IUCN Publications New Series No. 34

Proceedings of an International Meeting on

Ecological Guidelines for the use of Natural Resources in the Middle East and South West Asia

held at

Persepolis, Iran

24-30 May 1975

Sponsored by: IUCN, the United Nations Environment Programme, The United Nations Educational, Scientific and Cultural Organization and the Department of the Environment, Iran.

Supported by: the United Nations Educational, Scientific and Cultural Organization, the United Nations Environment Programme, the World Wildlife Fund and the Swedish International Development Authority.

Hosted by: the Imperial Government of Iran.

International Union for Conservation of Nature and Natural Resources
1110 Morges, Switzerland
1976

The International Union for Conservation of Nature and Natural Resources (IUCN) is an independent international body, formed in 1948, which has its headquarters in Morges, Switzerland. It is a Union of sovereign states, government agencies and non-governmental organizations concerned with the initiation and promotion of scientifically-based action that will ensure perpetuation of the living world — man's natural environment — and the natural resources on which all living things depend, not only for their intrinsic cultural or scientific values, but also for the long-term economic and social welfare of mankind.

This objective can be achieved through active conservation programmes for the wise use of natural resources in areas where the flora and fauna are of particular importance and where the landscape is especially beautiful or striking, or of historical, cultural or scientific significance. IUCN believes that its aims can be achieved most effectively by international effort in co-operation with other international agencies, such as UNESCO, UNEP and FAO.

The World Wildlife Fund (WWF) is an international charitable organization dedicated to saving the world's wildlife and wild places, carrying out the wide variety of programmes and actions that this entails. WWF was established in 1961 under Swiss law, with headquarters also in Morges.

Since 1961, IUCN has enjoyed a symbiotic relationship with its sister organization, the World Wildlife Fund, with which it works closely throughout the world on projects of mutual interest. IUCN and WWF now jointly operate the various projects originated by/or submitted to them.

The projects cover a very wide range, from education, ecological studies and surveys, to the establishment and management of areas as national parks and reserves and emergency programmes for the safeguarding of animal and plant species threatened with extinction as well as support for certain key international conservation bodies.

WWF fund-raising and publicity activities are mainly carried out by National Appeals in a number of countries, and its international governing body is made up of prominent personalities in many fields.

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Foreword

Throughout the drier regions of the world, wildlife and natural ecosystems are being rapidly degraded or destroyed and valuable natural resources are being wasted. These problems exist often because of lack of planning and control over the use of land and natural resources. This situation, in turn, is often a result of a lack of knowledge of the values of the natural resources involved and of the effects of various kinds and levels of land-use practices upon other resources of the region. Existing patterns of pastoral use in most of the world's drier rangelands are unsatisfactory; they contribute both to growing human suffering and dissatisfaction, as well as to destruction of natural resources. In a few areas things have gone beyond the point of repair. Clearly, there is an urgent need to formulate ecological principles that are relevant to the development process in the dry regions and to evolve guidelines for development based on such principles.

The formulation of the principles that would lead towards a better use of ecosystems currently subject to heavy development pressure was covered in the publication 'Ecological Principles for Economic Development' by Raymond F.Dasmann, John P.Milton and Peter H. Freeman, prepared for IUCN and the Conservation Foundation, Washington, D. C. (John Wiley & Sons Ltd., London, 1973). It was decided as part of the extension of this initiative to prepare guidelines relevant to the development process in some major ecosystems in selected regions of the world based on the principles thus established and taking into account the widest possible range of conservation objectives.

By mid-1975, ecological guidelines had already been prepared and published for development in the American and South East Asian humid tropical forest regions (following international meetings convened for this purpose in Caracas, Venezuela, from 20 to 22 February 1974, and in Bandung, Indonesia from 28 to 31 May 1974) and for island development. Plans were in progress for the preparation of further guidelines for coastal and for high mountain areas. The meeting on ecological guidelines for the use of natural resources in the Middle East and South West Asia, held in Persepolis, Iran, from 24 to 30 May 1975, was an essential contribution to this series.

Convened by the International Union for Conservation of Nature and Natural Resources (IUCN) and hosted by the Imperial Government of Iran, the meeting was sponsored by IUCN, the United Nations Environment Programme (UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO), and the Iran Department of Environmental Conservation. The meeting was supported by UNESCO, UNEP, the Swedish International Development Authority (SIDA) and the World Wildlife Fund (WWF).

The main objective of the meeting was to focus attention on ecological guidelines relating to the management and conservation of natural resources of the Middle East and South West Asia, with particular reference to wildlife and biotic communities, and, through the preparation of technical papers and discussion, to provide planners with material relating to such guidelines.

The meeting brought together ecologists and planners, along with specialists from appropriate disciplines and officers from government agencies, from the Middle East and South West Asia. They discussed and finalized draft guidelines for economic development, taking into account conservation objectives and existing knowledge of the ecology of arid and semi-arid regions, including the findings of a number of meetings and conferences recently held on this topic.

Field trips to Arjan International Reserve, Bamou National Park and historic sites in Shiraz and Persepolis were organized by the Department of Environmental Conservation during the course of the meeting, and provided participants with practical examples of conservation and its effects in arid regions.

The present volume contains the complete proceedings of the meeting, which includes the texts of papers presented as a basis for discussion, the guidelines, and recommendations.

IUCN thanks the many collaborators, both individuals and organizations (especially those referred to above), who contributed to the success of the meeting and to the production of this volume.

Contents

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* Reproduced from Plant Life in South West Asia (1971) Eds. Peter H.Davis, Peter C. Harper and Ian C. Hedge. Botanical Society of Edinburgh.

International Conference on

ECOLOGICAL GUIDELINES FOR THE USE OF NATURAL RESOURCES IN THE MIDDLE EAST AND SOUTH WEST ASIA

Opening Session

The Meeting was opened by Dr M. E. D. Poore on behalf of the Director-General of IUCN. He thanked the Imperial Government of Iran for acting as hosts to the Meeting and the Province of Fars for its hospitality.

He welcomed participants and guests and, in particular, H. E. The Governor General of Fars, Mr Pirouz.

He then introduced H.E.Mr Eskandar Firouz, Deputy Prime Minister and Director of the Department of the Environment, who spoke as follows:

Your Excellency, Distinguished Delegates, Ladies and Gentlemen,

It gives me great pleasure to welcome you to this Regional Conference on Ecological Guidelines for the Use of Natural Resources in the Middle East and Southwest Asia, which has been organized under the joint auspices of the Imperial Government of Iran and IUCN. On behalf of the Government of Iran I wish to say that we are very happy to have the opportunity of acting as your hosts. We hope that the setting of Persepolis will prove agreeable to all of you and that under the historical shadow of 25 centuries we will ponder more deeply on the environmental problems of our region in this age.

This is the fourth UNEP or IUCN sponsored conference I have had the privelege of opening in Iran during the last six months. Those of you who have heard me on the previous occasions do me honour in coming again, and I seek your indulgence if some of my statements should sound repetitious.

In the field of ecology and environmental protection I think many of us are beginning to feel that we are often repeating what has been said before. There has been an enormous amount of material on the subject, in the form of papers and books, by amateurs and scientists, from schools, parliaments and the United Nations. People from almost all nations and creeds have contributed, and few any longer doubt that we have been, and are, in the midst of an environmental revolution.

Without a doubt much has consequently been accomplished for the protection of our environment in many parts of the globe—particularly following the World Conference in Stockholm. But do we not still hear the anguished plea of the conservationists, the pent-up cries of environmentalists, and the reproaches of persistent civic groups? We do indeed, and these serve as urgent reminders that so much more needs to be done in our quest for a cleaner, healthier and richer life for man on a small and beautiful planet.

It is no longer enough to focus all our attention on progress. We must stop, and take stock of where we are going—we must adopt a whole new way of thinking about man's place on earth. We simply cannot continue to condone or disregard the insidious effects of consumerism, the disfigurement of the natural environment, the staggering increase in the human population, and the irrational exploitation of our natural resources.

It is the latter, of course, which has brought us together here in Persepolis.

As you know, this meeting constitutes the third of its kind, for IUCN has already held two successful meetings of a similar nature, one in Caracas, Venezuela, on the American Humid Tropics and the other in Bandung, Indonesia, on the tropical forest areas of Southeast Asia.

I think that most of the distinguished delegates here will agree with me that a meeting on ecological guidelines for Southwest Asia and the Middle East is long overdue. Ours is a region which man has continuously exploited for some eight millenia, and in which problems are further intensified by the aridity and low natural productivity of the environment. Nor must we forget in this context that Southwest Asia and the Middle East comprise the most densely populated arid region of the world. Much benefit will thus also accrue to this meeting through the careful scrutiny of the recommendations proposed at the recent regional conference on dedesertisation and arid lands ecology jointly sponsored by my government and UNEP.

Those gathered here are entirely aware that in economic planning and development inadequate attention has been paid to ecological guidelines. The deliberations and recommendations of this conference should therefore be of great value to all the countries of our region and, indeed, we hope, to arid lands in other parts of the world as well.

My country has been fortunate in embarking on the right course before mistakes and unwise policies have proven lastingly irreversible. Under the leadership and guidance of the Shahanshah, we have been able to attain the proper momentum in providing institutional arrangements and undertaking suitable programmes for the protection and conservation of the environment. Of particular significance in this respect was the passage of the Environmental Protection Act in June of 1974, which created our present Department of the Environment. Furthermore, a genuine effort has been made in the nation's present Five-Year-Development Plan to ensure that environmental considerations become an integral part of national development activities.

The activities of the Department of the Environment which are of particular relevance to this Meeting are divided between the divisions of the Human Environment and Nature Conservation. As will be explained to you in more detail during the course of the meeting, my Department has established eight National Parks, 27 Wildlife Refuges and 21 Protected Areas aggregating to approximately 7. 6 million hectares in area. These reserves will serve not only to protect the natural environment, its fauna, flora and scenic beauties, but will also constitute study areas for the initiation of proper land use practices for the wise use of natural resources.

The latter is of particular importance in the context of this meeting, especially if your discussions should focus on the development plans being proposed for two of the above areas. One is the enormous Touran Protected Area within which the Department intends to undertake studies on the establishment of guidelines for arid lands ecology both in respect of man's exploitation of the desert and the conservation of wildlife and plants. The second area is Lake Rezaiyeh National Park. Here the relevant Ministries have proposed that this Department provide not only a master plan for the lake and its islands but equally for the development and physical planning of the coastal zone surrounding the lake and outside the boundaries of the National Park.

It is clear that we cannot make comprehensive plans for such Protected Areas in isolation from regional and, indeed, national planning. We must therefore coordinate and synchronize our efforts with the work being initiated by the recently formed Iranian Center for National Spatial and Physical Planning.

This Center is one of the satellites of the Plan and Budget Organization and its mandate includes the preparation of a national land use plan and population distribution map; and the balanced development of population centers and resources. Under this mandate, over-development will be discouraged as much as under-development. A comprehensive approach is clearly an absolute necessity in the problems of spatial planning. Work has now commenced on the preparation of a 20-30 year 'National Spatial Strategy Plan' which will be followed by the Sixth Five-Year 'National Spatial Development Plan'.

In respect to the establishment of reserves, I wish to state that my Department is following with keen interest developments in the MAB programme of UNESCO and more particularly in its projected biosphere reserves. Many of the Protected Areas of this Department could be established as biosphere reserves without significant modification. I am happy that UNESCO is represented at this meeting by a delegate who will be able to assist us in the preparation of suitable guidelines for the establishment of biosphere reserves in this region.

I should add that continuous monitoring in such reserves will provide us with the necessary baseline data not only for the management of nature reserves but also, and of much greater importance, for the management of modified environments so that they can be utilized on a sustained yield basis without further degradation.

We also strongly support the World Heritage Foundation, and urge that other nations adhere to its Convention. After all, Iran's recognition of the truly international scope of today's environmental problems was vividly emphasized in 1971 when our Shahanshah, in his historical message to the Ramsar International Conference, advanced the now famous proposal that Iran was prepared to place one of the country's ecosystems of global importance in joint trust with a suitable international agency 'to conserve and administer for all mankind.' This area is not far from Persepolis, and you will be seeing it on your field trip in a few days. I need hardly add that we would be particularly pleased to benefit from your expertise in preparing an ecological strategy for the management of this special international reserve.

I should also like to make some suggestions regarding the wildlife component in the theme of your meeting.

My Department has been working on the preparation of a wildlife policy, dealing with such considerations as the use of pesticides, predator control, commercial exploitation, and the introduction of exotic species. We would welcome a discussion of our draft statement with you because I am sure that your countries have a similar interest in establishing basic wildlife policies. As a result, we might perhaps arrive at a model wildlife policy for the Middle East and Southwest Asia which could form the basis for legislation, management and research.

I would also like to make a plea, made on many, many other occasions and in many different parts of the globe, for a concerted effort to ensure the survival of endangered species. Such species, be they plants or animals, are essential elements in natural ecosystems; their permanent loss implies an irreversible change in such ecosystems and a progressive impoverishment of the human environment. The preservation of endangered species and their habitats is not only necessary for emotional reasons, but is perhaps fundamental to the quality of our life and, ultimately, to our own survival.

Before I draw my remarks to a close, I would like to thank the organizers, and many of the participants, for the excellent preparations they have made for this meeting and the valuable background papers which they have submitted.

It is this, and the knowledge that we all feel a deep commitment to the theme of our meeting, which inspires me to express complete confidence in the success of this Regional Conference.

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The Chairman Dr Poore, then presented the first of the two Introductory Statements, following upon which he called on Professor Antoon de Vos to present the other on behalf of the United Nations Environment Programme.

The text of Dr Poore's statement follows and, for ease of reference, is numbered as Background Paper No. 1, although the Paper which accompanied the statement and was circulated at the meeting, appears as Section 1 of the Appendices, having been previously published.

The text of Professor de Vos's statement is followed by his Paper, numbered as Background Paper No. 2.

Background Paper No. 1

Ecological Guidelines for Development of Natural Resources

INTRODUCTION TO THE THEME AND PURPOSE OF THE MEETING

M. E.D.POORE

Senior Ecologist, IUCN, 1110 Morges, Switzerland

I should first like to take this opportunity to express our appreciation to UNEP, SIDA and WWF whose generous assistance has made it possible to hold this meeting, and to UNESCO for its sponsorship.

My task this afternoon is a simple one. It is to explain the background and purpose of this meeting and what we wish to accomplish in the course of our deliberations during this week. I shall then put before you some suggestions about the way in which the meeting may be organized to accomplish our objectives smoothly and efficiently.

Mr. Firouz has explained the importance of the relationship between development and ecology and the need to apply ecological principles in the course of development if the results of that development are to be successful and lasting. IUCN has long been aware of this relationship. As part of the preparatory work for the United Nations Conference on the Human Environment (Stockholm, 1972) the Union commissioned a book*. This important text, which was produced after consultation with a large number of specialists throughout the world, deals in general terms with the contribution which ecological knowledge can make to the course of development. The manuscript had a wide distribution before the Stockholm conference and the book has been much used and referred to since.

After Stockholm, IUCN was encouraged by UNEP to organize a series of regional meetings in which these principles might be further discussed and refined in relation to certain important biomes.

These Guidelines were directed especially towards using ecological knowledge in trying to obtain the greatest possible sustained *benefit* for mankind for each unit of renewable natural resource and setting out certain simple and generally accepted axioms for the use of those who have the extremely difficult task of deciding the wise use of natural resources.

There are two important words here: one is 'benefit'. It is a matter of opinion what is called benefit. Of course nobody would deny that enough food is a benefit. Good health is undeniably a benefit. But, in using this word, we should think also of the less tangible benefits and of an environment that provides satisfaction and pleasure.

