buddhist priest at the nearby Kyaitiyo Pagoda apparently has established himself as their protector. As described above, the posterior horn of *D. sumatrensis* may be so little developed that it appears absent except on close examination. Such specimens may account for some of these one-horn observations.

At first one is apt to question the accuracy of estimates of individual rhinos in a land with the vast forested areas that exist in Burma. On closer examination several factors add to these estimates' credibility. Although the areas are vast and the people relatively few, the population is widely spread. The people are largely hill tribesmen or villagers who live on and

in the forest. The predominant agriculture of the hills is shifting cultivation, which means that a small human population may occupy a surprisingly large total land area.

The great value of a rhino has already been discussed. Although the live animal is protected by law in the Union of Burma, it is legal to sell rhino blood and other parts as medicine, and in recent years several rhinos have been killed on official permits by high Burmese officials " for medicinal purposes ". A rhino is a much sought animal ; as soon as the whereabouts of one is known the word spreads rapidly.

The Sumatran Rhinoceros is apparently a wanderer, occasionally travelling great distances. Being a large, conspicuous animal which leaves an easily identified trail, it is hard for one to escape detection. There are a number of records of rhinos whose location was known and recorded, day by day, for weeks or months until they were killed or had wandered off into some totally uninhabited country.

On the other hand, there is still some country that remains totally uninhabited. Not all Sumatran rhinos are great wanderers because some have been reported from the same locality for as much as three decades. Wandering may in fact be a response to disturbances by human activities and so it is possible that some rhinos may exist, undiscovered, in these out-of-the-way pockets. It has been my experience that in these countries estimates of wild animal populations tend to be lower rather than higher than the true numbers and it seems to me that the estimates of the Burmese rhino population are, if anything, rather low. They may, however, be considered a very good general indication of the status of rhinos in Burma. The rhinos reported are mostly single animals with a very few pairs, very rarely three at a time. This would be expected from a widely ranging animal, but the fact that these individuals are so very widely separated would seem seriously to reduce their chances of reproduction. With so few rhinos, harassed as they are, the odds on one even encountering another would seem quite slight. The chances of this encounter coinciding with the biological period for mating for both animals concerned are even more slight. Evidence supporting this surmise is provided by the lack of observations of young rhinos, possibly two out of the rhinos reported were noted as being young animals.

If the rhinoceros is to be saved in Burma, several steps should be taken quickly.

1. The office of Game Warden, with the departmental machin-

ery that goes with it, should be reinstated. Without such a post there can be neither co-ordination nor activity in wildlife conservation. Although many men in the Forest Department are interested in wildlife, each has his own job and no one has the time or authority to carry on the necessary wildlife work in addition.

2. An enlarged and effective system of reserves for the rhinos must be enforced. Burma had a fine system of reserves established before the war. However, what with the insurgents and the lack of a full-time game warden, it has not been possible to bring their administration up to the pre-war standards. But regardless of the present state of the reserves, only two of them are believed to have resident rhinos, Kahilu and Shwe-u-duang. Reserves are needed to include the known, present range of the largest possible number of rhinos. This might mean reserves in the Arakan Yomas, Pegu Yomas and Kachin State, and in other areas as they become known. Without reserves in order to keep out roads, cultivation and poachers, the few remaining rhinos will be continually forced back into the rapidly shrinking wild areas, and it may not be many years before all but the last solitary individuals have been driven out, hunted down and shot. These reserves must be large enough to allow for reasonable wandering of the rhinos—they cannot, of course, enclose those which wander dozens of miles, but if they are large enough, there may be no need for the resident rhinos to leave them—and they must enclose ecological units. For instance, if the rhinos make a seasonal migration up and down mountains, this movement should be considered when setting up the boundaries, as should such questions as seasonally available water and types of vegetation.

3. The laws legalizing sale of rhino parts for medicinal uses should be abolished. They provide the most serious loophole in what are otherwise quite good wildlife conservation laws. With public sentiment as it is, with widespread belief in the curative powers of rhino preparations, it would not have been possible to pass the present laws had they excluded such sale. It still may not be possible to change the law without a widespread public education program. (And this, again, points out the necessity for a game warden and staff, as other forest officers have not time for this sort of thing.) Until the law is changed there will be a legal incentive for illegal rhino poaching.

4. There should be a revision of the Wild Life Acts to afford greater protection to the rhino. The rhino is a " completely protected animal " under Section 6 of the Act, but penalty

for infringement of the law is imprisonment for a term not more than six months and/or a fine of 500 kyats (roughly $100). Even if all poachers were apprehended and the maximum fines were invariably imposed, rhino horn is so valuable that poaching would still be a very profitable business indeed. A much sterner penalty is surely indicated.

The Sumatran rhinoceros is an extremely rare animal in Burma. The widely dispersed survivors are being hunted down constantly, and unless effective measures can be taken soon, there may be no survivors in a few years' time. Small as Burma's rhino population is, it is still the largest known " concentration " of Sumatran rhinos left in any one country, which shows the extremely critical state of the Sumatran rhino throughout its range.

Thailand

Former.—In the last century Sumatran rhinos were found in most of the hill country of Thailand, with the possible exception of the north-western areas. By 1919 they were considered rare in the country.

Present.—Dr. Boonsong Lekagul reports that in 1958 three Sumatran rhinos were killed near the southern part of the Thai–Burma border and two more in 1959 on the border north-west of Karnchanaburi Province. One of these latter was undoubtedly *D. sumatrensis*, the species of the other is uncertain. No rhinos are known with certainty by the Thai authorities to survive in the country to-day. The Burmese, however, believe that an occasional individual wanders into the southern part of Tenasserim from the densely wooded, wild, Thai portion of the peninsula. If any rhinos do survive there, the population cannot be large, probably a few individuals at most. A few may also exist in the extreme southern part of Thailand, for I have received periodic reports of rhinos from the adjacent wild lands of Malaya and perhaps a few in mountainous areas of the Thai–Burma border. It is not clear from the reports whether some or all of the animals mentioned above (both from Burmese and Malayan sources) might not be *R. sondaicus* instead of *D. sumatrensis*.

It would be very useful to carry out a survey to determine what the status of rhinoceros actually is in Thailand, but it should be done in such a way as not to attract public attention to any animals that might be there, as this would probably hasten their end.

Cambodia, Laos and Viet Nam

Former.—It is difficult to be sure of the exact distribution records from early reports. All three asiatic rhinos, *D. sumatrensis*, *R. sondaicus* and *R. unicornis* were referred to and there seems to be considerable confusion in terminology. All, whatever their identity, have been subjected to severe hunting and poaching and have been virtually, if not completely, exterminated in the last 50 years. In the mid 1920s, the rhinos (*sondaicus* and *sumatrensis*) were abundant in the Mekong Valley and were hunted not far from Saigon. Apparently rhinos of one species or another were found throughout what are now the three nations. They were reported almost everywhere, from the marshy plains near Saigon to the high mountains.

Present.—Reports indicate that possibly one to three dozen animals remain in isolated areas where hunters have not yet been able to get them. Foresters and hunters insist that both a small, two-horned and a larger, one-horned rhino still exist. The best documented locality is an old royal forest reserve near Dalat, north and east of Saigon, Viet Nam. The Director of Forest Research at the Centre National de Recherches Scientifiques et Techniques, Saigon, told me that he had seen tracks there a few months before my visit. These he thought were *R. sondaicus* though he says he is sure *D. sumatrensis* is found in Viet Nam also. Other areas where rhinos were reported were: " East Cochin China " (the Cambodia–Viet Nam border area); the mountains above Natrang (Viet Nam, east of Dalat); South of Dalat (Viet Nam); mountains south and west of Hue (Viet Nam); forested country of south-east Laos and adjoining Viet Nam (near the juncture of the Laos–Cambodia–Viet Nam borders). In August, 1955, a French hunter told me that within the previous month he had seen tracks of a rhino in the latter locality. It was a large rhino which had been wounded by local villagers.

I collected reports during visits to Cambodia, Viet Nam and neighboring areas, but I was unable to confirm them or to visit any of the rhino locations involved. According to the research centre, both the Dalat and the Hue areas are particularly rich florally. If they should be found to contain rhinos also, every effort should be made to protect the area's fauna and flora with park or reserve status. In Viet Nam, initially, this activity would probably come under the Forest Department and the Research Centre at Saigon.

Malaya

Former.—The range of the Sumatran Rhinoceros extended throughout the country from Johore to the Thai border.

Present.—Rhinos still exist in northern Malaya, but neither numbers nor species are known for certain. Both *R. sondaicus* and *D. sumatrensis* were previously found in Malaya. Both from reports I was given on the spot and these received through 1957, and considering the combination of the rather dense human population and the military activities of the last two decades, I believe rhinos may be considered exterminated in southern Malaya, except perhaps in Johore. In the north and west, however, there are extensive wild, wooded tracts where there are still few humans and from which occasional reports of rhino are received. Such a report from Slim River, Perak, appeared in *The Times* (London) of 1st April, 1957, with a photograph. The animal was called a *R. sondaicus* but in my judgment it is almost certainly *D. sumatrensis* with a much reduced rear horn. The Game Warden's office has reports of " a few " rhino from the north and west areas but exact information on numbers or location is not available. The policy of the Game Department has been to discourage publicity on rhino reports. They felt that the less local attention drawn to the rhinos, the less poaching effort would be expended on them. Considering the difficult and unsettled conditions in Malaya, especially during the " Emergency ", it seems that this is a wise policy.

Reports gathered from the mainland of South-East Asia point to a very few, more or less isolated rhinos or groups of rhinos, scattered over a vast area. The protection afforded these survivors varies, but all are subject to hunting or poaching, and their numbers are being progressively thinned. It will probably be only a matter of months or years before most of these remnants have been hunted down. Some of the rhinos reported may be a one-horned variety, probably *R. sondaicus* and every possible effort should be made to protect them.

Recommendation

In view of the foregoing, I recommended that a survey be undertaken to determine, as far as possible, the numbers, locations and species of the surviving rhinoceroses in Malaya, Thailand, Cambodia, Viet Nam, Laos, Burma (such information is already available), India (Lushai Hills and Tirup Frontier Tract) and East Pakistan (Chittagong Hills). The survey

should include government personnel, both to locate and visit rhino areas and to work out protection programs based on their findings. Properly handled, public information about the survey could be very helpful, but locations of individual rhinos should not be publicized.

Indonesia

Sumatra

Former.—Throughout the whole island.

Present.—On a foot expedition in the totally uninhabited mountains of the South Sumatran Nature Reserve " Sumatera-Selatan " I only found fresh tracks at five places. Older signs in the form of trails, wallows and droppings were plentiful, but this may not be significant, for these rhinos seem to be wide-ranging. Although I visited only a relatively small portion of the wild area of south Sumatra it was of course the area where rhinos had been reported in recent years. However, it would be reasonable to assume that there are more rhinos in this area than those whose tracks I actually saw. In 1938 Buitenzorg estimated the rhino population of the South Sumatra Reserve at a maximum of 30.

In addition to my own observations, I collected reports of rhinos in Sumatra from all available sources in both Sumatra and Java. Besides villagers living near the wild areas visited, only three persons were found who had actually seen the rhinos in recent times. One of these was Mr. Kushnadi, Director of the new Department of Nature Protection of the Indonesian Forest Service. Most of the rhino reports were of tracks, wallows or droppings. In sifting and evaluating the reports I considered a number of factors, including the experience of the reporters. For instance, in many cases I found that tracks of the tapir " tenuk " were mistaken for those of the rhino " badak ".

The most reliable reports point to rhinos occurring in at least five widely separated areas on the island : the Losei Reserve in the north and locations in the Tapanuli, Djambi, Bankuku and Lampung Districts. My experience was in the last area. I consider the Djambi section to be most likely of the other areas as three recent sightings are reported there. The northern situation is unknown as the area involved is in the Atjeh country and I could find no one who had been there in recent years, but fairly continuous word-of-mouth reports of " badak " from Atjeh have reached the forestry people in central Sumatra during the past several years. In any case, the rhino is very rare

in Sumatra, but in my judgment not so rare as recent estimates would indicate (Shebbeare, 1953).

The magnificent series of reserves established by the Dutch seem quite adequate to protect the rhinos if they could be carefully patrolled. However, the Indonesian game laws only apply in Java ; in other areas, including Sumatra, game matters are controlled by the local government or the military. This plus the unsettled conditions and the number of men that would be required to protect even the reserves now accessible indicates that it may be a considerable time before adequate protection for the whole system can be established. The rhino population may not survive that long.

It seems to me that two steps should be taken as soon as possible :—

1. Intensify the legal protection of the rhinos. This should be done through local governments, by acquainting them with the critical situation, where necessary increasing the penalties so that rhino poaching ceases to be a profitable occupation even if the poacher is apprehended, and by intensifying the enforcement of anti-poaching and reserve protection laws. In some cases, the army might be directed to enforce the wildlife laws. The sale or possession of rhino parts for medicinal or any other uses should be strictly controlled, although this may be a long term proposition.

2. An ecological survey of the rhinos in Sumatra and Borneo should be undertaken to determine, as far as possible, the location and numbers of the remaining rhinos. It should also determine as much as possible of the ecology and life history of the rhinos, to provide a basis for effective management. If this were undertaken by foreign personnel working with the local authorities, it could serve to emphasize the international importance attached to the rhinos and to threatened species in general. Although publicity for the project is very desirable, it would not be wise to publicize the location of any rhinos found.

Borneo (Kalimantan, Sarawak and North Borneo)

Former.—The rhino was reported to be widespread both in British and Dutch Borneo. It apparently ranged from the lowlands to much higher ground, being common, for instance, in the mountains above the 3,500-foot Plain of Bario.

Present.—Tom Harrisson, Curator of the Sarawak Museum, reports : " I am perhaps the last non-Bornean to have crossed the fresh tracks of the Two-horned Rhino. In October 1945, at about 3,000 feet in the uninhabited Indonesian area between the

headwaters of the Bahau and upper Batang Kayan rivers. . . . "

I was unable to visit Borneo myself, and I could find no recent confirmed reports of living animals, except those of Harrisson. His estimate for the population of Sumatran rhinos in 1956 was " almost certainly not more than two living in Sarawak . . . .There may possibly be a few more in the Iwan-Bahau tract of Indonesian Borneo. . . . " And for North Borneo, " There are a few left there, mostly on the east side."

Traders I met in Singapore reported that rhino horn was still smuggled in from Borneo. This indicates that rhinos still survive, though how much longer they will continue to do so is a question. Reports in possession of the Indonesian Nature Protection authorities state that there are rhino in Kalimantan (Indonesian Borneo) but that there are " more in Sumatra ". The Bornean Dyak's only market is China—two sets of horns have been confiscated by Government (Sarawak and North Borneo) since 1955—but unsettled conditions, sparse human habitation and an extensive shoreline make it impossible to patrol against smugglers and poachers. Even if smuggling could be curtailed, it might not much reduce the ready Chinese market that hunters find for rhino horns. For the time being the only effective protection for these rhinos is their remote and difficult habitat. Their only hope for the future lies in carefully guarded reserves.

Ecological Notes

It is difficult to separate the rhino's preferred habitat from his enforced one. Cultivation and intensive hunting have rendered impracticable for a rhino's occupation most lowlands and savannas of south-eastern Asia.

This leaves densely forested and mountainous areas unfrequented by man, and here is where the rhinos are and have been reported. In Viet Nam, the Dalat area is a high plateau covered with rather dense, semi-coniferous forests. Most rhino areas reported in Burma are densely forested, though they range from sea level to over 6,000 feet in altitude. The Sumatran areas are the most varied. In the north, the Loser Reserve area is a country of grass plains (cogonalls, 4 to 5 feet high) interspersed with groves of pines (*Pinus merkusii*). Coming south, the rhino is also found in coastal swamps and in the mountainous areas in extremely dense, steep, monsoonal rain forest country. In short, the Sumatran rhino seems to frequent any habitat not occupied by man, from sea level to over 6,000 feet, from grassland and swamp to jungle and open pine forests. Freedom from

human persecution is the one common factor and given that, the animal seems able to adapt itself to any available non-arid situation throughout his geographical range.

Under excellent arrangements made by the Nature Protection Department of the Botanic Gardens of the Indonesian Government, I was able to take a two-week expedition on foot through the Sumatran rhinoceros habitat in the Sumatera-Selatan Reserve (formerly the Wildreservaat Zuid-Sumatera I). The reserve was established by the Dutch in 1934 to conserve " a typical and complete south Sumatra flora and fauna ", and, more particularly, to protect the rhino and elephant which occurred there. Except for the Loser Reserve in northern Sumatra the Sumatera-Selatan Reserve is the largest known remaining Sumatran rhino habitat in Indonesia. It is a strip of land with an area of some 1,400 sq. miles extending for over 150 miles parallel to the southwest coast of Sumatra and 4 or 5 miles inland. Much of the land is mountainous and extremely steep, uninhabited and unfrequented by humans. Not once during the period that two Indonesian forest officers and I with our four porters climbed through that country did we see any sign of another human. Inland from the partially cultivated belt of land along the seashore, which is out of the reserve, the mountains rise abruptly to nearly 6,000 feet. Streams are swift following rocky courses deep in steep-sided gorges. Except on the more level ridge tops, vegetation is extremely dense, and a parang (a sort of narrow-bladed machete) is needed to cut a way through it. Slopes are so steep that it is often necessary to cling to vines and branches in order to climb them. The time of my visit was " normally the dry season " but it rained, off and on, every day ; and at the ground level, far below the highest leaf canopy, it maintained a steady drizzle virtually 24 hours a day. Judging by the soil and vegetation, this was not an abnormal condition. This was the habitat of the Sumatran rhino.

The first fresh rhino tracks we found were about 11 miles up river from the coast. Other tracks were found from time to time during several days' travel up the mountains, and at equivalent altitude and isolation further south in the range.

Usually when rhinos are spoken of, they are associated with wallows. I had expected to find wallows in lowlands or at least in flat lands, and so they are when such land is available. But here I found wallows on the steepest slopes. The local belief is that the rhinos dig the whole wallow themselves. It appeared to me that they merely enlarged some natural depression, such as a rotted-out stump, mud backed up by a fallen tree trunk, or

the hole left by an uprooted tree. When pigs occur, rhinos may take over pig wallows. Mr. Hoogerwerf who was then director of wild-life research in Indonesia, believes that they do not use their feet in digging, but make wallows by rolling, just as the Javan rhinoceros does.

Some wallows gave the appearance of being much and long used, while others appeared to have been used only briefly or have been long unused. A wallow was usually on a hillside, 6 to 10 or 12 feet long and 3 to 5 feet wide. Several old wallows found on flat areas beside streams covered an area more than 15 feet across, although it was often difficult to determine the exact dimensions of former wallows.

Reports given me in Burma, Malaya and Indonesia stated that a Sumatran rhino may return to the same wallow for long periods of time, unless disturbed by man. In Burma they are reported to feed early and late in the day, and occasionally at night, spending much of the day in the wallow. The fresh tracks I saw in Sumatra had been made at all times of day, although in two cases the rhinos may have been moving near midday because of our presence, rather than for their own undisturbed purposes. Perhaps one reason for the rhinos' use of wallows even in such difficult places, is the prevalence of ectoparasites. If rhinos attract these pests as much as humans do, they are bedeviled creatures indeed. Land leeches were everywhere extremely common, particularly so along game trails and in the more flat areas frequented by various animals. Along the major game trails the leeches were joined by rather small, insistently biting, gnatlike insects and by others much like a very large gray horsefly.

The rhino droppings were most commonly found in the vicinity of wallows, though not in them, but were also found rather indiscriminately throughout the forest floor. Reports from Burma (Editorial Board—*Burmese Forester*, 1955) and other areas say that this rhino, when undisturbed, returns to the same spot to drop its dung, thus collecting piles measuring as much as 2 feet high by some 4 feet across. The Indian rhino has this habit, also, raising small hills several times that size. But apparently in Sumatra the rhinos are less topographically regular in their habits.

Even while following its tracks, it was difficult to believe that an animal the size of a rhino could get through such rough and steep country. Undisturbed rhinos had wandered through rivers—not only calm, gravel-bottomed rivers but extremely swift ones, up to 4 or 5 feet deep, with slippery rounded rocks

for a bottom. The Sumatran rhino seems to be a strong swimmer. In 1954 U Tun Yin referred to one seen swimming off the Burmese shore " near High Island which is a good 20 miles from the mainland although there are islands in sight all round ". Rhinos which I followed had scrambled over large logs lodged crossways at water level, rather than swim under them even in deep water. From the tracks and other signs the most frequented rhino paths were stream beds. Next came game trails, ruts in the mud up to 3 feet deep with roots and logs worn smooth by elephant and rhino. They also just wandered cross-country. Judging by the tracks, muddy, vine-covered slopes too steep for men to climb straight up, were ascended with ease by the wandering rhinos. On more level terrain an undisturbed rhino track would zigzag from tree to bamboo clump to thorn patch with no apparent set direction.

The Sumatrans say that the rhino eats a number of kinds of trees and bushes, and that he is a browser, breaking down or twisting down saplings. This agrees with the animal's reputation on the mainland. It would be interesting to know what it eats in the grass country in the north.

The Sumatran rhino's sight is reputedly quite poor and his senses of smell and hearing very good. It seems a much more wary creature than either the Javan or Indian rhino. This may explain why the Javan rhino was apparently exterminated from Sumatra while the Sumatran one survived. The Sumatran rhino is also widely feared as being potentially quite aggressive. I found its reputation more sinister even than that of the much more impressive Indian Rhinoceros.

Apparently the Sumatran rhino need fear no predators except man. A tiger could doubtless kill a juvenile rhino, but people in each area where they occur state quite positively that a full grown Sumatran rhinoceros has no wild enemies. However, his two-footed enemies are proving quite enough. Whenever we discussed getting porters for our expedition with nearby villagers, they expressed their willingness to accompany us, even to the rough and reserved area where we did go later, only if they thought the expedition was going to hunt rhino. They had no interest in a journey to see or to protect rhinos. So that even though the rhino occupy what is probably Sumatra's least accessible habitats, without adequate protection it will be only a matter of time until the last of them is hunted down.

THE GREAT INDIAN RHINOCEROS [*Photo: E. P. Gee*

GREAT INDIAN RHINOCEROS; INDIAN RHINOCEROS; GREAT ONE-HORNED RHINOCEROS

Rhinoceros unicornis Linnaeus

I. Description

Largest of the Asiatic rhinoceroses, this great animal reaches a height of over 6 feet at the shoulder and a length of more than 14 feet. The weight of a large adult may be as much as 2 tons. There is a single horn, thick at the base and often quite blunt, probably averaging 8 to 9 inches in length; specimens with horns up to 2 feet long have been taken. The thick hide hangs in great folds at the neck, shoulders and hindquarters, giving the appearance of armor plate. A fold in front of the shoulder does not continue all the way across the back of the neck, as it does in the slightly smaller Javan rhinoceros. Like the Javan, there are folds continuing across the back behind the shoulder, in front of and across the thigh and around the neck. The legs emerge from beneath other folds, looking far too slight for the weight they must carry. The legs, the flanks and occasionally the sides of the body, are studded with large, round, rivet-like tubercles which further add to the armored appearance. The skin is hairless, except for a fringe of hairs on the ear tips and tail. As with other rhinoceros, the color usually is determined by the mud of its most recent wallow. The unusual individual that happens to be clean, perhaps just having swum a river, is brownish gray with a very slightly pink or reddish tinge to the edges of skin folds, ear and nostrils.

The only animal with which the Indian Rhinoceros could be confused is the Javan rhinoceros, as both of the African species and the other Asian one (*Didermocerus sumatrensis*) have two horns and a relatively smooth hide. The Javan rhino is a little smaller than the Indian, has usually a shorter and slighter horn, and has the transverse fold of skin in front of the shoulders extending all the way across the back of the neck. The Indian rhino appears the more massive animal, partly due to its great depth of body. Although the two single-horned rhinos once occupied overlapping ranges, at present the only known Javan rhinos are found in Java's Udjung Kulon Reserve, some 2,000 miles south-east of the last known surviving Indian rhinos.

II. Distribution and Status

Cambodia, Laos and Viet Nam

Former.—There is some question about the Indian rhinos' occurrence in what was French Indo-China. Some authors include it, but others assume that the rhinos referred to in this area by earlier writers are either *R. sondaicus* or *D. sumatrensis*. Blyth, in 1862, believed *R. unicornis* to be limited to the Terai region of the Himalayas and the valley of the Brahmaputra. He thought that the animal referred to as *R. unicornis* (or *R. indicus*) by previous writers was really *R. sondaicus*. Harper states that " The older works do not include this country in the range of the species, and the recent reports probably require verification ". Rightly or wrongly, the species has been recorded from virtually the whole area, from Cochin China in the south to Tonkin in the north, and north-westwards of them.

Present.—Unconfirmed reports of a very few one-horned rhinoceros larger than *D. sumatrensis* were received. If these reports are true, they probably refer to *R. sondaicus*.

Thailand

Former.—" Its occurrence in this country is doubtful." (Harper, p. 380).

Present.—The existence of any kind of rhino in Thailand today is doubtful.

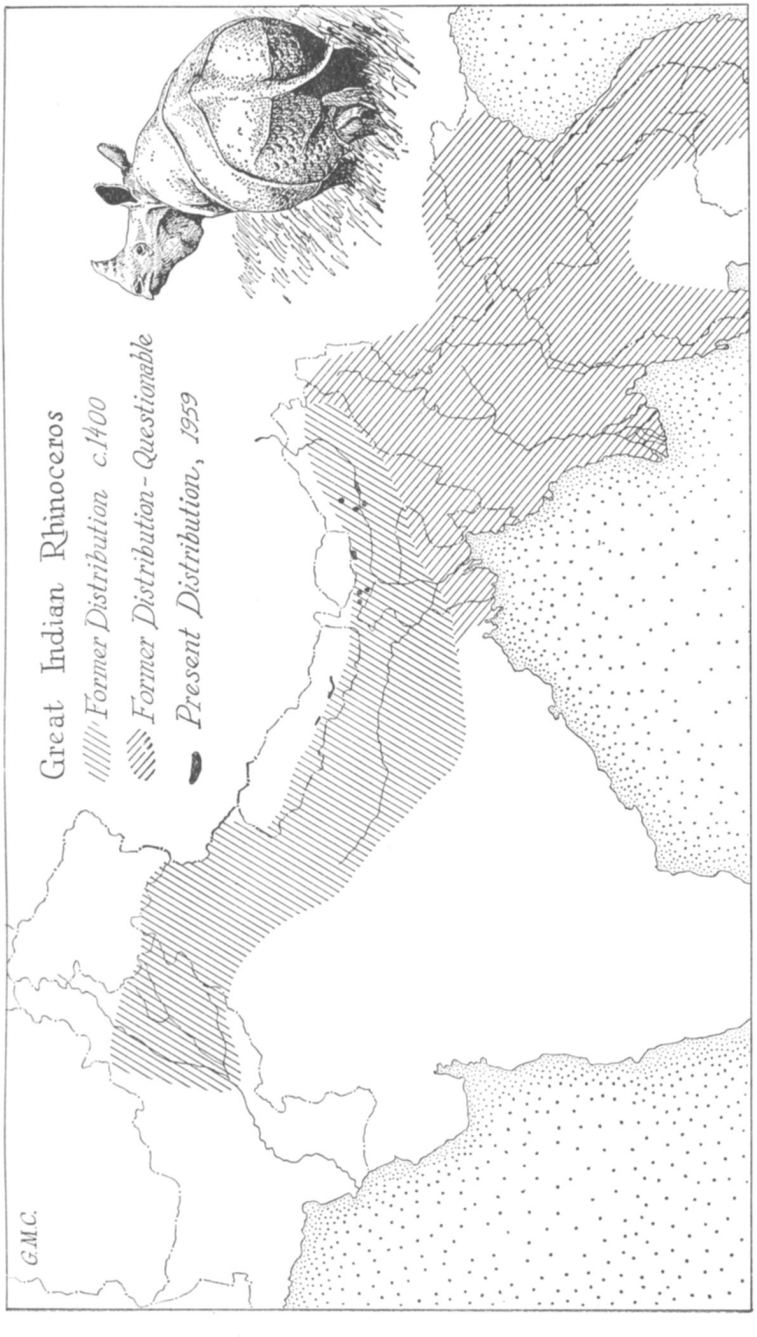
Burma

Former.—If the Great Indian Rhinoceros ever inhabited Burma, its range by the late 1800's was probably limited to the areas adjoining Assam and Bengal.