The Guidelines are also directed towards maintaining the *potential* of renewable natural resources. For these are the capital on which mankind must continue to live. We should use the income and not the capital; but in fact we have been using the capital and treating it as though it were income.

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* DASMANN, R. F., MILTON, J. P. and FREEMAN, P. H. 1973. Ecological Principles for Economic Development. John Wiley & Sons Ltd., New York.

The first meetings on Ecological Guidelines were selected to deal with the region of the tropical rain forest. There are still large regions in which these forests still remain almost unexploited, though this situation is rapidly changing. The resource is there still intact. The countries which still have substantial areas of such forest are in a fortunate position because they have still a wide range of choice of how to use their land. They can, therefore, with wisdom and foresight, avoid the mistakes made elsewhere in the world and develop their resources in the right way from the beginning.

There were two meetings in this series, one at Caracas in Venezuela and one in Bandung, Indonesia; and Guidelines have been produced from these that apply to the whole area of tropical rain forest.

Another very important region is that comprising the arid regions of the world; and it is for this reason that a meeting is being held here. The problem in the arid regions is quite different. Particularly in the Middle East and South West Asia, there have been many thousands of years of civilization during which much of the natural resources — the forest resources and the resources of soil — have been destroyed. The task here, therefore, is to save what is left, and to try to restore the degraded areas by recreating some of their original fertility. There are severe problems in attempting to do so. In this region, as in most of the world today, there is a rising population and what is required is to relax the pressure on natural resources and allow them to recover at a time when the population is growing. This can pose very difficult problems of choice for decision makers, problems with great ethical difficulties. But this particular region has an opportunity to resolve these conflicts which is not open to other comparable areas elsewhere in the world. It can use the enormous access of capital from oil to buy time to restore the natural resources; so that when, as it undoubtedly will, the income from oil becomes lower, that natural capital will be greater than it is now.

I have tried so far to explain why these meetings are important and why it is important that one should be held in this region.

Now let me talk about what we wish to accomplish. The objective of this meeting is an intensely practical one, to produce a few pages—there need not be very many—of guidelines. These should be quite short sentences saying what ought, or ought not, to be done.

Most of you, I expect are faced with too many meetings and you must suspect (I think that we all do) that these meetings overlap and deal with the same subjects.... And indeed they often do.

What will be discussed at this meeting has been discussed in part, I am sure, at many other meetings in the last few years. We make no apology because this meeting is designed to accomplish something different. It is not a scientific meeting in which the discussion of papers will be the main object. We want to come out with a limited number of quite clear principles to take their place on the desks of those who are going to influence land-use policy in the future; people like Mr. Firouz, heads of land use departments all through the region, and those who have an influence on land use; those in positions of responsibility in industry, or those who are going to influence the ways future generations think about the problem, university professors and others. We want these Guidelines to be in front of them so that, if they go through them when any development is proposed, they say: 'Have we taken account of this ? Have we taken account of that ? We haven't taken account of that. Why not ? Let us go to our department and get the evidence we need.'

For this purpose the guidelines must not be too detailed or technical but must be expressed quite simply. Those to whom they are addressed are very busy men; they want to know the main point and will go to their advisers for details. Detailed implementation will depend on technical handbooks and, where these are not already available, they should also be prepared. So- simple statements of what should, or should not, be done directed towards those who are to make decisions.

There is one other point which should, perhaps, be emphasised and that is what we mean, for the purpose of this conference, by the term natural resources. In order to make the topic of this conference not too broad to be useful, we mean to concentrate on renewable natural resources, particularly naturally-occurring plants and animals, the communities of range land and forest that they form and the soil that develops under them. This should be the focus of our discussions. We should also, of course, consider water; but only in so far as the management of vegetation affects the quantity and quality of the water that is yielded by a catchment. We do not want to discuss minerals or water as a resource in itself (impoundment, drilling and so on).

Finally I would like to suggest how the meeting may be handled in order to attain the best result; these suggestions are based on experience with other meetings of this kind. We want everyone to leave Persepolis with a copy of the Guidelines in their pocket. The text need not be absolutely final, but it should be very nearly so; and it should be approved by the meeting on the last day. This means that our discussions must be directed towards the production of Guidelines and the papers that have been provided for us should be considered as background to these discussions. We are very grateful to all those who have contributed in preparing papers which give the width and scope of background that we require.

We hope that in each of the sessions the author of the paper will give a brief introduction (we suggest not more than 20 minutes) and that he should use this to draw attention to the principal points of the paper and to the issues raised in it which he feels should be the subject of guidelines. The discussion will be recorded by the rapporteur and I shall take responsibility for taking note of any suggestions that are made on guidelines. As the week goes on we may feel that it is desirable to set up small working groups to discuss aspects of the subject and to formulate guidelines for particular parts of it. We can make a decision about that later when we find out how things work out. But whether we do that or not, we hope that there will be a drafting committee of dedicated volunteers who will meet on 29 May and will sacrifice themselves by not seeing the beauties of Shiraz. They will work on producing a final text of the guidelines which will be approved in Plenary session on the last day.

As well as the guidelines it has been suggested that we should have a small number of recommendations for urgent action—they will have much more force if there are few.

My tentative suggestion for the Guidelines is that we might divide them into three groups: the first group concerned with policy for resource conservation, with land use planning and the designation of land for particular uses—policy and land use; the second section should deal with Protected Areas, their selection, their purposes, their management; and third section should deal with the management of the wildland resource, that is the area in each country which is predominantly covered by natural or modified natural vegetation—forest lands, range lands, wildlands.

There is only one more matter to which I wish to refer. These are intended to

be ecological guidelines; but we have found in all the meetings on this subject that, for very obvious and good reasons, many points are made about the need for education and the increase of public awareness, for facilities for training, for the need for research. It may be that a few of these points can be incorporated in Guidelines, but our experience so far has been that it is better to take these points out and make firm recommendations about them elsewhere, rather than to try and include guidelines on them at every stage.

It only remains for me to thank you for listening to me for so long and so patiently and to say once again on behalf of the IUCN that I am confident that, with such magnificent representation from the countries of the region we shall come out with something that is valuable and something that will be not only valuable but used.

Note. The background paper to this introductory statement that was circulated at the meeting is reproduced in section (i) of the Appendices of these proceedings.

INTRODUCTORY STATEMENT ON BEHALF OF THE UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP)

A. DE VOS

Deputy Project Manager FAO and Consultant for UNDP, PO Box 1555, Tehran Iran.

UNDP welcomes the opportunity to be represented and to participate in this important technical meeting. We share with the governments of the Midddle East and South West Asia the increasing anxiety which is being felt about the degradation of the natural resources of these regions and in particular the interest which is now being expressed in the rational utilization and management of marginal, sub-marginal and so-called wild-lands. Great technical strides have been achieved to ensure the proper use of these lands by institutes in the region under consideration and in other regions of the world. We share the opinion that the technology to manage and develop these lands for the benefit of future generations is already available. UNDP stands ready, as one of the principal sources of international assistance, to respond to requests from governments in your regions for assistance and to join forces with you in achieving your objectives.

Awareness of the vital importance of environmental protection and of the interdependence of all governments in achieving protection and a sound world ecological balance, has only crystallized very recently. Particularly there has been an acceleration of interest and action since the Stockholm conference. UNDP has consistently encouraged and provided assistance to projects in the fields of conservation and management of natural resources for many years, and the organization has supported efforts of many governments in a wide variety of fields in important sectors such as land and water use, plant protection and conservation measures. It is important to underline that all UNDP activities, not only those pertaining to ecological and environmental matters, are fundamentally based upon the requests and priorities which are addressed to the organization by governments on both a national as well as a regional and inter-regional basis. Although UNDP has consistently *encouraged* the devlopment of projects in fields of ecological and environmental sciences, it is ultimately the governments themselves who must *decide* what their development priorities are, and to whom they will turn to seek technical or financial assistance to achieve their objectives. Thus, as scientists and representatives of government ministries attending this meeting, you can assist UNDP's efforts by encouraging your respective governments to strive to achieve a wider and deeper social and political consciousness and commitment to improving environmental standards in your countries. In addressing yourselves to achieving such progress, it will be necessary to examine how the numerous departments and sections of different ministries of your governments can more effectively pool their scarce human and financial resources to achieve implementation of your policies. These remarks are no less pertinent for all of the various bilateral and multilateral assistance agencies who are interested in these fields. Furthermore, in setting your objectives, you may find it helpful to focus on the medium and longer term targets that must be achieved for the betterment of mankind, and to clarify these issues before risking a dispersion of scarce resources on some of the shorter term problems.

We commend the policies which the Imperial Government of Iran has initiated

to improve the quality of the environment. The establishment of a Department of the Environment, the definition of clear policies, the establishment and support of institutions to train personnel at both technical as well as professional levels, and the identification of priorities such as stopping the advancement of the desert, and especially the practical project implementation activities, should serve as an example to all of us present here. However, we must all view our responsibilities and targets in perspective. For hundreds, indeed for thousands of years, vast areas of land in the regions under consideration by this meeting have suffered from progressive degradation as a result of poor land use practices by man and his animals. We now have a clearer idea of the challenge that is before us to restore these lands, not only to improve environmental conditions, but also with a view to the more immediate and urgent needs of restoring marginal and sub-marginal lands to their former productivity. But although such restoration work is very costly and will take a long time to achieve, it is vital for the future prosperity of the region, and the necessary allocation of resources must be made to achieve these objectives.

Unfortunately, some of the particular problems of this region, such as desertification and pollution, do not respect national or international boundaries. It is UNDP's policy to actively encourage cooperation between the governments in the regions under consideration to join forces in combatting these problems. You will be interested to know that we are engaged in discussions at this time with representatives of UNEP to develop a coordinated work programme for the 1977 International Conference on the problems of desertification and their control. The UNDP and UNEP are jointly supporting the implementation of four trans-national feasibility studies in conjunction with ongoing projects in the region. We intend to implement this programme by injecting the necessary technical and material inputs and providing the services of senior consultants to coordinate and evaluate the results. Senior consultants will be appointed in July of this year for this purpose.

I would also like to inform you at this point that UNDP's Bureau for Europe, the Mediterranean and the Middle East*, which has responsibility for our programmes in most of the countries represented here today, has tentatively set aside the sum of $l-million within its regional programme for the period 1977 to 1981, in order to support a project for 'Demonstration and Research for Arid Land Forestry and Rehabilitation'. We expect that countries in the Near East and North Africa will energetically participate in this project, which will include in its work programme identification of the best techno-economic methodology for soil and water conservation and protection. In conformity with present practices, UNDP intends to consult with specialists in the other agencies of the UN system, including FAO, UNESCO and UNEP, as well as with other appropriate institutions, to ensure that the important objectives of this project will be achieved within the minimum period of time. Other new inter-country proposals which have been proposed for UNDP assistance, include projects for pollution abatement in the Mediterranean, and the implementation of feasibility studies for development of the coastal zones in Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

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* Afghanistan, Iran and Pakistan are handled administratively by UNDP's Bureau for Asia and the Pacific; these countries are, however, welcome to participate in regional projects covered by UNDP's Bureau for Europe, the Mediterranean and the Middle East.

The three projects which I have just mentioned as examples of proposed initiatives in the environmental field which UNDP intends to support, are all of a multi-disciplinary nature. Successful implementation of them will necessitate close coordination and direct involvement in varying degrees of several specialised agencies of the UN system. It is the intention of the Bureau for Europe, the Mediterranean and the Middle East that the relevant portion of each of these projects be implemented by the agency which is most directly concerned with the subject matter. Coordination of all activities will be achieved through the establishment of a small group of highly specialised consultants whose work will be directly supervised by UNDP. This method of operation, which has not previously been attempted, will hopefully serve to avoid undue emphasis on certain selected sectors of activity while disregarding others. In the special case of the project for pollution abatement in the Mediterranean, UNDP has already suggested to UNEP that either singly or in conjunction with UNDP, the UNEP should be responsible for coordinating the team of consultants.

These remarks will serve to stress the continuing interest that UNDP has in environmental matters, to give you advance information on some of our proposed initiatives, and also to share with you some of the tentative conclusions that we have reached to identify the most effective means to respond to requests to assist in resolving environmental problems in the future. However, our organization, indeed the entire UN system with which we are associated, can only be as effective as the governments that we serve. An essential ingredient for our joint success, is the political commitment that individual governments make to work with us and with other governments in the region in order to identify and overcome common environmental problems. All of you assembled here are keenly aware of the need for decisive and unselfish action to prevent further dissolution and deterioration of the precious natural resources of the world, and especially of the regions you are examining. Collectively, we can achieve great success, and UNDP urges you to develop common strategies during this meeting, and return to influence your respective governments to attach increasing priority to resolving environmental problems and, for those countries which are in a position to do so, to contribute in a direct financial way to supplement the limited resources which are presently available to UNDP for allocation to these problems.

A great opportunity has presented itself within the last few years to the governments of this region to allocate capital resources and join together to reverse the deterioration of your land resources. We in UNDP will be keenly examining the ideas and recommendations that will result from this meeting with the expectation that it will assist us in formulating our own assistance plans in the future.

On behalf of the Administration of UNDP, I wish you a successful meeting, and to that end, I now have pleasure in presenting a short supporting paper explaining in more detail our relevant programmes.

Opening Session

Background Paper No. 2

UNDP and UN Agency Programmes in Natural Resources in the Middle East and South West Asia

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INTRODUCTION

As the major ecological problems to be discussed in this meeting are in the arid and semi-arid zones, this paper will emphasize these, as well as the role which UNDP and the Specialized Agencies can play in agricultural development and environmental planning on a sound ecological basis.

A review of past experience in the agricultural development of arid areas* shows agriculture both as a victim and a culprit with regard to desertisation. The fragility of the resources and the scarcity and unreliability of rainfall in arid areas have often diverted development efforts and investments towards more favourable areas. Consequently, the type of development and conservation measures required could not be implemented at a level sufficient to prevent desertisation. As a result, limited sectoral and uncoordinated development efforts have led to the progressive deterioration of the natural resources under growing pressure of human and animal populations.

It can be argued, however, that not all agricultural activities have downgraded the environment. In many areas, irrigation development activities have contributed to the reduction of desert encroachment. Irrigation is usually followed by afforestation and the establishment of wind-breaks, the reduction of dust and sand storms, and locally cooler climatic conditions. Major works of land reclamation, sand dune stabilization, afforestation, control of watersheds, temporary exclosures, nature reserves and national parks have also contributed significantly to the recovery of deteriorated arid areas.

The overall situation in the Region is, however, not encouraging: in several countries, the high population pressures, the size of the areas to be reclaimed, the very low level of investment capacity and the limited profitability of most land reclamation works, have so far precluded any possibility of reversing the desertisation trends.

Diversification of the sources of income may often be the only possible approach to development, for instance by combining grazing of domesticated animals with other activities such as development and management of wildlife resources, the use of solar energy and wind energy, the use of vegetation for special production, such as medicinal and aromatic plants, as well as handicrafts and tourism.

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* Problems and trends of agricultural development related to desertisation: paper presented by FAO at UNEP Regional Meeting on De-Desertisation and Arid Land Ecology, Teheran, 1975.

The majority of traditional social structures and most of the land and water tenure systems, however effective they may have been in the past, are now often grossly inadequate to meet the pressure of the changing times. Some form of restructuring is, therefore, usually needed. When considering opportunities of establishing new socio-economic units, a distinction must be made between different systems of land and water use associated with different groups of people, with different levels of management capabilities and different carrying capacities of the land resources. Consideration of the existing commercial links between these systems and groups of people are also essential*.

The development of new forms of land use systems through land reforms, cooperatives or other groupings of cultivators and associations of pastoralists do not necessarily provide, however, any great incentive for better land management. Security of tenure needs to be associated with security of income and progressive transfer of responsibility, including financial responsibility for development, from Government to the people. In many cases, the creation of new socio-economic units in arid areas has led to the confinement of people within restricted territories with insufficient carrying capacity, thus resulting in an acceleration of the processes of land degradation and desertisation.

Major lines of resource development action to control or reverse land degradation

In most cases, the solution of land degradation problems necessitates the implementation of long term remedial measures. It should be recognised that such measures frequently may have a negative impact on the welfare of the local population, and great care must be taken to explain and introduce such corrective actions.

Short-term remedies

Some short-term measures are necessary in order to buy time and enable the recovery of productive potential of the land. These include:

(1) Changes in the diet of pastoral people, to reduce their direct dependence on livestock; food supplies and establishment of food reserves; supplies of animal feeds and fuel in order to relieve the pressure on natural vegetation;

(2) Improved communications, marketing and other structures to assist offtake of livestock and integration of pastoral and agricultural economies;

(3) Additional *ad hoc* employment opportunities in land improvement works, construction of reservoirs, establishment of shelter belts and wind breaks and in other activities, such as fisheries and wildlife utilization.

Long-term remedies

Most of the techniques which can contribute to the control of land degradation or desertisation are known. Their success mostly depends on their implemen-

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* See 'The Improvement of Nomadic and Transhumance Animal Production Systems', 46 p. FAO/AGA Misc. 74/3, Demiruren, A.S., FAO, 1974.

tation within a rational sequence of actions. Some of the basic pre-requisites for this control include:

(1) the provision of basic services and development of institutions: in many countries, arid areas have been neglected in the overall development of national institutions;

(2) the establishment of a mechanism of co-ordination, involving the various ministries concerned;

(3) the assessment of land and water use capabilities: in many cases, the inventories of arable lands, rangelands and forests are carried out by different institutions and, as a result, one of the most critical aspects, e.g. the delineation of the boundaries between cultivable areas, forests and grazing lands, is not adequately covered. Methodologies for integrated surveys, for multi-purpose evaluation of land resource capabilities and for assessing the dynamic aspects of various forms of land degradation: it is essential that socio-economic surveys make use of natural resources surveys as a base for relating present land use problems to specific natural conditions;

(4) the formulation of land use policies and basic legislation, largely based on the assessment of the land and water resources capabilities and on the socio-economic conditions of the people living in arid areas; and

(5) the development of rational land use plans followed by issuance of land zoning ordinances and land use permits, which can be considered the major tool in preventing degradation of land resources by misuse and mismanagement: such plans should not only delineate the areas devoted to specific land use, but also indicate the areas which require specific land improvement and conservation activities, as well as areas which should remain protected.

Obstacles to development

Often the main obstacles to development are existing social structures and the conditions of tenure of land and water resources associated with them, and not the availability of resources or the methods of managing these resources.

The rate of economic growth and increases in GNP within the region as a whole, have been exceptionally rapid; however, it is necessary to distinguish between countries benefitting from revenues from the development of oil resources and the situation of a number of countries in the region whose development has not been so spectacular.

For purposes of examining the restraints upon development, the great variety of physical, biological and cultural features of arid and semi-arid zones must be recognised. In addition to climate, the principal factors include topography, social organizations, and diversity and access of the mineral resource base. The immense heterogeneity of cases and circumstances which need to be considered thus results from the numerous possible combinations between a great variety of natural parameters and a large diversity of situations, due to socio-cultural settings, political divisions and the historical conditions of exploitation.

The approach to development problems will differ greatly according to whether or not traditional populations and civilisations exist, and also to what part nomads, semi-nomads and sedentary peoples play in a country.

This great diversity makes it extremely difficult to elaborate general models for development. While development in most of the Region is difficult on account of the irregularity of the water supply available for use by man, it is the semi-arid zones, rather than the arid ones, that present the most serious problems. Specific solutions for the use of arid zones can be found, based on division of arid areas into specialised land use units. In semi-arid zones, on the other hand, there is a conflict between various methods of development (agriculture or animal husbandry) and the choice becomes even more difficult with increasing population densities.

Many problems exist in animal husbandry in the arid and semi-arid zones. The essential problem is in the sub-arid regions where crop production and animal husbandry become competitive rather than complementary forms of land use. Additionally, the size of herds has increased as a result of improved sanitary conditions and the provision of numerous watering places. Furthermore, farmers have everywhere sought to extend their cultivated land, to grow not only their subsistence crops, but also various cash crops, at the expense of the rangelands which have been pushed back towards the least hospitable zones. As a result of the current population increase and the spread of cash cropping, crops dependent on rainfall are spreading more and more into areas where the yields are largely a matter of chance. Hence, the increase in cultivated areas leads to a very wasteful use of land, an obvious consequence of which is the destruction of the fragile plant cover and the exacerbation of erosion phenomena.

Development possibilities

While the possibilities offered by technical development should not be ignored, care should be taken to avoid too rapid a break with tradition characterized by symbiotic relationship and balances between human societies and the natural environment, in which any change necessitates consideration of the whole.

The first requirement in developing animal husbandry should be to ensure that herds are provided with more ample, regular and nutritive food. This involves, first of all, limiting the concentration of livestock. However, the causes of overgrazing demonstrate the difficulties of an operation which can be successful only within the context of an overall policy for land use management and integrated economic development. This evidently relates to the search for ecological solutions, as within the framework of Project 3 of MAB of UNESCO and of the FAO work programme on Ecological Management of Arid and Semi-Arid Rangelands in Africa and the Near East (EMASAR).

A systematic policy to encourage fodder-producing trees and shrubs could be the keystone of land use management programmes.

In the matter of water management, a policy based on the provision of rationally sited wells is preferable to the sinking of deep boreholes. The numbers of livestock using the wells or boreholes should be kept in line with the numbers using the grazing land that they supply.

Agricultural planning in dry regions, especially the choice and distribution of rain-fed crops, should be based on more systematic use of climatological information.

The following technological innovations should be examined:

(1) introduction of new genotypes of forage plants;

(2) introduction of legumes, as a strategy for countering fertilizers shortages;

(3) elaboration of strategies for conservation of forage and fodder supplies;

(4) improvement of animal performance through introduction and breeding of suitable livestock; and

(5) evaluation of strategies for conservation and utilization of water resources.

Recommendations which have been made to UNDP and the specialized agencies

The increased international interest in arid and semi-arid zones is evidenced by a series of conferences, programmes and workshops held and supported by the UNDP and various UN agencies during the last two years. These include:

(1) Expert consultation on the ecological management of arid and semi-arid rangelands in Africa and the Near East held in Rome in 1974.

(2) The FAO/UNEP programme for the Ecological Management of Arid and Semi-arid Rangelands (EMASAR).

(3) MAB Projects 2, 3, 4, 5, 6 and 8 are all relevant with regard to solving ecological problems in the Region under discussion.

(4) The UNEP Regional Meeting on De-Desertisation and Arid Land Ecology, Tehran, 26 February-4 March 1975.

Although efforts have been made to minimize overlap between the conferences which have been held so far, it seems rather evident that there has been considerable overlap between the recommendations that were made. Rather than list all the various recommendations, it seems more sensible to present them under appropriate subjects and not to mention which UN agency (agencies) is supposed to execute them, assuming that one of these will do so. The need to improve the co-ordination of research development and training requirements, derive the maximum benefit from existing institutions and avoid establishing duplicative operations, merits special attention.

1. *Conservation of the natural environment*

   (a) An information co-ordinating center should be organized for data and literature collection, bibliography making and the dissemination of conformation.

   (b) Seminars and/or orientation symposia should be held periodically for planners and decision makers to increase their awareness about the value of conservation.

   (c) Establishment of range and watershed and wildlife management training for personnel of all levels and initiation of studies in wildlife biology. Strengthening of environmental training institutions.

   (d) Strengthening of vegetation studies in the Mediterranean Region.

   (e) Co-ordinated studies of windbreak planting and construction techniques.

   (f) Co-ordination of pilot projects on national parks and biosphere reserves for the purpose of establishing base-line data for the management and monitoring of protected areas.

   (g) Regional workshops on sand dune fixation.

   (h) A workshop on afforestation techniques.

(i) Seminars on wildlife management and on the conservation of wild and domestic plant species which are in danger of extinction.

2. *Range management and animal husbandry*

(a) Training of professionals and sub-professionals in range management and animal husbandry techniques.

(b) Launching of pilot projects on seed nurseries, trials of known techniques in protected areas, water requirements and salt tolerance of range plants, palatability studies on local plants.

(c) Studies on vegetation and range potentials.

(d) Regional meeting on animal diseases.

(e) Identification of harmful flora and fauna and their adverse effects on man and animals.

(f) Studies on the present legislation for rangelands and protected areas and of existing institutions.

(g) Development and promulgation of a range policy incorporating ecological guidelines.

(h) Evaluation of current and completed range and livestock investigations, surveys and development programmes, for determining their impact, and for making recommendations for the future.

(i) Review and compilation of existing literature relative to the ecological, socio-economic and range use aspects.

(j) Information related to primary and secondary productivity, including relations between population and natural resources carrying capacity.

3. *Agriculture*

(a) Seminar on ecological management of rain-fed agriculture.

(b) Research to identify, select and breed plants tolerant to deficiency or excess of variable elements.

(c) A consultation on present conditions in oases.

4. *Irrigation*

(a) A co-ordinated network of pilot projects arriving at testing the feasibility of alternative techniques for rational conveyance of water with particular emphasis on reducing water losses by seepage, evaporation and/or evapotranspiration.

(b) A co-ordinated network of pilot experiments aiming at assessing techniques and conditions under which saline waters can be economically utilized without causing significant harmful effects to the soil and growing plants.

5. *Soil degradation*

(a) Assistance to countries and regional institutions in strengthening their activities in the field of surveys of critical soil areas, and development of comprehensive soil conservation programmes and

a methodology for monitoring soil degradation through periodic surveys supported with remote sensing and other techniques.

(b) Developments of methods for identifying and locating the origin of sand storms and for monitoring air pollution caused by wind erosion of soils.

(c) Co-ordinated studies and promotion of windbreak planting.

(d) Sub-regional workshops on sand dune fixation and afforestation in different ecological situations.

(e) Expert panel to review existing publications, data, experimental results and other experience in soil erosion and degradation.

6. *Environmental planning*

(a) Compilation of an inventory of ecological training and research resources in the Region and the support for the establishment of training institutions in all aspects of environmental management.

(b) *Ad hoc* regional training courses and seminars on environmental management for decision makers and interested members of the general public.

7. *Integrated ecological research on human settlement patterns*

A regional meeting for development of pilot studies on integrated ecological studies on human settlements.

Several of these recommendations are already being implemented. It is clear that many of the others will also be implemented by bilateral aid programmes or for that matter by individual governments.

INTRODUCTORY STATEMENTS

SUMMARY OF DISCUSSION

In answer to questions about the aims and procedural arrangements for the meeting, **Dr. Poore** suggested that general discussion of development would be inappropriate; the meeting was concerned with ecology as applied to development and its aim was to provide guidance for conservation of natural resources in the process of development. Promotion of funding for resource conservation within the region was not an objective of the meeting, although it was to be hoped that oil-producing countries would be ready to devote significant amounts of funding for conservation operations (as had been suggested by Dr.de Vos). **Mr. Nabi** considered that where the claims of nature conservation competed with conventional economic development claims on land, the case for conservation was considerably weakened by our inability to put a value on amenity. It was agreed that discussion of techniques for this purpose did not fall within the remit of the meeting, but that the report of the meeting should include guidelines on choices in development in such situations. Choices should certainly not be based entirely on economics.

Dr. Labani accepted that global regulation of human populations was an essential component of natural resource conservation, although he doubted its applicability to most of the dry regions of the Middle East and South West Asia, where lack of human populations often imposed restraints on resource development. He felt that control of animal populations that interfered with human food production should also be recognized as an important factor in the maintenance of a human/natural balance. Several speakers considered, however, that the problem of keeping man in balance with his natural resources dwarfed most other needs in this regard. People often required more from the land than it could provide and a change in land management could change the status of an animal from a pest to a resource and vice versa. The object of this meeting was to help make choices. **Prof. Nader** suggested that, in these discussions, a clear distinction should be drawn between management of domestic and wild stock. There was a definite need for research to determine carrying capacities. **Mr.Khattak** referred to the perils of interference with nature and the repercussions of overuse of land, especially overgrazing by domestic stock. There were 73 million cattle in Pakistan, they made reafforestation extremely difficult and their overuse of hill land threatened the Indus river dams by siltation.

Dr. Anwar was disappointed by the dearth of material on soil conservation in the papers for the meeting. He thought that land reclamation merited discussion in view of its implications for conservation of natural vegetation. It was pointed out that papers had been prepared as a background for discussion and in no way restricted subjects for the meeting's consideration. It was agreed that land reclamation should be considered. Human pressure on land would clearly be a dominant factor in the meeting's deliberations. As human populations increased, land was used more intensively and often necessitated zoning to ensure that a particular form of use was concentrated in a particular area and its application elsewhere limited.

Election of Officers for the Meeting

In the inaugural sessions of the meeting, on 25 May 1975, Mr. Abdul Malek Khattak (Pakistan) was elected President of the Meeting (proposed by the Delegation of Iran and seconded by the Delegation of Jordan).

Mr. Khattak thanked the delegates for his election. He referred to the vast areas of arid and semi-arid country within the region under consideration and the technical, social and economic problems of these often neglected areas. He urged active participation by delegates to produce practical guidelines and emphasized the importance of implementation of proposals that would arise from the meeting.

Dr. Homayoun Shariari (Iran) was elected First Vice-President of the Meeting (proposed by the Delegation of Iraq and seconded by the Delegation of Jordan). Dr. M. E. D. Poore (IUCN) was elected Second Vice-President of the Meeting (proposed by the Delegation of Saudi Arabia and seconded by the Delegation of Iran).

Dr.Colin Holloway (IUCN) was elected Rapporteur of the Meeting (proposed by H. E. Mr. Eskandar Firouz and seconded by the Delegation of Iran).

Subsequently, on May 27th, 1975, a Drafting Committee was elected, to prepare ecological guidelines and recommendations for consideration by the plenary session. Its composition was as follows:

Convener: Dr. H. Shahriari (Iran)

Members: Dr. R. M. Anwar (Egypt), Dr. H. R. Gharaybeh (Jordan), Prof. I. A. Nader (Saudi Arabia), Dr. I. H. Zaidi (Pakistan).

Technical Advisers: Prof. F. Barth, Prof. A. de Vos, Dr. F. A. Harrington, Dr. C. W. Holloway, Dr. H. N. Le Houérou, Dr.M. E.D. Poore, Prof. B. Spooner, Prof. P.Wendelbo.

Session I: CHANGING PATTERNS OF LAND USE AND LAND USE PLANNING IN RELATION TO NATURAL RESOURCES

Background Paper No. 3

Ecological Management of Arid Grazing Lands Ecosystems

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FOREWORD

Several workshops, seminars, meetings and conferences on arid lands and rangelands problems were held during the course of the past few months. Many of these meetings, like the present one, were supported by UNEP.

Let us quote some of them:

(1) Regional Meeting on Integrated Ecological Research and Training Needs in the Sahelian Region. UNESCO (MAB 3)/UNEP, Niamey, Niger, 11-15 March 1974, Report: MAB No. 18.

(2) MAB 3 International Working Group, UNESCO, Hurley, 2-5 July 1974 Report: MAB No. 25.