Present.—Consistent, but unverified, reports of large, single-horned rhinos in upper Burma in the areas adjoining the Tirup Frontier Tract may indicate a few survivors there. More likely, the animals reported have wandered east from Assam. There is also the possibility that they may be *R. sondaicus*. In any event, there is no confirmed resident individual or population.

India and Nepal

Former.—Five hundred years ago the Indian rhino ranged over a large part of northern India and Nepal. The westerly boundaries of its range were the foothills of the Hindu Kush west of Peshawar and the bush country south along the Indus River; the northern limit was the frontier of Kashmir. The boundary presumably then went south-eastward along the foothills of the Himalayas, through the Terai to the Burmese border. The



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southerly limit is uncertain, although arid conditions presumably limited its southern extension in much of India. The rhino was said to be quite common in much of its former range. Two principal factors brought nearly to extinction the numerous population which once roamed a large part of the Indian subcontinent if not of South-East Asia—hunting and habitat encroachment.

Hunting was doubtless important, and may well have been a sort of *coup de grâce* to a population already in rather desperate straits, but instrumental in reducing the rhino population to the point where hunting became critical was man's modification of the rhino's habitat. As the human population of India increased so did the land area put under cultivation or grazing. One expression of this increased pressure on the land has been the growing area covered by desert in west and north-western India, where it is largely a result of man's land abuse.

As the fertile lowlands were taken over by agriculture, the rhinos retreated to hill areas. They were followed there by different forms of agriculture, largely paddy and tea. The change of land ownership from hill tribes to more sedentary agriculturalists often brought an end to the fires traditionally set by tribesmen, which had had the effect of keeping large areas open or in savannah. As a result of the protection from fire, tree cover, initially Sal, *Shorea robusta*, took over areas formerly covered with dense grasses, probably predominantly *Imperata cylindrica*, with *Microstegium ciliatum* in the hill areas and *Saccharum spontaneum* and *Phragmites karka* in the flood plain along the major rivers. So that rhinos even where they were not actually displaced by agriculture, were deprived of cover and became easier targets for poachers.

By the early 1900's the rhino population was so far reduced that the British authorities became alarmed. About 1910 they prohibited all hunting of the rhino in Assam and Bengal. Starting with Kaziranga and Manas, a series of sanctuaries and reserves were established in the upper valley of the Brahmaputra and nearby Bengal, to protect the last concentration of the rhinos together with some of their habitat. Protecting the animals in the reserves sometimes required strenuous measures, including the intervention of troops of the Assam Rifles, for by 1930 rhino horn had become so valuable that poaching was growing into a highly organized activity. This protection resulted in greatly slowing down rhino poaching and in more or less maintaining the position, at least within the reserves.

The intensity of poaching pressure, probably slackened

during the war, and the rhinos both in and out of reserves got several years' rest. Following the war, but especially following Indian independence, there was a renewed interest in the wildlife conservation in Assam, sparked largely by Mr. P. D. Stracey, then Conservator of Forests of Assam, under whose jurisdiction wildlife matters were carried out, and Mr. E. P. Gee, long time tea planter in Assam and member of the Indian Board for Wild Life.

Present.—The present range of the Indian rhino consists of eight reserves or sanctuaries in India, and the Rapti Valley region of the Nepal Terai. Occasionally individual rhinos are reported outside the reserves, some of them presumably stragglers from the Indian reserves or the Nepalese Rapti Valley area. In the latter category are those occasionally reported from Northern Champaran District of Bihar State which adjoins Nepal. Other reported individuals may indicate small isolated populations, such as the few animals consistently reported from an area a little way up the Brahmaputra river from the Kaziranga Sanctuary in Assam. E. P. Gee estimates this group at about ten animals.

The occasional but unverified rhino reports from the Tirup Frontier Tract in Assam may indicate the presence of a few survivors in that area.

Nepal.—Although an estimate made in the late 1940's placed the number of Indian rhino in Nepal at 48 (Gee, 1953 ; Shebbeare 1953), there is abundant evidence that the population was much larger. The Rapti Valley and other areas where the animals may be found are quite isolated ; indeed until recently there was not even a motorable road into the Rapti Valley area. Very few westerners have ever been to these places and it is extremely difficult to get any accurate information about animal life in them.

According to the Nepalese Department, of Defense, under whose jurisdiction protection of the rhinos comes, 72 rhinos were poached in 1954. During the same period several rhinos were reported to have been washed down rivers into India during floods. All told, I received reports of the deaths of almost 100 rhinos during 1954.

Under the previous government, the rulers maintained a careful guard over the Rapti Valley as it was a royal hunting area, the Chitawan Game Reserve, and poaching the rhinoceros

was almost a capital offense. However, none of the Nepalese consulted considered the reported poaching toll for 1954 unusually high for recent years. No limited population of an animal reproducing as slowly as the rhino, whose gestation period is estimated at 18 months and with whom single young are the rule, can long sustain any such rate of attrition.

In September 1958, an apparently reliable report was received by the International Union for Conservation of Nature, then assembled at Athens, that during 1957 a band of Indian poachers had entered the Rapti Valley and slaughtered all the rhinos they could find. Estimates of the kill were as high as 500 animals.

Thereupon the Survival Service Commission of the Union, with the active co-operation of the Government of Nepal arranged for Mr. E. P. Gee to visit the Rapti Valley.

He was to report upon the situation and to make recommendations for the preservation of the rhinoceros.

Mr. Gee's most interesting report which the Fauna Preservation Society published in *Oryx* in August 1959 gives the number of rhinos in Nepal in April 1959, as about 300 and shows their distribution.

Mr. Gee's recommendations include: an extension of the Mahendra National Park to include the rhinoceros migration routes; the establishment of other protected areas in the valleys of the Narayani, Rapti, and Reu rivers; the re-introduction of the rhinoceros into a new santuary in the Morang District of south-east Nepal; that a Nepal Board for Wild Life be constituted with full authority for wild life preservation.

The International Union for the Conservation of Nature has adopted Mr. Gee's report and has recommended it to the Government of Nepal.

India.—The great authority on the Great Indian Rhinoceros, E. P. Gee, estimates that there are about 400 rhinos in India. He himself deserves a great deal of the credit for this encouraging position, for he has long been one of the most active and effective proponents of sound wildlife conservation and the planning of national parks in the country. Besides his other activities, he has through his prolific and popular writing, greatly encouraged interest in conservation among the people of India. Mr. Gee gives the following approximate distribution of the rhinoceros in India at the end of 1959.

State of Bihar		2
State of Bengal	Jaldapara Reserve	45
	Garu Mara	3
State of Assam	North Kamrup Sanctuary (162 square miles)	25
	Kaziranga Sanctuary (166 square miles)	260
	Orang (24 square miles)	15
	Sona Rupa (85 square miles)	5
	Laokhowa Reserve (27 square miles)	25
	Outside reserves	20
Total		400

Compared with Nepal, the rhinoceros areas in India are quite accessible. But due to the nature of the vegetation and terrain, it is extremely difficult to determine exactly the rhino population and no regular census has been attempted, except at Kaziranga. There counting from an airplane was tried, but the elephant grass cover was so dense that most of the animals were not visible. It is believed that because of the efficient protection they now receive, the number of rhinos is increasing. A few rhinos are sold alive to responsible zoos. The rhinos are trapped in pits, stockaded, crated and shipped; 16 were disposed of in this manner in the eight years up to 1959. The operation is carried out by the Forest Department and all applications for live animals must be approved by the Forest Minister for Assam.

Through the kind arrangements of E. P. Gee, the Indian Board for Wild Life, and facilities extended by the Government of Assam, I was able to spend two weeks in Kaziranga. Much of this was on elephant back, observing flora and fauna in the sanctuary.

The sanctuary covers 166 square miles, roughly 25 miles long by as much as eight miles wide. It is bounded to the north by a curve of the Brahmaputra River. This is a rather mobile boundary, because the river's course is continually shifting. The southern boundary runs more or less parallel to the Assam trunk road. The actual boundary winds about, partly following the Hora Diffeu stream and partly following surveyed lines.

The government has provided well for visitors. There is transport to the nearest airport, Jorhat, 55 miles away. Near the sanctuary there is a fine guest house and riding elephants are provided for viewing the animals. A resident staff of about 40 men patrols and protects the area, and supervises improvements such as building roads and observation towers. The opportunity afforded there to view Indian rhinos in some numbers and at close range is unique.

The main threat to the rhinos at Kaziranga is by domestic stock within the sanctuary boundaries. Officially, grazing is only

allowed on an area one mile deep and 3 miles long inside the edge of the sanctuary. But since the permitted area is unfenced and unmarked and the herds of buffalo and cattle are generally grazed free without supervision, it is extremely difficult to enforce those limits. From time to time deaths of rhinoceros and other wildlife have been tentatively traced to disease spread by these domestic stock. Anthrax and rinderpest are believed to be the worst offenders.

As most Indian wildlife are forest animals or edge dwellers, they do not lend themselves to tourist viewing in the manner that the plains game of East Africa does. Nevertheless, with a somewhat different approach to tourism, the Indian wildlife gives promise as a resource to be developed. This is illustrated well at Kaziranga. In spite of its status as a sanctuary and not a park, and with virtually no publicity, the number of visitors there in the season, December to April, is very large indeed. The Kaziranga Sanctuary is a magnificent example of what can be done to conserve Asian wildlife.

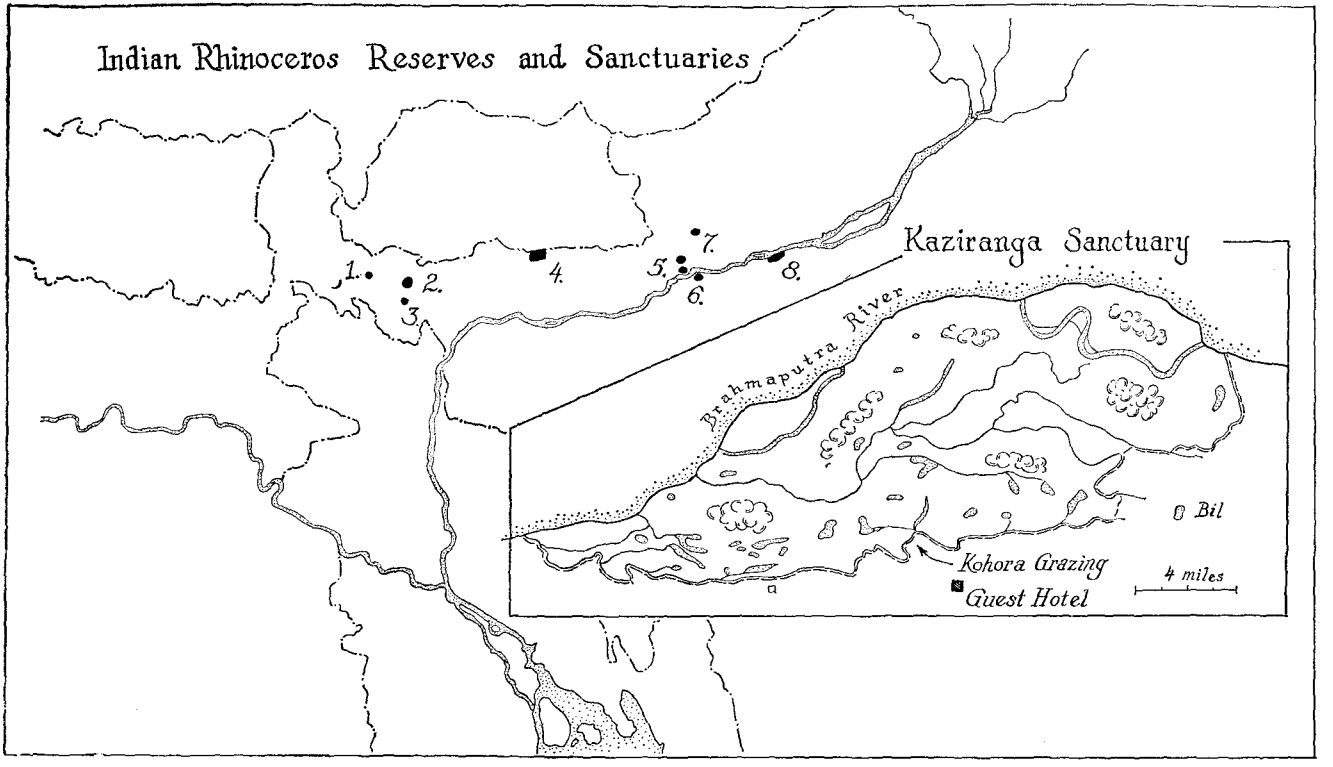
III Ecological Notes

Habitat.—Traditionally, the Indian rhinoceros has been considered an animal of inflexible habitat requirements, the usual explanation for its present distribution being that it requires a swampy area, or at least one with dense stands of tall grass and abundant water. As this habitat was taken over either by agriculture or tree growth, the animals supposedly died out because they could exist under no other conditions.

It is true that the area where the rhino may most readily be seen, the Kaziranga Sanctuary in Assam, fits the accepted habitat description perfectly. On the other hand, analysis of some of the other habitats still occupied by rhino tells quite a different story :

Dense moist forest, some steep slopes, some grassland.—Outside India all the world's Indian rhinos live in the Nepal Terai. The known habitat is the Rapti Valley, the southern part of which I was able to visit thanks to the kindness of Mr. Raymond Sheppard and the Nepalese authorities. Before 1956 the valley was extremely isolated, during any but the driest season the only access was on foot or by elephant. This isolation probably secured the survival of rhinos in the valley.

The area inhabited by rhinos includes a strip some 30 to 40 miles long, starting several miles north of Hataura, a village on the Katmandu-Amlekhganz trail, now a dry-weather road. At its south end the valley floor is less than a mile wide and the



1. Garu Mara. 2. Jaldapara. 3. Cooch Behar. 4. North Kamrup.
5. Orang. 6. Loakhowa. 7. Sona Rupa. 8. Kaziranga.

side slopes rather steep. As it drops gradually to the north-west the floor widens to about 8 miles, with correspondingly wider hill slopes, east and west.

A transect taken in rhino habitat some 6 miles down stream from Hautaura, shows the following: Central in the valley floor is the main river bed, shallow boulder strewn, 100 to 200 feet wide. Side channels and tributaries make a mile-wide lace-work through the valley floor, cutting off islands up to half a mile wide. These islands are littered with boulders and flood debris but are crossed at intervals by game trails used by rhinos. The extreme width of river flow is marked by a bank some 20 feet high, cut by tributary streams and well-worn game trails. Extending back from this for a quarter to half a mile is a terrace-like alluvial plain covered with a dense low forest composed largely of *Shorea robusta*, *Terminalia* sp. and *Lagerstroemia flos-reginae*. No grass is evident, although a water-cress-like growth fills the tributary streams. Farther downstream this terrace widens to three or four miles. In places, the dense forest gives way to agriculture or where burned, to savannah areas, apparently dominated by *Imperata* sp.

Next up the hill comes a quarter mile wide band of grass, including *Imperata* sp. and *Themeda* sp. Following this is a slightly steeper rise, 100 to 200 feet in half a mile, again tree covered. Dominants here again seem to be *Shorea robusta* and *Terminalia* sp. Then between here and the densely forested ridge top is a savannah area, varying from a few hundred yards to 5 miles in width. Here are scattered trees in grass stands 8 to 12 feet high. Farther downstream both the river beds and terraces widen. The slope varies from a gentle rise to quite steep pitches; occasionally tree cover is continuous from the river bank to the ridge tops. Rhinos wander all through these areas, in the forestlands as well as the savannah or open grasslands.

Drier, mixed forest and bush, hills.—In the North Kamrup hills of Assam adjacent to Bhutan, about 25 rhinos live in the North Kamrup Wild Life Sanctuary. It is mostly flat, fairly dry in places, containing a mixture of heavily and lightly forested country with open stretches of grassland. Some of the prominent trees are *Dillenia pentragyna*, *Terminalia* sp., *Sterculia* sp., *Acacia* sp., *Lagerstroemia parviflora* and *Eugenia jambolana*. Grasses where present, include *Themeda arundinacea*, *Cymbopogon nardus* and *Imperata cylindrica*. The Manas and Biki rivers

where they come through the Sanctuary are fairly broad, edged in places by wide beaches. Extensive tall grass jungles predominate in this sanctuary.

Tall, dense, elephant grass jungle on flood plain.—This habitat is exemplified in Kaziranga Wild Life Sanctuary which is an almost flat expanse of tall grass. This grass sea is cut by several ridges, about 8 feet high, a series of interconnecting streams and a number of small, usually permanent lakes called " bils ". These areas flood, becoming open water during the rainy season. Some are 10 or more feet deep but most are rather shallow. During the dry season, until the grass burns they provide the only open areas to be found in the sanctuary. The climate is monsoonal with rains usually from May to October. By December the ground and grass are getting fairly dry and in January, February and March part of the grass (between one-fifth and one-third each year) is burned off. During this period, and for the next two or three months, while it is still young, the grass provides fine food and is low enough for the animals to be seen. Enough unburned grass remains, however, to provide ample cover for the animals. The " elephant grass " here is made up of several species of grasses and reeds. In areas more or less continually wet, *Phragmites karka* is the dominant. Areas flooded during the rains but later dry, are mostly covered by *Saccharum* spp. and *Erianthus elephantinus*. Slightly drier areas (ridge tops and surrounding higher land) are dominated by *Imperata cylindrica* with a number of other andropogonous grasses. Apparently with regular burning and heavy grazing pressure, even in fairly low parts of the sanctuary favours the andropogonous types and these probably provide the best year-long food for wildlife and domestic stock. *Phragmites* and *Saccharum* are regarded as favorite rhino foods, but rhinos, as well as the other animals, probably get the most nutrition from them when new growth starts following burning. By late summer elephant grass grows to a height of 15 feet or more. Rhinos and other animals literally tunnel through it, and as long as it stands they can remain completely hidden. If unburned, the dead grass may remain more or less upright, creating after several seasons, a mass so dense that even elephants can barely force their way through. In this form it is useful only for shelter, and the periodical burnings are apparently necessary to encourage and expose the new growth. There are scattered stands of trees at both ends of the sanctuary and denser groups clustered on the ridges. Dominants are " simul " (*Bombax malabaricum*),

" ajar " (*Lagerstroemia flos-reginae*), and the leguminous " koroi " (*Albizzia procera*). *Terminalia* sp. is also present.

In considering the Indian rhino habitats described above, I am impressed—not by a uniformity of conditions but rather by the wide diversity displayed. The one obvious factor common to all is freedom from human persecution. In Nepal, rhinos were protected as Royal Game by the former rulers. Although such effective protection no longer exists, the inaccessibility of the habitat effectively carried on that protection until recently. In India the rhino habitat, once isolated, is now easily accessible and much of it surrounded by cultivation; but nearly all of it is located within reserves and sanctuaries. For over 50 years the increasingly effective protection afforded these areas has accomplished the protection that the terrain no longer affords. In my judgment, the evidence does not point to an animal of inflexible habitat requirements, gradually being exterminated along with its one suitable type of habitat. Instead, it points to an animal which retreated before human pressure to some of the most remote lowlands of the Indian sub-continent; it survived because it was able to adapt itself to the wide variety of habitat conditions which they presented.

Relationship with other animals.—Probably the most common large mammal in the Kaziranga Sanctuary is the Indian buffalo (*Bubalus bubalus* Linnaeus). Solitary buffalo may be seen, but more commonly herds of from a dozen to about 100 are reported. The wild population is estimated at 400, but there are also a number of semi-wild " buffs ". This is because domestic water buffalo are grazed within the sanctuary boundaries and there is some intermingling between them and the wild stock. The rhino and buffalo often appear together; I saw them grazing within 10 to 20 yards of one another in open bils and immersed in adjacent wallows 20 yards apart.

Gaur (*Bos gaurus* ssp.) are rare; one herd of nine was reported and one skull was found in the sanctuary.

Indian elephants occur in herds of up to 60 animals. These presumably move back and forth between the Mikir Hills and the sanctuary. When in the sanctuary, they remain on the low ridges or in the tree areas unoccupied by the rhino. Both in Nepal and Assam, elephants were described as normally being afraid of rhino. At Kaziranga, the game staff said it required about a year and a half to train riding elephants to approach rhino. Once trained, some elephants apparently lose or overcome this fear, At least one elephant in Nepal was far famed for

actually chasing rhino and twice in Assam I saw elephants stand fast before charging rhino, apparently outbluffing them. Others apparently never lose their fear. One I was riding bolted several times when approached closely by rhino.

Indian rhino can do considerable damage to elephants or to each other with their lower incisors or tushes. Most rhino I observed were somewhat scarred, the scars apparently being inflicted with something sharper than the usually blunt horn. One rhino attacked the elephant on which I was riding, inflicting a cut some 18 inches long and from 1 to 2 inches deep on the elephant's flank. The rhino was a female with a young one. When we came upon her in a clearing in the 15 foot grass, she snorted and plunged back and forth several times. Then she charged my elephant, who coiled his trunk high, wheeled about and crashed off through the grass and water, trumpeting shrilly. The rhino, snorting continually, caught up with the elephant with apparent ease, then ran along behind for some 100 yards with her mouth open, tossing her head, apparently trying to gouge the elephant's rear. Failing in this, she pulled up along the left side of the elephant and with a toss of her head, made the gash. The elephant veered off to one side and the rhino continued in a straight line for some yards farther, then turned off into the grass and disappeared. Examined later, the top of the gash measured 7 feet from the ground, which height is explained both by the Indian rhino's considerable stature and its neck articulation. The Indian rhino can throw its head up and back considerably farther than the African rhino, and this would greatly increase the effectiveness of its tushes as weapons. I never saw a rhino use its horn as an offensive weapon during my two weeks observations. I am not sure how effective the horn would be in real combat, for it is often quite blunt and may be somewhat loosely attached to the skull. In the zoo at Katmandu, a keeper could grasp the horn of one of his two Indian rhinos and visibly wobble it.

Tiger (*Panthera t. tigris* Linnaeus) are fairly common in Kaziranga and both their tracks and buffalo kills were in evidence. I was given one report of a young rhino mauled by a tiger, but the general belief is that tigers are afraid of rhino, or at least leave them alone. An adult Indian rhino has probably no predator to fear except man.

Deer are well represented in the Kaziranga area. Hog deer (*Axis p. porcinus* Zimmermann) are common, especially in the shorter grass area outside the dense elephant grass jungles or in

bils in the interior. Both sambar (*Cervus unicolor niger* Blainville) and swamp deer or barasingha (*Cervus d. duvauceli* Cuvier) may be seen grazing in bils in the interior, occasionally within a few yards of rhino.

Wild boar (*Sus scrofa cristatus* Wagner) seems to be more tolerant of the rhino than any other animal. Both the jungle myna and the cattle egret were observed riding on the backs of rhino. The ubiquitous egret was so often an associate that it served as an easy means of locating rhino where the grass was too high to see the rhino itself. Both birds apparently serve as a warning device, the rhino usually bolting when the birds fly in alarm.

Crocodiles are reported from the sanctuary's many streams during the summer. They could conceivably be a menace, at least to young rhinos. Rhinos so often swim the streams that their points of entry and exit from the water are wide and hard packed.

Fire, Flood.—There are no reports on rhino behaviour during the annual fires, probably because such a large amount of the grass area remains unburned that a rhino can retreat to and through it without being noticed. The grass jungles of the Brahmaputra valley are probably caused by fire and are certainly maintained by it (Bor, 1938), so that fire is probably an integral part of the rhino habitat in that area.

Some degree of flooding is a regular and expected thing in the valley of the Brahmaputra. The great earthquake of 1950 loosened a vast amount of silt which washed into the headwaters of the Brahmaputra and has since been slowly moving downstream. It has made a sort of moving dam which has caused floods far in excess of the historical normal. (Gee, 1952). The flood of 1955 inundated almost all the sanctuary except the tops of some ridges. At time of flood some rhinos have usually moved up into the Mikir Hills, where they are apt to fall prey to poachers. In addition, as a result of floods some rhinos are always reported dispersed, swimming or wandering into other areas. To date, most of the rhino conservation effort has gone into the Kaziranga population, but as long as this area is vulnerable to the catastrophe of flooding, it is extremely important to assure also the safety of the other known rhino concentrations.

Another by-product of the floods is the spreading of water-hyacinth (*Eichhornia crassipes*). In recent years it has invaded the sanctuary, choking the streams and bils. Floods serve to

clear these temporarily, but they also spread the ubiquitous plant over formerly clear areas. As it is, navigation through much of the sanctuary by canoe or elephant has become difficult or impossible. What the effect of this will be on the ecology of the area is not known. Rhinos are not now found in the areas of greatest hyacinth concentration, but whether this represents cause and effect or coincidence is not known.

Man.—Rhino poaching seems well under control, at least in the vicinity of reserves and sanctuaries. When rhinos wander out into the surrounding territory, especially into districts of the hill tribes, very little control can be exercised. If there are any rhino poachers at Kaziranga they probably enter the area from the Brahmaputra side.

As far as other animals go, some poaching takes place in areas remote from sanctuary activities, patrols, road building, visitors. This might be inferred from the behaviour of wildlife, especially chital and barasingha. Near areas of sanctuary activity these animals are relatively fearless, while in outlying places all one sees of them is a movement in the grass. Part of this behaviour may be tolerance acquired through almost a decade of harmless visits by people on elephants.

In the case of the rhinos, the tolerance is striking. Those seen in remote parts of the sanctuary seem to become nervous, though not particularly frightened, at the sight of a riding elephant. If the elephant in the open where he can be seen approaches to within 40 or 50 yards, these rhinos sometimes become aggressive. The place where rhinos are easiest to observe is the Kohora grazing ground, a field of medium to low grass at the sanctuary edge near the hotel. Here, where they are accustomed to humans, it is often possible to ride up to within 30 yards of the rhinos without much disturbing them. Mothers with young are the aggressive exception.

An occasional old rhino, usually assumed to be a bull driven out of the sanctuary by other rhinos, takes up residence outside the sanctuary near the paddy fields to the south. Instead of becoming dangerous rogues, these individuals have become extremely docile, paying little attention to livestock or to the native life which goes on nearby. There have been several such rhinos at Kaziranga, the most celebrated living in that docile state for more than 14 years. There are a very few cases where rhinos have run amok, causing injury or destruction. These may have been driven from the sanctuary by floods and then wounded by poachers.

Rhinos from the sanctuary do raid the rice fields nearby, especially when the rice shoots are first put out. The villagers have built little shelters on high towers, and from these fairly safe vantage points they try to drive off the rhinos. So far nothing very effective has been devised to protect the crops.

Life History.—The best accounts of what little is known of rhino life history at Kaziranga are in the writings of E. P. Gee. The rhinos feed, off and on, both day and night. They spend considerable time in mud wallows, most of the day during hot weather. This may serve to allay the clouds of insects which inhabit the swamps; for in spite of its armor plated appearance the rhinos hide is quite sensitive and a comparatively slight scratch will draw blood. Rhinos usually drop their dung in large piles but whether or not a rhino is truly territorial, always using the same pile or piles as markers, is unknown. From my brief observations, I should think that at the season of my visit the rhinos were not strongly territorial. Some identifiable ones appeared each day in about the same area, but wallows were shared by as many as five rhino at the same time. Other rhinos wandered through the areas at will, and use of the dung-hills seemed to be a matter of chance, determined by which hill they were nearest at the time. Several rhinos used more than one hill while I watched them. These dung hills are quite considerable structures, some of them measuring over 15 feet long and up to 4 feet high.

From the numbers of young in evidence, the rhino population at Kaziranga would seem to be vigorous and healthy.

IV. Recommendations

As my work in connection with the Indian rhino in India was mainly concerned with the largest known concentration of the animals, i.e. those in the Kaziranga Sanctuary, the following recommendations refer primarily to that area.

1. Livestock grazing, at present allowed in parts of the sanctuary presents a considerable threat to the rhinos and other wildlife. Even though most of the livestock may be inoculated for rinderpest, the disease suspected of doing the worst damage is anthrax, and the animals cannot be inoculated for that. In addition, large numbers of domestic stock compete directly with the wildlife for the available forage, and the greater grazing pressure resulting, may alter the vegetation makeup, possibly reducing the carrying capacity of the area. Consequently, I would urge further consideration by the authorities of the resolution passed in 1954 by the International Union for the

Conservation of Nature indicating the desirability of recommending that all domestic livestock should be excluded from the sanctuary.