(3) Expert Consultation on the Ecological Management of Arid and Semi-Arid Rangelands in Africa and the Near East. (EMASAR)FAO/UNEP,Rome, 27-31 May 1974.

(4) First Latin-American Arid Zone Conference. UNEP/IADIZA, Mendoza, Argentina. 11-16 November 1974.

(5) EMASAR Conference, FAO/UNEP, Rome, 3-8 February 1975.

(6) Obstacles to Development in Arid and Semi-arid zones. UNESCO/ECOSOC, Paris. 30 January-5 February 1975.

(7) Regional Conference on Dedesertization. UNEP/lranian Government. Teheran, 28 February-6 March 1975.

(8) International Seminar on Evaluation and Mapping of Tropical African Rangelands. International Livestock Centre for Africa (ILCA); Bamako, Mali, 3-8 March 1975.

(9) Ad Hoc Inter-Agency Meeting on Arid Zones. FAO, Rome, 10-11 March 1975.

(10) Regional Meeting on the Formulation of a Cooperative Programme on Research, Training and Management of Grazing Lands in North West Africa. FAO/UNESCO/UNEP. Sfax, Tunisia, 3-12 April 1975.

These are the meetings in which I have personally participated (except for 9.) There might have been more, so that this one is the eleventh within 14 months, dealing with similar or closely related topics. In this paper, I shall try to report on the main findings of these meetings which seem to me of relevance to the region we are concerned with here.

I shall deal with the subject in a global way without referring particularly to any specific meeting, unless expressly stated.

1. CHANGE IN LAND USE PATTERNS DYNAMICS OF VEGETATION AND ECOSYSTEMS

1.1 Range depletion

It is unanimously recognized that Rangelands are being misused by overstocking, clearing for cultivation, burning and removal of woody species for firewood, charcoal or distillation. This results in:

(a) *reduction in plant cover and biomass,* mainly perennials, and hence of carrying capacity for livestock;
(b) *Increased erosion* which, in many low precipitations areas, leads to a more or less irreversible desert encroachment;
(c) a sharp *reduction in production* and (far worse) in productivity of rangelands: this production is often only ¼ and sometimes as low as $^{1}/_{10}$ of the potential as measured on control plots;
(d) an *increase of unpalatable species* in numbers as well as in biomass;
(e) an *increase of annual species* which leave the ground bare and subject to erosion during the dry season;
(f) *rarefaction* and sometimes *disappearance of the most valuable forage species,* ecotypes or populations, and hence erosion of the genetic stock available for future research; and
(g) *rarefaction, or disappearance of wildlife* and consequently impoverishment of the environment quality.

1. 2 Expansion of cultivation

Cultivation mainly for cereals is expanding very fast over arid regions where the crop expectancy is extremely uncertain and the yield very low. This is due to the demographic explosion which characterizes the second half of this century. In the Near East and North Africa, the increase in cereal production, necessary to meet the needs of an increasing population, has been obtained mostly from expansion of the cropped area and to a very limited extent from higher yields. This fact is clearly shown in the study of official statistic records (Le Houérou 1973). It has been indicated that the increase in cultivated acreage is roughly of the same magnitude as population increase (i.e. about 3% per annum).

The result of this situation is that the best grazing lands on arable soils in the arid zone are progressively cleared for cereal cropping with very low and irregular yields. These newly cultivated areas are often turned almost sterile in a few years by erosion, either hydric or eolic, or both, and are then irreversibly lost for cropping or grazing.

1. 3 Salination hazards

The most common remedy used so far to meet the food needs in arid zones is the development of irrigation schemes.

These have sometimes been successfully achieved but also sometimes turned out to be catastrophic, resulting in salination, alkalization and sterilization of large tracts of lands where huge investments were expended.

These are mainly due to mistakes in conception and planning by using waters

and soils which should not have been utilized without strict technical specifications.

Even when these specifications are planned from the beginning, they tend to be forgotten once the water is there.

On the other hand, very often irrigated areas are devoted to food or industrial crops, with total disregard of fodder crops and animal production and without links between steppic stock raising and irrigated agriculture. However, it has been shown in many countries, for instance the USSR, that the establishment of such links is essential to develop extensive livestock raising (fodder reserves, fattening operations for young and culled animals) and that the whole operation is globally profitable at the region level, even when it does not seem profitable at the level of an irrigated farm.

1. 4 **Multiplication of boreholes and watering points**

In many so called range development schemes or areas,'development' has essentially consisted in multiplying water points (boreholes, surface wells, cisterns, ponds, hafirs, etc .. .).

This makes it possible to use during the dry season rangelands which could not previously be used in that season owing to the lack of water availability. A distinction should here be made between boreholes discharging large quantities of water (several litres per second) and low or temporary yielding water sources such as shallow wells or cisterns.

Large boreholes are usually very harmful in the fact that they allow for important concentrations of livestock (in many cases 5 to 10 times what the range could sustain) and the consecutive destruction of pastures in a radius of 5 to 20 kms around the boreholes. This has produced catastrophic results in the sahel of Africa and elsewhere.

Low yielding or temporary water sources are much less harmful; cisterns, in particular, allow only a few weeks extension of the grazing season; when there is no pasture, there is no water either and hence pasture depletion is rarely acute in this case.

1. 5 **Settlement of nomads and transhumants**

Nomadism and transhumance are constraints imposed by the ecological conditions in arid zones. Climate is such that plant growth and production is too irregular in time and space to allow year round feeding of livestock. When the forage and/or the water available are consumed, people and herds have to move to other areas where forage and water are available.

Hence settlement of nomads and transhumants implies two possible strategies:

(a) the feed supply for livestock in period of scarcity is insured either artifically by irrigated fodder crops or by concentrates (or both) or through deferred grazing systems, or through plantations of fodder shrubs and trees as feed reverses. That is to say that one way or another a feed supply is insured to replace the migration in search of pasturage.

(b) nomadic populations are turned to other activities: irrigated farming, trade, handicraft, tourism, industry, civil service, army, etc .. .

Settlement of nomads is a general tendency usually favoured by governments. Some attempts to organize nomadism, such as nomadic schools, have been successful, to a certain extent, but do not seem to be widely expanded.

In some countries like Syria and Algeria, settled graziers cooperatives have been established on quite sizeable surfaces. However, these cooperatives need surfaces large enough to balance the effect of rainfall patchiness on range production. This is also the case of modern range exploitations in arid zones of USSR, Australia, USA and elsewhere, which usually cover several tens of thousands and, sometimes, several hundred thousand hectares.

2. OBSTACLES TO DEVELOPMENT

The main obstacle to development of arid zones is the lack of a global policy taking into account and integrating all the various facets of this difficult task, or the will or the power to enforce such a policy.

The basic cause of arid land degradation and desertization is an increase in human and livestock populations whereby the population densities grow beyond the carrying capacity of the land under the present system of exploitation.

This situation could be improved in several and complementary ways:

— Population control
—Emigration
— Rational use of the land

It might be interesting to see why these have not usually been carried out successfully; that is to say what are the obstacles to development.

2. 1 **Population control** has been attempted in several countries with little success (China and Japan being excepted). The reasons are manifold: basically the lack of education and motivation of the people and the inadequacy of the methods (including education and advertisement) to the mentality and traditions of the populations involved.

2. 2 **Emigration** is very successful in many countries, but it has some inconveniences, for instance, the money sent home by emigrants is often used to buy tractors, which allows clearing of natural vegetation over vast surfaces, thus accelerating the desertization process.

In some areas, emigration permits population density over 100 per km^2 in areas with 100-200 mm of rainfall and without irrigated agriculture. Such a density results very quickly in 'mineral landscape' where almost all perennial plants are removed.

2. 3 **Rational use of the land** is a result of numerous conditions which interact in a very complex way:

2. 31 *Education:* The number of trained ecologists, conservationists and range specialists is extremely small in respect to the need. In a recent meeting in Sfax, a rough estimate was that, in North/West Africa, the immediate needs for Range management specialists and ecologists were at least 200 for the whole region; that is to say more than ten times the present number.

It is obvious that unless a sufficient number of trained specialists at all levels is available, any large scale development plan is doomed to failure. It is certainly not the foreign experts, however competent and numerous they are, who can achieve any large scale development plan.

2. 32 *Research and Survey:* Insufficient research and survey are sometimes also an obstacle to development especially when land capabilities and carrying

capacities have not been determined. In such a case, development schemes initiated with insufficient basic data may be hazardous.

Very often, however, there would be enough data available to initiate development, but these data are not integrated, or some very important aspects have been overlooked, especially those concerned with social sciences.

This is also a recommendation coming out of almost all recent meetings: the need for coordination and integration of natural and social sciences with engineering and other aspects. This is especially stressed in programmes such as MAB and EMASAR.

2.33 *Development planning:* This point is closely connected with survey. Planning should always result from an integrated survey. However, it is rarely so. In most cases, planning is carried out after partial and sectorial pre-investment studies where generally only climate, water and soils are taken into consideration. Such important factors as vegetation, rangelands, their productivity, social facts such as technical level of farmers or herdsmen, land tenure, traditions and motivations of the local population concerned, are simply ignored. As development anyway has to be achieved through the local populations, it is not realistic to plan any action without the agreement and involvement of those populations. Although this might seem very elementary common sense, it is often overlooked in the planning process.

2. 34 *Legislation and organization:* Many countries have no modern range legislation. Rangelands are exploited under traditional customary legislations which are not any more adapted to the present types of societies or exploitations.

In other cases, some laws exist but are not enforced, especially laws concerning limitations to cultivation under certain circumstances of particular erosion hazards, to woodcutting, etc ...

This is usually due to the lack of a clear-cut government policy and/or the will and power to enforce a policy once it has been decided.

However, policy and law making are not sufficient without an efficient organization able to enforce the policy. In many countries there is for instance no range service powerful enough to coordinate all actions taken concerning rangeland, research, survey training, water development, land tenure, range development, health services, marketing, etc .. . This supposes a strongly structured organization represented at regional and local levels and able to help local populations to organize themselves in order to move from a traditional subsistence economy towards a production-profit orientated system. This mutation is a very difficult one, but it is rendered necessary in modern economy and because of the growing demographic pressure.

Establishing a well structured organization able to deal efficiently with extension and development supposes a well defined policy and numerous well trained personnel at all levels. Here we come back to point 2.31 and the vicious circle of under-development is closed.

3. GUIDE LINES FOR DEVELOPMENT

Any development in arid zones should be based upon:

—a realistic acceptance of ecological facts which are:

(a) low and erratic rainfall

(b) unpredictable recurrence of periodic droughts

(c) uncertain and irregular production

(d) low potential per unit of land area, hence the necessity of having large land management units

(e) unstable and fragile ecosystems

(f) erosion and salination hazards

—an adequate knowledge of economic criteria and social attitudes,

—availability of good preinvestment studies giving a sound evaluation of the carrying capacity of the land as a function of various development strategies and investment inputs (of all kinds).

3.1 **Training**

In most of the recent international meetings, especially those devoted to range conservation and management, training has been rated as No. 1 top priority. As aforementioned, one can hardly see any large scale development without proper training of numerous specialists at all levels and in the various disciplines involved. Training should include learning how to work in inter-disciplinary teams. Some specialities of paramount importance for arid zones such as ecology and range management are usually neglected or are not given adequate importance (whereas rangelands represent usually over 80% of land surface in arid zones).

Also training is too often inadequate in quality: too academic, too bookish or unadapted to the conditions of the country.

Therefore, ecology and range management, especially, ought to be taught within the countries (or the regions) themselves, using local examples. Too often, students who have been trained abroad in different environmental conditions (socio-economic if not physical) can hardly adapt what they have learned to the case of their own country. Too often also students, especially if trained abroad, are employed, when they come home, in other jobs than those for which they have been trained.

Another aspect of training is the need to attract to technical careers involved in arid land development young people of good quality. It is an easy governmental task to make these careers attractive by appropriate salaries and other incentives to field work.

It is usually the contrary that happens: urban or easy bureaucratic life is made much more attractive to the young, which of course, is of little help to actual development.

Prior to joining the central administration, technicians and administrators should have spent several years devoted to actual field work which would make them more knowledgeable of real development problems at that level.

3. 2 **Research and survey**

Development without a minimum of research and survey is unthinkable. Research and survey should always be carried out in an integrated way through interdisciplinary teams involving specialists of physical, natural, social and economic sciences. This recommendation again emerges from almost all recent international meetings. It is true that this philosophy is behind the Man and Biosphere Programme as well as a basic principle in the EMASAR

Programme. Other recently established Research institutions such as the International Livestock Centre for Africa (ILCA) are developing this same philosophy for action.

One of the bottlenecks to such integrated research and survey is the scarcity of trained manpower able to carry it out. Therefore, it should perhaps be advisable to establish regional centres grouping together interdisciplinary training research and survey teams. Establishment of such centres has been recommended by MAB, EMASAR, UNEP and others.

3.3 **Technical improvements**

Technical improvements can be achieved in many complementary ways:

3.31 *Range development* through rotational and/or deferred grazing adapting stock rates to carrying capacity. One of the simplest ways is the establishment of grazing reserves, which were known in several traditional systems such as the 'Hema' of Arabia, or the 'Gdal' of North Africa.

3.32 *Herds management* must go together with range management. This includes better nutrition conditions, better health care, adequate proportion of males, proper culling, timely selling, etc …

3.33 *Water development.* As mentioned afore, water development should never be carried out alone, i.e. without being able to manage this resource in conjunction and harmony with the management of other resources such as range management, proper irrigation and drainage techniques, etc .. . Some very efficient traditional systems of water harvesting (surface or underground) could be popularized in other regions.

3.34 *Complementarity between range areas and farming areas.* Improved range and herds management practices and the settlement of nomads or transhumants imply additional forage resources to replace the feed which cannot be found on the range in certain periods.

These additional resources ought to come primarily from farming areas either from bordering semi-arid zones or from irrigated farms within the arid zone. This means the growing of fodder crops and/or concentrates to be made available to the graziers through various ways, even, if necessary, by subsidizing the farmers.

The system is not easy to work out; it supposes the establishment of buffer fodder reserves, the role of which is not only to avoid periodical hecatombs during severe droughts, but also a better animal nutrition and production in 'normal times'.

Large scale experiences in USSR, Syria, Tunisia and elsewhere show that this is perfectly workable and economically feasible. It is above all a matter of education by the extension services.

3. 35 *Use of crop and industrial residues for livestock feeding.* Very often crop and industrial residues such as cotton seeds, peanut cakes, sugar molasses, bran, etc … are exported at very low prices whereas they could be locally used in fattening operations.

3. 36 *Fodder shrubs and trees.* Pasture reseeding is very often a deceiving and always expensive practice in arid zones. However, establishment of fodder shrubs and trees has been successful on large areas in several countries. In Tunisia, for instance, over 50, 000 ha of fodder shrubs were planted during the past five years.

Similar results were obtained in Iran, in Israel, in Pakistan and a programme has been started in Syria. The establishment of such reserves is rather costly ($150 to $300 per ha), therefore, it must be insured that they be adequately protected from the beginning and rationally used and managed when they come to production later on. In such conditions, this solution is economically feasible even in areas receiving as little as 200 mm of average rainfall.

3. 37 *Village afforestation.* As fuel gathering is one of the major causes of range deterioration and desertization, it has been advised, and sometimes accomplished, to establish around villages tree plantations for firewood production which, at the same time, provides landscape beautification and amenities.

This is feasible in many areas using fast growing trees such as Eucalyptus, Poplars and others. Two conditions are necessary: good soil (if possible with water table or run-in), effective and total protection and, later on, a rational management. Again, it is a matter of organization.

3. 38 *Establishment of vegetation and wild life reserves.* This implies, of course, investments and resettlement of populations previously living in these areas. This has been carried out very successfully, especially in East Africa and in Iran. It is the cheapest way of restoring natural ecosystems. However, it has also its limitations, especially on shallow soils in the desert and predesert areas where vegetation dynamics are almost null and desertization is an irreversible process.

3. 39 *Sand dune fixation, windbreaks.* Sand dune fixation techniques are now well mastered in arid zones even in areas receiving as little as 150 mm of annual precipitation. After decades of trials, foresters have now compiled an impressive list of trees and shrubs suitable for sand dune fixation and windbreak planting as well as their techniques of establishment. However, more research and experimentation is still needed in the most arid areas (50-150 mm) in order to use some very promising desert species which are not yet domesticated such as: *Leptadenia pyrotechnica, Ochradenus baccatus, Salvadora persica, Aerva persica, Boscia, Maerua, Ziziphus, Genista, Retama,* etc.

3. 40 *Monitoring and project evaluation.* Monitoring is concerned both with natural undeveloped areas where ecological trends ought to be identified, and if possible quantified, and development projects to evaluate the change in the environment induced by the development process.

Monitoring should use both remote sensing (aerial photographs and satellite imagery) and ground checking.

Satellite imagery (of the Erts type) which is available regularly over a number of years, can also give extremely helpful information on spatial distribution of rainfall through successive seasons, information which is of primary importance in determining the size of the land management units. The variables to be monitored are mainly vegetation (composition, cover, etc …), erosion, soil loss, sedimentation, land use and migration pattern, human and animal populations. Development Projects not only need to be monitored but ought to be subject to periodical evaluation, preferably by outside appraisers with the help of the development agencies.

This evaluation should in particular be concerned with:

—Demographic and social changes
—Range conditions and trends

—Changes in soil (erosion, sedimentation, salination)
—Livestock performance
—Water balance and water tables
—Pests and diseases
—Economic results

The objective of monitoring and evaluation is to identify and correct faults, and, possibly, to take advantage of them in further development or in planning new programmes.

3. 4 **Government policies and administrative structures**

3. 41 *Planning and execution.* Before any large scale development is possible, a clear government policy has to be defined and a firm political commitment must be stated.

Development is a very complex matter involving many governmental as well as non governmental services and agencies. The first need is a good coordination at the planning level (which is often the case) and then at the execution level (which is not too often the case).

Normally, one single agency should be responsible for the coordination of all actions taken in a specific domain, e.g. in range areas; all forms of development executed by other departments or agencies should be coordinated by the Range Department (both at central and local levels), i.e. actions taken in the fields of water development, communications, marketing, housing, etc … Inverseley, in irrigation development schemes, it would be to the water development authority to draw upon other agencies for the execution of the parts in the plan in which it has no competence.

In other words, each department should have coordinating powers strong enough to command the support of other relevant departments and the local administration for the execution of its own development projects.

3.42 *Marketing.* The major problems in the marketing of livestock products is the extreme irregularity in the offer which tends to overload the market at some periods and leave it unsupplied for long spans of time. Improved range conditions and herd management would somewhat regularize the market through more balanced feed supply and more regular offtake selling. However, some measures could further improve the situation:

—improved network of routes and holding grounds with feeding and veterinary services
—improved credit facilities for traders and pastoralists
—new outlets for livestock in fattening schemes and foreign markets
—improved purchasing power in agricultural and urban areas
—subsidies on a sliding scale of prices to encourage the sale of livestock during off-peak periods and at the beginning of drought period before the animals damage their environment
—prices policy encouraging good quality meat and differential prices between meat cuts.

3.43 *Credit facilities.* In some countries, range development, forage crops and fodder shrubs plantation have been encouraged through special credit facilities and subsidies. This is, of course, to be developed whenever possible.

3. 44 *Legislation.* Legislation designed to control land use has rarely been enforced in the past:

—legislation designed to prevent overgrazing has not usually worked in the past either;

—much of the legislation dealing with land use has been designed for agricultural rather than for range areas;
—future legislation should be directed at enabling range users to improve their current form of management, e.g. to secure land tenure, prevent tresspass or disturbances and, if need be, retain preventive safeguards against range destruction.

Wherever possible, range users should be involved directly in the preparation and enforcement of their own legislation, thus ensuring closer relations between government and pastoral people.

3. 45 *Fiscal policies.* It is in principle desirable that range areas contribute to general revenue of the country. However, many different situations are encountered, for instance:

—rangelands belong to the state;
—rangelands are the property of the users, whether legally or by customary rights;
—the country is mostly arid and has few other assets than range livestock;
—the country enjoys a more balanced agricultural economy and range areas are of marginal importance;
—the country is an oil rich one.

One principle, however, should be followed and that is that any taxation raised in the range areas should primarily be devoted to financing services for these areas.

Taxes may be imposed by head of livestock or per head of people, or per surface of land area (in this case, on groups of individuals having land rights). In all cases, the rate charged per unit should be calculated on a sliding scale related to the potential of the land, so as to discourage overuse of the resources.

Payment for services (maintenance of wells, boreholes, marketing facilities) should not be equated with taxation and the money so raised used to maintain the services.

4. INTERNATIONAL PROGRAMMES ON RANGELANDS

During the past two years, new programmes on rangelands have been launched especially by UNESCO and FAO.

4. 1 The MAB 3 Project

In the framework of its global programme on Man and the Biosphere, UNESCO has developed a Project (No. 3) on the Impact of human activities on grazing land ecosystems. The general objectives of the project are the following:

—to secure, quantify, synthesize, distribute and apply information on natural and social science research on grazing lands, in order to provide guidelines for the optimal management of these lands and to provide more effective means to achieve optimal management.

This project is concerned with interdisciplinary research and training involving natural and social sciences. It works through national MAB Committees. A central joint UNESCO/FAO Secretariat in charge of the coordination aims at organizing meetings and workshops at sub-regional, regional and global levels, where guidelines are proposed and cooperative programmes

established. The overall guidance for all projects is given by an international governing council, meeting every second year and composed of 25 countries elected at UNESCO's general conferences and several international organizations (within and outside the UN system). Several MAB 3 meetings were already held:

—An expert panel (Montpellier, 2-7 October 1972) which defined a general outline of the project and methods.
— A regional meeting on Research and Training needs in the Sahel region of Africa (Niamey, Niger, 9-15 March 1974).
—an International working group (Hurley, 2-5 July 1974) which defined an outline of regional programmes.
— a Regional meeting on the formulation of cooperative research training and management on arid and semi-arid rangelands in North West Africa (Sfax, Tunisia, 3-12 April 1975), (MAB/EMASAR meeting).

Several national MAB 3 Sub-Committees have been established and have started working.

One of the ambitions of the Programme is to help establishing working links between MAB 3 Sub-Committees in developed and developing countries.

Some copies of these reports are available for consultation; more may be obtained from MAB Secretariat, Department of Environmental Sciences and Natural Resources Research, Division of Ecology, UNESCO, Paris.

4. 2 **The EMASAR Programme**

FAO has recently set up, with the help of UNEP, a general programme on the Ecological Management of Arid and Semi-Arid Rangelands which takes place in the FAO general programme of 'Natural Resources for Food and Agriculture'.

The objectives and outline of this EMASAR programme was defined by a panel of experts who met in Rome, 27-31 May 1974.

The conclusions of this panel were endorsed by a general conference held in Rome (3-8 February 1975). This conference, where 38 countries of Africa, Near and Middle East were represented, proposed a framework for the implementation of the programme. A short report (11 pages) giving the findings of the conference is being circulated in this meeting. I therefore need not insist on this subject.

The programme is at present concerned with Africa, Near and Middle East, but it will be extended by 1976 to Latin America where similar problems exist.

The follow-up actions of the first EMASAR Conference are taking shape. A Coordinating Officer has been appointed. Several projects are under consideration among which the establishment of a regional EMASAR Centre in the Middle East, likely to be located in Iran, following the generous suggestion of the Imperial Government.

MAB 3 and EMASAR Programmes have different objectives: MAB is concerned with Research whereas EMASAR deals with management and development. Both programmes are closely coordinated since there is a Joint FAO/UNESCO MAB 3 Secretariat. Some meetings are held jointly—for instance the Sfax Meeting, since research survey and development ought to be tightly linked.

Session I (continued): CHANGING PATTERNS OF LAND USE AND LAND USE PLANNING IN RELATION TO NATURAL RESOURCES

Background paper No. 4

Land use Hazards in an Arid Environment: The case of The Lower Indus Region

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INTRODUCTION

The story of land use in the Lower Indus Region is actually a story of the strategies that the people inhabiting that region have adopted from time to time vis-à-vis the natural environment. Formulation of such strategies and their effectiveness in achieving the best results from the utilization of useful elements of the environment and buffering the undesirable ones, however, depends on the way environment is perceived (Zaidi 1972). Thus land use in a region implies a complex process of decision-making and involves a number of questions relating to not only its economics but also to its social and political impacts. Greed and careless use of modern agricultural technology in many parts of the world, particularly in the developing countries, has, however, shown that whereas in the quest of the green revolution man has in many ways succeeded he has in the process also created a number of problems for himself (Manners 1974). Little concern has been shown toward the environmental impact of such developmental activities.

In the arid environment of the Lower Indus Region agricultural activity, indeed with the help of irrigation, has been going on since the days of Mohenjodaro. In recent years with the introduction of modern barrage irrigation system and management processes, including use of improved seeds, fertilizers and pesticides, higher levels of crop productivity have been attained; and since the opening of Sukkur Barrage as much as two million hectares of land have been brought under plough; about a million and a half of that are irrigated by canals. But at the same time it is also important to realize that mismanagement of irrigation supplies and seepages from the canals give rise to menaces like waterlogging and salinity. Application of improved seeds, fertilizers and pesticides, if carelessly managed, also creates hazards leading to a disturbed state of ecological balance. What are the nature and extent of such hazards and how well are the farmers of the region aware of these hazards, are the main questions that this study seeks to answer. More specifically the purpose of this paper is to attempt a description of the agricultural land use hazards with reference to an ecological framework based on the model of input-output analysis. Such ecological studies are important from the standpoint of development planning for they enhance the goals of development and also help in anticipating the effects of development activities on the natural resources and processes of the larger environment (Dasmann *et al.* 1973).

THE ENVIRONMENT CONTEXT

The Lower Indus Region represents that part of Pakistan which is functionally

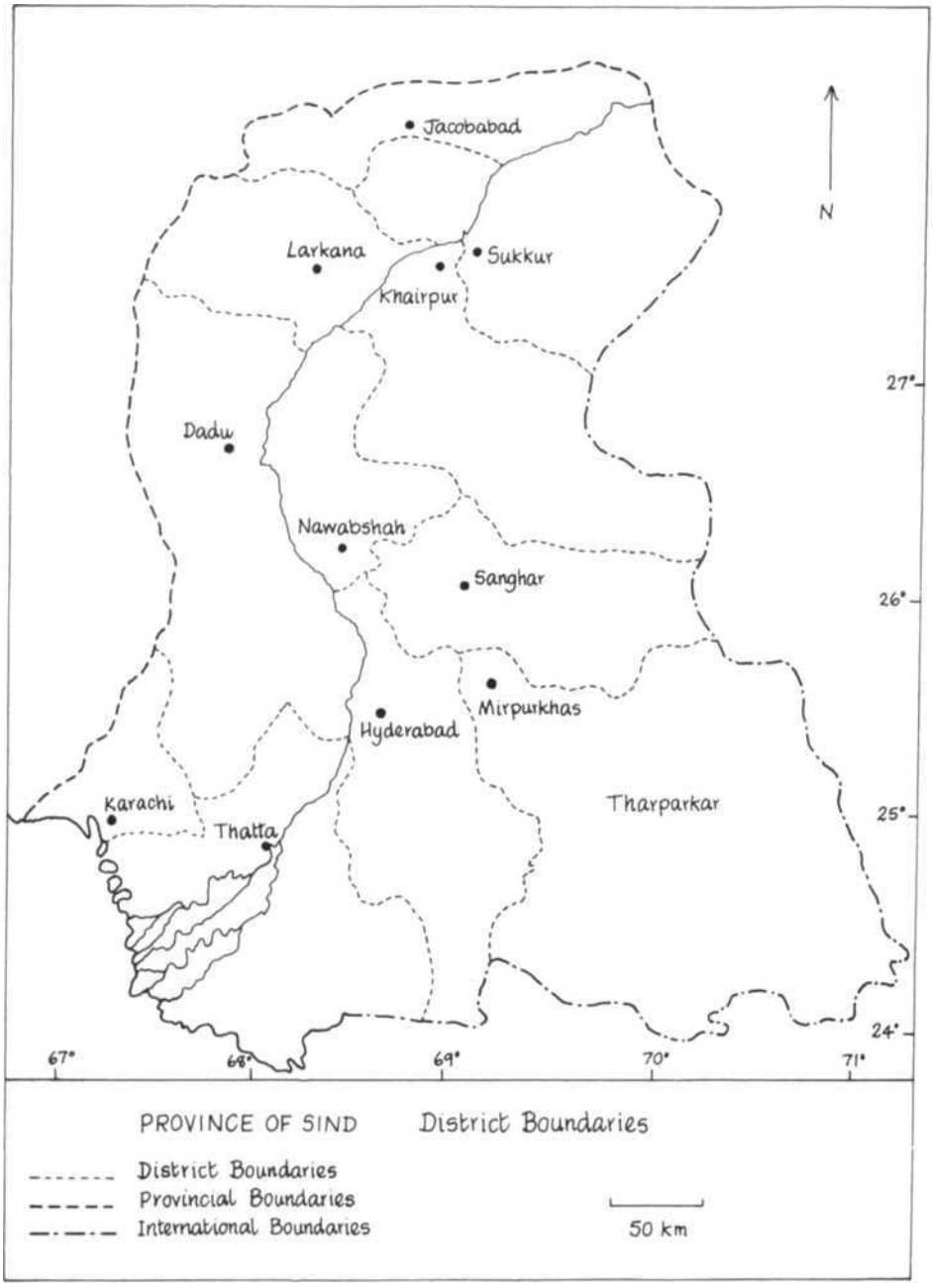

Figure 1.
A reference map showing administrative boundaries of the districts of the Province of Sind.