2. It is impossible to eradicate the water-hyacinth because of the annual floods. However, from the dual standpoints of ecological stability and ease of access for tourism and patrolling, it may prove necessary to effect some annual control of the plant. To this end, knowledge is needed on the ecological impact of hyacinth in Kaziranga, and on economical means of control (for instance, spraying). This might be handled by the forestry personnel in the sanctuary.

3. The Kohora grazing field should be included in the sanctuary because of its large and accessible resident rhino population.

4. More protection should be given to wild life in the Mikir Hills which are adjacent to the sanctuary. Animals move there during the flood season.

5. Through effective and timely protection of the rhino and its habitat, the Indian government has shown at Kaziranga what can be done to prevent a seriously endangered species from becoming a " fossil of tomorrow ". Conditions (floods, disease, firearms, etc.) in that part of India are changing so rapidly that implementation of the above recommendations would, I believe, help to strengthen the fine work already accomplished. The only way to provide for effective management of a wild animal in the face of continually altering conditions is to have a sound knowledge of the animal's ecology ; yet at present extremely little is known of the ecology of the Indian rhino. The Kaziranga Sanctuary affords a magnificent opportunity for the study of the rhino in its natural habitat. In my judgment, ecological study of the Great Indian rhino should be undertaken as quickly as possible.

JAVAN RHINOCEROS; LESSER ONE-HORNED RHINOCEROS

Rhinoceros sondaicus Desmarest

I. Description

The Javan Rhinoceros looks much like a slightly smaller edition of the Great Indian Rhinoceros. Males may be 5 feet 10 inches high at the shoulder and females 5 feet 6 inches—approximately 6 inches lower than the Great Indian Rhinoceros. The Javan is said to be of slighter build than its Indian relative, but from personal observations at close range of both animals in the wild, I find it difficult to detect much difference between them in size, although the Javan rhino appears to have a slightly less deep body than the Indian.

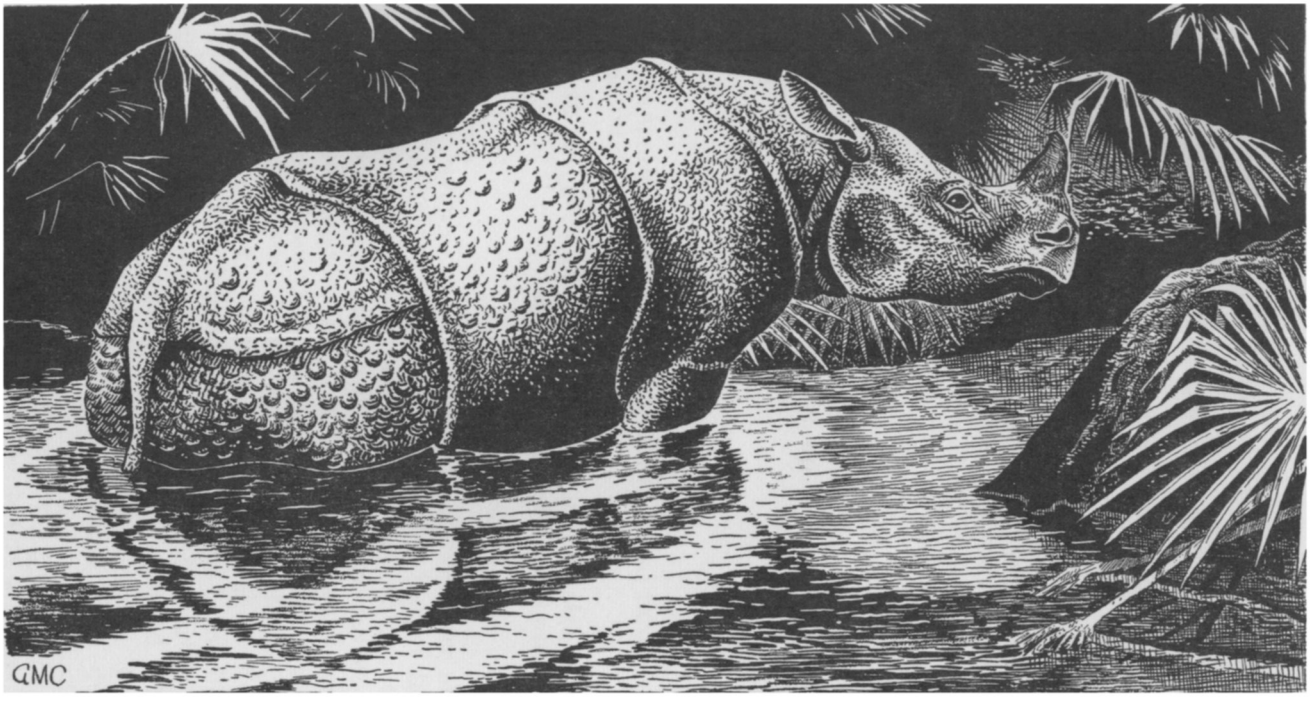
The obvious points of distinction between the two rhinos are the horn and the body folds. While the Indian rhino has a prominent horn which attains a length of 2 feet, and both sexes are conspicuously horned, the male Javan rhino's horn may be only slightly over 10 inches in length; the female's horn is very slight or totally lacking.

Both Indian and Javan rhinos have prominent folds in the hide across the back, over the withers, and behind the shoulder. In addition to these, the Javan rhino has a similar fold just in front of the shoulder. Reports state that the skin is broken into a scaly mosaic by small cracks (the Malay name, " badak tenggiling ", means scaly rhino) but these were not evident on the wild specimens I saw even at 5–6 yards range.

II. Distribution and Status

India, Sikkim, East Pakistan

Former.—The most westerly range recorded by Harper is " in the forests of Orissa and about the delta of the Mahanadi River, in the Bay of Bengal ". But he notes that there is considerable question about the validity of that report. In 1950 the range included the Sikkim Terai, the valley of the Brahmaputra River in Assam and Bengal, the Sunderbans,



THE JAVAN RHINOCEROS

along the Torsa River, the Jalpairugi and Chittagong Forest tracts, Manipur, and the Lushai Hills.

Present.—Probably extinct throughout the above range.

Burma, Thailand, Cambodia, Laos and Viet Nam, Malaya

The literature and reports bearing on distribution of rhinos in these areas often are not clear as to whether the animals involved are *Rhinoceros sondaicus*, *Didermocerus sumatrensis*, or even *R. unicornis*. For a discussion of distribution and status of the Javan rhinoceros in these areas, see the chapter on " Sumatran Rhinoceros ".

China

Former.—*R. Sondaicus* was definitely reported as far north as Tonkin. Other reports indicate that it may have been found over the Chinese border, particularly up the Song Koi and Mekong Rivers.

Present.—Probably extinct.

Sumatra

Former.—Apparently the Javan Rhino was found throughout the entire island.

Present.—It has been presumed extinct in Sumatra for at least two decades. I have found no evidence to the contrary.

Java

Former.—The Javan rhino may once have roamed over most of the island, although some sources quoted by Harper limit the range to the west and central parts. In the last century with the tremendous population growth in Java [1] the rhinos would have been excluded from most of the island by agriculture, even if they had not been hunted to death for their horns. By the mid-1930's the last known Javan rhinos were in the Udjung Kulon game reserve on the western tip of the island. From 1934 to 1937 at least 15 rhinos were known to have been killed. Three more were poached about 1939, and one at the start of the Japanese occupation. No further rhinos were reported killed until the period following the Japanese occupation, when firearms again became available and conditions were quite

[1] The population of Java in 1800 was estimated at 3–4 million ; in 1850, 11 million ; in 1900, 28 million ; and 1930, 41 million ; in 1958, 57 million.

unsettled. Between the end of the war and 1955 an estimated 10 animals were poached, at least two of which had wandered out of the reserve into the mountains to the east.

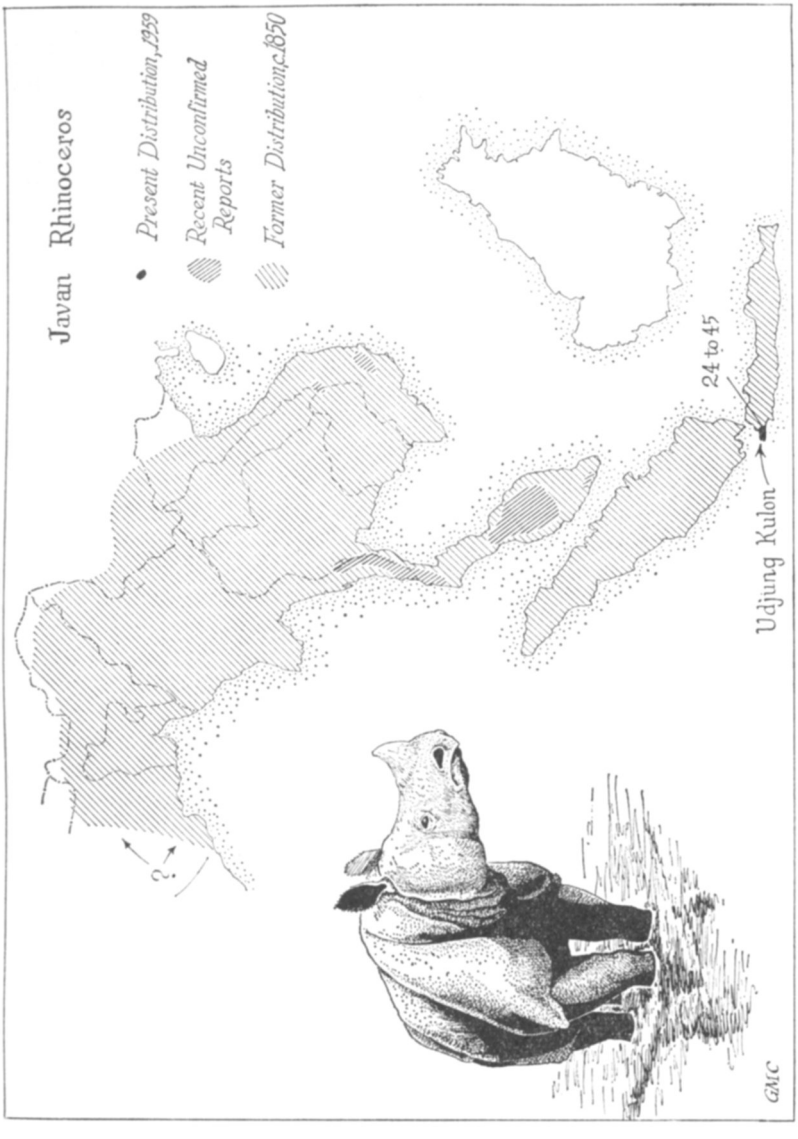
Present.—The last known population of Javan rhinos is estimated at from two dozen to four dozen animals. These live in the Udjung Kulon Reserve, although occasionally an animal wanders out into the mountains immediately to the east. The Nature Protection and Wildlife Management authorities of the Indonesian Government very carefully protect the rhinos from interference by man. The greatest threat to the rhinos at present may be biological. In the population of a few dozen animals, only one or two young are known to exist, and perhaps the population has reached such a low level that adequate reproduction may not occur.

III. Ecological Notes

Habitat.—The Udjung Kulon Game Reserve. In the last century when the Javan rhino's range included much of South-East Asia, it was reported to be generally a creature of the lowlands, while the Sumatran rhino was found at all elevations. The Udjung Kulon is lowland and as such may be representative of the rhino's habitat of choice. Today, however, it must be considered primarily a habitat by necessity for it is the only place where these rhinos have received enough protection to survive.

Thanks to the courtesy and fine arrangements of the Indonesian Government, I was able to carry out a two-week ecological reconnaissance of the Reserve. Both this and the Sumatra expedition were made possible by Professor Kusnoto, Director of the Indonesian Government Botanical Gardens; by Mr. Andries Hoogerwerf, then head of the Botanic Gardens' Department of Nature Protection and Wildlife Management, who made all the advance arrangements; and by Mr. Kusnadi, head of the Nature Protection Department of the Forest Service, who provided personnel and boat transport.

Location, Topography, Weather.—The Udjung Kulon Reserve is the westernmost point of Java, a bulbous peninsula jutting out for 13 miles into the Sunda Straits. At its junction with the mainland, the peninsula is only ·6 of a mile wide, but it widens rapidly reaching a maximum width of 7 miles. The area of the reserve is 117 square miles. The highest land is on the western tip where a several hundred foot high ridge with one higher peak rises above the fairly uniform level of the rest of the



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peninsula. Most of the coastal areas are low and flat, the land gently rising toward a low central plateau. A number of slow, meandering streams and rivers originate on the plateau and radiate in all directions towards the sea. The peninsula lies about seven degrees south latitude and the climate is tropical, with a wet western monsoon from December to March, and a dry eastern monsoon the rest of the year.

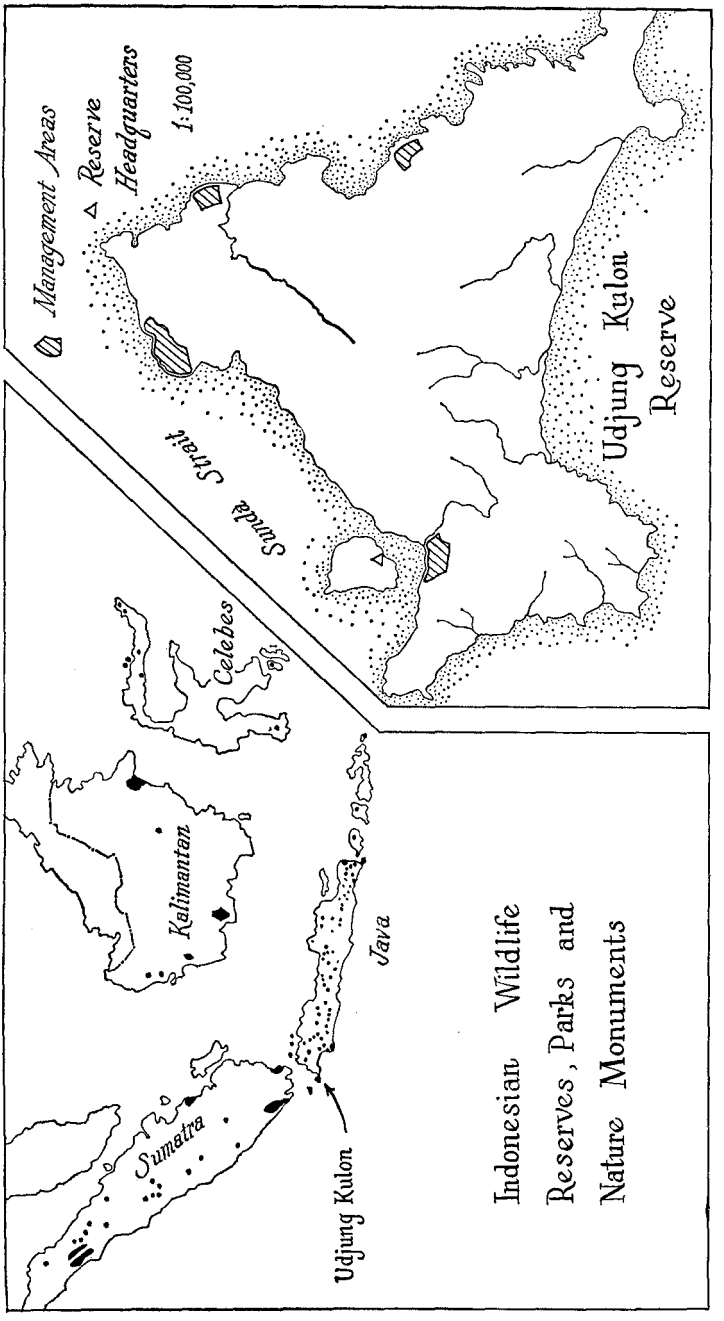
Vegetation.—Except for a few open pastures, most of the reserve is clad in dense, tropical forest. It is of significant botanical value in that it is the last remaining example of Java's indigenous lowland forest. The pastures may be caused by soil or drainage, but in my opinion they are more probably left over from the period of human occupation. Several pastures have been recently reopened and enlarged.

In the open pastures the vegetation is dominated by alang alang, a perennial cogonal grass. Along the northern coast there are casuarina groves on slightly raised headlands which separate wide sandy beaches or low rocky edges. The southern coast is much rougher, with an abrupt drop past picturesque crumbling horizontal rock strata to the water, from 10 to 50 feet below. Here pandanus groves are conspicuous next to the coast, with small close-grazed grassy openings between. The rest of the reserve is mostly dense jungle or forest, with 2 or 3 canopies, the highest being of giant trees such as *Ficus* and *Terminalia*; then a middle canopy of various palms (*Corypha* sp., *Corypha utan*, *Arenga* spp.): and a low canopy or screen of various bamboos, giant ferns, rattans, and broad leafed plants. All of this is laced together by vines and lianas, most of which are thorny. The terrain while basically level, is cut by numerous low ridges. The ridges are well drained, with sandstone outcroppings, and support a more open, woody growth; while the wet bottoms between are poorly drained and have a much denser growth dominated by monocotyledons.

The western highlands, like the ridgetops, are better drained and support a generally two-canopy woody vegetation dominated by giant *Ficus*, and with an equally dense but less thorny undergrowth than the lowlands.

There is a curious lack of apparent organic matter on or in the soil of most of the peninsula. The leaves, twigs and trunks which fall from the dense jungle cover quickly disappear leaving the surface apparently devoid of litter or humus.

History and Management.—The peninsula was set aside by the Netherlands Indies Government in 1921 as a Nature Monument



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to preserve the Javan rhino, the Banteng (*Bos sondaica*) and the Javan tiger (*Felis tigris sondaica*), all of which were threatened with extinction. Human habitation has been excluded since that time, and although one can still find traces of villages, the general impression is that of a primeval forest.

In the early 1930's the status of the area was changed from that of a Nature Monument to a Game Reserve. This allowed the nature protection authorities to carry out a certain amount of management, which has taken the form of opening, or re-opening, pasture land along the north coast to augment the limited existing pasture. In 1951 the current habitat management program started under the instigation and direction of Mr. Hoogerwerf. There are now four large management areas. By maintaining these areas as open pastures of alang alang grass, the habitat for the Banteng and the Javan deer (*Rusa timorensis*) is greatly improved. The deer, for instance, have increased from estimated population of 75 to something over 250. The reserve is administered by the Nature Protection Department of the Forestry Service. No residence is allowed on the peninsula and the headquarters and homes of the reserve personnel are on nearby islands or the mainland. The permanent staff number about 50, including one chief warden, and one supervisor, each with three assistants, four rangers with police powers, and the rest wardens. The area is constantly checked by foot patrols of four wardens and an armed ranger. Patrol paths have been cut along the perimeter of the reserve; patrol huts have been constructed at strategic points about a day's march apart along the paths. Dugout proas, are available on the larger rivers for checking the interior of the peninsula. When the weather permits (from April to November) patrol boats keep watch over the coastline. The principal area occupied by the rhino lies in the centre and south of the peninsula, so the management activities on the north coast, and along patrol paths should not affect them at all.

The Rhinos.—The estimates I was given of the number of rhinos in Udjung Kulon varied from two dozen to around eighty. Mr. Hoogerwerf, who has a more thorough knowledge of the area and its fauna than anyone else, favors a low estimate and from my brief observations I should agree. The animals wander considerable distances, zig zagging back and forth. So what at first appear to be tracks of numbers of rhinos turn out, on investigation, to be due to the meanderings of a single animal. Most estimates are based on tracks; for the rhinos hide so well

and the forest is so dense that the animals themselves are rarely seen. It seems to me that a safe estimate of the rhino population is between two dozen and four dozen.

The Javan rhinos are so rare and secretive that even less is known of their habits than of those of the Sumatran rhino. They have wallows which Mr. Hoogerwerf states they may use for from several days to a month, before moving on to another. These wallows appear much like those of the Sumatran rhino, some even being located on hillsides, although never in as steep a situation as some of the Sumatran examples. I found one fresh one on a hillside in dense jungle. It measured 12 feet by 6 feet. Along the well-worn path to it was a tree, about 4 inches in diameter, with its bark worn smooth to a height of 5 feet. Apparently it was used as a rubbing post. Mr. Hoogerwerf states that these rhinos do not use their feet for digging wallows and he believes that they may enlarge pig wallows or natural depressions. He thinks that the animals are territorial to some extent, at least to the degree that they have established centers of activity, though they roam considerably through other rhino's areas. There are well established rhino paths leading into streams and rivers, smooth sided trenches several feet deep in places. But like the Sumatran, the Javan rhinos show considerable agility in scrambling up steep banks and over or through obstacles.

The rhinos occupy the parts of the peninsula least accessible to man: the low central jungle-clad plateau and the southern coastal area. They may travel through the pasture lands of the north coast or the highland forests of the western tip, but none apparently live there or are reported to have lived there in the past.

As with the other species of rhino, the Javan's eyesight seems rather poor, while the sense of smell and hearing are acute. None of the six animals I closely approached seemed to recognize me as a human being by sight, and I was within 5 meters of one female with a baby! When disturbed from the down wind side, the rhinos snorted and made short dashes cross wind through the jungle growth, possibly in an attempt to pick up my scent. When this failed, they would rush off directly up wind.

My very good fortune in seeing the rhinos was due to the efforts of Mr. Amin Soekardi, the director of the reserve, who kindly accompanied me during the expedition. Through his knowledge of the animals' locations and his energy in finding them, we came to within a few yards of six animals and had good observations of four of them.

In the case of the female and baby, we had been following their tracks when we caught sight of the baby disappearing into the jungle some yards ahead. The carriers and trackers promptly and prudently took to the trees as they always did when we came to a rhino. Mr. Soekardi and I pushed ahead and crawling around a clump of rattan, we unexpectedly came upon the little rhino at a distance of about 5 meters. It was chewing tepus, a favorite food of the rhino. Soon it lay down, first folding its hind legs and sitting with its front legs stiff, looking around. Then it folded its front legs also and laid its head down on the ground. This jungle is so dense that even at that range our view was not very clear, for although it was early afternoon the jungle floor was very dark. Suddenly the mother rhino stepped from behind a rattan clump and stood beside the baby looking at us. She stared for a long while, blinking her black eyes, swinging her head, sniffing with flaring nostrils, and flicking her ears. We were down wind, exactly 5 meters from her tracks. She suddenly jumped back about two steps, turned, and began calmly feeding. Shortly thereafter the baby got up and the two moved away.

For forage the rhino seems to choose tepus (*Nicolaia* sp.) young bamboo of various types. *Donax arundinastrum*, *Ficus septica*; leaves of *Ardisia humilis*, *Desmodium umbellatum*, other *Ficus* spp., *Terminalia* spp., *Spondias* spp.; and some fruits. Mr. Kushnadi reported seeing the rhinos knee deep in the sea and he believed they ate the intertidal Rhizophora. To get at the leaves, twigs, and possibly fruits of some trees the rhinos merely pushed them over. Judging by the tracks they accomplish this by leaning a shoulder on the tree, and then, as it starts to give way, they walk up over it forcing it down between their front legs. In this manner they had pushed down trees up to 6 inches in diameter and over 20 feet high.

Other Animals.—It is estimated that between three and four hundred banteng live in the reserve. Most of these are around the open areas along the north coast, but a few are found near the smaller clearings along the southern coast, where they keep the grass in the open spaces so closely grazed that the appearance is of a well kept park. Few, if any, banteng live yearlong in the dense interior; during the dry eastern monsoon they tend to concentrate in the pasture areas, and are then easier to observe than during the wet west monsoon.

The Javan deer or rusa is even more a creature of the pastures than the banteng; in fact these graceful animals with their long hair and fine antlers are probably never found in the interior.

Wild boar (*Sus vittatus*) are quite common both in the pasture lands and along paths in the deep forest. They are found scattered here and there throughout the interior of the reserve also.

The lesser mouse deer or kanchil (*Tragulus javanicus*) and the barking deer or kidang (*Muntiacus muntjak*) are widespread throughout the forested areas. Three species of monkey can be seen: the common Javan mojet (*Macaca irus*), the black lutung (*Presbytis cristatus*), and the rarer surili (*P. aygula*). Other occupants of the forest which may occasionally be seen include a squirrel (*Callosciurus notatus* ssp.), a mongoose, the gungaragan (*Herpestes javanicus*), and the Malayan giant squirrel or jelerang (*Ratufa bicolor*).

Flying foxes (*Pteropus vampyrus*) can be seen each evening. They fly out over the peninsula or to the off-shore islands, returning to their roost trees at dawn. The numbers of these bats at each roost are incredible. One evening I counted one sector of a sky full of bats. In 11 minutes 6,000 came by, and they continued in undiminished numbers for half an hour more until dark.

The largest predator is the Javan Tiger (*Felis tigris sondaica*). Mr. Hoogerwerf considers it the most threatened animal in Java. There are an estimated 10 to 12 in Udjung Kulon, with a possible 20–25 in all of Java. From the rhino's standpoint, the tiger is a very useful citizen. The human residents of this part of Java believe that the tigers are the souls of their departed ancestors, so they will not aid poachers in killing them. The tiger has a rather fearsome reputation. During the Japanese occupation when guns were not allowed, several persons were killed by tigers and Mr. Kushnadi told me that two of his men had been attacked by a tiger a month before my visit. There is a story that after the last war poachers planned to try to kill all the Udjung Kulon rhinos for their horns. When they entered the peninsula one poacher was killed by a tiger, and since they could not get any help from the nearby villagers in combating the tigers, the poachers gave up. It is an interesting situation where one of the world's rarest herbivores may have been saved from extermination by an even rarer predator. Signs of tiger was widespread throughout the reserve although fresh tracks were not common. I found pig hairs defecated by tigers, and probably their primary sources of food are pigs, deer and banteng. Management of the pasture land aids the tigers by increasing their food supply.

Leopard or panther tracks are also widespread throughout the

peninsula. Javan wild dogs (*Cuon alpinus javanicus*), although I saw no signs of them, have been reported periodically from the pasture areas in the north and are considered to be very destructive to deer and banteng.

Bird life in the reserve is abundant and gorgeous. The Green peafowl (*Pavo muticus*), two species of junglefowl (*Gallus* sp.) and the hornbills are the most conspicuous birds.

The commonest big reptile seemed to be the water monitor (*Varanus* sp.) which reaches lengths of more than 3 feet. It or its tracks are commonly seen along the beaches where it has been searching and digging for turtle eggs. Crocodiles were also seen near the mouths of two rivers. Several smaller lizards were in evidence, skinks and geckos were conspicuous around all the patrol cabins. Snakes are less commonly seen although I saw a dozen small water snakes along one river.

The rhinos live somewhat apart from the rest of the large wildlife of the area and probably do not come into direct contact with them or into competition with them for either food or space. A tiger could possibly kill a very young rhino, but to do so it would have to face the formidable mother. Where there is such an abundant supply of alternative less dangerous prey there would seem to be little danger to the rhinos from tigers.

Recommendations

The Government of Indonesia deserves great credit for the fine condition of the Udjung Kulon Game Reserve. Without its active and well-directed program the Javan rhino would probably be extinct.

Man remains the greatest immediate menace to the rhino's continued survival. The provisions of the Government for the reserve's protection were quite adequate in 1955. As conditions change, however, the policies of the reserve will have to be reassessed. A sound knowledge of the rhino's ecology is a necessity as a basis on which to build future plans both for habitat management and for possible tourism. This knowledge is also necessary to judge what actual danger exists from the effect of the low population level on potential breeding success. A start has already been made on this enquiry.

Mr. George C. Ruhle, Park Naturalist from the Hawaii National Park, went to Indonesia in June, 1959, to carry out a six months' study of the Indonesian National Parks to help that country to start a National Park Service. The project is under the direction of Mr. Harold Coolidge.

It is most important that no significant disturbances be made—trapping rhinos for zoos, for instance—until there is enough knowledge of the animals' ecology to predict the effects on the remaining rhinos with some certainty. Where so few individuals remain, even an apparently slight disturbance may mean the difference between survival and extinction.

ASIATIC LION; INDIAN LION

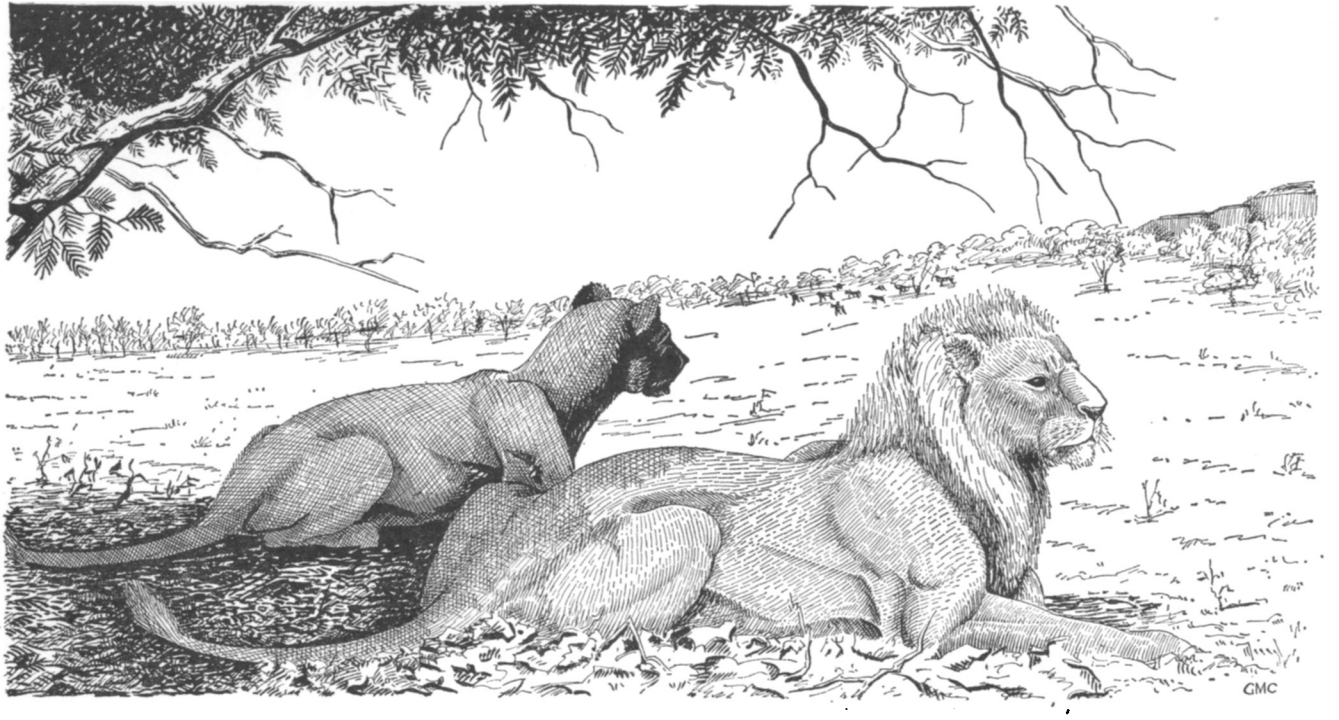
Panthera leo persica Meyer

I. Description

The Asiatic lion closely resembles its African counterpart, though it is commonly believed that the African animals differ in size and appearance from the Asiatic. In literature the Asiatic lion is variously described as being both lighter and darker in color than the African; of longer and of shorter mane; with more and with less body hair; and of equal as well as of considerably smaller size. A careful review of available descriptions fails to show consistant differences between the two lions in these characteristics (Harper, 1945; Cadell, 1935; Dharmakumarsinhji, 1951; Gee, 1956; Pocock, 1930; Roosevelt and Heller, 1914; Rowland Ward, 1914 and 1928; Smee, 1834; Wynter-Blyth, 1949, 1950, 1951).

The descriptions of African lions are based on thousands of lions killed and observed, many by biologists. Descriptions of the Indian lions, on the other hand, are based on a very few specimens killed or observed, and few of these by trained biologists. Consequently, the available descriptions of the Indian lions may be much less representative of the race as a whole than those of the African animals. There seems to be little difference in average total body length between Indian and African lions. The average weights of both are probably between 400 and 500 pounds. There seems to be wide individual variation within both species with regard to the length and color of the hair on mane and body including tail tassel, elbow tufts, and belly fringe. The available data do not appear to warrant distinguishing between African and Asian lions on the basis of those characteristics.

It appears to me that this paucity of specimens is the reason for the widespread belief that the Asiatic lion differs considerably from the African lion, for by the time western investigators started describing the Asiatic lion, it was almost extinct. Indeed, they were so little known in the wild that zoo specimens were used to describe them. According to Pocock (1930) the first description of the Asiatic lion was by Griffiths, who wrote about one displayed in Calcutta. In 1827 a pair from Persia in the London zoo were described by Temminck as the " Persian Lion " and were subsequently named *Felis leo persicus* (Fischer).



THE INDIAN LION

The same year Bennett described and named (variety *bengalensis*) a pair of Indian lions displayed at the Tower of London. In 1834 Jardin described two zoo specimens in London, naming them *Felis leo asiaticus*. These were presumably the same animals Temminck had described, now grown adult. So the same two zoo animals may have served as type specimens for two different races.

Apparently the first description based upon specimens collected in the wild was by Smee in 1833 and 1834. On the basis of eleven such specimens from India, he named the lion *Felis leo goojratensis* and published it under the name " The Maneless Lion of Gujerat ". For the next century there followed very occasional accounts or descriptions of the Asiatic animals and even more infrequent specimens of the same. So rare were the specimens that in 1930 Pocock was unable to find more than one skin of " the Persian lion " and eleven skins of the Indian lion, five of which were collected within a year of his publication. At least two of the remaining six were from zoos, another " when unstuffed was found to contain a tiger's skull ", and another was " merely cured, hot dressed and stretched, and is certainly dried and shrunken."

There was not a single complete wild-killed example of the lion in the British Museum of Natural History at that time, and five of the specimens Pocock studied were sent from overseas, Chicago and Bombay. With so little material for comparison, there has been a tendency to generalize on the basis of a very few specimens, some of them apparently quite atypical (such as maneless or melanistic ones) and others modified by life in a zoo.[1]

The foregoing discussion points out the lack of reliable information on the Asiatic lion, for the considerable but often conflicting literature is based on a minimum of valid zoological material. The situation has changed little since 1930 when Pocock wrote regretfully of " the tolerably copious literature and deplorably scanty material. . . . " One partial solution will be to make sure that any Asiatic lions, shot in the future are carefully described and recorded by suitable people and, where possible, the specimens supplied to museums. Few animals are likely to become available in this way, and I certainly would not recommend any wholesale collecting of a rare species ; but a considerable number of specimens must adorn the floors, walls

[1] The effect of captivity on lions' morphology may be quite significant ; the mane may become considerably enlarged, skins darker, musculature and bone structure somewhat modified. (Pocock, 1930).

and trunks of present and former officers of the Indian government, Indian royalty and big game hunters. These trophies are usually in the form of tanned skins with or without heads; or mounted heads, often with the skull inside the mount. With whatever records accompany them, they provide an untapped source of zoological materials. If this were studied together with specimens in museums and with data from subsequent specimens, it might yield the information needed properly to describe and classify the Asiatic lion and give an insight into any morphological changes, which may be taking place within the Gir population.

II. Distribution

Europe

Probably the last lions in Europe were those in Greece. Aristotle and Herodotus wrote of the lions of Thessaly attacking baggage animals attached to Xerxes' army in 480 B.C. but by 100 A.D. these lions were considered extinct. Whether the Greek lions were a separate race from the Asiatic lion is not definitely known. It is generally assumed they were, but the ranges of the two were adjacent at the Straits of the Bosporus. No specimens from Europe have been found (Harper, 1945).

Asia Minor

Former.—Harper quotes one record from the upper Euphrates in Turkey, and Murray (1866) says " It is . . . not rare in Asia Minor."

Present.—Extinct.

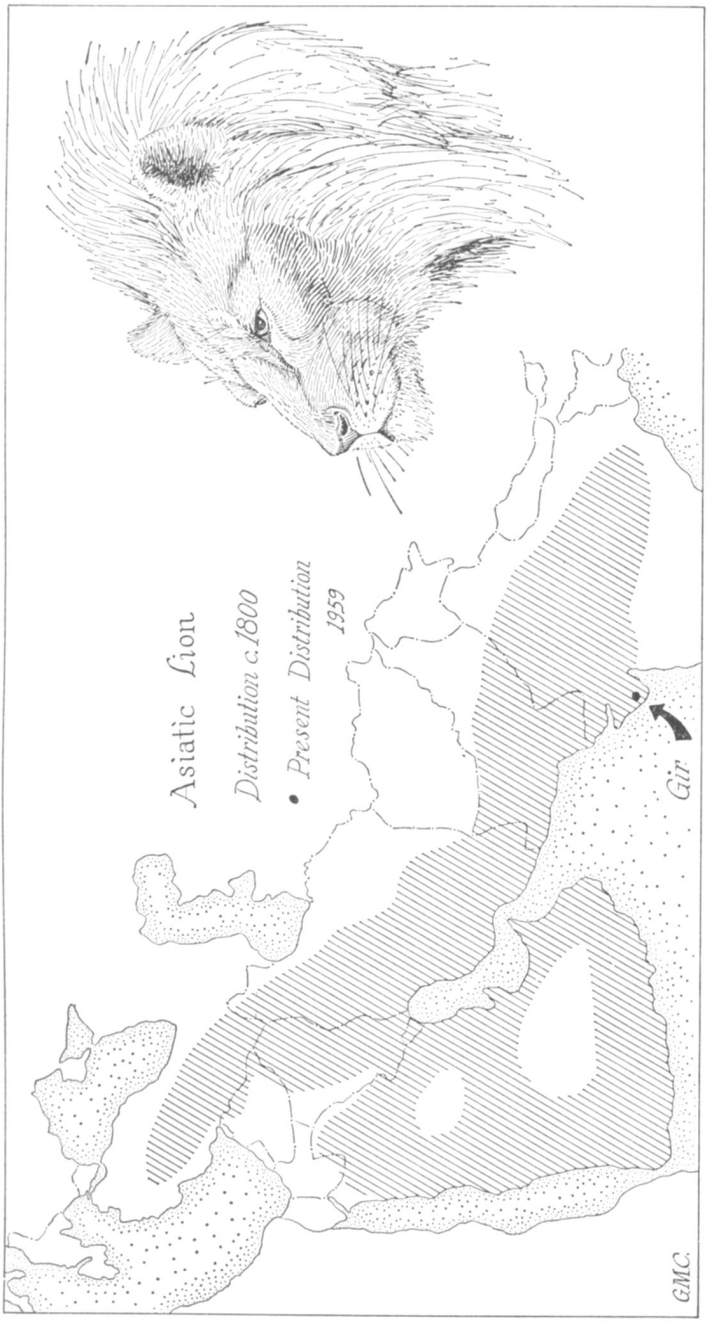
Syria, Palestine, Iraq and Arabia

Former.—At the time of Christ the lion was sufficiently common to be mentioned approximately 130 times in the Scriptures. Apparently it was exterminated in Palestine about the time of the Crusades, but a few survivors still existed into the present century in the wilder parts of non-desert Arabia, and in the dense vegetation along the less frequented parts of the Tigris and Euphrates.

Present.—Extinct.

Iran

Former.—Although probably once common over much of the country that was not actual desert, by 1900 lions were exterminated in most of their range, being common only in west Persia, especially in Khuzistan. There they remained until the



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late 1920's though isolated reports from the south of Persia continued into the 1930's.

Present.—In Baghdad and Damascus, I was told that reports still come down occasionally of lions in southern or western Persia, and there were several references to lions seen in the Zagros mountains during the last war. As most such report stemmed originally from tribesmen in the area involved, I regard them as questionable. This is not because of any lack of trustworthiness on the part of the tribesmen, but rather because of the difficulties in translation. " Nim'r ", or variations of it, can refer to lion, tiger, panther or wildcat, and I found this to be a source of considerable confusion while working on the cat family in the Middle East. Considering the possibility of semantic confusion, and the abundance of modern rifles, the existence of any lions west of India is highly unlikely.

Afghanistan

Apparently the lion did not inhabit Afghanistan, at least in recent times.

Pakistan

Former.—The lion probably once occurred all along the Indus and its tributaries. There are a few reports of lions in the Baluchistan mountains, one of the latest being 1935 from Bolan Pass, south of Quetta. The last known individual was killed at Kot Diji (in the southeast) in 1842 (Pocock, 1930).

Present.—Extinct along the Indus ; probably extinct in the Baluchistan mountains.

India

Former.—The very early distribution may have included some of southern India, but in the last 200 years the range probably extended into India as far as a line running roughly from Hariana in the Punjab, south-east to south-central Bengal, then generally west to Baroda and the Kathiawar Peninsula. (Pocock, 1930). The last lion recorded outside Kathiawar was in 1884 in central India. (Wynter-Blyth, 1949).

Present.—Since 1884 the range of the Indian lion has been limited to the Gir Forest and its immediate environs. The forest, an area of about 500 square miles, is roughly 20 miles south of Junagadh, in the south-west of the Kathiawar Peninsula. Small population, wanderers from the Gir, are found year-long at Girnar and Mytiala, respectively 11 and 14 miles from the forest. An occasional individual may wander farther from the

forest's protection, but such animals are usually shot before they get very far.

III. Ecological Notes

History and causes of extermination.—In country after country, as the human population and occupation of the land increased, the lion retreated and this process accelerated as more efficient weapons became available; especially with the presence of foreign military forces. In Palestine, for instance, the lion disappeared about the time of the Crusades. In Persia and Iraq the increase in firearms during the first world war is blamed for the lion's extinction. In India the greatest lion kills were held by the military. For example " . . . during the Mutiny, Colonel George Acland Smith killed upwards of 300 Indian lions . . ." (Kinear, 1920, quoted by Harper, 1945.)

Lions were regarded as the symbols of strength, bravery and nobility and their sculptured and painted images appeared again and again in the palaces, forts and great cities of the ancient middle eastern world. Hunting the lion was the sport of nobility. As modern firearms reduced the risk and skill required, the ranks of the royal hunters were swelled by ever-increasing numbers of lesser government officials, military officers, influential visitors and travelling big game hunters, anxious to secure an ever-rarer trophy. But even without the trophy value attached to the lions, the interests of men and lions were bound to clash. Lions were a direct threat to human life and predators on domestic ungulates.[1]

Lions can exist under a wide range of habitat conditions. It is not likely, in my opinion, that physical alteration alone (vegetation change, cultivation, etc., short of producing actual desert) was enough to drive the animals out of their habitat. Nor is it likely that the presence of human beings by itself had that effect. Lions live quite successfully in the Gir in the midst of considerable numbers of people. Conflict probably came through direct competition for food. Human occupation often affected the lions' wild supply of food, substituting for it or augmenting it by the more easily captured animals.

Tigers have often been accused of aiding the extermination of the lion where the two shared the same area. Unless there was

[1] The record of larger mammals exterminated throughout the world during the past 2,000 years shows that the larger predatory mammals as a group have sustained the greatest losses at the hand of man (26 forms of larger predators exterminated contrasted with only 18 forms of Bovidae, Equidae, and Cervidae. (Harper, 1945.) The lions of Asia merely followed the trend of the large predators and are more fortunate than many, even to have survived.

some striking increase in the tiger population and the spread of its range (neither of which is known to me) it seems highly unlikely that tigers played any role at all in the lions' retreat. Before the reduction of the lion's range, both tigers and lions shared parts of India, and that fact alone should settle the question. Long after lions had become virtually extinct in the tigerless portions of their range, they survived in some numbers in parts of India also occupied by tigers. In any event, it is doubtful if tigers and lions filled the same ecological niches in their adjoining habitats. Tigers like dense vegetation, while lions choose open land. Tigers also are much more difficult to approach than lions, which from the earliest records are noted as being comparatively fearless. Given these conditions plus gunpowder, selective extermination of the lions would certainly be expected.

By 1884 the last known lions in India were in the Kathiawar Peninsula, in the vicinity of the Gir Forest. Several factors combined to make this the lion's last refuge. The local people had religious scruples against killing animals, even stronger than those over most of India. The forest was isolated both by topography and by administration—the peninsula area being an assemblage of 202 small states, each with an absolute ruler in the form of a royal prince or maharajah.

By 1900, however, continual hunting by visiting officials and royalty had considerably reduced the lion population. One commonly accepted estimate is that in about 1900 less than a dozen lions existed in the forest. Many estimates have been published for the period from 1890 to 1913, most of which indicate two to three dozen animals remaining. On the other hand, E. P. Gee states that there were at least 100 lions in the central forests at that time. His reference is the Jam Sahib of Nawanager, who informed him that the nawabs of Junagarh (the state in which most of the Gir Forest lies) let it be known officially that the number of lions was so low, in order to discourage over-hunting by " every British Viceroy, Commander-in-Chief, Governor of Bombay, Indian Prince, and others down to persons of less importance ".

Whatever the number of lions surviving around 1900 actually was, the animals were then declared protected and have been so ever since. This protection allowed a few lions each year to be converted into trophies by important guests of the Nawab. This number was officially set at three per year for most of the period. The actual kill may have varied between three and twenty, but with that degree of protection the lions increased. Even in the very early 1900's a few lions straggled out into

adjoining states. It did not require straggling very far, for the forest area included or adjoined several small states. Virtually every lion found outside the Gir was killed, and some elaborate schemes were devised to lure or drive them over the boundary line. From sometime before 1920 up to 1947, an estimated ten to twelve lions were thus killed annually.

A census in 1936 showed 289 lions in the forest, but there is considerable question about the validity of that count (Wynter-Blyth, 1949). In 1950 Wynter-Blyth himself undertook a census based on measured foot prints, assuming that no two lions have the same foot measurements and that in a period of two days almost every lion will have moved enough to leave suitable foot prints. The result of this census was a count of 219 to 227 lions. From his research, Wynter-Blyth believed that there had been a decrease in lions between 1936 and 1950. In 1955 he conducted a second census in much the same manner as the first, counting a total of 290 lions. This, when the variables between the two censuses were worked out, gave him an increase of 25 per cent between 1950 and 1955. Between 1947 and 1950 no permits were given for hunting lions. A maximum of four permits a year was then publicized, but this policy was discontinued and since then few permits have been granted.

From 1950 to 1955 there were over 20 known kills, some to protect stock, some in alleged defense of life ; two were wounded animals that had to be destroyed. Several of the unauthorized kills were in the vicinity of villages where " home guard guns " had been issued. Such poaching is to be expected and will probably increase as long as there are so many lions living in such close contact with so many people. The significant thing is that even with this degree of killing, the number of lions should have increased 25 per cent.

Breeding and Rate of Increase.—Little is known regarding the rates of increase of wild Indian lions. A lion's biological potential is high. One Gir lioness in the Junagadh zoo produced a litter of three in August 1949, and another of five, six months later. Whether this would happen in the wild is not known. For that matter, the breeding age of a lioness is not known.

The lion population appears to be on the increase, judging both from the census figures and the proportion of young animals. Regardless of the absolute accuracy of a census method, if subsequent censuses are carried out in the same manner, they will give a valid picture of the relative numbers and population fluctuations. In 1950 Wynter-Blyth's figures gave 19 per cent

of the lion population as being young animals. In 1955 this percentage had dropped to 16·9 per cent, while the total population had increased by 25 per cent.

One factor that vitally affects the increase rate is the ratio of lions to lionesses. Local herdsmen and forest officers believe that lionesses predominate, citing as evidence both their own observations and the numbers of males killed for trophies. On the other hand, Wynter-Blyth firmly believes that males predominate. He gives a ratio of roughly 1·6 males to 1 female, and notes that the " belief in the preponderance of lionesses is due to the fact that all young males, being maneless, look like lionesses from a distance ".

Wynter-Blyth's sex-ratio is based on lions shot or found dead from 1936 to 1947, and from the results of five censuses. Most of the latter figures are based on track measurements, about which he says—" It is difficult to say to what extent these figures are accurate, as the method of determining sex by the shape of the pugmark is far from infallible . . . ". He had in 1949 noted the possibility that the 1936 census had been padded to attract hunters. If this were so, the padding would be expected to favor the males, and would probably indicate a lower per cent of lionesses than actually existed.

If males do predominate to the extent that Wynter-Blyth believes, up to half of the adult male lion population in the forest may play no part at all in reproduction, unless there is some unrecorded need for numbers of spare lions as a sort of breeding stimulus, a condition suggested in some bird and animal species. A considerable number of adult or sub-adult males could then be culled without adversely affecting the rate of increase. It must be remembered, however, that in Africa, lionesses apparently do most of the hunting, and there is no reason to suspect that Indian lions are different in that respect. Consequently lionesses are more likely than lions to run foul of humans and be killed. This is borne out by the high percentage of lionesses in the " in defense " kills in the Gir. This factor should be considered if culling is ever carried out in the forest.

Several writers have speculated on the possibility of inbreeding adversely affecting the Gir lions. The danger from this would depend on how low the population had dropped. If there actually were only a dozen or so lions in the forest around 1900, inbreeding might be a significant factor. However, if the minimum figure is nearer 100, which seems more reasonable to me, I should expect no difficulties from inbreeding. Selective downbreeding is another thing entirely. If, out of a small population, several

of the largest, trophy, males have been killed each year, for over a hundred years, the genetic effect could be significant.

Since breeding data are vital to effective management of the lions, this is a subject which merits early study. (See *Recommendations* section following).

Habitat.—The Gir Forest. Thanks to the efficient arrangements made by the Bombay Natural History Society and the facilities kindly provided by the government of Saurashtra, especially its Forest Department, I was able to visit the Gir forest during the second and third weeks of June, 1955.

During and immediately after the rains the forest must appear lush and green. When dry, with the leaves dead and the ground cover grazed off, its appearance is much less inviting.

Six years before my visit, Wynter-Blyth had written that "'The Gir Forest has been so strictly preserved that for many years it has been a terra incognita except to the very few". In spite of his fine articles about the forest subsequently published in the *Journal* of the Bombay Natural History Society, the forest still remained little known and before my visit I received a remarkable variety of descriptions of it.

Location, weather, topography.—Lying in the south-west of the Kathiawar Peninsula at 21° N. the Gir Forest is at roughly the same latitude as Honolulu, central Cuba and southern Formosa. The climate is strongly monsoonal, with steady west-south-west winds off the Arabian Sea bringing wet weather, usually from June or July through to September or October. A dry cool season follows, extending to February or March, and this in turn is followed by the hot season with desiccating desert winds from the north east.

In general, the Kathiawar Peninsula is a low-lying, seasonally arid, scrub-desert land in which the Gir is the only large wooded area remaining. Its highlands are the source of several rivers, very important in the regional economy for the supply of irrigation water. Where such water is available, staple crops especially wheat are grown. These are the population centers. The rest of the land is thorn-scrub desert and is used for marginal grazing and a little dry farming.

The area covered by the forest is an irregular tract of about 480 square miles about 15 miles north and east of the sea and from 500 to 1,741 feet above sea level. Its maximum length is some 44 miles and the width varies from 5 to 24 miles. Narrow fingers of forest extend out into the surrounding country. The land is intersected by several low ridges, with the higher hills,

mostly of volcanic origin, basalt and trap, rising abruptly in the north and tailing off toward the south or south-east. The highest land is oriented along a north-west to south-east line. Five rivers rising there and flow generally south or south-east with one flowing off to the north-west. These larger watercourses with their numerous smaller tributaries have cut gulleys or " nalas " of varying depths through the forest. Soils show considerable variety. Fairly rich " black cotton soil " is found in some of the lower forest areas, along some of the large streams, and in part of the cultivated " revenue lands " adjacent to the forest. The people who farm these " revenue lands "—for which they pay rent to the Government—live in permanent villages of stone houses surrounded by fences made of stone or thorn and usually located just beyond the forest boundaries.

In some of the hills there is virtually no soil cover. Infertile, reddish soils are found especially in the north.

Vegetation.—The vegetation of the Gir Forest may best be considered as falling into three main formations : the central core is a dry mixed deciduous forest composed mainly of teak ; surrounding this is a wide belt of thorn scrub ; and both of these are intersected by long narrow ribbons of evergreen riverain vegetation.

Mixed deciduous forest—dry teak forest. The principal tree is teak (*Tectona grandis*) which covers roughly half of the forest area. The best merchantable timber has long since been harvested. What remains is mostly second growth or rejected scrub timber, contorted by indiscriminate branch cutting, grazing and burning, described by an Indian forest officer as " a forester's nightmare ". Here and there in the almost pure stands of teak are groups of banyan trees (*Ficus* sp.) standing green and aloof on their many trunks. Other common trees are ebony (*Diospyros melanoxylon*), laurelwood (*Terminalia tomentosa*), flame of the forest (*Butea frondosa*) and karanj (*Pongamia glabra*). There is very little undergrowth. Except for the contorted aspect of the much misused teak, the appearance of the forest in the dry season is much like that of an open deciduous forest of northern Europe or north-eastern United States. Openings through the forest are common ; in fact, the forest appears more open than closed. Where any grass remains, species of *Aristida* and *Heteropogon* are conspicuous.

Thornscrub.—Probably half the forest area is covered by thornscrub which varies from dense acacia thickets to almost bare ground. This formation surrounds the teak stands, except

where cultivation enters the former forest core. It is also found on the hills and here and there through the teak forest proper. Most conspicuous plants are the acacias, *Acacia arabica*, *A. catechu*, *A. suma*, *A. ferruginea*, and *A. leucophlaea*. The first, *A. arabica*, " babool ", forms dense forests over 25 to 30 feet high. Candelabra (*Euphorbia* sp.) and *Sterculia urens* trees stand out above scrub brush. Ber (*Zizyphus jujuba*) is one of the more common bushes, often occurring as isolated clumps in otherwise bare ground. Other species found interspersed with the acacias are *Soymida febrifuga*, *Adina cordifolia*, *Boswellia, serrata*, *Carissa* sp., *Emblica* sp., and *Garuga* sp.

Riverain.—The larger rivers are more or less permanent, and there is apparently permanent sub-surface water along some of the tributary streams. In the nala bottoms and extending for some yards on each side, the perennial moisture supports vegetation that is significantly different from the rest of the forest. Here the banyan, karanj and laurelwood trees are joined by jambudo (*Eugenia jambolana*), simul (*Bombax malabaricum*) and a variety of evergreen bushes and creepers. Where water is present, it is often edged with rushes. The result is an evergreen strip, often dense, cutting through both teak and scrub forest, which provides the only real cover for wildlife during the dry parts of the year.

Location of the Lions.—The whereabouts of the lions within the Gir seems dependent on the food supply—that is livestock—with the vegetation characteristics more or less incidental. The greatest concentrations are those found near the permanent revenue villages on the forest edge and outside it. Wynter-Blyth's surveys show movements of lions from time to time corresponding to movements of people with their livestock. Presumably, a lion requires an area that is fairly open, with at least enough cover provided by vegetation or terrain, both to stalk its prey and to lie up undisturbed. A handy water supply is also necessary. During the heat of the day the lions usually lie up in the nalas, but they are also reported to do so in the isolated *Zizyphus* or acacia clumps, when no nala is available. During the wet season there is probably no lack of cover within the forest, but at that time many lions are reported to leave the forest proper and to stay on hilltops or in open fields. The herders and foresters told me they believed the lions moved to escape the insects, especially the mosquitos, that accompany the annual flooding of the lower parts of the forest. The forest has widespread notoriety for malaria during the monsoon period,

and since grass is available outside the forest during this time, the herders move out with their livestock. It appears reasonable that the lions, when they leave the forests, are following their food as much as fleeing from insects. Wynter-Blyth believes that the lions are following their natural propensity to wander, returning to the forest in the dry season because water is available there. Whatever the reason, the lions do wander some distances. Several have been reported at Junagadh, 17 miles away, and one wild lioness actually walked into a cage in the Junagadh zoo. Others have been killed at greater distances from the Gir, and some wanderers have been reported every year from places 11 and 14 miles from the forest proper.

Within the forest boundaries there is a gradation of habitat from dry, coverless ground to dense, evergreen thickets. Lions may be seen wandering through any of these areas, of which few offer the necessary conditions for permanent occupation. To help understand the ecology involved, I classified the forest area from the standpoint of lion habitat. The factors considered included resting cover, ambush cover and visibility for lions, as well as suitability for prey species.

I. Open areas, dark soil with very sparse grass cover, brush kept out and grass kept down by grazing; the only dry season cover is provided by very occasional termite mounds or small acacia clumps, 2 to 4 feet high; visibility virtually unlimited. Wet season grass would provide fair stalking cover.