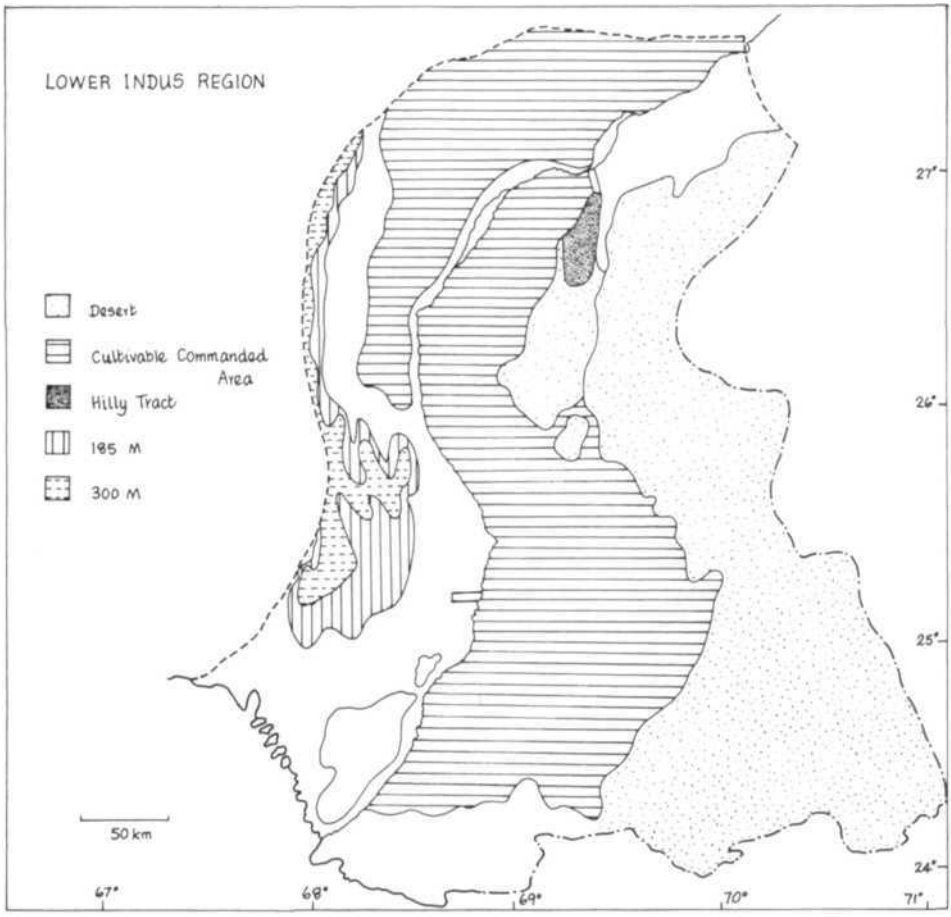

Figure 2.
Area commanded by canals; Source: Hunting Technical Services, *Lower Indus Report* Vol.7, 1965.

connected with the Lower Indus irrigation system. More specifically, the boundaries of this region coincide with those of the province of Sind flanked by Kirthar range in the west and the Thar desert in the east (Figs. 1 & 2). Greater emphasis, however, is placed on the area commanded by barrages comprising about 83 percent of the total cultivable area of the Region. The environmental context of the Region refers to those components of its physical and biotic space which are directly relevant to farming activity; namely, climate, landforms, soils and water-table.

The Region can be classed in BWs category of Coppen's classification which typifies the hot desert where average annual temperature is over 18 °C, a type of climate in which evaporation far exceeds precipitation, causing aridity. Relative variability of rainfall for the period 1884-1955 ranges from 25 to 60 percent (Ahmad & Khan 1961). Normal annual potential evapotranspiration, according to Thornthwaite's method, is generally higher than 1500 mm; and

water deficiency is greater than 1000 mm, exceeding 1400 mm in the central and northern part of the region (Khan 1968).

The Lower Indus plains are entirely of alluvial origin. The alluvium has been deposited by Indus and its tributaries over many thousand years. The uppermost layers, however, are not as old. They are estimated to be of one to two thousand years of age. In some parts, especially in Kotri Barrage command, these alluviums are only a few hundred years old. The meander flood plains are comparatively rough and possess coarse soils. These lands include larger sections of the central and northern parts of the Region. Southward towards delta they become progressively narrower where cover flood plains become more widespread. Levees, with coarse soils overlying fine soils, are associated with such plains. Northwest of the region is a strip of piedmont area where the alluvium has been deposited by streams from the adjacent hills. Almost the entire land in this class is fine textured and differs in physical properties from the Indus alluvium (Hunting, Vol. 2., 1965).

Soils are generally silty. The most common textures are silty loam and silty clay loams. The clays and medium or coarse sands are rare, at least in the upper alluvial layers which form the medium for plant growth. Due to arid conditions the content of organic matter is low, not exceeding one percent in the surface layer. The cation exchange capacity of the soils is about 50 milliequivalence per 100 grams of clay. Since most of the soils have clay content between 15 and 30 percent, the exchange capacities are between 7. 5 and 15 mi Hi-equivalence per 100 grams of soil.

Salinity is a very widespread characteristic of the soils. A more detailed classification based on electrical conductivity (EC) of saturated extract expressed in millimeters per centimeter at 25 °C is given in Table 1. The EC extracts were found to be correlated with alkalinity, the exchangeable sodium percentage (ESP).

TABLE 1.

Salinity classes, percentage of alkali soils and their effects on crops. *Source:* Hunting, *Lower Indus Report,* Vol. 2, 1965.

Salinity class	EC range	Percentage of alkali soils to total soils in the region	Effect on crops
Non-saline	0-4	1.7	No effect
Slightly saline	4-8	23.0	Noticeable effect on all field crops
Moderately saline	9-16	82.8	Serious effect on all crops
Saline	16-40	97.0	Unsuitable for any crop except dates
Ultra-saline	40	100.0	Unsuitable for any crop reclamation slow and expensive

TABLE 2.

Pre-barrage and post-barrage conditions of generalized land-use pattern 1921-22, 1964-65 and 1971-72 area in thousands of hectares.

Sources: *Gazetteer of the Province of Sind* B, District Volumes, *Development Statistics of Sind,* Vol. 1, No. 1, 1971; Government of Sind, Karachi, 1971;

Agricultural Statistics of Sind, 1970-71 to 1972-73, Government of Sind, Karachi, 1974.

Land-use classes	Pre-barrage	Post-barrage				Increase/decrease	
	1921-22	1964-65	Percent change	1971-72	Percent change	Area	Percent
Total area for which statistics are available	12,006	12,566	4.7	12,282	2.3	276	+2.3
I Not available for cultivation	6,242	4,908	10.8	4,445	9.4	+17	+0.4
A Forest land	288	380	31.9	489	28.7	+201	+69.4
B Others	5,954	–	–	–	–	–	–
II Cultivable area	4,808	7,236	50.4	7,348	1.5	+2,538	+34
A Culturable waste	1,095	1,966	79.5	1,783	9.3	+688	+62
B Cultivated	3,713	5,270	41.9	5,565	5.6	+1,852	+50
a Current fallows	2,228	1,750	21.4	2,882	64.7	+554	+29.4
b Net area sown	1,402	7,295	420.3	2,683	63.2	+1,281	+85

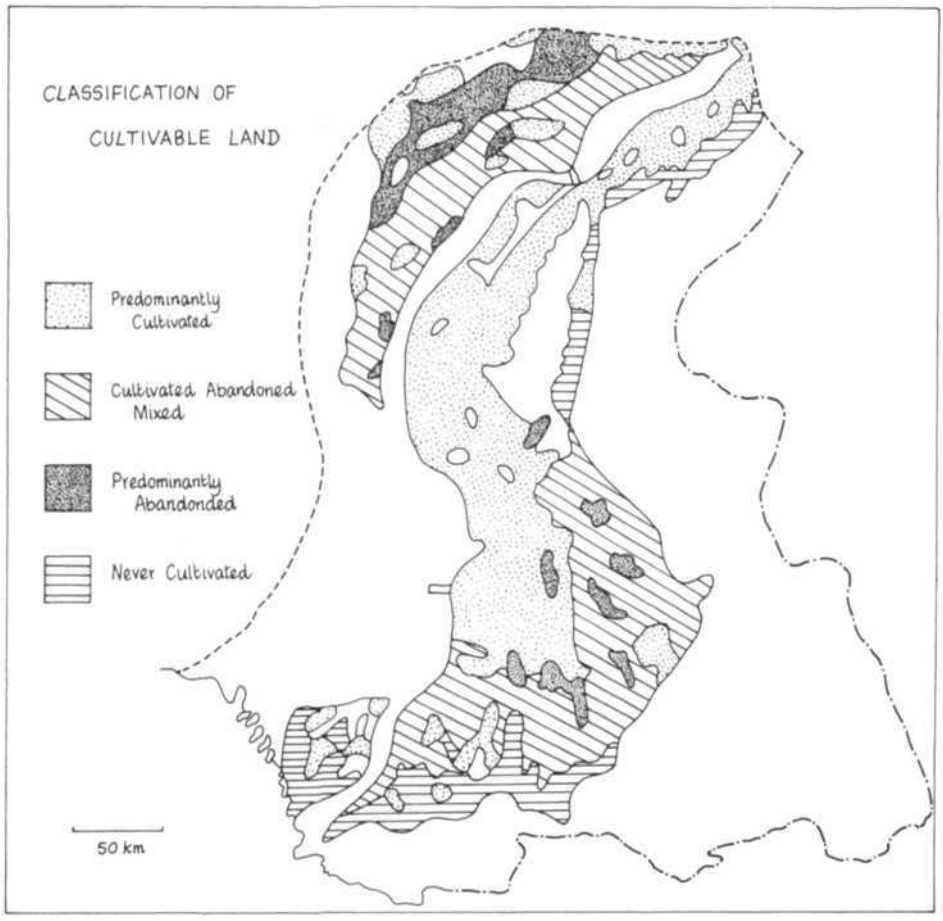

Figure 3.

A generalized pattern of land categories; Source: as Fig. 2.

The areas of shallow water-table in the northern parts are mostly concentrated on the right bank of the Indus where the water-table depth in October ranges from 0 to 1. 25 m. On the left bank the Nara Canal command represents the case of shallow water-table in the month of October, where more than 60 percent of the area falls in this category. In the Kotri Barrage command, too, a high percentage of the area is included in the same water-table depth class.

LAND-USE SYSTEM

The entire area of the Region can be divided into two broad categories: (1) that which is not available for cultivation and (2) that which is available for cultivation. Urban areas, graveyards, rock outcrops, sand dunes and sand hills, lakes and permanent swamps are included in the area referred to here as not available for cultivation: whereas arable (cultivated) land, orchards, forests never cultivated, abandoned or culturable waste, and seasonal swamps

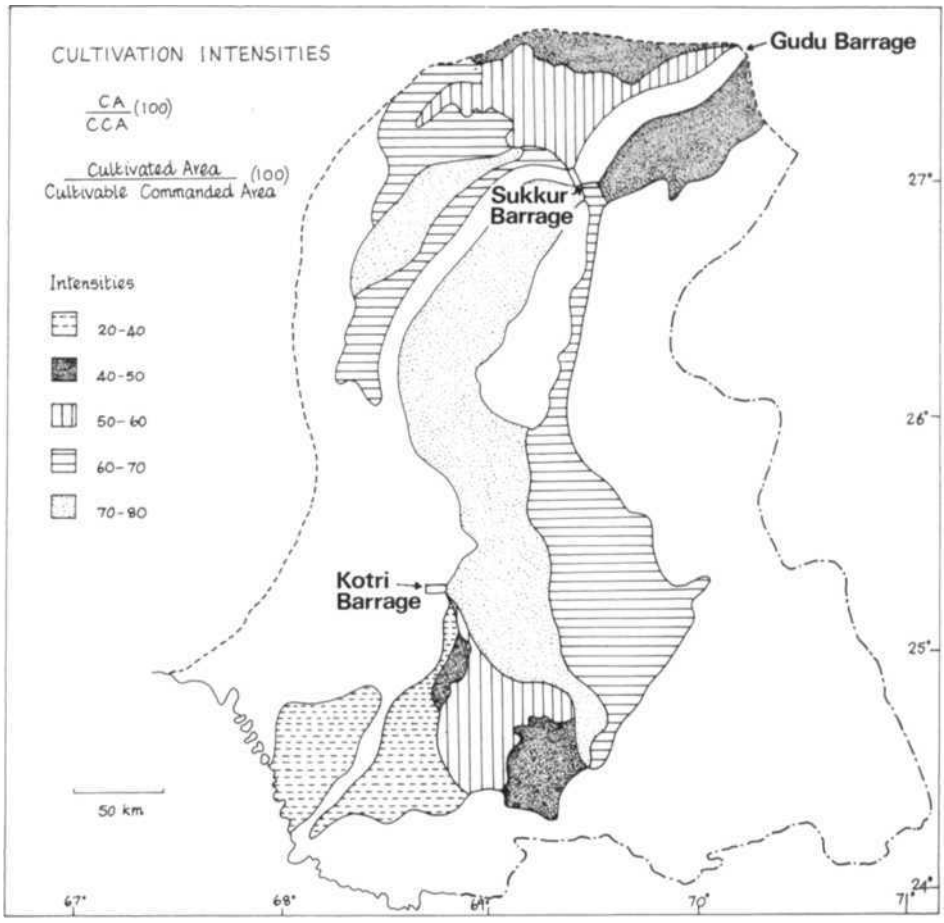

Figure 4.
Cultivation intensities shown as the percentage of the total cultivated area to cultivable commanded area; Source: as Fig. 2.

form subclasses of the cultivable area. Since the construction of Sukkur Barrage substantial increases in the arable land have taken place. A comparison of the 1971-72 figures with those of the pre-barrage period, depicted in 1921-22, shows a 50 percent increase in the arable land. The net sown area in 1964-65 recorded an increase of about 420 percent, which due to more extensive fallowing declined in 1971-72. This led to a corresponding decrease in the farming intensity, the percentage of total cropped area to total cultivable land declining from 69.4 percent in 1964-65 to 59.1 percent in 1971-72. An important feature of the land use in the Region is the presence of large tracts of abandoned land which in the last fifty years has increased by 62 percent (Table 2).

THE CLASSES OF CULTIVABLE LAND

The total cultivable commanded area (CCA), as reported in 1964, was approxi-

TABLE 3.

Breakdown of cultivated land into land-use classes 1963-64.
Source: Hunting, *Lower Indus Report,* Vol. 7, 1965.

Main canal or feeder command	Percent of CCA in various classes					
	Total CCA OOha	Culti-vated	Forest	Aban-doned	Never culti-vated	Seasonal swamps
Desert Pat	402	43	—	19	38	1
Begari Sind	384	53	5	25	17	1
Ghotki	334	44	10	10	36	—
TOTAL GUDU BARRAGE	1, 120	46	5	19	30	1
North West	376	61	1	34	4	1
Rice	208	74	1	19	2	5
Dadu	205	65	1	25	8	1
Khairpur West	106	82	2	16	1	1
Khairpur East	151	88	—	10	1	1
Rohri	1,044	89	1	8	3	1
Nara	896	67	—	19	13	1
TOTAL SUKKUR BARRAGE	2,986	76	1	17	6	1
Kalri Baghar	270	27	—	9	58	6
Pinyari	322	36	2	10	39	13
Fuleli	377	59	1	18	16	7
Akram Wah	199	48	—	10	35	7
TOTAL KOTRI BARRAGE & CHULAM MOHAMMAD BARRAGE	1,168	43	2	12	35	8
TOTAL THREE BARRAGES	5,276	62	1	16	19	3

mately 5, 278, 000 ha (Hunting, Vol. 7, 1965); of this, only 62 percent were cultivated with large tracts lying in Rohri Canal command. About 37 percent fell in the categories of abandoned and never cultivated lands and seasonal swamps. The right bank commands of Sukkur Barrage suffer from almost contiguous tracts of abandoned lands; whereas in Gudu and Kotri Barrage commands abandoned and never cultivated lands are found scattered. A comparison of Figures 2 and 3 would show that much of the abandoned land is associated with tail areas of the canal commands which, due to maladministration of

TABLE 4.

Distribution of percentage change in cultivated area and culturable waste, 1964-65,1971-72.

Source: Development Statistics of Sind, Vol. 1, Government of Sind, 1971; *Agriculture Statistics of Sind,* 1970-71 to 1972-73, Government of Sind, Karachi, 1974.