II. The same, with scattered small acacia or *Zizyphus* clumps with grass growing within them; clumps still too small to provide any but occasional cover. Visibility unlimited.

III. The same, with 6 to 8 feet high acacia scattered each 20 to 30 yards; open below grazing line but shade provided by umbrella-like tops. No secondary growth or regeneration. Visibility unlimited.

IV. Rather vast areas completely devoid of trees or cover over three to 4 feet high. Effect from distance is of cover of moderate thickness; but closer inspection reveals scattered, thin brush clumps, mostly a thorny conquest of badly overgrazed pasture land. Very little grass. Visibility at 3 feet—150 to 200 yards, at cow height—unlimited. Topography is rolling country or low hills. Sheet erosion, bedrock showing especially on gentle slopes. Fig. 1.

V. Large areas of red, virtually bare soil and black bedrock; umbrella-like low acacias scattered throughout, no cover below grazing line, virtually no grass. No secondary growth or regeneration; visibility unlimited. Fig. 2.

FIG. 1.—Habitat type IV. Low, open, thorn scrub.

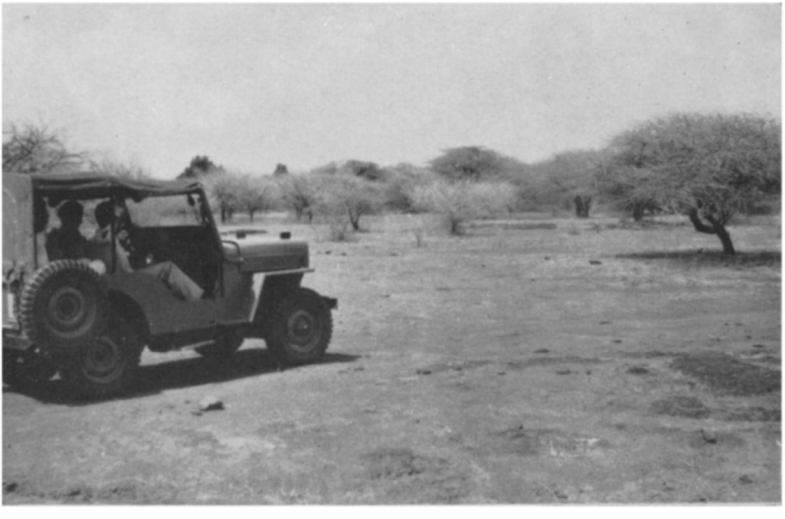

FIG. 2.—Habitat type V. Bare ground, scattered acacias.

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FIG. 3.—Habitat type VI. General Aspect.

FIG. 4.—Habitat type VI. Seclusion cover provided by clump of *Zizyphus*.

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FIG. 5.—Habitat type IX. Scattered acacias with a light stand of grass. Note the charred stump in the right foreground ; fire as well as grazing plays a role here.

FIG. 6.—Habitat type X. Mixed second growth protected from the worst overgrazing

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FIG. 7.—Habitat type XI. Second growth teak forest; fairly open with some brush and grass, scattered older teak and banyan trees.

FIG. 8.—Habitat type XII. Teak forest. Note single banyan tree in centre background, stock trails, rock showing through leaf covered forest floor.

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VI. Areas around hills, beyond fringes of fields or denser forest; 20 to 30 per cent of ground covered by round, dome-shaped clumps of *Zizyphus* or *Carissa*. Clumps are 3 to 6 feet high, and three to six feet in diameter at base, some reaching 10 feet. Ground between is bare, very little grass. Occasional lone banyan or acacia trees stand high above with no regeneration apparent. Brush clumps are very thick, with grass and brush regeneration within them where it is protected from grazing. Topography is flat or gently rolling. Effective visibility about 75 yards between clumps. Figs. 3 and 4.

This area is much used by lions during hot periods when they can find shade and concealment within the depths of the larger clumps.

VII. Areas almost identical with type II and probably covering more land, but all clumps are thorny acacias, the more edible and less armored species apparently all being grazed out. This area probably offers less resting cover because of the impermeability of the clumps, and possibly less effective stalking cover because there is less food to attract prey animals.

VIII. Areas dominated by low *Acacia arabica* maximum height about 15 feet. Trees either grouped in patches 30 to 50 yards across, or more open stands over large areas. Trees 2 to 10 yards apart but top foliage above the grazing line often is interlocking providing a continuous canopy. Virtually no grass or brush. Shade provided, but little cover; only obstructions to visibility are anthills, acacia trunks and fallen limbs. Lions are not reported here.

IX. Areas dominated by large acacias, reaching heights of 20 to 25 feet; trees widely enough spaced so that canopy is not interlocking; ground cover is a light stand of grass. Good grazing here, both wet and dry season; habitat for nilgai and four-horned antelope.

Lions reported to hunt here but there is not enough cover to hold them permanently. Fig. 5.

X. Areas of protected second-growth. These are lands badly overgrazed and overcut, in process of replanting by the Forest Department. Low thorn fences and occasional checks by the foresters discourage some of the grazing, so vegetation is not completely grazed down, as it is in open areas. The vegetation, consisting of grasses, thorn scrub, and plantings of acacias and other trees, is not thick, but fairly continuous. Cover is excellent for lions and food plentiful for prey animals. Lions reported very common here. Fig. 6.

XI. Areas of second-growth teak. In early stages these are

rather open, with young teak, brush and grass with an occasional old teak or banyan trees standing above. Such areas provide cover for lions and food for prey, even if grazing is somewhat limited. Later the teak crowds out much of the other surface cover, the thickets of young teak 6 to 12 feet high providing neither cover nor food for herbivores. Fig. 7.

XII. Teak forest. Most trees are not fully mature, but the aspect is of a mature forest, with the trunks and shed leaves constituting almost the only ground cover. Visibility is unlimited. Tree tops interlace, forming a solid canopy with complete shade when in leaf. Terrain flat or rolling, often with rough volcanic rocks showing, due perhaps to accelerated erosion because of the shortage of ground cover and the lack of canopy protection during part of the rainy season. Grass grows mostly in glades or other openings, but the only cover is provided by occasional clumps of other vegetation or by nalas. Chital and sambar, monkeys and pigs are the most conspicuous wildlife in this habitat, or more properly, in its edges or glades. Few lions are reported in it. Fig. 8.

XIII. Deep, major nalas with permanent water. These are up to 20 feet deep, with steep and very densely overgrown sides. Large trees, especially banyan, jambudo, karanj and simul grow in the nala bottoms and provide support for various creepers. Water is always present in running streams or nearly connected pools. Rushes often edge the water. Bed rock often shows through in the stream bottoms. Vegetation is very dense, evergreen, and apparently follows the lowering water level all year. It varies in width from a strip a few yards wider than the water to bands up to 100 yards wider than the nala proper. Bird life is rich and varied, and smaller mammals are much in evidence. Most lions are reported to live in these areas. They have fine cover, along with food to bring in prey species. Most important, probably, is the water which attracts and keeps other animals here in the dry season. The nala bottom may be over 100 yards wide, though it is often much less. Fig. 9.

XIV. Lesser nalas, dry or mostly dry. These are up to 10 feet deep with hard mud banks and the remains of pig wallows where the last water remained. Islands of evergreen vegetation surround large banyans or other trees. This is really a complex of types caused by seasonal water in the nala which appears to concentrate the dominant vegetation from surrounding areas, without much changing the species composition. This area of concentration extends from the edge of the evergreen broadleafs, where they exist in the bottom, out some 10 yards on either side

of the nala. Because of the lack of water, these areas are of lesser dry season importance to the lions than the previous type.

XV. Plowed fields fenced with stone walls or candelabra trees. The fence rows often provide good cover for small animals and birds, but are of little use to lions except as stalking concealment.

XVI. Barren, desolated land, grazed completely bare and trampled hard near villages, nesses and watering places. Nesses are the temporary homes of the herders, consisting of one or more reed and wattle hut surrounded by a thorn lion fence. Each evening the stock is driven into the nes for protection. Figs. 10 and 11. There may be banyan, *Terminalia* or other tall trees, but absolutely nothing within reach of livestock, from goats to camels. These areas extend a good quarter mile around their centres and farther along roads. Concentration of livestock and the gathering of wood for fire and building bring about this condition. An incidental effect may be the protection this desolation affords the nearby inhabitants from lions, since there is no cover at all. This does not eliminate lions from the area, but reduces the chances of people and their livestock stumbling into lions at close quarters.

XVII. Roadways. These may be just tracks, not affecting the habitat, or they may be deeply worn below the level of the surrounding land, lined either by stone fences or by narrow bands of forest vegetation, vestiges of the forest that has been destroyed by cultivation. Here there is grass and brush among the trees and fine ambush cover is provided for lions. Roads and paths are so much used by lions that Wynter-Blyth uses the signs left on them as the basis for his lion censuses. Fig. 12.

Types I to X are in the thorn scrub; XI and XII in teak forest; XIII and XIV, riverain. XV, XVI, and XVII are extreme man-modified areas, but it must be remembered that the whole forest, as it stands today, is strongly man-modified. so that every remaining habitat is in some degree a product of human land use. The descriptions of thorn scrub especially spell out the impact of overgrazing on the forest form. It will be evident from the descriptions that much of the area provides hunting ground for lions at some season, but that there is a shortage of seclusion cover in the dry season. I would say that adequate seclusion cover is found only in some 5 per cent of the forest area.

Lions are found throughout the forest area, but the majority follow their primary sources of food, the domestic livestock. Other needs, as I have previously mentioned, include water, at least a little stalking cover (provided by vegetation, terrain, or

even human fences) and concealment where the lions may lie up after kills and in the heat of the day. The food supply in the form of livestock is virtually unlimited.

Water is available all year both in nalas and from livestock watering troughs which the lions will use. So it is unlikely that competition or stress within the lion population would arise from competition for food or water. A possible source of social stress is what amounts to competition for seclusion. It may well be that the factor that would limit the Gir lion population is a social one, involving the number of neighboring lions that lions will tolerate. If so, the key factor in the physical makeup of the forest would be the amount and location of seclusion cover that is available at the critical time of year, the dry season. If the lions' requirements along these lines were known, it might be possible to manage the lion population through manipulation of the vegetation cover in the forest.

There is not much seclusion cover in the Gir in the dry season and my impression is that a figure of nearly 300 lions is high, for that reason. On the other hand, a relatively short visit to the forest does not provide adequate basis for close estimates of a wildlife population about which so little scientific information is available. Another census is due in 1960.

Human Land Use.—The Gir Forest is important to man in several ways. It is locally believed that its presence influences the weather, and that the weather has become progressively drier as the forest has been shrunk by cutting and grazing. The forest certainly provides a watershed for the several rivers that rise in its highlands and, being the only real forest on the peninsula, it probably is a significant factor in the water table of Kathiawar.

Some of the teak is harvested each year under the supervision of the Forest Department. Although inferior for most purposes this contorted teak is highly valued for small ship building and most of it is exported to the Middle East for that purpose. Firewood and charcoal are minor products. Grazing is the most conspicuous use of the area.

The forest is almost wholly government owned. Adjoining the forest in the lower, more arable areas are cultivated revenue lands. Within the forest there is a large population of professional herders, known as Maldharis, semi-nomadic people who graze large herds of water buffalo and some zebu cattle. They milk their stock to make ghee, the clarified butter that is the basis

of their economy. Moving from place to place to follow their food and water supplies, they build their temporary nesses.

The human population in this part of India has greatly increased during the last century. Along with this has come an increase in livestock. By the mid-1800's the Indian Forest Service wrote of the extreme overgrazing throughout north and western India, and expressed fear of large scale land deterioration if grazing controls could not be enforced.* As the grazing intensity increased and the forage available decreased, more and more grazing pressure was put on the best areas—the forest lands.

Wherever I went in the forest, herds of rangy, half-starved zebu cattle and water buffalo were always in sight. In addition there were the draft bullocks of the cultivators and lumbermen, and a few herds of goats and camels. Estimates of the present bovine population of the Gir run between 30,000 and 80,000 head. Accurate counts have been difficult, both because the herders are somewhat nomadic and because they do not seem over anxious to pay the small government grazing tax levied on each animal they declare.

There are no specific data on the grazing capacity of this kind of land. However, the Indian Forest Service has said that figures from areas of nearly comparable rainfall and vegetation in the western United States seem to be applicable.* The most comparable range type from the western United States seems to be woodland-chaparral or oak-savannah land, with an annual rainfall average of about 20 inches. Here, for sustained production, 24 to 36 acres per animal per year are required. The American figures are based on range Herefords, which may be roughly compared to the Indian zebu cattle and draft bullocks. Most of the domestic animals in the Gir, however, are water buffalo. These require more than twice as much fodder as the zebu. Indeed, in this part of India, for each 35 pounds of fodder required by the zebu cattle or draft bullocks, 80 pounds are required by domestic water buffalo.*

Accepting even the most modest estimates of the livestock in the Gir, there can be only ten acres per animal per year which would seem to be critically low even for cattle, and much more so for buffalo. These conditions have resulted in extreme overgrazing. The ravenous animals have first eaten all the palatable grasses and low brush, and then turned to the lower branches of trees, even grazing off the hanging aerial roots of banyans.

* K. M. Gorrie, 1946.

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Through much of the forest, between the grazing line on the trees and the ground level there is virtually nothing growing but bare stems and trunks. Most tree reproduction is eaten, so that when the mature forest dies or is cut, it is not replaced but thorn scrub takes over. With continued overgrazing, the scrub eventually gives way to desert.

The Gir is one of the last surviving forests in this part of India, and since the 1880's it has shrunk from over 1,200 square miles to 480. It lies in a wide desert-scrub belt that surrounds the Great Thar Desert.[1] Since 1870 this desert has been advancing at the rate of a half-mile a year along its entire Indian perimeter. The shift to desert is not due to climatic change or to spectacular blowing of sands, but rather to a steady deterioration of the land, primarily through overgrazing (Gorrie, 1946 and [1]).

From the standpoint of wildlife, the effects of this land abuse are drastic. In times of drought water competition is serious. During the Great Kathiawar Famine of 1899 when livestock from surrounding lands were concentrated in the forest, " almost all the game in the Gir Forest died " (Wynter-Blyth, 1951). Overgrazing by domestic animals removes food available to wildlife during the critical dry period. It equally removes the cover, drastically reducing the areas where wildlife may seek refuge. As in other areas where wildlife is in contact with concentrations of domestic stock, transmission of disease becomes an important factor. Little is known about disease in the past, but in December, 1956, Gee said that many of the wild deer and antelope had died of foot-and-mouth disease.

Most significant is the destruction of the forests themselves. As the forest goes, the scrub and desert that remain are untenable for the forest forms of wildlife, even if they could find sufficient food. Consequently, the wildlife has been almost eliminated, even in an area such as the Gir where hunting has been a minor factor for 60 years. Where grazing has been most severe and desert has taken over, the lion's available range has been reduced by that much.

Wildlife, which one would expect to be the lion's source of food, has almost been wiped out by earlier hunting and present day competition for food with domestic animals. Species present in the forest include chital (*Axis a. axis*), sambar (*Cervus unicolor*

[1] Data concerning climate and vegetation in relation to the spread of the Thar Desert, as well as figures on the advance of the desert since 1870, were received from discussions and correspondence with representatives of the Botanical Survey of India, Indian Forest Service and the Indian Department of Meteorology.

niger), wild hog (*Sus scrofa cristatus*), chinkara (*Gazella g. bennetti*), four-horned antelope (*Tetracerus quadricornis*), nilgai (*Boselaphus tragocamelus*), monkey, porcupine, fox, wild cat and leopard. Estimates on the numbers of these animals have varied, but in general all wild animals, except for porcupine and monkey are fairly scarce. During my time in the forest, I saw only three chital, two small herds of nilgai and chinkara, one hog, several porcupines and wildcats and a large *Varanus* lizard. Only monkeys were common. From careful checking of signs as well as questioning people living in the forest, it appeared to me that the populations of all the deer and antelope were extremely low. The very few animals I did see were surprisingly tame. If they were any indication it would appear that the animals do not fear poaching. This further emphasizes the role of domestic stock in reducing wildlife, unless one chooses to blame the lions for the shortage of their wild food. This does not appear impossible to me, if close on 300 lions actually do live in the small forest area, but it also does not seem very probable, when the lions have such an easy source of food in the vast number of domestic stock.

Wild food of the lion probably includes antelope, deer and hog. The last may be the most important at present, due to the scarcity of the others. There is much disagreement among Indians concerned over the role of the leopard, or panther. Some feel strongly that leopards should be killed because they compete with the lions for wild food. Others feel equally strongly that leopards should not be killed because they control the porcupine and monkey, neither of which lions take. The proponents of the latter idea say that leopard's kill is mostly limited to smaller animals, dogs, birds, porcupines, monkeys and that they only take a few small deer and antelopes. There is doubtless truth in both arguments, and so little is actually known about the matter that without further study on the spot, it would not be possible to reach a satisfactory conclusion.

According to the figures I was given, which are more modest than some of those published, the lions kill between 10 and 20 domestic animals a day, mostly buffalo with a few zebu and bullocks. Large as this number seems, it could not decrease in the least the total livestock population in the forest. The herders are reported not to kill any of their animals and the best efforts of the lions would fall far short of even matching the normal annual increase in the herds.

The herders seem somewhat fatalistic about the lion depredations, possibly considering the lions' take as a sort of informal

tax for the privilege of grazing in the forest. They speak with some annoyance of the lions' habit of sitting near the nes in the evening, choosing their dinner from the stock being driven in. Whatever the truth of that complaint, the lions have been so long and so well protected that they are amazingly indifferent to man. One night an old male lay for 20 minutes a few yards from where my Indian hosts and I were nervously digging out our jeep which had been stuck in a hole.

The villagers and herders report that stock are taken at all times of the day, but that the preferred time for hunting is at dusk. At that time the lions often catch cattle or buffalo that have not been herded into the lion fence surrounding the villages or nesses. If, as is stated, buffalo make up the bulk of the kill, it must indicate considerably laxity on the part of the herders, because I was often told how a herd of buffalo would stand together to ward off lions, even going so far as to charge those near them. Lions also kill goats and camels and a man of the forest department told me of having two horses killed at noon a week before my visit.

There have been various proposals to pay compensation to the herders and villagers for the stock the lions eat. With the revolutionary political and social changes that are taking place in modern India, the expressed desires of these people must be considered more than they were in the days of absolute rulers. In time, if herders and lions continue to share the forest, some sort of compensation may become a political necessity, but it might well result in the number of old and sick livestock reported lost rising considerably. This problem of compensation is one of the several difficult problems that must be solved if long term lion management is to be effected.

In spite of their apparent lack of fear of humans, no lions in the Gir have been proven maneaters for about 50 years. During and just after the great Kathiawar famine when wild game and domestic stock were much reduced, there was difficulty with maneaters. In two years, 1901 and 1904, Junagadh State recorded 60 humans killed and another 19 mauled. It is " unlikely there was any great decrease " in the intervening years, and at the same time active maneaters were reported in the neighboring small states.

By 1913 or so, presumably because of the increased numbers of wildlife and livestock, the lions reverted to quadruped dinners and " never again are they heard of as a menace to human life " (Wynter-Blyth, 1950). In recent years the only difficulties between men and lions have arisen from wounded or

FIG. 9.—Habitat type XIII. Deep major nala with permanent water.

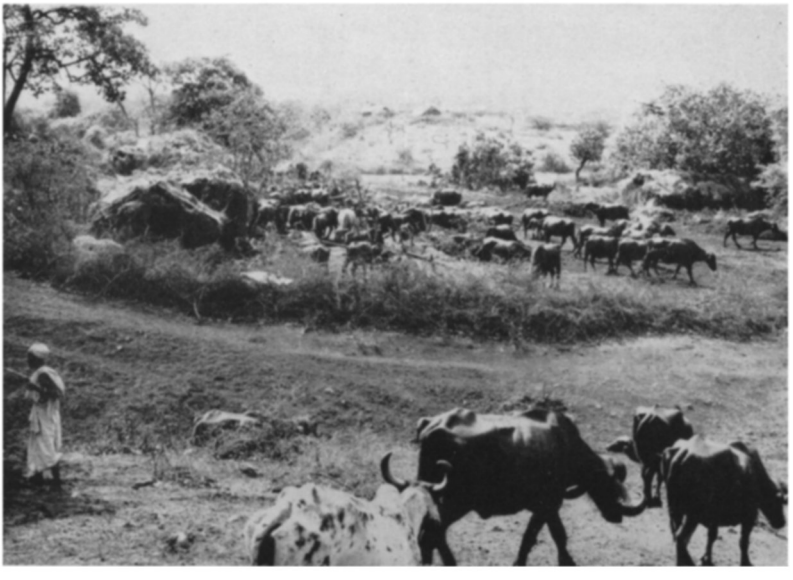

FIG. 10—Buffalo and zebu being driven into a nes for the evening. Most of the livestock are inside the thorn fence. To their left and right are the reed and wattle huts of the herdsmen.

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FIG. 11.—Chavan herders at a village watering trough.

FIG. 12.—Habitat type XVII. Roadway worn deep between cultivated fields. The trees and other vegetation edging such roads are vestiges of the forest that existed here before the fields were made.

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FIG. 13.—Ditch-and-berm planting and erosion control technique. Ditches are dug across the slope with the earth piled at the lower edge to form the berm. Tree shoots are planted in the loose earth.

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much-molested lions, or from attempts by herders literally to drag a cow from a lion's jaws. A sort of reciprocal *laissez faire* attitude seems to prevail between the herders and the lions; the herders remaining fairly tolerant or resigned to the lions' depredations in their stock, and the lions for their part leaving alone the herders and their more closely watched herds. This certainly does not appear due to the lions' fear of the herders, nor to the deterrent effect of their nes fences. One lioness recently jumped over a seven-foot village wall, and the average nes thorn fence I saw was only 4 to 6 feet high, just enough to discourage the cattle inside from going out.

The State Forest Department administers and manages the forest. Their operations are aimed at improving the forest, especially the teak stands, while keeping an eye out for the interests of the lions. To these ends they carry out controlled cutting operations, reforestation, erosion control, and a little grazing control, especially on the newly planted areas. Teak, usually in the form of root-shoots, makes up about 80 per cent. of the plantings. For erosion control in the nalas, the Forest Department builds stone check dams, and in places, small concrete dams. The latter also provide additional dry weather water sources. On the open eroding hillsides, rather large scale ditch-and-berm plantings have been carried out. These consist of a ditch about 8 feet long by 1 foot deep and wide, dug at right angles to the slope run-off. Excavated earth is piled along the downhill side and seedlings are planted in it. Fig. 13. Local labor is used throughout, supervised by forest officers trained at the Indian Forest College at Dehra Dun.

At the time of my visit a large dam was being constructed on the Hirwan River at Kamleshwar. This was a considerable project, the dam rising 70 feet to impound a lake of one and a half square miles. Hand labor was being used for most of the project, 1,200 people being required for three seasons. This large extra human population must have had some effect on the forest wildlife. More significant, probably, will be the ecological effect of such a body of water in an area as sensitive to moisture balance as the Gir. If this becomes a recreation spot, there will be other factors affecting wildlife to be considered.

IV. Conclusion and Recommendations

Overpopulation of domestic livestock appears to be the primary threat to the lions. The herds are continually increasing and by their overgrazing are constantly reducing the supply of forage both for themselves and for wildlife. Not only are they

driving out the wild ungulates; they are destroying the forest itself. Even if the human and livestock population remain at their present level, land degradation will continue and forest land available to humans and lions will continue to decrease. At the present rate of attrition, the Gir should only last another twenty years, during which time there will be more and more contact and conflict between men and lions. It will be very difficult to convince the herdsmen that the lions' culling of their cattle is in their own best interests, however true that happens to be. Political opposition to the lions because of their cattle killing is growing and maintaining the lions is becoming a political problem, as well as a biological one.

The ideal solution would be to reduce the grazing pressure to the point where a balance is struck between livestock, forest growth and wildlife. Before that can be done the balance point must be known, and effective ways must be found to reduce the domestic herds.

Overgrazing is one of Asia's biggest land use problems. Livestock represents wealth. Herders often need the largest possible herds merely to provide subsistence for themselves. In India the Hindu religion which prohibits killing bovines further complicates the situation, often preventing meat packing and marketing as well as culling. The vagaries of local politics, as they affect grazing control and land use, add to the difficulty.

Even if these problems were solved, there is not at present sufficient information available on which to base effective long term land use and wildlife policies. Remarkably little is known of the ecology of the vegetation, the wildlife, or the domestic livestock involved.

Through enlightened and effective protection, the Indian governments, past and present, have provided a sanctuary where the Indian lion has survived and thrived while the species was exterminated throughout the rest of its vast former range. The protection has been based almost entirely on prohibition of killing the lions themselves; it cannot take the form of positive management of the lions and their ever-changing habitat until the basic ecological studies have been carried out and more is known of the animals' habits and requirements. Consequently, in my opinion the greatest present need is for an ecological study of the Gir Forest and its lions. The proposal for such a study was approved by the International Union for the Conservation of Nature and the Indian Board for Wild Life in 1956, but it has not yet been possible to implement them.

Although the ecological study is needed to define what is or

may be the balance point between livestock numbers, forest growth, and wildlife, it is immediately obvious that there are too many domestic animals for the long term benefit of any of the interests concerned. Determination of ways to reduce the livestock pressure on the Gir Forest is more in the field of the Indian administrators than of ecologists. It would seem to me that the attention of those responsible should at once be directed to solving this difficult problem. One approach would be to give the forest area either park or sanctuary status. It would probably not be possible to exclude all grazers and their herds from the forest, but the numbers of people and livestock and the conditions of their occupancy could be strictly prescribed. Access to the area by air from Bombay is easy and rapid. Lions can be a prime tourist attraction and, properly managed, numbers of visitors would adversely affect neither the lions nor other wildlife of the area. With the accessibility of the forest, the ease of viewing the wildlife and the great interest it holds for visitors, both Indian and foreign, the Gir Forest could become one of India's most successful national parks.

The lake to be produced by the Kamleshwar dam will probably bring about significant changes in the ecology of the surrounding forest. If these results are carefully observed and recorded, they should provide data of great help in future management of both vegetation and wildlife in the Gir. Therefore I believe that it would be most desirable for the Forest Department to survey the pre-lake conditions and then keep subsequent periodic records of what changes take place in the surrounding flora, fauna and soils. Photograph stations, vegetation maps and sample plots would prove of particular value.

ARABIAN ORYX; ARABIAN WHITE ORYX; WHITE ORYX

Oryx leucoryx Pallas

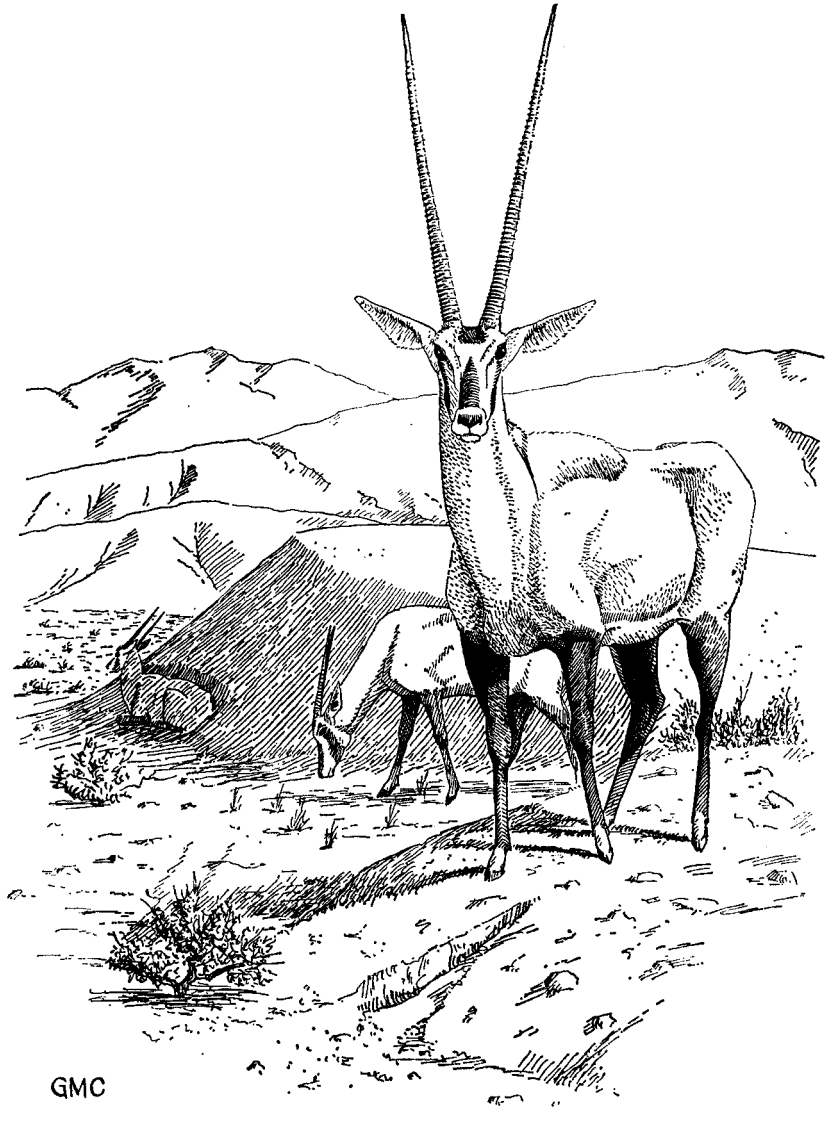
I. Description

The Arabian oryx is a medium sized antelope with a distinct shoulder hump, and a conspicuous tufted tail. Males stand about 40 inches high at the shoulder. The horns are annulated, virtually straight and 20 to 29 inches long, the females' horns being longer than the males'. At a distance the animal appears pure white. White is in fact the main color, but the legs are tan to chocolate brown; the tail tuft which may hang to or below the hocks is black or brown; there is a black stripe through and extending down from the eye; and a dark brown or black patch between and just in front of the horns, with another longer patch on the nose extending from just below the eye level almost to the nostrils. There may be a fawn colored stripe on the flank.

II. Distribution and Status

Former.—It seems probable that in past centuries the Arabian Oryx ranged throughout the greater part of the Middle East. For the purposes of this report, however, I am limiting " Former distribution " to the period since 1800. At about 1800 the oryx was still found in Sinai, lower Palestine, Transjordania, much of Iraq, and virtually all of the Arabian peninsula. According to Murray (1866) the oryx " . . . extends eastwards into Arabia and Persia ", but there is some question as to just where his border between Arabia and Persia lay. Since there is no other reference to oryx ranging much east of the Euphrates at that period, I have not included Persia in its distribution. During the 19th and early 20th centuries the range of the oryx was rapidly pushed back toward Saudi Arabia, and by 1914 there were only a few survivors outside that country. The increased human activity in the deserts and coincident increase in firearms that attended the world war, brought about the extirpation of most of those remaining northern oryx. There were a few reports of oryx in Jordan into the 1930's, but by the mid-1930's the only remaining populations were in the Nafud Desert in northern Saudi Arabia and the Rub al Khali in the south.

In the late 1930's the Arabian princes had access to oil money and automobiles, which they promptly put to use in hunting the



THE ARABIAN ORYX

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desert wildlife, especially oryx. The motorized onslaught increased rapidly until, in the early 1950's, as many as 300 vehicles were employed in a single hunt. By 1950 the northern oryx population was practically extinct and the remaining oryx were scattered around the most remote southern portions of the Rub al Khali.

Present.—Except for Saudi Arabia, the Arabian oryx is extinct throughout its former range. The last reported sightings of oryx or oryx tracks in the Great Nafud were in 1954 ; indeed it seems probable that the oryx is exterminated everywhere but in the extreme southern Rub al Khali. One hundred to two hundred animals may still survive in that area. The hunting pressure remains unabated, with both surface vehicles and airplanes being used, so it is probably only a matter of a few years at most until the wild Arabian oryx is totally exterminated.

III. Ecological Notes

History and causes of extermination.—The oryx traditionally has been very highly regarded by the Arabs. It has great strength, endurance, and bravery, and there has been the belief that by killing it, or by eating it, the Arab would partake of some of these qualities. This belief is reflected by one common name for the oryx which means " Doctor of the Arabs ". The properties attributed to oryx flesh by the Bedouins are rather similar to those attributed to rhinos by South-East Asians. It is supposed to recondition old bodies, take care of stomach ills, help to heal fractures and other injuries, and to impart strength.

And, since the animal was quite wary, it took a good hunter to kill one, before the days of modern weapons and vehicles. A hunter's skill and fame were somewhat determined by the number of oryx he had taken, and not enough were killed for the population to suffer. Pieces of hide were wrapped around a rifle butt or used as a decoration and display of social position.

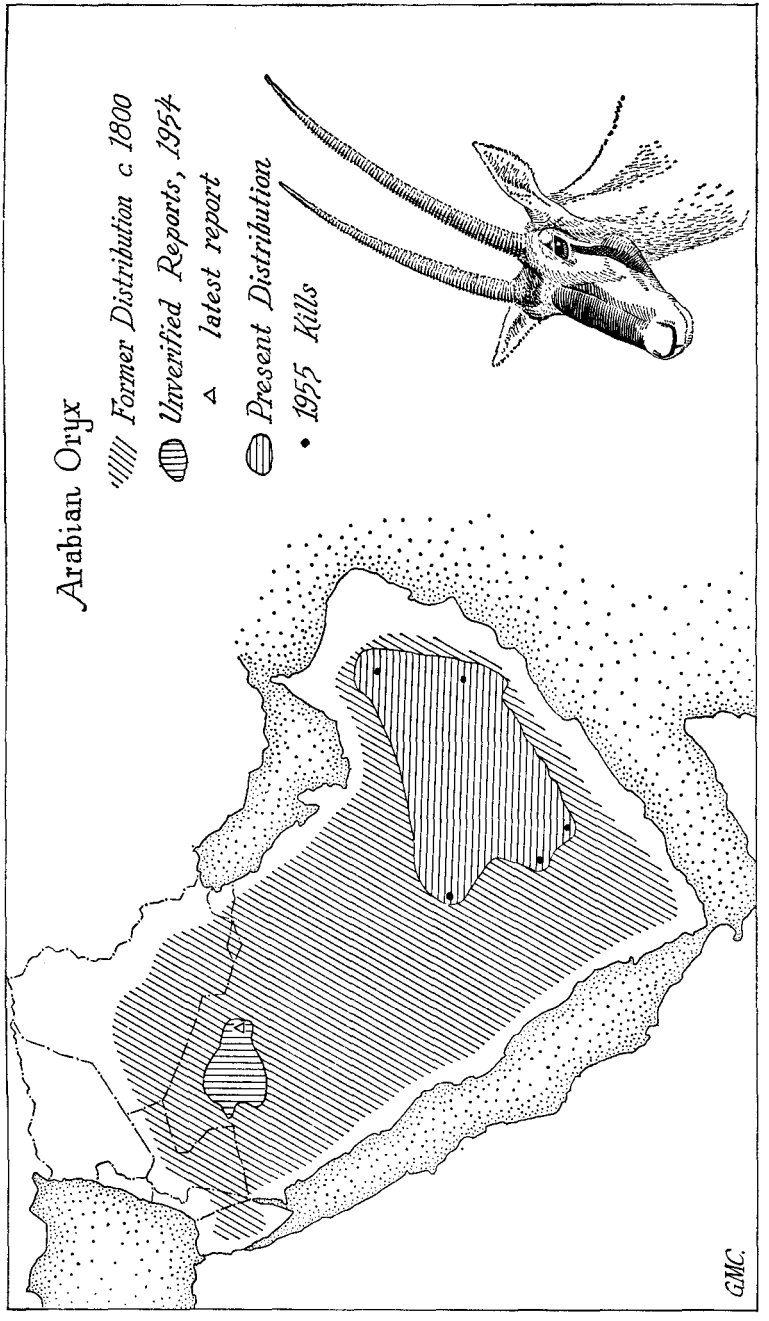
The oryx were hunted in the winter or autumn when it was cool enough to use camels in the desert. At that time of year a camel can travel for about 15 days without water, and the method was to follow a set of oryx tracks for days until they got close enough for a shot. Other methods were to stalk the oryx at noon when they were sleeping in depressions on the side of dunes or hillocks ; or to walk them up at dawn or dark, risking a jump shot.

When automobiles and high powered rifles came in, the oryx stood little chance. The animals preferred gravel desert or hard sand where their speed and endurance best protected them

against enemies on foot. These surfaces were also suitable for high speed driving ; unless the oryx struck off into rough terrain or soft sand, he could be driven down. The members of the royal family received most of the oil royalties from the foreign oil companies and they did the greatest damage to wildlife. They have taken hunting trips with as many as 300 vehicles, although the average for an oryx hunt was 40 to 60 cars and trucks. Of these, some are hunting cars, usually large convertibles, and the rest are supporting supply vehicles carrying food, supplies and servants. The hunting cars fan out into a sort of skirmish line, driving down and shooting virtually everything that moves. Here repeating shotguns are used more than rifles, and often the animals are run until they drop from exhaustion and their throats are cut by servants. St. John Philby told me of riding with the late King Saud when the king personally shot over 100 gazelles in a day. Between January and April 1955, in a royal goodwill tour around northern Saudi Arabia the retinue numbered 482 cars at one point. Hunting was a part of this excursion and this vast army of vehicles spread out, crossing the desert, and shooting everything.

As a result of the incredible blood lust of the past 20 years, virtually all of the abundant wildlife of Arabia has been extirpated from areas accessible to automobiles. In the last eight years the Arabs have been also using airplanes for hunting. It is hard to see how any animal can survive this attack. The Arabian Ostrich has been exterminated, the bustards greatly diminished, three species of gazelle (once present in vast herds) reduced to the danger point, the cheetah almost exterminated and the oryx reduced to one or two hundred individuals.

It is rare to find an Arab from Saudi Arabia—or for that matter, from anywhere in the Middle East—with much sympathy for the concept of conservation of wildlife or vegetation. Instead, one gets the impression that hunting success, based on kills, is of considerable importance in a complicated social and cultural way ; the prevailing idea being " if I don't kill it now, somebody else will ". There is strong historical basis for this outlook ; in a nomadic culture where raids, exploitation, and uncertain weather were for long the rule, such a policy could result from the needs of survival, as well as of economics. Moreover the motorized slaughter was introduced by foreigners and is still practiced by them. Hunting from a car was first practiced by British clerks on off days when they did not have time to go out and hunt in the " proper manner ". Subsequently the American Oil companies brought in fleets of desert cars ;



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then the royalties from oil production financed the Arabian princes who followed the American and British example in a grand manner. Although American personnel of Aramco (the Arabian American Oil Company) no longer take much part in this motorized hunting, there are many examples from the Middle East and Africa where Americans on foreign aid programs, British, French and Germans have conspicuously indulged in motorized slaughter. So that before one flatly condemns the Arab people for their attitude towards conservation and wildlife, one should consider their historical and cultural setting, the example set by foreigners in their country, and the not unparallel histories of wildlife slaughter in other countries.

Habitat.—The people in Aramco's Exploration Office and Research Division at their base in Dhahran kindly offered to take me to the remote remaining habitat of the oryx, in the southern Rub al Khali, but I had no time to go. However, I did take the opportunity to study Aramco's excellent ground and aerial photographs of the area, and to visit former habitats in the region nearer Dhahran.

Much of the former habitat of the oryx was in the gravel plains. These are large expanses of almost flat alluvial country, the surface a hard erosion pavement, often studded with rocks of varying sizes. These plains surround isolated hills or mountains, and in parts of Arabia they form basins between mountain ranges. In places the plains are much cut by wadis, gullies, or canyons, which collect the water when it rains. There is a certain amount of vegetation in these wadis where it has not been cut down by the Bedouin. On the plains proper there is a surprising amount of vegetation. It is widely dispersed, largely woody and often of thorny growth, and there is very little that could be considered good forage for any animal. After the infrequent rains, there is a sudden appearance of grasses and annuals whose seeds may have lain dormant for years. Animals such as the gazelle and oryx move about following the rains to take advantage of this growth.

There are two great expanses of true sand desert in Arabia, the Great Nafud in the north, and the Rub al Khali in the south. The two are almost connected by the Dahana, a 20 to 50 mile wide sand strip some 700 miles long. The Great Nafud is an irregular desert some 250 miles long by 170 miles at its greatest width. The Rub Al Khali is a vast expanse of sand extending over 750 miles in length and with an average width of some 250 miles.

In the west of the Rub Al Khali the sand is in long, parallel ridges " irqs ", extending unbroken for hundreds of miles. Farther east these change to shifting, crescent dunes that finally break up into a jumble of dunes and sand mountains, hundreds of feet high. Beyond this area the desert is flat with steep pyramidal dunes scattered at random across it. The flat base of hardpan or rock, showing through between the sand ridges, dunes, and sand mountains, supports the only vegetation, scattered brush, with grass and herbs after rains. A wide band of gravel plains surrounds the sand area and this breaks up into rough hills cut by numerous wadis displaying violent water erosion gullying.

The oryx used to be found on the flats between the softer sand of the dunes and ridges. Hunting has forced them out to the wadi-cut edges where vehicles cannot travel, and the last oryx today are probably in this rough area immediately south of the sand.

Life History.—Very little is known about the life history of the oryx. They are nomadic animals, their movements determined by rainfall. They have been tracked 30 to 40 kilometers in a day, moving in a practically straight line towards an area of recent rainfall. Males and females are usually seen together. The Bedouin recalled seeing small herds of a few dozen animals, but in late years they had never seen more than 9 at a time and usually a pair or a pair with young. Mr. J. Ames of Aramco's Exploration Office saw 30 to 40 together in a particularly remote area just following rain. That is the largest concentration reported in recent years.

According to the Bedouin, the favorite oryx food is " zahar ", an annual resembling a buttercup ; and they are also fond of a sweet grass, " nussi ". They will eat dry vegetation if necessary, and are often found in areas of tall grass. The two captive oryx at Dhahran are each fed a gallon of wheat and barley mix a day, with some dry alfalfa hay ; green food made them sick. They are given water but no salt.

The Bedouin and the Aramco men insist that the oryx don't need to drink, and one Bedouin name, " jawazi ", means " he who drinks not ". The Aramco people have seen them in the Rub al Khali, up to 200 miles from any known water.

Oryx are strong diggers, using their hooves. I observed this with the captive oryx who were occasionally digging into the very hard surface of their enclosure. The Bedouin say that,

lacking other shade, the oryx dig little depressions in the side of hills or dunes and lie up in them during the heat of the day.

Other Animals.—In the past there may have been some competition for food between oryx and the numerous gazelle, but with both animals so much reduced in numbers, this can no longer be so. Oryx shun man to such an extent that there seems no possibility of disease being transmitted to them from domestic livestock.

Predators used to abound in Arabia, cheetah, leopard, wolf, lion, hyena, jackal, fox, and wild cat. Motorized hunting and the modern rifle have exterminated or so depleted these animals that they probably present no danger to the oryx.

Conclusion and Recommendations.—The worst menaces to the survival of the oryx, in order of importance, are : The motorized hunts of important Saudi Arabian personages ; Aramco's and other oil company's drivers and soldier escorts, who are Arabs and over whom by government decree the companies have little control ; armed Bedouin and visiting foreign hunters. The last oryx are being squeezed even in their remote refuge, with Aramco moving in from the north, the Iraq Petroleum Company in Hadhramaut, and City Service Richfield in Dhofar crowding them in from the south.

There is no evidence of any inclination on the part of the Saudi Arabian government to protect the animals. Politics and communications being what they are, legal protection might have little effect anyway. Consequently it is probable that in a few years the oryx will be extinct in Arabia.

I believe the only way to assure survival of this interesting species is to transfer some specimens to a safer habitat. Oryx have done well in zoos in different parts of the world, in temperate as well as tropical and desert climates. Capture of the animals should present little trouble if planes were available for spotting and possibly herding, and cars for catching and roping them, as is done in Africa with some animals. This should be done as soon as possible, to be assured of finding enough animals. A final site for the oryx could be found after the animals were captured as they could be held safely in a zoo for a time, and would in any case have to be held temporarily to satisfy the quarantine requirements.

An ecological study of the animals in the wild would be desirable, and would be especially interesting, scientifically, in order to determine their water requirements, but I do not feel that such a study is of first priority ; first, because of the urgency of capture while there are still some specimens available,

and second, because oryx have proved hardy and adaptable in captivity and so have a good chance of survival, even with the limited available ecological information.

The most desirable compromise would be to have these operations arranged and supervised by an ecologist who could get valuable information in the process of location and capture, and who might then remain some months longer to follow up the study.

SYRIAN WILD ASS

Equus hemionus hemippus I. Geoffrey

There is considerable doubt as to whether one or two forms of wild ass were found in the region of Syria-Palestine-Arabia-Iraq. Harper states that " The question . . . is a very troublesome one, especially on account of the meagerness of material and information ". If two forms did exist, one was the Syrian wild ass, the smallest of modern horses ; and the other was the larger onager. There is also considerable evidence that they are both the same animal. Harper (page 367) reviews the problem and its literature.

The latest report of any wild ass in that area in the literature is from Jebel Sinjar in 1927. Col. Meinertzhagen told me he had seen them in 1914 and again in 1920 at Hada, 30 miles west of Mosul. This area is now cultivated, as is all the land between Mosul and Aleppo with an annual rainfall of 250 mm. or more.

My enquiries throughout the area, in Arabia, Iraq, Jordan, Syria and Lebanon brought absolutely no evidence that any such animal exists now or has existed in the recent past. Nor did they bring any indication as to whether there was one or two types of ass. Occasionally reports come of asses which have gone wild but which might be mistaken for truly wild ones. Many Bedouins whom I consulted said of wild asses " Our fathers have seen them ".

The one area where such an animal might still exist lies just north of the Syrian-Turkish border midway between Aleppo and Mosul. This area is little known and virtually uninhabited, and I could get no reports from there at all. A large animal might live there, but it seems highly improbable.

From my enquiries and the literature I conclude that the truly wild asses that inhabited the greater Syrian desert have been extinct for 20 to 30 years.

PART II

FURTHER INFORMATION ARRANGED BY COUNTRIES

INDIA

General

During their administration of India, the British established an effective and comprehensive system of reserve and sanctuaries. These were usually administered by the Forest Department whose officers and rangers were trained at the fine Forest College at Dehra Dun.

When India gained independence, reserves, sanctuaries, forest and hunting regulations were among the things temporarily rejected as colonialisms. During this period a great deal of damage was done to India's wildlife and forest resources, but fortunately the new government maintained the Forestry Service with its core of well trained Indian personnel. Gradually they have regained control of the situation and the Department's status now is essentially what it was before independence.

During the difficult post-independence period the strongest voice for conservation in India was the Bombay Natural History Society. In 1952 the Indian Board for Wild Life was founded, and these two organizations are the primary force for conservation in the country. It was they who, assisted by the UNESCO Science Co-operation Office in New Delhi, saw to my arrangements, itinerary, and visits during my Indian stay. I am particularly indebted to Dr. Salim Ali and Mr. Abdul Ali of the Bombay Society, the late Dr. Hora, then Secretary-General of the Indian Board for Wild Life ; and Dr. Ellis, of the UNESCO Office.

In 1958 the Wild Life Preservation Society of Northern India was founded. The founder and vice-president is Mr. P. D. Stracey, of the Forest Research Institute and Colleges at Dehra Dun. For many years Mr. Stracey has been one of Indian wildlife's most effective protagonists. The new society's journal is called *The Cheetal.*

Conservation

Under the provisions of the constitution of the new Indian Union, all matters relating to wildlife, forests and parks are the responsibility of State governments, not the central government and there is not, as yet, much uniformity in the manner in which these matters are handled. The consequences of this are felt particularly in the fields of law enforcement and national parks policy.

Enforcement of Laws

One of the greatest conservation problems to be faced is the enforcement of conservation laws. There are some excellent laws on the books, based on sound wildlife management. But throughout most of India, the wage scales for the subordinate staffs are so low that it is difficult to see how these men live on their wages only. This situation must encourage poaching; for the sale of meat and trophies can be very profitable.

Lack of money also prohibits the engaging of adequate numbers of enforcement staff and often of their proper training. Guards and wardens are unarmed and the surprising thing is that they have any effect at all on the activities of armed and often aggressive poachers.

Another country-wide problem is the lack of adequate fines or other punishment for wildlife offences, often making it profitable to poach even if the offender is apprehended. Equally important, where adequate measures are provided for by law, is the lack of judiciary co-operation in using them. Undoubtedly the activities of the state wildlife boards are having some effect on this problem, as members of the judiciary are often on these boards. In Kashmir, for instance, the Chief Justice of Kashmir is a member of the Kashmir Board of Wild Life.

Personnel Training

In India, as well as in most other countries of Asia and Africa there are no facilities for training either subordinate or supervisory wildlife staff. Since most wildlife work is done by the Forest Department, lectures on wildlife problems and conservation are being introduced into the curriculum at the Indian Forest College at Dehra Dun, where all the forest officers for India receive their training. This is a fine first step. The desirability of maintaining permanent wildlife training staff at the College is very clearly realised by the authorities there, but such staff are not yet to be found in India. Desirable as it would be to be able to send Indians to other countries, for instance to the United States, to receive training in wildlife management, this would only have a very limited effect. The best way would be to establish wildlife training courses in India, presumably at the Indian Forest College where everybody affected could be reached. To accomplish this, however, either foreign training or foreign teachers would at first be necessary.

Indian Board for Wild Life

In 1952 the Indian Board for Wild Life was set up with the following functions :

1. To devise ways and means of conservation and control of wildlife through co-ordinated legislative and practical measures, with particular reference to seasonal and regional closures and declaration of certain species of animals as protected animals, and the prevention of indiscriminate killing.

2. To sponsor the setting up of national parks, sanctuaries and zoological gardens.

3. To promote public interest in wild life and its needs.

4. To prevent cruelty to animals caught alive.

5. To advise government on policy regarding the export of animals, animal products and trophies.

6. To perform such other functions as are germane to the purpose for which the board was constituted.

The Board consists of representatives, both official and unofficial, from all parts of India. It meets at least once in two years and the work done is presented in the subsequent volume of the official bulletin of the Board, *The Indian Wild Life Bulletin*.

Among the difficulties which faced the new Board were :— It was advisory, with final decision and execution of most of its recommendations at the discretion of individual state legislatures. Its membership was purely honorary and required a considerable drain of time on the over-worked but not over-paid officials of the new government. There is a part-time secretary of the Board at New Delhi.

As a result of the Board's recommendations, most Indian states have set up State Advisory Boards or Committees for Wild Life, usually on the lines of the central Board. The success enjoyed by these state groups has been proportional to the interest taken in them by the State Ministers involved. Undoubtedly they are having their effect, for instance on law enforcement.

For further information on the activities of the Indian Board for Wild Life and the wildlife problems facing India, see the writings of E. P. Gee in the *Journal of the Bombay Natural History Society*, and in the *Oryx* and in *The Indian Wild Life Bulletin*.

Bombay State

In most states wildlife problems are handled by the Forest Department. In Bombay State, however, a separate State Wild Life Department was established, under the Forest Department. It was placed under a State Wild Life Officer, and operates under a comprehensive Wild Life Protection Ordinance.

Instrumental in the creation of this ordinance and the department was the Bombay Natural History Society. It is the oldest organization concerned with wildlife and conservation in India, and has been operating for almost 80 years. It is the only full-time, comprehensive Indian natural history organization and it has had, and continues to have, a most active part in Indian conservation activities. Its *Journal** is the best organized source of information on all phases of natural history and conservation in India.

National Parks

One of the principal reasons why, in most states, the Forest Department has been given the work which in other countries would be done by game departments, is that in India most wild life is found in the forests. Thus duplication is avoided and co-ordination effected. It was so even in the days of Artha Shastra, 300 B.C.

Culturally, historically and traditionally, national parks have had an important place in India. They were recorded at least as early as the 3rd century B.C. (Asoka, Pillar Edicts, 250 B.C.).

National parks are the responsibility and province of the individual state governments. At the time of my visit there were several "national parks" and many more sanctuaries and reserves for the preservation of wildlife. The sanctuaries are formed by State Governments, by formal notification, whereas national parks are created by acts of the state legislatures. As either can be revoked by the same means by which they were formed, the national parks are the more permanent and desirable.

The Indian Board for Wild Life is considering the establishment of a nation-wide criterion for national parks to assure that the parks would be uniform and truly national in character, not merely enlarged state parks. Up till now, planning of national parks has varied according to the state involved. For instance, the question of exploitation within the parks—lumbering,

* *Journal of the Bombay Natural History Society*, Bombay, India, 1902 to present.

grazing, hunting, fishing, even human occupancy—is decided by the State Government. Local politics and local finance may determine the policy of a park.

In view of financial exigencies and the varying situations involved, it has been suggested that any nation-wide national park plan should allow certain exploitation, but provide for inviolable sanctuaries within each park. These would be wilderness areas where no exploitation of any kind would be allowed.

THE WILD ASS OF KUTCH : INDIAN WILD ASS *Equus hemionus khur* Lesson

The Bombay Natural History Society reports that there are still several hundred of these asses. Most of them live in the Great Rann of Kutch, northward from Bombay. During the war some of the animals were captured to breed " super mules " for the army, but since then they have been unmolested. Virtually all known ecology of these animals is in an article by Salim Ali in the *Journal of the Bombay Natural History Society*, December, 1946.

Harper considers this ass to be of the same race as those in Persia and Baluchistan. Its range probably was once continuous, from India through Persia : I talked with Pakistanis in Karachi who remembered its occurrence in the deserts near there in earlier years. But with increasing population and greater intensity of land use, the Kutch population became isolated. They are apparently in no immediate danger.

INDIAN CHEETAH ; INDIAN HUNTING LEOPARD *Acinonyx jubatus venaticus* Griffith

This is the same animal that ranges, or used to range, throughout the Middle East. The last definite report of cheetah in India was in 1951 when 3 were shot in one night. One subsequent sighting of a pair in Hyderabad has been unpublicised in order to protect them. For all practical purposes the cheetah may be considered extinct in India.

BROW-ANTLERED DEER ; MANIPUR RACE OF ELD'S DEER, MANIPUR THAMIN *Cervus eldi eldi* M'Clelland

This deer is usually considered to be the same race as the Burmese Thamin, although it is now considered to be different subspecies in India (E. P. Gee, 1954).

Since the deer was first described, the valley of Manipur has been the only area in India where it has been known. During the war it was much poached, as it was in Burma, both by the military and by the local villagers. The horns found a place in the Chinese medicinal trade and both meat and hides were used.

After the war it was assumed to have been exterminated but in 1951 one was shot. In 1952–1953 the Thamin was rediscovered near the Logtak Lake in Manipur and, in 1954, a sanctuary of 10 square miles, called Keibul Lamjao was established to protect the wild population. This sanctuary was visited by Mr. E. P. Gee in 1959 and he will go there again in 1960 to complete his report on the deer.

In 1956 a pair were sent to the Calcutta Zoological Gardens where they are thriving.

For the state of this deer in Burma, see page 262.