District	Cultivated area ('000 ha)			Culturable waste ('000 hs)		
	1964-65	1971-72	Percent change	1964-65	1971-72	Percent change
Sind	5,270	5,564	+5.57	1,966	1,783	–9.30
Khairpur	266	318	+19.54	206	16	–92. 23
Jacobabad	578	354	–38.75	55	78	+41.81
Sukkur	491	461	–6.10	117	96	–17.94
Nawabshah	429	457	+6.52	73	52	–28.76
Larkana	342	406	+18.71	60	116	+93.33
Sanghar	442	516	–16.74	82	48	–41.46
Thar Parkar	1,084	1,146	+5.71	365	329	–9.86
Dadu	393	555	+41.22	403	433	+7.44
Hyderabad	859	886	+3.14	158	78	–50.63
Thatta	346	426	+23.12	466	510	+10.72
Karachi	39	37	–5.12	16	16	—

canal supplies and poor maintenance generally, suffer from water shortage. There are cases which confirm that silting up of canals has also contributed to the abandoning of the land. Gudu command seems to have suffered more from the increased withdrawals of water upstream of the canal off-takes, which was further aggravated by the relatively low income of the farmers. Waterlogging and salinity have also led to the land being abandoned. This has occurred generally in those areas adjacent to perennial canals where, because of seepages, the water-table has risen significantly (Table 3, Fig. 4).

Nearly half of the never cultivated land lies in the Kotri Barrage command. Gudu command shares about 36 percent of this category of land. In other canal commands such lands represent a phase of transition between sand hills and sand dunes and the arable land. It might also include lands which were abandoned far back in history and the traces of previous cultivation of which have completely vanished. Lakes and permanent and seasonal swamps constitute about 233, 000 ha; 74 percent of this falls in the Kotri command cultivated area which includes the productive land excepting forest reserves. Cultivation intensity (percentage of cultivated area to CCA) varies greatly. Rohri Canal command with a share of 89 percent stands out; whereas Kalri-Baghar presents a poor record of 27 percent. Rohri Canal command is closely followed by Khairpur feeders both East as well as West. In general, the area

TABLE 5.

Cropped areas by feeder or main canal commands 1963-64 ('000 ha).
Source: Hunting, *Lower Indus Report,* Vol. 7, 1965

Feeder or main canal command	Rabi 1963-64			Kharif 1964			Total cultivated area
	Dubari or bosi	Irrigated	Total	Rice	Other kharif	Total	
Desert Pat	56	—	56	88	50	139	195
Begari Sind	131	—	131	145	21	166	297
Ghotki	69	—	69	13	62	76	145
TOTAL, GUDU BARRAGE	256	—	256	246	133	381	637
North West	50	106	158	98	10	108	266
Rice	99	—	99	161	1	152	251
Dadu	20	81	101	39	18	57	158
Khairpur East	15	41	56	4	38	42	98
Khairpur West	10	58	76	6	60	66	142
Rohri	0.80	451	452	6	375	381	833
Nara	0.80	250	250	27	280	307	557
TOTAL, SUKKUR BARRAGE	203.60	989	1,192	331	782	1,113	2,305
Kalri Baghar	15	10	25	63	3	66	91
Pinyari	8	—	8	110	4	114	122
Fuleli	29	—	29	138	14	152	181
Akram Wah	—	32	32	25	23	48	80
TOTAL, KOTRI BARRAGE	52	42	94	336	44	380	474
TOTAL, THREE BARRAGES	511.60	1,031	1,542	913	959	1,874	3,416

as a whole has low intensities, whereas Sukkur Barrage, which has a longer history of settlement, is far ahead.

However, it is important to note that, whereas the crop year 1971-72 shows an increase of about 5. 6 percent in the cultivated area of the Region over that of 1964-65, there are certain districts which have recorded a decrease: namely, Jacobabad, Sukkur and Karachi (Table 4).

On the other hand, although there has been a general decrease in the area classed as culturable waste, over the same period some of the districts have recorded appreciable increases: they are Jacobabad, Larkana and Dadu. Jacobabad falls in Gudu Barrage command and Larkana and Dadu are under the right bank command of Sukkur Barrage.

CROPPING PATTERN

In the agricultural year 1963-64 the total cropped area in the barrage command was reported to be approximately 3. 42 million ha; 1. 54 million ha were devoted to *rabi* (winter) crops and 1. 87 million ha to *kharif* (summer) crops. Area under wheat occupied a dominant position in *rabi* as the irrigated crop; *dubari* and *bosi* followed as the unirrigated ones. The former refers to the crop grown on the residual moisture in the rice fields, whereas the latter depends on one or two ends of the *kharif* season. On the right bank command of Gudu Barrage cropping followed a non-perennial pattern, in which rice was predominant in *kharif,* and *dubari* and *bosi* in *rabi.* North West and Dadu Canals both had the larger part of their commands under *rabi.* (Table 5).

TABLE 6.

Cropping and farming intensities by feeder or main canal commands (1963-64).
Source: Hunting, *Lower Indus Report,* Vol. 7, 1965.

Feeder or main canal command	Cropping intensity percentage			Farming intensity percentage		
	Rabi	Kharif	Total	Rabi	Kharif	Total
Desert Pat	14	35	49	33	81	114
Begari Sind	34	43	71	64	81	145
Ghotki	80	23	43	47	52	99
GUDU BARRAGE	22	33	55	49	73	122
North West	42	29	71	69	48	117
Rice	48	73	121	66	100	166
Dadu	49	28	77	76	43	119
Khairpur West	53	40	93	65	49	114
Khairpur East	51	44	95	58	50	108
Rohri	43	37	80	49	41	90
East Nara	28	34	62	42	51	93
SUKKUR BARRAGE	40	37	77	53	49	102
Kalri Baghar	9	25	34	33	92	125
Pinyari	3	35	38	9	100	109
Fuleli	8	40	48	14	68	82
Akram Wah	17	25	42	35	52	87
GHULAN MOHAMMAD BARRAGE	8	33	41	19	79	98
TOTAL, THREE BARRAGES	29	36	65	47	57	104

In the left bank commands of Sukkur Barrage, a perennial pattern of irrigated *rabi* and dry *kharif* was generally the rule. Nara Canal command was the only exception, but although it is a perennial area, it had a larger part under *kharif*. Kotri Barrage command was occupied mainly by rice. However, the cropping as well as the farming intensities were low. Cropping intensity is measured as a percentage of the cropped area to the CCA and can serve as an index of the degree of development of the irrigation system. Farming intensity is the percentage of the cropped area to the cultivated area. In cropping intensities, Sukkur Barrage ranked highest, where the total of *rabi* and *kharif* intensities ranged from 62 in East Nara to 121 in Rice Canal command. Kotri Barrage commanded presented a poor state with Pinyari command falling as low as 3 in *rabi*. Farming intensities also varied greatly: in *rabi,* they ranged from 9 in the Pinyari area to 76 in the Dadu Canal command; in *kharif*. the lowest intensity of 41 was found in Rohri Canal command, with Pinyari and Rice Canal commands each recording 100. Annual farming intensities go as high as 166 in Rice Canal command, the lowest being 82 in the Fuleli Canal area (Table 6).

DEGREE OF CROP DIVERSIFICATION

Of the various crops being produced in the Region, wheat and rice have long occupied a predominant position. Cotton has also been important as a cash crop, but occupies a very small proportion of the area. In 1904-5 only 87,000 ha were devoted to cotton. Quality was also poor. Cultivation of the Egyptian variety was first tried in 1904 (Aitken 1907). The post-barrage period, however, shows substantial increases in the area under various crops; certain new crops, like sugarcane, have also been introduced; yet the traditionally important wheat and rice have retained their position. A closer examination of the data by canal commands reveals a highly specialized system of cropping, particularly in the Sukkur Barrage command. Ever since the opening of Sukkur Barrage, wheat, despite the changes in the area, has remained the major crop in all the canal commands, except in the part irrigated by Rice Canal. Nara Canal command stands out. In 1932, about 90 percent of the cultivated area in *rabi* was under wheat, which increased by 50 percent in 1964; but as compared with the total area under *rabi* crops, it fell to 68 percent. Kotri and Gudu commands present a more diversified pattern. Nevertheless, wheat maintans an appreciably good position in all the canal commands, particularly in the area irrigated by Akram Wah and in all the subcommands of Gudu Barrage. Increases in the area under various crops that have taken place in the Kotri Barrage command since its opening are noteworthy, particularly in the case of fodder crops which, in 1964, occupied about 24, 000 ha, as against a little over 7, 000 ha in 1958. The area under oilseeds shows a decrease. In Gudu Barrage the area under various crops has generally declined (Tables 7 & 8).

Turning to *kharif* season it is important to note that Sukkur Barrage command had a more specialized system of cropping in 1932 than in 1964. Rice and cotton are the main crops. Rice Canal command, with about 99 percent of its cultivated area under rice, presents the most specialized system. This position of Rice Canal has been the same, with minor fluctuations, since the opening of the barrage. Rohri and Nara Canal commands specialized in cotton in 1932. But in recent years they have become more diversified. Sugarcane, fodder and legumes are the newly introduced crops. Kotri Barrage again presents a wider range of crops, but rice continues to remain an important crop. Gudi Barrage command, on the contrary, shows a relatively more specialized system, with rice as the dominant crop (Tables 9 & 10). At a more

TABLE 7.

Distribution of crops by canal command according to the first date of the data availability, *Rabi* (area in ha).
Source: Hunting, *Lower Indus Report,* Vol. 7, 1, 1965

	Wheat	Sugar Cane	Gardens	Oilseeds	Legumes	Fodder	Grams	Other crops	Dubari	Total
SUKKUR BARRAGE	253,439	–	2,665	–	22,996	–	–	35,880	92,528	367,316
Sukkur N.W. Canal	51,159	–	66	–	2,936	–	–	10, 447	12,750	77,358
Rice Canal	–	–	–	–	–	–	–	–	72,944	72, 944
Dadu Canal	29, 504	–	1,234	–	1,117	–	–	3,155	6,654	1,653
Khairpur Feeder W.	8,657	–	–	–	–	–	–	8,665	180	17,302
Khairpur Feeder E.	7,955	–	–	–	–	–	–	5,592	–	13,547
Rohri Canal	71,026	–	–	–	18,293	–	–	–	–	89,319
Nara Canal	85,138	–	1,365	–	650	–	–	8,021	–	95,193
KOTRI BARRAGE	7,856	209	1,122	17,312	–	7,217	–	16, 400	–	50,336
Pinyari Feeder	400	–	160	1,320	–	1,560	–	680	–	4,120
Fuleli Canal	2,430	–	360	8,450	–	3,040	–	4,720	–	19,300
Akram Wah	2,520	120	200	5,000	–	1,040	–	1,200	–	10,000
Gaja Branch	1,506	89	122	2,502	–	577	–	80	–	4,876
Kalri B. Feeder	1,000	–	280	40	–	1,000	–	9,720	–	12,040
GUDU BARRAGE	64, 489	–	–	19, 688	35,118	–	83,649	10, 764		213,708
Desert Feeder	11,177	–	–	8,126	12,434	–	24,848	2,982	–	59,567
Begari Sind Feeder	53,312	–	–	11,562	22,684	–	58,801	7,782	–	154,141
Ghotki Feeder		–	–	–	–	–	–	–	–	–

TABLE 8.

Distribution of crops by canal commands *Rabi* 1963-64 (area in ha).
Source: Hunting, *Lower Indus Report*, Vol. 7, 1, 1965

	Wheat	Sugar cane	Gardens	Oilseeds	Legumes	Fodder	Grams	Other crops	Dubari	Total
SUKKUR BARRAGE	605,427	23,123	17,910	7,649	20,633	–	–	357,069	185,470	1,227,281
Sukkur N.W.Canal	75,157	–	130	–	3,428	–	–	44, 269	58,810	181,714
Rice Canal	–	–	–	–	–	–	–	–	99,256	99,256
Dadu Canal	55,689	–	1,016	4,108	1,316	–	–	24, 835	19,598	106,562
Khairpur Feeder W.	30,187	–	5,712	3,541	4,402	–	–	12,835	5,748	62,425
Khairpur Feeder E.	39,425	–	–	–	–	–	–	37, 146	546	77,117
Rohri Canal	234,455	18,787	4,026	–	5,430	–	–	175,928	690	449,316
Naral Canal	170,514	4,336	7,026	–	6,057	–	–	62,056	822	250,811
KOTRI BARRAGE	36,456	14, 494	1,358	19,136	–	23,708	–	12,552	–	107,724
Pinyari Feeder	880	80	240	1,920	–	2,600	–	2,400	–	8,120
Fuleli Canal	9,446	1,120	360	10,126	–	5,610	–	2,800	–	29,482
Akram Wah	17,400	6,920	280	5,600	–	950	–	1,280	–	32,430
Gaja Branch	4,320	6,254	158	770	–	508	–	432	–	12,442
Kalri B. Feeder	4,410	120	320	720	–	14,040	–	5,640	–	25,250
GUDU BARRAGE	84,618	–	–	25,607	32,147	–	97,181	37, 201	–	249, 800
Desert Feeder	20,998	–	–	8,483	5,036	–	21,045	843	–	56.405
Begari Sind Feeder	31,044	–	–	13,272	27,111	–	47,356	7,578	–	126,361
Ghotki Feeder	32, 576	–	–	3,852	–	–	28,780	1,826	–	67,034

TABLE 9.

Distribution of crops by canal commands according to the first date of data availability *kharif* (area in ha).
Source: Hunting, *Lower Indus Report,* Vol. 7, 1, 1965

	Rice	Cotton	Sugar cane	Millet	Sor-ghums	Gardens	Legumes	Fodder	Other crops	Total
SUKKUR BARRAGE TOTAL	188,425	177,920	154	–	–	3,282	639	–	180, 537	550,957
Rice Canal	112,040	–	–	–	–	162	–	–	17	112,219
Sukkur N.W.Canal	26,270	125	–	–	–	56	–	–	37,374	63,825
Dadu Canal	19,380	2,265	–	–	–	1,279	–	–	14,039	36,963
Khairpur Feeder W.	2,239	61	–	–	–	60	–	–	16,015	18,375
Khairpur Feeder E.	1,161	5,083	–	–	–	–	–	–	22,662	28,906
Rohri Canal	771	40,862	–	–	–	–	–	–	90,430	132,063
Nara Canal	26,564	129,524	154	–	–	1,725	639	–	–	156,606
KOTRI BARRAGE TOTAL	386,036	22,113	465	–	–	776	–	12,347	11,782	433,525
Pinyari Feeder	69,600	–	–	–	–	120	–	40	1,080	70,840
Fuleli Canal	85,000	12,120	200	–	–	160	–	1,320	7,120	105,926
Akram Wah	38, 200	4,960	80	–	–	80	–	3,280	2,160	48,760
Kalri B. Feeder	179, 200	–	120	–	–	320	–	2,840	1,240	183,720
Gaja Branch	14,036	5,033	65	–	–	96	–	4,867	182	24,279
GUDU BARRAGE	189, 589	912	2,068	6,377	20,369	–	–	–	5,918	225,283
Desert Feeder	139,393	471	1,876	1,032	7,044	–	–	–	4,845	154,661
Begari Sind Feeder	50, 196	441	212	5,345	13,325	–	–	–	1,103	70,622

TABLE 10.

Distribution of crops by canal commands *kharif* 1964-65 (area in ha).
Source: Hunting, *Lower Indus Report,* Vol. 7, 1965.