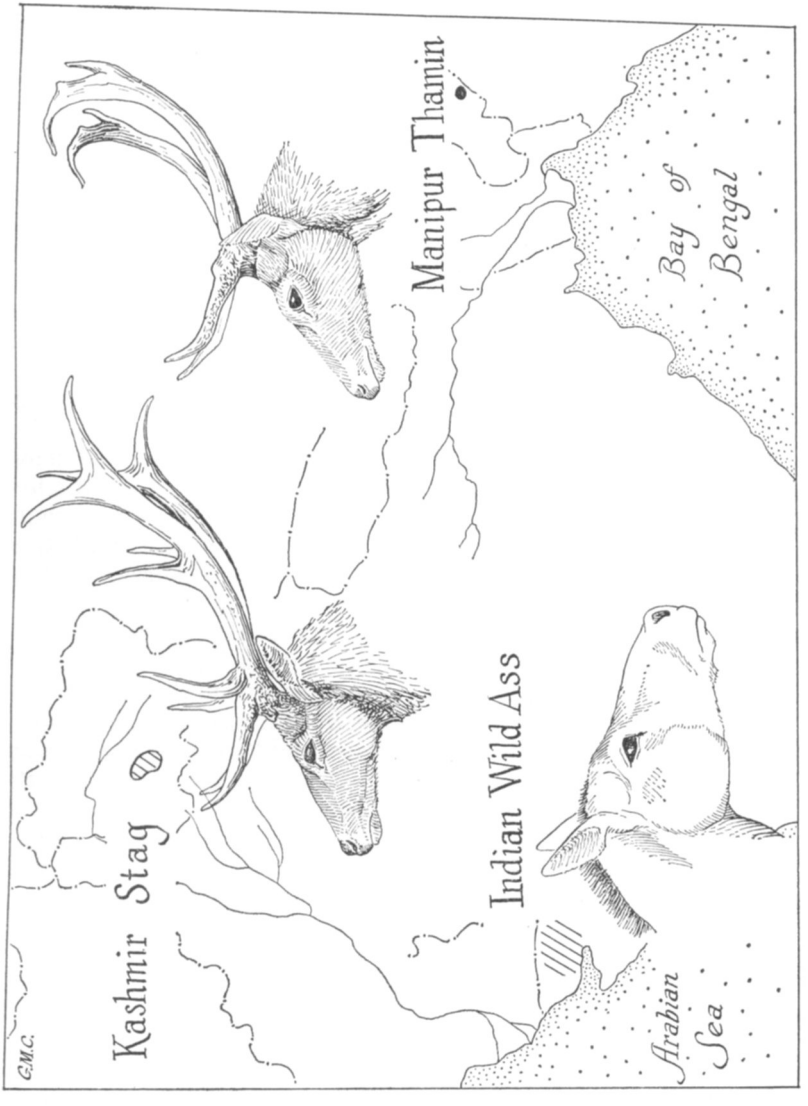
KASHMIR STAG; HANGUL; KASHMIR BARASINGHA *Cervus elaphus hanglu* Wagner

Description.—The Kashmir Stag is an Himalayan relative of the European Red Deer and the American Wapiti. It is one of the largest of the deer family, standing a little over 4 feet at the shoulder and weighing four to five hundred pounds; the antlers may reach over 4 feet on the outside curve. These magnificent antlers, as well as the stag's spectacular environment, have attracted hunters from all over the world. Consequently the stag has figured prominently in the history of the area.

Range.—The stag or hangul has a restricted range in the densely forested mountainous area immediately to the north and east of the Vale of Kashmir. In previous centuries it was apparently more widespread in Kashmir.

In summer the hangul moves up into the mountains, occupying an area above the village of Aru, between 9,000 and 13,000 feet in altitude. In the fall, as the weather turns cold and the snow starts, the stags migrate westward, down to the Vale of Kashmir. Here the hangul winters in a series of valleys starting 18 miles east of Srinagar at an elevation of some 5,500 feet.

Status.—Before Indian independence the stag was considered the property of the Maharajah of Kashmir. He and his predecessors had laid out an intricate system of rakhs (game reserves and sanctuaries) to protect Kashmir's then abundant wildlife. Recognizing the migratory habit of the hanguls, the maharajahs located the rakhs to protect them in their winter, summer and migratory ranges. The rakhs of upper and lower



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Dachigam include most of the stag's present winter range, beginning at the floor of the Vale and extending up the first mountain range. Adjoining the Upper Dachigam Rakh, starting at an elevation of 11,000 feet, and extending north-east along the stag's migration route to their summer range above Aru, is the Chumnaiye Sanctuary. Under the maharajahs, these and Kashmir's other rakhs were carefully supervised and patrolled, no human entry being permitted except by special permit. But several factors then combined against the stag. A period of lawlessness, aggravated by difficulties with Pakistan had followed the independence of India and many well armed troops were moved into the area. Moreover, a large number of gun licenses were issued ostensibly for crop protection. There were but few tourists or organized hunting parties, which had helped to supervise areas little visited by regular guards. In all, the government was more than occupied by other problems and close supervision of the rakhs lapsed.

Until recent years the stag has never been considered particularly rare. It is not mentioned by Harper in 1945. But by 1955 its status was considered so precarious by the Indians that members of the Bombay Natural History Society and the Indian Board for Wild Life urged that I include a survey of this animal in my itinerary.

On a very brief visit it is impossible to obtain a very accurate idea of such an animal's population. But during the winter of 1957–1958 a census was made when nearly all the deer were concentrated in their winter range in the valley. In Lower Dachigam Sanctuary 325 were counted and 218 elsewhere in the valley. It may safely be said that there are altogether about 550 head. (E. P. Gee, *Oryx*, December, 1958).

During my visit everyone without exception whom I asked about the stag predicted its coming extinction if the present conditions remained unchanged. Villagers, herders, traders, and forest guards from the mountains, as well as government officials and others in Srinagar all agreed that the hangul was fast disappearing. Since my visit the position seems to have improved.

Problems Involved.—Most of the remaining hanguls are believed to live within the Dachigam Rakhs and Chumnaiye Sanctuary. Most of the poaching is done during the winter when snow drives them down to lower ground.

One great difficulty in preserving them is the almost unrestricted use of "crop protection" guns by villagers and herdsmen. Damage to stock and crops by the black bear is very

real, and some sort of protection is needed, but the guns are kept and used all the year round, even during the winter when the bear hibernates. And it is during this period that the stags are most vulnerable. High prices paid for venison, especially by residents of Srinagar and the rest of the Vale, provide a strong incentive to poaching.

Hand in hand with the problem of crop protection guns is the difficulty of law enforcement. For one thing, the various reserves are not under a unified administration, so there may be a good deal of confusion both of legal jurisdiction and of applicable laws. Also, the game department of Kashmir, like that of most of the Indian states, has not sufficient funds either to hire enough personnel, or to pay high enough salaries to get well trained subordinate personnel. For these reasons most of the patrol men are unarmed, and are at a considerable disadvantage when dealing with well armed and aggressive poachers, to say nothing of an occasionally aggressive black bear. If game department guards had the training and weapons, much of the necessary crop protection could be undertaken by them, as it is in parts of Africa, and there would be no need for so many weapons in the hands of herdsmen and villagers.

It is said to be extremely difficult to get any convictions for stag poaching, and the fines imposed on conviction are less than what the poacher would realize from the sale of the meat; and, a most important point, the poacher retains his weapons. So poaching remains a profitable occupation.

The presence of large numbers of soldiers in the area is a continual threat to the Kashmir stag and to other wildlife. The stag's winter grounds are only a few miles from the large military posts near Srinagar. As the forest and game guards have no effective jurisdiction over soldiers' activities, this problem must be met at a higher level.

In the summer range country above the village of Aru, even though it is quite high in the Himalayas, there is a remarkably large human population with their domestic animals. I saw goats, sheep, cattle, mules, water buffalo, wherever I went in the Himalayas up to and above timberline, except in the Dachigam reserve. This has a four-fold effect on the stag in its summer range.

1. The herders have guns. Since they share the summer range with the stag, they have, and take, every opportunity to poach them.

2. The large numbers of domestic stock compete with the stag for food, which is sparse at these high altitudes.

3. The Gujars, one of the herder groups, take great pride in their large dogs which, they claim, run down and kill quite big stags.

4. Probably the most serious threat is from the chance of disease transmitted from domestic stock. In the past, when the stag population was higher, cattle-borne diseases are said to have almost exterminated it over portions of its range. Now with the limited population and range, and apparently increased numbers of livestock involved, the threat would seem to be much more severe.

The Game Warden and Conservator of Forests are well aware of most of the problems involved. In 1952 the Bombay Natural History Society made a series of recommendations on wildlife preservation in Kashmir.[1] It would appear that these recommendations, if applied, would have checked the subsequent decimation of Kashmir's wildlife. One of the most potentially effective measures recommended, though a very difficult one to effect, was the withdrawal of crop protection guns from the villagers during the winter, when there is no need for such protection and when most of the poaching takes place. In 1955 the Indian Board for Wild Life recommended that the stag be placed on the completely protected list. I believe this has now been done.

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[1] Salim Ali and R. C. Morris, *Recommendations of the Bombay Natural History Society's Delegation on the Subject of Game Preservation in Kashmir*, October, 1952

BURMA

General

Wildlife in Burma has suffered from military action during the past two decades. When the Japanese held the country they reduced the arms of the local people by imposing a death penalty for anyone found with a rifle. This had the effect of protecting the wildlife, for the Japanese themselves were not very fond of hunting and many animals apparently became rather tame.

When the Allies pushed the Japanese out, they hunted continuously and there are many records, even of automatic weapons being used on the game. As the Japanese took over the country, or part of it, twice, so the wildlife had the same rough treatment twice.

With the end of the war, insurgents captured many areas. As many were good Buddhists, they generally protected the game. They were also very short of arms and ammunition but when the Burmese regular army or the Union of Burma Military Police took over an area they had plenty of arms and ammunition. Usually coming from other parts of the country, they did not respect local taboos on killing animals, so again the game was shot out.

According to first-hand reports received throughout South and South East Asia, the pattern just described is typical of man's impact on wildlife throughout the area during the last 15 to 20 years. Periods of relative freedom from hunting alternated with periods of uncontrolled slaughter; after the formal war was concluded, the same pattern continued with the local strife between insurgents and government troops.

Most forms of wildlife could retreat into the densely wooded parts of all the countries involved. They suffered considerable losses but were not brought to the danger point. A few forms, however, were particularly vulnerable. Outstanding among these is the Burmese Brow-antlered Deer, which is discussed below.

In Burma, before the second World War, wildlife conservation was carried out under the direction of a Game Warden who was in the Forest Department but when World War II broke out, this post was discontinued. Unfortunately, it has not yet been re-established. There are good laws on the books; where they are enforced it is done by the staff of the Forest Department.

The " Conservation " discussion under the section on India apply largely to Burma also. Comments on problems of wildlife

conservation involving training, law enforcement, judiciary, pay, etc. are equally applicable to Burma. As in India, the best opportunity for training wildlife personnel is through the Burmese Forest Department training system.

Matters of wildlife and forests are the concern of the individual states. Some of these states have more autonomy than their Indian counterparts. They have, for example, the right to secede after a given period of time. This affects wildlife in that it makes even more difficult the achievement of unified conservation laws or planning.

BROW-ANTLERED DEER: BURMESE THAMIN: ELD'S DEER, *Cervus eldi thamin* Thomas

Once one of the most abundant deer in Burma, the Burmese Thamin became so depleted that even before the second World War it was feared to be on the road to extinction. The deer is big and fairly easy to approach and kill. It lives in or near the edges of open lowlands—just the lands that are first cultivated when people move into a new area. These factors combined to reduce its numbers to the point where Peacock wrote in 1933 " In the absence of sanctuaries there is nothing so certain as an early termination to the existence of the brow-antlered deer ".

The thamin has also the misfortune to live in the areas that were fought over almost continuously for more than a decade. The Japanese twice occupied its home range and were twice driven off it and after the war, reports of this large tame deer were so gloomy that in 1949 it was placed on the list of the most gravely threatened species.

At present the thamin's hide has no commercial value. Its flesh is eaten only by jungle people and poor villagers, because of the general belief that the eater of thamin flesh will be afflicted with white leprosy (leucordena)—in fact Burmese call this skin disease thamin kivet (thamin patches). There is not therefore, the economic demand for the thamin that there is for other hooved animals in that part of the world. Another point in the thamin's favor is the local belief that eating its flesh causes or aggravates venereal disease.

To get as accurate an estimate as possible of the present numbers of the thamin, I met the Burmese forest officers from all the districts or " circles " known to contain the deer. They were unanimous in thinking that the thamin was continually increasing. Forest Conservators from the two northern circles estimated roughly 2,500 animals and the Conservators from the lower areas added 300 to 500 more. This makes a total thamin

population for Burma of 2,500 to 3,000 head and is a considerable increase on previous estimates, but it must be remembered that mine was the first comprehensive, although second-hand, census of the animals attempted since the war. The Burmese government has declared it a completely protected animal.

The above figures for the thamin were considered at the conference of the International Union for the Conservation of Nature held in 1956 and the thamin was removed from the list of animals in danger of extermination.

INDONESIA

General

Starting in 1916 the Government of the Netherlands Indies established a magnificent system of nature monuments (wilderness areas) and game reserves (parks or management area). These included areas in Java, Sumatra, Borneo, the Celebes, Lesser Sunda Islands, Molluccas, and New Guinea. By 1938 these totalled 97 reserves and monuments protecting approximately 1,431,000 hectares (4,500 sq. miles). Initially they were administered through the Government Botanic Gardens at Buitenzorg (Bogor) and in 1935 the post of Nature Protection Officer was established. The first man appointed was Mr. Andries Hoogerwerf who held the post virtually alone until Indonesian independence. Under his direction the total number of reserved areas had, by 1947, risen to 120, most of them under the official supervision of the Forestry Service, the standing of the Botanical Gardens being only advisory. Until 1951, the Forestry Department had no Nature Protection Department but in that year, after Indonesian independence, a true Nature Protection Department of the Forestry Department was established. This was placed under the direction of Mr. Kushnadi, an energetic, enthusiastic young Indonesian ex-army officer. He had built up the department to a force of about 250 men by 1955; they were charged with managing the reserves and handling nature protection activities throughout Indonesia.

In the years following independence conditions throughout the Indonesian archipelago were very difficult for nature protection. With rival governments, military rule on most islands, and large numbers of well armed men under a minimum of civil rule, the nature protection authorities on Java found it difficult to manage their home reserves and wildlife laws, much less those on the other islands. Nature protection laws apply to all the islands, and the former system of parks and reserves is still recognized, but it is difficult to reach many of these areas and management of many of them is as yet impossible. Hunting regulations are under the control of the military in the areas outside Java and this has resulted in much damage to the wildlife resource.

A further difficulty is animal smuggling. Singapore is the world's greatest market for animals and animal products, and the laws are and have been such that illicitly obtained goods can often be traded with some ease. With the combination of

laxity in Singapore and unsettled conditions, and long coast lines in Indonesia, there seems little hope of any significant reduction in this trade in the near future. Its most valuable objects are rhinoceros horn and orang-utans.

The only really effective way to curb the trade in live animals would be by reducing the demand or by tightening the laws and their enforcement in Singapore. Periodically attempts have been made along both these lines: adequate laws are on the books in Singapore; and there have repeated resolutions, e.g. by the International Union of Directors of Zoological Gardens, urging accredited zoos not to display animals obtained in violation of the laws of their country of origin. The trade, however, continues.

The Indonesian government led the new governments of South-East Asia in the field of conservation, by establishing its Nature Protection Department in 1951, and since then has pursued an energetic, if necessarily limited, wildlife and wildland management program. The outstanding example of this work is the Udjung Kulon Reserve, which I have already described.

Now that political and military conditions and administration of the archipelago are becoming more settled, the Government is interested in the establishment of national parks as well as in restoring the management of their existing reserves and monuments. Dr. George Ruhle, naturalist of Hawaii National Park, is now in Indonesia studying the local problems of parks and reserves in order to help the Government to establish a National Park Service.

One of the largest problems facing Indonesian conservation is the lack of trained personnel. In Indonesia, as in most former colonial territories, wildlife protection and wildland management were carried out by men from the colonial country. When they left, the country was left with very few people with any training at all in conservation matters.

Indonesia has had a fine start in conservation in its system of reserves. Botanical Gardens organization and game laws, all originated with the Netherlands Indies Government. The Indonesian Government has wisely, and to the best of its ability in the face of most adverse conditions, maintained this legacy and improved upon it. There is a very great deal to be done, but if the present beginnings are continued, Indonesia may become the conservation showplace of South-East Asia.

EGYPT

General

Until about 1200 or 1300 A.D. Egypt had extensive forests principally along the Nile Valley, but also in wadis (valleys) throughout the country. Stringent and comprehensive laws were enacted at that time for the protection of these forests. But due to corruption and failure to enforce the laws, these resources were largely destroyed, and the process continues.

There are still some good forest conservation laws on the books, but constant demand for wood for charcoal and continual overgrazing by goats render them ineffective.

Where protection from grazing and cutting has been practised, Egyptian vegetation has shown it can recover rapidly, but such protected areas are few, small, and mostly accidental from the standpoint of conservation. Most were mine fields along the coast which were enclosed by barbed wire fences to protect people and livestock. The one exception is Wadi Rishrash, described below, which is quite large and has been protected for some 40 years as an ibex refuge or hunting reserve.

At the time of my visit there were virtually no organized conservation activities in Egypt, only a few individuals who were much concerned with the problems. One such was Mohamed M. Drar, Keeper of the Herbarium of the Agricultural Museum at Cairo, who has urged tree conservation for some 20 years.

Wildlife

In former years, there was a Zoological Section of the Ministry of Agriculture. Under this there were the zoological gardens and museum at Giza, the aquarium, the Zoological Survey, and the duties of inspection of municipal gardens and " preservation of birds, game, etc. ".

Before the war this Section carried out a certain amount of wildlife research such as bird banding, and desert survey and was responsible for enforcing the preservation laws. However, since the war the Frontier Division troops have had charge of this. From all accounts, most of them do not even realize this is part of their duties, they do not know the laws, and being on the desert with vehicles and guns, are often the worst offenders.

There are a few laws on the books protecting quail and " birds useful to agriculture ", but these are rarely enforced. Although it is illegal to do so, large numbers of quail and other birds are captured, usually by netting, when they land exhausted after

their trans-Mediterranean migration flight, and are subsequently sold openly in Cairo, Alexandria and other cities.

The war in the desert was destructive to animal life both through shooting by soldiers and subsequently by Bedouin who had collected guns and ammunition from the battlefields.

In Egypt, as throughout the Middle East, hunting from automobiles has greatly reduced the gazelles and other desert animals. Even one of the officials of the Desert Institute, which would be expected to be the most conservation-minded organization, described to me how he successfully hunted ibex from a jeep.

Wild Ass

Wild asses were evidently domesticated by 3,300 B.C. A slate palette from the Pre-Dynastic Period, one of the earliest pictorial records in the Cairo Museum, shows Egypt's first commercial exchange with Libya, traders taking asses. There are also painted scenes of hunting asses for sport as late as King Tut-ankh-amen.

The wild ass was once found over much of the Eastern Desert, occasionally ranging further west along the Sudan border. At present the only concentrations known are in the isolated mountain groups north of the Sudan between the Nile and the Red Sea. They apparently are also partly feral, as they are considered the property of the local Bedouin.

Wadi Rishrash Ibex Reserve

History

The area was created as an ibex reserve by Prince Kamal El Din Hussein, early in this century. He improved the water supply, planted some forage and palms, occasionally fed the animals and posted Albanian guards both in the wadi and around the very large area (approximately 20 by 10 miles) that was included in the reserve.

The Prince died in August, 1932, and the next year the reserve became the property of King Fuad. He protected the ibex, though he established large pigeon colonies in the reserve, apparently both for breeding stock and shooting. In the late 1930's as many as 50 ibex were seen together coming down for water and feed.

When the recent King Farouk took over, he turned the place into a " shooting preserve and country house ".

Description

Wadi Rishrash is situated about 80 km. south-southeast of Cairo, and some 20 km. southeast of Es Saff, a small desert-edge village 62 miles up the Nile from Cairo. It is a typical wadi, or gorge, cut into the scarp where the high plateau of the Eastern Desert drops 2,000 feet to the flat desert edge of the Nile Valley. It is a trough cut into the sand and limestone strata by an intermittent desert stream on its journey from the high plateau to the Nile.

Entering from the lower desert, the wadi mouth is wide, but it soon narrows from 200 to 300 yards. The walls, impressive vertical cliffs showing the horizontally striated sand and limestones, are broken here and there by tributary wadis and talus slides. Above are also rocky hills, much eroded.

The floor is that of a typical Egyptian desert wash—an aggregation of large and small stones with the stream bed of white sand. The basement rock is visible along much of the watercourse.

Fauna and Flora

The vegetation consists of scattered desert scrub with virtually no grass except higher on the talus slopes. There are small groups of dwarf palms, mostly on the side of the watercourse and a few single palms two to four feet high.

In such a wadi throughout the Eastern Desert region there are four types of growth form: ephemerals, evergreen perennials, summer-deciduous perennials and winter-deciduous perennials. So, although the wadi appears an almost bare desert, there is a continually changing vegetation richly varied, though sparse.

Plants most in evidence here on 30th April, the date of my visit were species of *Achillea*, *Acacia*, *Cassia*, *Tamarix* and *Ephedra*.

The animals found in the wadi are hares, jerboas (*Jaculus jaculus*), gerbils (*Gerbillus* and *Meriones*), spiny mice (*Acomys*), domestic camels, and ibex (*Capra nubiana*) if any remain. The only lizard I saw was a *Uromastix*.

At the entrance to the reserve two bronze statues of Bavarian hunters guard a place which seems to be deserted except for an old Albanian caretaker. Three giant beehive-like pigeon lofts look over the dilapidated shooting blind, half a dozen square buildings including Farouk's lodge (with two ornate double beds) and the small palm grove and oasis. The Albanian thought

Wadi Rishrash—Headquarters buildings and protected grove of trees at a spring.

Wadi Rishrash—Typical vegetation on wadi floor near entrance.

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Wadi Rishrash—Entrance, with bronze Bavarian statues.
View looking east.

the ibex were gone, but their trails down the steep wadi sides showed some recent use, and I was told of some Europeans who had not long before shot several ibex near here, on permit from the army.

At the time of the visit, the Egyptian Hunting Club was trying to obtain the area as a shooting preserve.

Although Wadi Rishrash is not the only spot in Egypt where the Nubian ibex is found it is—or was—its last refuge in northern Egypt. It is also probably the place of its greatest concentration in recent years. Wadi Rishrash still has importance as a preserve for indigenous flora and fauna and is particularly notable because of its 40 year history of protection, unique in Egypt. If protection of the ibex were enforced, these animals would probably increase to their former numbers and could constitute a valuable scientific and tourist asset.

SUDAN

The following notes refer to conditions up to 1958.

Wildlife conservation activities are carried out by the Game and Fisheries Department of the Sudanese Government. This Department has three branches :

1. Game Preservation Section,
2. Zoological Gardens Section,
3. Fisheries Section,

The Game Preservation Section which was reorganized in 1946, operates under the " Preservation of Wild Animals Ordinance and the Game Regulations ", published by the Sudan Government. They have the two-fold duty of protecting the game in accordance with the ordinances, and taking reasonable measures to protect the human population and its agricultural interests from the animals. They also administer the national parks and reserves. To do this the Section has 82 persons ; 72 game scouts or park and reserve guards, 2 park wardens, 2 elephant control officers and 2 directors at Khartoum. This leaves 4 responsible trained men in the field, for an area of over a half-million square miles. Every officer must spend a certain proportion of this time each year on safari. These safaris are largely on foot.

All visitors' safaris in the Sudan must be arranged through the Department or approved by it.

After the British officials departed from the Sudan Government, the Game Department was taken over by the Sudanese. They had been well trained by the British and the Department held considerable promise. Shortly after my visit in May, 1955, the rebellion, or " Mutiny ", in the southern provinces took place, followed by considerable disruption of government.

The present status of wildlife in the south is not known. Permission for foreigners to travel freely in the southern provinces has only recently been granted. The few reports that have come out of the area indicate that the effect of the mutiny and subsequent conditions has been devastating on the wildlife.

According to information obtained at the southern border in 1956, from 100 to 200 armed rebels were at large in the south. A few are still believed to be there. Their presence occasioned—and may still occasion—a three-fold threat to wildlife :

1. As the northern forces garrisoned in the south have control of most of the agriculture, the mutineers must " live off the land ", and being well armed, are or were undoubtedly eating game.

2. The armed and numerous northern troops in all probability shoot considerable game, both for " sport " and for food. It is unknown whether any restrictions on this are being enforced.

3. The generally unsettled conditions prohibited normal functioning of the Game Department either in protection of the game or the human population.

National Parks

General Regulations

Except Government officials on duty, no one may enter a park without a permit from the Minister of Animal Resources or from the Game Warden.

No animals may be hunted, killed or collected, nor may birds' eggs be taken, except under the direction of the Game Warden.

No work involving alteration or configuration of the soil or vegetation may be carried out except with written permission from the Minister of Animal Resources.

No introduction of animals is allowed except for transport of government officials or provided under government arrangements.

Except under control of the Game Warden, camping is strictly limited to established camp sites. All visitors' movements are strictly controlled by the Game Warden.

Entrance fees are prescribed by the Minister of Finance.

Dinder National Park.—This park of 2,470 square miles is forested; it lies between two rivers in flat, partially swampy land. It is particularly noted for roan antelope, buffalo, greater kudu, reedbuck, giraffe, with lesser numbers of tora hartebeeste, lion, leopard, elephant and hyena. The area was often mentioned by early writers as an outstanding hunting ground and was also on the traditional poaching path from Abyssinia. The poaching problem has always been difficult, especially so after the last war when there were unlicensed rifles in Abyssinia.

In 1946 an ex-army officer was appointed park warden with 10 armed game scouts and 30 Sudan police armed with rifles and bren guns. Poaching is said to have been stopped completely after four years of sporadic fighting.

Nimule National Park.—Originally a reserve, Nimule became a national park in 1913. It is a large flat area of 100 square miles, surrounded by mountains; and including mountains to the west and north. It follows the Nile northwards from where the river leaves Uganda at Fula rapids. The vegetation is typical

of that part of Africa; veldt, bush, tree-covered hills. It is particularly noted for the white rhino and giant eland, the latter more or less migratory. The rhino, elephant and buffalo are very tame and are easily seen in fairly large numbers.

Game Reserves

The purpose of the game reserves is to preserve either some special species of animal or all species in a certain area.

There were 14 reserves in 1955; 3 for Nile lechwe, 1 for wild sheep and ibex, the remainder for all species. No hunting is allowed in any reserve except by special permit from the game warden.

Wildlife

Nubian Wild Ass.—This animal is found primarily in two areas of Sudan; one within the great bend of the Nile, north of Khartoum, the other in the north-eastern sector.

There is considerable doubt whether the animals now considered " wild asses " in Sudan are truly wild or merely " feral ". The following evidence I secured supports the view that the true form of the wild ass no longer exists in the Sudan.

The present populations are in areas where Arabs fleeing the Italians are reported to have released wild asses many years ago.

The wild asses are reported to vary in color, just as domestic asses do. Domesticated asses similar in both color and size to the wild ones are found all over the country.

There are two kinds of domestic asses, the large " Egyptian " riding donkeys and the small pack asses. The wild ones are similar in all respects to the latter.

They are not hunted as food by the Arabs, who consider all wild asses their property. However, the Arabs do trap them at water holes for pack and riding use. They also tether domestic mares to be mated by wild asses at the water holes and complain that occasionally the mares are taken away by them.

A recently captured wild ass seen by Ibrahim Eff Khalil, Director of Department of Animal Resources was " Identical with other domestic ones in the possession of Arabs, except that it was fatter and in better condition, with no saddle marks or rope burns ".

The reports indicate that the herds of wild asses still existing are localized near certain permanent water holes and do not range far from them.

Nubian Ibex.—The ibex is plentiful, according to reports, especially in the Red Sea Ibex Reserve, where many visitors have reported them in recent years. They seem to be in no danger.

Oryx and Addax.—The oryx and the addax are found chiefly in the north-west deserts of the Kordofan and Darfur provinces. There is very little information available about this area; in recent years the game department has had no expedition there. The only means of access is by camel caravan.

The only recent reports are:

1946: by C. P. Ionides, a Tanganyika game ranger.

1948 and 1953: from officers of the Western Camel Corps of the Sudan Defence Corps.

The animals are mentioned in all these reports, and addax in some numbers—herds to 60—and the oryx in fewer numbers with more scattered individuals, although one herd of 25 was reported.

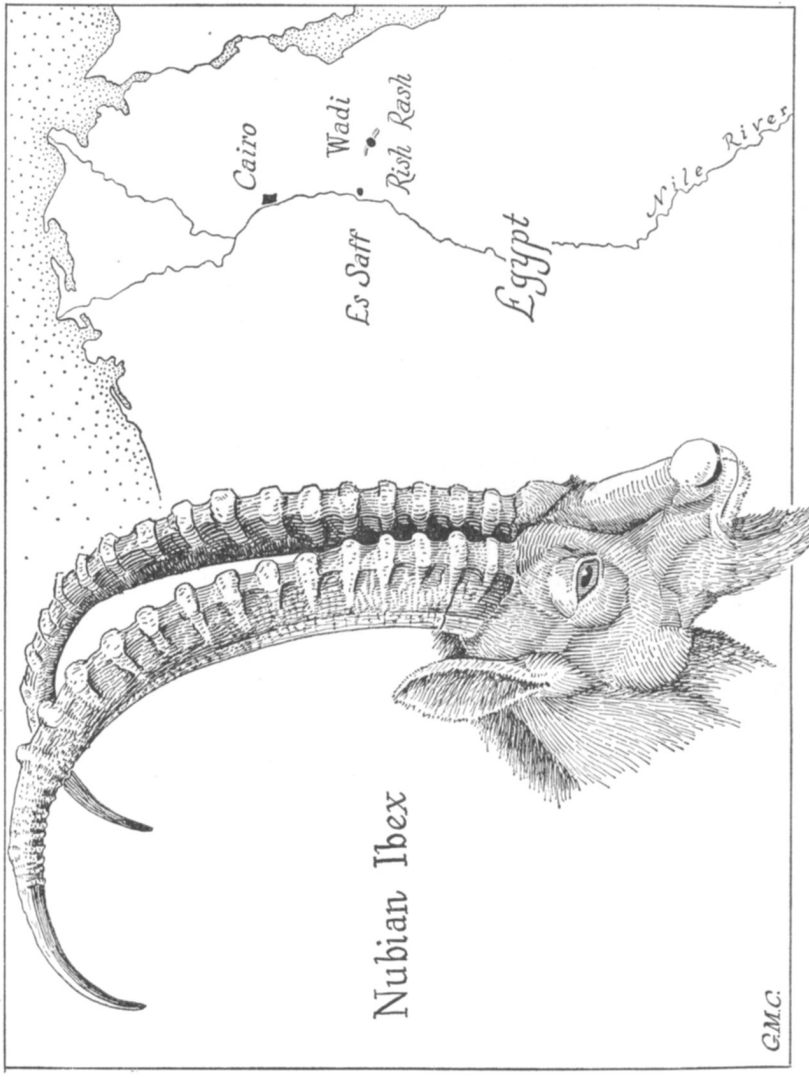
The principal threat there, where the animals are out of automobile range, is the desert nomads of several tribes (Kababish, Bedaget, etc.) who, when the weather permits, hunt the animals on camels with dogs. They run down the addax and oryx using relays of camels where possible. When the animals are tired and brought to bay by the dogs, they are hamstrung by the nomad's broadswords or speared. In addition to the meat, the hides are highly prized for the rope made from them. In the south-west Sahara the Tuareg use the skins for making shields.

The animals appear to be fairly independent of ordinary sources of drinking water, and are widely ranging, moving far distances following the available vegetation. These movements are probably regular enough to be considered migrations; the Bedouin count on finding them in certain areas at the same time each year.

The few westerners' reports indicate great reduction in numbers in late years.

Barbary Sheep or Udad (*Ammotragus lervia*) found not only in Barbary but in Kordofan.

These animals are found mainly farther east than the oryx and addax, and there is very little information about them. Indications are that being confined to much smaller areas than the oryx and addax their position is much more critical.



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LEBANON

General

Land Use and Vegetation.—In the historical past much of the Lebanon was forested. The higher parts, including most of the Lebanon and Anti-Lebanon ranges, were covered by pine, fir and juniper, with stands of the famous Cedars of Lebanon. The lower areas, the Bekaa Valley and the coastal flats and foothills were of Mediterranean type oak-scrub grasslands.

Today, only four stands of the Cedars of Lebanon remain. They are fairly carefully protected but are too small to be significant in the forest economy. The other forests, except those in the Bekaa Valley are found in more or less inaccessible areas at from 6,000–10,000 feet in both the Lebanon and Anti-Lebanon ranges. The most extensive area is in the Kammouha region in the north of the Lebanon range. Here one can still see at work the unchanged processes which have denuded the forest cover of the rest of the country:

1. The more or less virgin timberlands are first invaded by wood cutters primarily interested in the hardwoods for making charcoal.

2. Where accessible, and removal to areas of demand is practical, the better conifers are cut. The most recent demand here was during the war for the Beirut-Tripoli railroad. The valley floors are cultivated, intensively and more or less destructively.

3. The population pressure becomes too great for the cultivated areas on the valley floor and they become so abused that their yield is lowered to the point where it fails to fulfil the needs of the population. Cultivation then moves up the surrounding hillsides, removing all tree cover in the process.

4. The cultivation methods on these steep hillsides are extremely destructive—plowing straight up and down the hills, for instance. After about three years, the fields on the steepest sites are deserted, for their soil is so exhausted and their yield of grain so low that cultivation is no longer practicable.

5. In less steep areas and areas where terraces have been built, the cultivation may continue for many years.

6. Other areas, where cultivation is no longer or never was possible, are used for grazing. Goats are numerically and economically the most important animals. Then come sheep. A few cattle, horses and donkeys are also kept for transport.

The people in the highlands spend the summer months as nomads, as far up the mountains as food can be found for their flocks. They live in goat-hair tents and in shelters of fir branches. In winter, when weather makes this existence impractical, and grazing can no longer be found at the higher elevations, these people move down to their permanent stone villages.

Human and livestock concentrations are extremely high even on the summer ranges. In the grazing region above the Akkar villages, in an area of about 500 hectares, there are 5,000 people, who graze 12,000 goats, 4,000 sheep and the usual cattle, horses and donkeys.

All this results in the virtual destruction of the better grazing on the flats and the destruction of grasses and the more palatable forage on the hillsides. Both on the flats and slopes, sheep and goats browse off all the new bush shoots, leaving small frameworks of the heavier branches protecting the leaves in the center of the bush. Regrowth of tree or bush is impossible because all seedlings and shoots are immediately eaten.

7. To furnish food for the ravenous animals, especially towards the end of the season, the graziers climb the conifers, principally the firs and pull down the limbs for the goats and sheep to graze. This leaves straggly forests of scarred tree trunks each topped by one tassel of green branches. These trees are more susceptible to disease and unable fully to carry on their life processes in hard weather. Many soon die.

8. The final result is an extension of the deserts of the flatlands below—bare, treeless, windswept stretches of rocky land. The former rich profusion of useful grasses and herbs is completely destroyed, except where protected from grazing by rough terrain. Even the few bushes that remain are grazed into woody rounded balls, existing but not actively growing or reproducing. The soils, unprotected by vegetation and in many areas already diminished through previous agriculture, have eroded away, leaving rock and gravel.

Some authorities credit the loss of the extensive forest and vegetation of the Middle East to a gradual change in climate which has made such vegetal life is impossible. This does not appear to me to be so for the following reasons :

1. Forest vegetation still exists in several parts of Lebanon.

2. In areas where the forests have long since been destroyed, a few small areas have been protected as holy places. These are either monastery enclosures or " sacred groves " where some holy man is buried. Here, where cutting of the trees is prohibited and goats excluded by fencing, there is lush growth of the

remnants of the former forests, the oak in lower areas, or the conifers higher in the mountains.

3. The holy groves are usually on eminences or hill tops, in places where water would apparently be most difficult to obtain and where any extreme climatic change would first be felt and shown by loss of the vegetation.

4. Sir Julian Huxley, " From an Antique Land ", 1955, has argued against the climate change theory by noting that one of the remaining groves of the Cedars of Lebanon exists in a walled-in monastry yard. Here, before the area was fenced, some cedars stood alone, their fellows cut and all reproduction destroyed by goats. After fencing, these trees seeded successfully and produced a dense stand of some 400 vigorous young cedars.

5. At Terbol in the Bekaa Valley, in an area particularly devastated by agricultural and grazing misuse, a large enclosure has been made under the joint American-Lebanese " Point 4 " (Technical aid to under developed countries) agricultural program. Here all grazing or agriculture was excluded, no water was provided or other modification made ; the area was left alone to regenerate itself. At the time of my visit to Lebanon, after only two growing seasons, the results were spectacular. Even in such a short time the original vegetation had come up in great variety and density. The Point 4 report on the agricultural and forestry potential of the country says : " The ability of the land to respond to protection and lighter grazing use, as demonstrated in the Terbol Enclosure, is almost unbelievable ".

Out of a total of 1,300,000 hectares (4,300 sq. miles) only 74,000 hectares (230 sq. miles) less than 6 per cent is now forest, made up as follows :—

Oak (*Quercus* spp.)	43,000 ha.
Nut pine (*Pinus pinea*)	12,000 ha.
Juniper (*Juniperus excelsa*)	11,000 ha.
Aleppo pine (*Pinus halepensis*)	5,000 ha.
Fir (*Abies* spp.) and cedar (*Cedrus libani*)	3,000 ha.

Forty-seven per cent of Lebanon's land area is unsuitable for cultivation. Another sixteen per cent is cultivated with great difficulty. Other areas are considered sub-marginal. Roughly, two thirds of the country is best suited to production of forests and pasture.

Considering the productive capacity of the land and its ability to respond to protection, it would seem that an effective program for management of the grazing and forest lands in

Lebanon would show significant results in a very short period—possibly even in two seasons on parts of the pasture lands. From the economic standpoint, the need for such a program is obvious. The supply of timber from the Lebanese forests is estimated by their forest department to meet only 60 per cent of the country's needs. The program would also have great importance for Lebanese wildlife. If the half to two thirds of the country unsuited to agriculture were managed correctly and conservatively for grazing and forests, the presence there of wild animals, except for the larger predatory forms, would be quite compatible with good land use.

Fish

I received a number of reports about the damage to fish supplies off the coast by dynamiting. This method of fishing is so widely used that fish are said to have been virtually exterminated along accessible parts of the shoreline.

Birds

Migratory birds from Europe and north western Asia travel south via one of three major flyways : Across Gibraltar ; across the central Mediterranean ; and down the east coast of the Mediterranean.

These latter birds' route lies right through Lebanon, as it is squeezed in by the Syrian desert on the east and the Mediterranean coast on the west. Because of this, Lebanon is a vital ecological link in the life of many of the Old World birds.

Throughout Lebanon birds are ruthlessly hunted. All birds are shot, from partridges and sea birds down to sparrows. I even watched people hunting songbirds with small gauge shotguns within the city limits of Beirut. As one drives along country roads during the migration season, people hold up strings of birds, big and little, for sale. It is hard to see how the few cents gained from selling a tiny finch can pay for the shell used to kill it. More important than the questionable economics is the impact of this slaughter on the bird life that passes through. It is a matter of direct concern, for instance to the Germans, if their birds never reach the carefully protected German nesting grounds because they were killed in migration.

There are some hunting laws but they apparently are not rigorously enforced. One man in Beirut claimed to have killed 800 McQueen's Bustards in several months with hawk, car and shotgun.

Mammals

With a high density of human population, intensive cultivation even on the steep mountain areas, severe overgrazing, and heavy hunting pressure, few large animals survive in Lebanon. Most of these are scavengers such as jackal and hyena and small predators such as fox and wildcat, whose economic or trophy value is quite low. Leopards are reported every few years and usually promptly killed.

National Park

There is some interest in the possibility of establishing a national park but the government think that it should be close to Beirut, easily accessible for tourists.

The most promising possibility is Gebel Keniss, on the road to Damascus. It is a large mountain, now quite bare, with villages about the foot and on the sides. It is government property, the present plan is to have the Society of Friends of the Trees administer it as a national park. This Society, with government encouragement, is planning to plant the mountain with many kinds of native trees, protect it by a wire fence and resident guards, and then wait for a forest. They started planting in 1954, and have prepared a budget and plans for the entire project. They anticipate a forest of sorts in five or six years.

An excellent place for a national park would be in the Kammouha in the north, where part of the forest that once blanketed much of this country still remains. This forest has played an important part in Lebanon's history but is now fast disappearing. It would be well worth an effort to preserve some of it.

Reserves

Officially there are 12 " protected places ", where birds and vegetation are protected. Their actual effectiveness may be shown by this example: A visitor was offered grouse by a guard. On being reprimanded by the government official conducting the visitor, the guard promised not to shoot any more in the sanctuary—while the official was around.

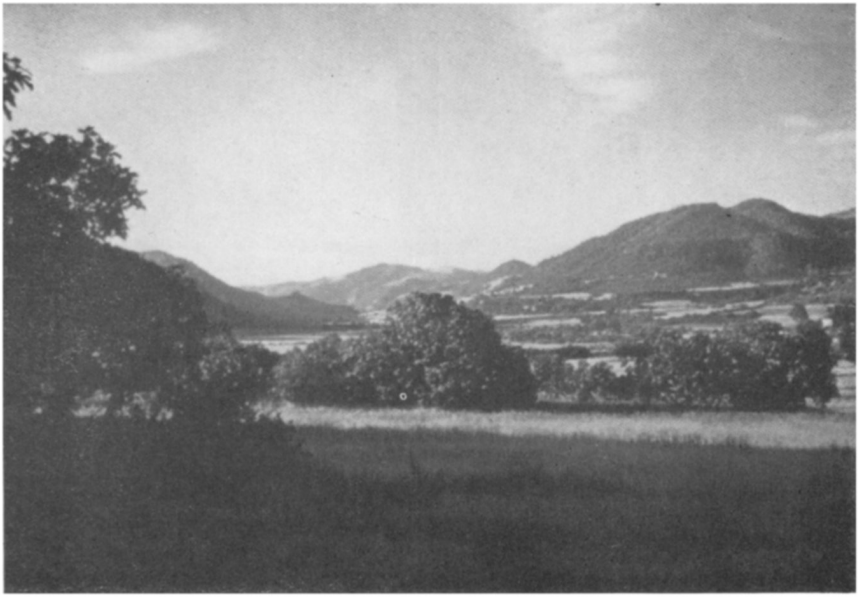
In the Bekaa Valley there are two areas that serve as reserves: 250 acres taken over in July, 1953, by the American University of Beirut for research; and at Terbol where, as mentioned earlier, the American Point 4 program has fenced a large area and is letting natural vegetation regenerate itself as an experimental

area. These two spots, and the grounds of the monasteries and a few sacred groves are the only effective reserves or sanctuaries in the country.

General

In spite of this lack of parks and reserves and the ruthless hunting, Lebanon is probably the most promising Middle Eastern country for conservation projects. The French influence is strong and the Lebanese think of themselves as " seeing both east and west ". They are, therefore, potentially nearer to the western point of view regarding conservation than are the more typically Arabian or purely Arabian countries.

There are a number of individuals interested in conservation and there are several groups concerned in whole or in part with it. The oldest and most active of these is the Lebanese Society of Friends of the Trees.



How to Make a Desert—1

How to Make a Desert—2

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How to Make a Desert—3

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How to Make a Desert—5

How to Make a Desert—6

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MIDDLE EAST LAND USE

How to Make a Desert

In and near Lebanon's remote Kammouha Forest, 6,000 feet high in the northern mountains, is evidence that man, and not changes of climate, is responsible for the growth of the desert—man and past practices of forestry and agriculture that forgot the long run, that probably seemed to be producing the greatest good for the greatest number at the time.

Short-term thinking about forests sent most of the Cedars of Lebanon out to the sea in ships, and overzealous search for food and fiber sent the soil out to sea after the ships. Adjacent to today's desert and in the same climatic zone is a handsome mixed forest which still exists because it was protected from exploitation by accident. It is a pitifully small island of an Eden, too small to ward off enduring poverty. All around there is the barren stone skeleton of the greater Eden, the Promised Land towards which Moses once led his people.

The Six Steps

The six steps of desert-making—about which no nation can be smug—are illustrated in Lebanon :

1. Resembling the forest of the Sierra Nevada, the uncut Kammouha forest still contains pine, juniper, and fir, with oaks on the lower flats.

2. Fields are cleared in the forest ; cultivation remains on the deep fertile soil of the flats until population pressure or exhaustion of the soil forces use of the slopes. Here erosion is much more rapid ; eventually cultivation is no longer profitable.

3. The abused flats are then grazed—and overgrazed—by sheep, cattle, and horses. Bedrock or hardpan appears.

4. Livestock, like cultivation, moves to the slopes when the formerly better flats are overgrazed. When the poorer feed here goes, branches are pulled down for forage. With seedlings eaten by ravenous livestock, forest regeneration ceases.

5. Goats finish off all traces of forest vegetation and nomads with their flocks constantly move about in search of the meagerest feed. Here in an area famed for its lumber in Roman times timber is now totally unavailable, even for the roofs of buildings, so " bee hive houses " are built of stones and mud heaped up in the fashion of an eskimo igloo.

6. And finally, abandoned terraces, irrigation systems, and cities blend with the sere landscape, to testify silently of the riches the land has lost.

SYRIA

General

Except for a few scattered individuals and the Forestry Department, there is no effective conservation interest in Syria. The political events of the past several years have further diverted public interest from such matters. The notes regarding Arab attitudes toward conservation, in the chapter on the Arabian oryx, apply also to a large part of the Syrian population.

There are some hunting laws but they have limited effect outside the cities, and those delegated to enforce them, the military, are said to be the greatest offenders. They have access to desert vehicles, automatic weapons and ammunition, and also leisure time. This is a bad combination for wildlife anywhere in the world.

According to the Secretary General of the Ministry of Agriculture, a Nature Protection Committee in the government with representatives from the Ministry of Agriculture, Interior, Commerce, etc. was being planned in 1955. In 1953 they had a scheme to make two national parks, one in Latakia and one in the southern desert. They were thinking in terms of areas of about 200 hectares (less than a square mile) " maybe more ", surrounded by a wire fence. Even this scheme has not materialized.

Forests

The Department of Forests at Latakia (Syria's sea port on the Mediterranean coast north of Lebanon) seems outstandingly active and foresighted. There were three fairly young men in responsible positions there: Mr. Fozi Raslan, head of the department; Mr. Sateh Ranneh and Mr. Fati Rehman. The three were trained at the Forestry School in Cyprus and started their present work in 1954.

Their plan for the management of the forest areas is in four parts:

1. Improvement of cutting.
2. Fire protection.
3. Forest delimitation.
4. Ranneh's plan for rehabilitation of the forest area. This is the most progressive and farsighted conservation proposal that I found anywhere in the Middle East.

Human economy is based on grazing goats and on growing very poor quality millet in small fields, cut out from the forests

and deserted after about three seasons of extremely poor yield. Together they are rapidly destroying what little forest remains.

Ranneh's plan is :

1. Remove the goats, giving the villagers a government subsidy for them.

2. Change the village agricultural economy from grain-growing to apple growing. The grain is terribly marginal and apple trees would not only have a spectacular monetary yield in comparison but would protect the forest from shifting cultivation. During the five years which the trees would need to start yielding, the government would have to subsidize the villagers. This would take the form of payment for forest improvement work—building roads, fire lines, forest improvement cutting, etc.

3. Resettlement of the villagers outside the forest boundaries. At present there are 448,960 hectares in the District of Latakia, some 56,120 of which are forest, and roughly 150,000 more are what the Forest Department calls " potential forest ". The plan would move the villagers out of these lands, giving them other lands now held by the government, and increasing their individual holdings to compensate them for the move.

The forest land itself is dominately conifer, with the same assemblages of species that are found in the Lebanese Kammouha region to the south, *Abies*, spp., *Pinus halepensis*, *Juniperus excelsa*, *Pinus pinea*, *Quercus* spp. The combination of forest-clad mountains and neat cultivated valleys made this to my eyes a most lovely land and quite different from most of the sere Middle East. However, the process by which much of the Middle East has been changed from this rich forestland to desert was strikingly evident here also. From high points my companions would point out nearby barren, eroded hill skeletons, saying " When I was a boy we played in dense forest there ". There are occasional holy groves between Latakia and the forest area, and the presence of comparable forestland nearby shows the validity of these groves as ecological reference points and as indicators to the previous condition of the surrounding land.

Wildlife

Gazelle.—The former large herds are seriously depleted and becoming more so, because of shooting from cars, especially by the military. According to reports, gazelles serve as a supply of meat for the military, even though the animals are protected, on paper.

Leopard.—There is much confusion as to the identity of the big cats found in Syria, especially in the Latakia area, as the Arabic word " Nim'r " is indiscriminately used for leopard, tiger and occasionally, wildcat. This is apparently a source of the repeated stories about tigers remaining today in Syria and Lebanon.

In the north the leopard is found in the forests north of Latakia ; near the Jabel Akar ; near the Sanjak border ; in the Kassab Forest. One skin at Latakia measures $2\frac{1}{2}$ metres in length. In the south the leopard is reported near Jabel Rum ; elsewhere in the Palmyra region ; in the Nahura region ; near the Israel-Lebanon border. It is also found in the west near Hama, where a cub was caught in 1953.

Deer.—Roebuck (*Capreolus*) is still found in the mountains east of Latakia. A fallow deer was reported as late as 1940 from the Alawit region north of Latakia, but I can find no verification of the report.

Cheetah.—Occasional reports are received, but cheetah are apparently often confused with leopards. One cub was caught alive in 1952 and brought to Damascus for exhibition.

Wildcat.—The smaller cats are reported in some numbers in most mountainous parts wherever there are substantial patches of bush or forests (Alawit Mountains) and along major watercourses (Euphrates River in north Syria).

Wild Hog.—Hunters report that this animal is still common in the Alawit Mountains.

Syrian Bear.—Bears are still reported from the slopes of Mt. Hermon. They also occur in the Alawit Mountains though less common than formerly ; but skins and cubs are brought down to the Latakia fairly regularly. This is the bear used by travelling circuses and performers throughout the Middle East.

IRAQ

I had not enough time in Iraq to carry out any field work, so the information given below is based entirely on reports received during and since my visit.

General

In Iraq there is virtually no conservation of wildlife or of wild country, and there is little, if any, public opinion to support such policies. What I have said about attitudes towards conservation in the chapter on the Arabian oryx is applicable to much of the Iraq population.

There are no national parks and none are at present officially contemplated. There were some good hunting laws on the books, which presumably have been retained by the present government, but these were never enforced to any appreciable extent. It is difficult to enforce hunting laws with a population of nomadic or remote hill people. The army, who are responsible for patrolling and enforcing protection laws, are reported to be among the worst offenders. Gazelles, bustards, and other forms of wildlife are hunted from cars. Machine guns are said to be used frequently. The nomadic herders and the villagers in the hills, having little access to cars or automatic guns, probably exert little pressure on the wildlife through direct killing. But through over-grazing of flocks of sheep and goats these people are seriously modifying the habitat and have been doing so for centuries.

Wildlife

Gazelle.—Greatly reduced or exterminated throughout their former range. The principal cause is motorized hunting with automatic weapons.

Leopard.—There are consistent reports of snow leopards from the northern Kurdistan mountains. The animal referred to apparently is an occasional pale specimen of the common leopard or panther (*Felis pardus*). Hatt (1958) reported examining several such hides. He also refers to Danford and Alston (1880) and Pocock (1930) who " recorded and ably refuted " the snow leopard story. Leopards are widespread but very uncommon in Iraq.

Fallow Deer.—The only specimen recorded, to my knowledge, was killed near Zakko in 1917. Antlers, perhaps from this specimen, were shown at the 1936 Berlin Hunting Trophy Exhibition. Reliable reports I received indicated that a small population of these deer survive in a thinly populated area where the Shirwán River crosses the Persian border. They are said to live in the scrub-covered mountains up to an altitude of 4,000 feet, occasionally coming down to a narrow valley near the river.

Roe Deer.—Fairly widely distributed but nowhere common.

Bear.—Cubs are brought to Baghdad and Mosul periodically, but the animals must be rare except perhaps in the northern mountains.

Cheetah.—Very rare, if any survive they are in the south-western region adjoining Saudi Arabia.

Wild Ass or Onager.—Extinct. See page 248, Syrian Wild Ass.

SAUDI ARABIA

General

In the chapter on the Arabian oryx I have described the attitude in Saudi Arabia towards the exploitation of wildlife; the attitude towards vegetation is the same. There are a few areas protected from grazing, cutting and hunting because of religious significance, " holy groves " for instance. These have an increasing importance as ecological reference points while land use conditions continue to change.

Arabian Ostrich

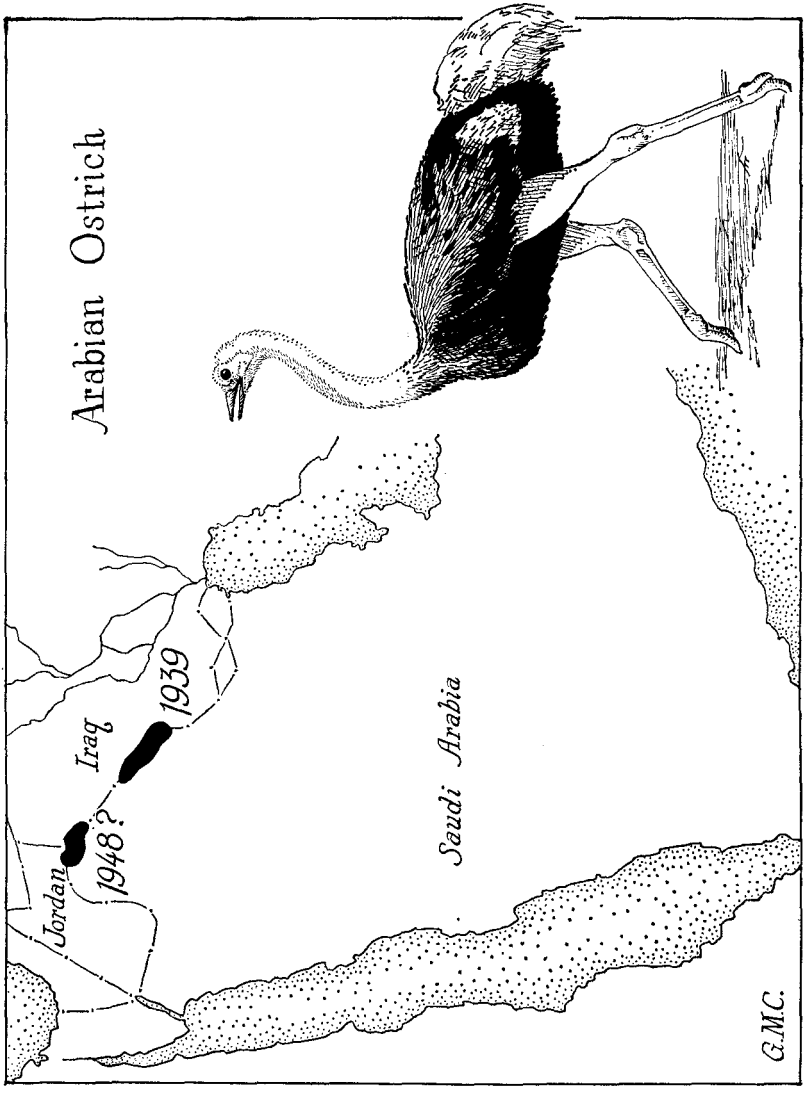
The Arabian ostrich (*Struthio camelus syriacus*) was probably exterminated in the south of Arabia in about 1900. Several old Bedouin I spoke with claimed to have seen them in the south-east part of the Rub-al-Khali when they were boys. Old egg shells are still found occasionally. In the north, the last confirmed report of an ostrich was one killed in 1933 on the border of Iraq and Saudi Arabia, by a survey party of the Arabian American Oil Company led by Mr. R. Hatrup.

A number of people in Arabia, Syria and Lebanon told me a story of two ostriches being killed in 1948, near the junction of the borders of Iraq, Jordan and Saudi Arabia. Apparently at the request of an official in Palestine, a local sheik had sent some of his people in to the desert area to see if they could find any ostriches left. They saw only two, tried unsuccessfully to catch them, and then shot them. I could neither obtain written confirmation of this story nor trace the whereabouts of the skins.

Hunting by man has exterminated the ostrich both in the north and the south. In the north this process was accelerated by the use of cars. The Arabian ostrich may be considered extinct.

Gazelle

Three species of gazelle were widespread and very common until the mid-1930's. Following the rains countless numbers could be seen in herds in many areas. Now it is rare to see any gazelle in any part of the country. Motorized hunting by the Arab princes, where single parties killed over 300 gazelle a day, and meat hunting by Arab contractors for the Aramco pipeline,



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using machine guns mounted on trucks, have nearly extirpated, them from the country. This is a modern version of the meat hunting which accompanied the building of the trans-continental railroad in the American West.

Cheetah

The Indian cheetah. (*Acinonyx jubatus venaticus*) was once fairly common, at least in northern Saudi Arabia. It is now extremely rare. One was seen and two killed in 1950, and another shot in 1951 near Turaif, on the trans-Arabian pipeline roughly 170 miles east of the Dead Sea. Another was killed in the northern Great Nefud in 1952.

Other Animals

Leopard and lynx are still present but very rare. Ibex have fared better than most wildlife as they occupy mountainous areas impassable to cars. The ibex is probably the only large wild animal which is not threatened with virtual extinction in Saudi Arabia.

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APPENDIX

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