	Rice	Cotton	Sugar cane	Millet	Sor-ghums	Gardens	Legumes	Fodder	Other crops	Total
SUKKUR BARRAGE TOTAL	332,966	391,846	37,818	–	–	54, 448	54,448	–	268,232	1,104,733
Sukkur N.W. Canal	98,840	47	1,322	–	–	146	–	–	1,526	109,881
Rice Canal	151,487	–	–	–	–	146	–	–	1,210	152,643
Dadu Canal	39, 048	447	2,206	–	–	972	–	–	14,835	57,588
Khairpur Feeder W.	4,243	1,003	–	–	–	5,956	–	–	18, 502	43, 708
Khairpur Feeder E.	5,892	18,435	–	–	–	3,507	–	–	38,775	66,609
Rohri Canal	5,934	172,158	26,078	–	–	1,444	45,776	–	116,168	367,558
Nara Canal	27,523	186,756	8,212	–	–	7,224	8,672	–	69,216	307,652
KOTRI BARRAGE TOTAL	340,925	14,931	17,545	–	–	2,403	–	6,002	16,467	295,097
Pinyari Feeder	110,440	–	200	–	–	160	–	1,320	2,440	114,560
Fuleli Canal	138,120	2,160	1,200	–	–	1,000	–	920	9,280	152,680
Akram Wah	25,360	10,880	8,520	–	–	520	–	2,400	1,240	48, 920
Kalri B. Feeder	62,246	–	120	–	–	440	–	400	3,240	66,446
Gaja Branch	4,759	1,891	7,505	–	–	283	–	962	267	15,595
GUDU BARRAGE TOTAL	247,024	3,306	369	840	2, 844	584	–	–	122,208	377,153
Desert Feeder	88,988	–	–	–	–	–	–	–	50,299	139,287
Begari Sind Feeder	140,436	14	26	840	2,844	–	–	–	16,605	160,733
Ghotki Feeder	17,600	3,292	343	–	–	594	–	–	55,304	77,133

TABLE 11.

Sale of various kinds of fertilizers in the Lower Indus Region, 1969-70 to 1972-73.

Source: Development Statistics of Sind, Vol. l,No. 1, Government of Sind, Karachi, 1971;
Agricultural Statistics of Sind, 1970-71 to 1972-73, Government of Sind, Karachi, 1974.

Fertilizer	Amount sold (in '000 metric tons)				Percent change
	1969-70	1970-71	1971-72	1972-73	1969-70 to 1972-75
Nitrogenous	65,693	71,710	87, 550	93, 977	44
Phosphatic	6,701	8,673	8,070	11,404	70
Potash	418	632	298	322	–22
Total	72,812	81,015	95,918	105,703	45

TABLE 12.

Consumption of various types of pesticides, 1970-71 to 1972-73.

Source: Agricultural Statistics of Sind, 1970-71 to 1972-73
Government of Sind, Karachi, 1974.

Types of pesticides	Amount consumed (in metric tons)		
	1970-71	1971-72	1972-73
Chlorinated hydrocarbons	114.40	42.55	44.16
Indigenous	242.99	481.03	499.18
Phosphates	239.70	143.55	148.97
Carbonates	29.66	284.79	295.54
Miticides	0.80	1.02	1.06
Weedicides	1.04	29.70	30.82
Fungicides (Seed Dress)	–	2.00	2.07
Fungicides (Spray)	1.92	38.28	39.72
Fumigants	1. 76	2.25	2.34
Rodenticides	2.80	1.60	1.66
Nematodicides	0.32	0.83	0.86
Soil Insecticides	0.80	32. 40	33.62
Total	636.19	1,059.00	1,117.87

detailed level, the author (on the basis of field work) has found that mono-cropping is a special feature of this Region. Cotton and sugarcane happen to be the more popular ones in this case.

FERTILIZER AND PESTICIDES

Fertilizer and pesticides are essential inputs in modern agriculture and hence form an important part of the discussion on land-use systems. The requirements for various kinds of fertilizers during the last four years have increased substantially, by about 45 percent. According to an estimate, around 220, 600 metric tons will be required for the year 1974-75. Of these, nitrogenous fertilizers seem to be in greatest demand. Sale of phosphate, though much smaller in quantity, has recorded an impressive rise of 70 percent (Table 11).

Consumption of pesticides has also increased during the last three years by about 72 percent. The demand for indigenous pesticides is rather greater than that for others. Carbonates and phosphates follow. In 1970-71 consumption of chlorinated hydrocarbons was also appreciably high but in the following years it has fallen sufficiently (Table 12). Aerial spraying of the pesticides is also being practised with 100 percent subsidy.

Cotton, sugarcane and paddy are the main crops on which the spraying is done. The total area covered by the Plant Protection Department has increased from 35, 256 ha in 1970-71 to 99, 177 ha, in 1972-73, recording a 183 percent rise. The largest percentage of the area covered by aerial spraying is under sugarcane in the district of Hyderabad, which also shows minor increases (Table 13). However, the present amount of fertilizer and pesticides used do not fulfil the entire requirement of the Region, rather they fall far short.

THE HAZARDS

The various aspects of the land-use system in the Region, as described in the preceding section, coupled with the arid conditions of the environment and the maladministration of supplies, provide a sufficient basis for the existence of hazards. According to their associations, these hazards can be conveniently grouped into three categories: namely, irrigation hazards, cropping hazards and pesticide hazards.

Irrigation Hazards

Development of perennial systems of irrigation and maladministration of canal supplies both give rise to hazards like waterlogging, salinity and alkalinity. Measured in terms of the abandonment of land the irrigation hazard seems to have taken a toll of about 688, 000 ha since the introduction of Sukkur Barrage. Almost all the irrigated land suffers, to some degree, from such menaces. Waterlogging is generally caused, as described earlier, by seepages from the perennial canals which raise the water-table to such shallow depths that part or whole of the root zone becomes saturated with water and the crop suffers from aeration. Rohri and Kalri-Baghar Feeder lower canals are good examples.

The annual fluctuation of the water-table from 1936 to 1964, especially in the Northwestern Canal command provides good evidence of the manner in which modern irrigation has affected the water-table depth. In 1935, the water-table

TABLE 13.

Distribution of area covered by aerial spraying according to crops by districts.
Source: Agricultural Statistics of Sind, 1970-71 to 1972-73 Government of Sind, Karachi, 1974.

District	Crops	Total area cropped ha	Area covered ha	Percent
1970-71				
Hyderabad	Sugarcane	27,316	22, 703	83.1
Jacobabad	Paddy	158,233	9,617	6.1
Thatta	Paddy	88,233	2,936	3.3
Total		273,774	35,256	12.0
1971-72				
Tharparkar	Cotton	102,740	12,140	11.8
Nawabshah	Cotton	59,854	12, 143	20.3
Sanghar	Cotton	80,153	10, 117	11.4
Hyderabad	Sugarcane	27,316	20, 234	74.1
Thatta	Paddy	88,223	19,231	21.8
Larkana	Paddy	146,904	21,246	14.5
Total		505,190	95,111	18.0
1972-73				
Tharparkar	Cotton	102,740	12, 140	11.8
Nawabshah	Cotton	59,854	12,140	20.3
Sanghar	Cotton	88,911	14,154	15.9
Hyderabad	Sugarcane	27,326	28, 308	103.7
Larkana	Paddy	146,904	32,375	22.0
Total		425,725	99,117	23.0

depth was reported to be a little above 2. 5 m, in 1940 it went down to 2. 7 m; it started rising again since 1945 and with minor fluctuations it reached the peak of about 1. 9 m in 1956; again it fell to 2.16 m in 1965 (Hunting, Vol. 2, 1965). Obviously, such fluctuations are due to the opening of Sukkur Barrage. Rise in water-table occurred because of excessive seepage from the newly constructed perennial canals, and also because the low intensity of cultivation in the initial stages gave rise to a situation in which the unwanted water was channeled into fallow lands. Due to the fine sediment deposits and subsequent rise in the cultivation intensity, the canal sections became less permeable and thus the water-table began to fall. By 1940 the cultivated area had enlarged with a sharper increase in the area under rice. This, and the fact that canal seepage had become steady, resulted in the water-table rising again. Thus it is reasonable to assume that, whereas the perennial irrigation provided a great

scope for agricultural development in the Region, it has also been responsible for hazards like waterlogging and salinity, mainly due to defective planning of a canal system which completely ignored the need for drainage canals, and mismanagement of canal supplies.

Salinity is also associated with shallow water-table. The main factors causing such hazards are: insufficient irrigation water, past flooding, waterlogging, and high rate of evaporation. As an example, take the case of Khairpur district which is commanded by three perennial canals, namely, Khairpur Feeder East, Khairpur Feeder West, and Hingerja minor taking off from Rohri Canal. These canals are designed for a cropping intensity of 80 percent; but the actual intensities achieved range between 95 and 110 percent. This causes shortage of water as more of the area is cropped than the canal supplies are designed to cater for. Periodical canal closures, whether due to water shortage in the river during winter or to high floods in summer, also contribute to the salinization of soils. Hyderabad district is another case, though with a different situation. A large part of the district is commanded by Rohri Canal and the available water supply is far less than the requirement. The canal is designed for cropping intensity of 81 percent; 54 in *rabi* and 27 in *kharif*. But the water discharge at the head is low and the water available caters for only 65 percent cropping intensity. Thus, the tendency of the farmers to spread the available water on as large an area as possible, creates further shortage of water to all crops. Under such a situation, the moisture moves down only a few centimeters. As a result, the salts are left behind at the surface due to high evaporation. The irrigation water is insufficient to leach out all the salts thus accumulated (Reconnaissance Soil Survey, 1970).

Cropping Hazards

In addition to low farming intensities which lead to salinization of soils, as described earlier, there are a number of problems which arise out of cropping pattern and poor farm management. Traditional methods of farming generally result, at the end of the production cycle, in the land becoming less productive. Among the hazards soil impoverishment and crop pests are more intriguing. Monocropping is one of the special features of the Region. This is particularly the case with cotton cultivation. Even if the land is left fallow, monocropping of cotton causes magnesium deficiency. For treatment of such cases, heavy doses of magnesium are required which in turn create potassium deficiency. Soils are also affected adversely by the defective system of crop rotation. For example the farmers in Hyderabad district follow one or more of the following sequence:

Wheat — fallow — wheat
Wheat — cotton — fallow
Wheat — fallow — sugarcane — sugarcane
Berseem *Trifolium alexandrinum* — cotton — fallow
Cotton — sugarcane — sugarcane

This pattern does not conform to a relatively more diversified pattern of cropping and their intensities as recommended by the team of specialists (Hunting, part 2, 1965).

Crop pests and diseases refer to those pests and diseases which are caused by a cropping system prevailing in the Region: termites in cotton and wheat stem fly *Altherigona miliaceae* and the rusts *Puccinia.* Termites are associated with isolated fields and cause considerable damage to cotton crops. The

wheat stem fly is a pest which bores into earing tillers causing them to die. The severity of the attacks of these pests is considerably enhanced due to late planting and excessive nitrogen applications. Rusts are also reported in the Region. They find favourable conditions under humid microclimates (resulting from weed growth, over-irrigation, etc.), and under the lush growth caused by excessive manuring. Wheat yield suffers greatly from the attack of these rusts. Wider spacing and topping practices expose the rice plants to severe attack of stem borer *Schoenobius incertulas.* Stem borer attack is mainly due to topping which delays the maturity of crop by 15 days. It has also been reported that the increased use of nitrogen fertilizer has increased the attack of sugarcane mite *Paratetranyckus indicus.* This was particularly the case with Gaja cane growing area in 1965. However, the susceptibility differs in accordance with the variety.

Pesticide Hazards

In order to protect the crops from various kinds of pests and diseases, a variety of pesticides and insecticides are being used, but it seems that measures are not being applied with proper care. The predators and useful insects are also killed in the process. As a result, the ecological balance is disturbed. Although appropriate data are still lacking, there does exist circumstantial evidence of this thesis. The very fact that the concept of integrated pest control has been introduced in the Region provides sufficient evidence to a careless use of pesticides and insecticides. This system was planned by an FAO panel of experts in 1967, and takes into account the environmental context and the population dynamics of the pest species; it aims at maintaining the pest population at a level below that which causes economic injury. It is only in the case when the population of the pest rises above that level that the application of pesticides and insecticides is regarded as permissible (Agricultural Research Council, 1972).

The use of toxic chemicals like chlorinated hydrocarbons (D.D.T.) which has been employed all over the world as the most useful insecticide from the standpoint of pest control, creates more harmful effects. However, the realization that D.D.T. is capable of creating poisonous effects on grain crops, which in turn affect human health and life adversely has made this insecticide unpopular and its use has been banned in many countries. But from the statistics available for the consumption of pesticides in Sind it appears that the use of D.D.T. continues to form an important part of the pest control programme (Table 13). The farmers in general are not conscious of such intricate problems of hazards, except the enlightened few. Even these enlightened farmers, in their quest to improve cost-benefit ratios, generally ignore the harmful effects of pesticides and insecticides. However, the consciousness of the pesticide hazards among the environmentalists and biologists in Pakistan has recently been evoked. Under WHO, a project has been initiated since February 1974, which aims at a survey of the nature and extent of the damage that the pesticides cause (Hashmi & Thompson 1974). The results of this survey are eagerly awaited.

The farmers of the region have frightingly little awareness of such hazardous outputs of their efforts toward modernization of land-use systems. To them, water shortage and drought are the most easily perceived hazards. Pesticide hazards are generally remembered in terms of cattle and chicken deaths. Cropping hazards are measured in terms of crop failures, and are generally thought of as a matter of luck. Waterlogging and salinity menaces are recog-

nized in the form of land abandonment, but again most of the farmers assign it to luck.

CONCLUSION

From the discussions in the preceding sections, it is evident that during the last half century or so, substantial increases in the arable land have occurred. The land-use system has become more modernized and somewhat diversified, although the farming intensities continue to remain generally low, and the specialization persists as the major characteristic of the cropping pattern. Such developments imply use of modern irrigation technology, fertilizers and pesticides. At the same time it has also been found that the Region is beset with a number of problems rooted in various kinds of hazards. From the nature of these hazards it becomes amply clear that the land-use inputs have been employed carelessly without giving due consideration to the environmental properties which render the area vulnerable to the side effects of such innovations. Thus the ecological balance has been disturbed. What is needed is an approach to economic development which would not only restore the balance but also ensure its maintenance.

SUMMARY

The paper focuses on the nature and extent of the hazards that have resulted from the prevailing agricultural land-use system. During the last fifty years or so, the land-use system has become somewhat diversified: but the specialization in the cropping pattern continues to persist, even to the extent of monocropping. Modernization of irrigation technology, fertilizers and pesticides are the major inputs. These inputs, however, have been carelessly used. As a result, a number of hazards have appeared, which have been grouped into three categories. They are, irrigation hazards, cropping hazards, and pesticide hazards. This situation indicates a disturbed state of ecological balance which needs to be restored.

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Session I (continued): CHANGING PATTERNS OF LAND USE AND LAND USE PLANNING IN RELATION TO NATURAL RESOURCES

Background Paper No. 5

Land use Planning: Mineral and Fuel Exploration, Agriculture and Forestry Development in Arid Areas

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INTRODUCTION

This paper is concerned with land-use planning in dry areas, in the particular geographical context of S.W.Asia and the Middle East. It discusses land-use planning in relation to two principal objectives: the assessment of optimum land use and the resolution of conflicts between opposing land uses. The problem is considered in a broad regional or river basin context: detailed assessment of land capability for specific purposes, such as irrigation, is considered to be outside its brief.

The presentation is based to a large extent on actual work undertaken in the region under consideration, and references to the actual reports—which are the property of the Governments concerned—are given at the end of the paper. It was considered important that case studies should be used, so that practical experience in tackling such planning problems could be taken into account rather than offering a philosophical treatise. One difficulty arising from this approach has been that no relevant case studies, within the author's experience, could be found dealing particularly with mineral and fuel exploration in the present context, or even, regrettably, a specific commitment to include wildlife conservation in their terms of reference. These aspects of the paper are therefore discussed at a rather different level in its final section.

S.W.Asia and the Middle East present particular problems in land-use planning because of the very long history of occupation by human civilizations. This means that the physical resources of 'land' have been greatly altered throughout most of the area, and this makes it more difficult to assess broad land capability by means of bioclimatic systems which rely principally on the existence of climax vegetation. On the other hand, a good deal is known, in this region, of the course and nature of vegetation succession under the influence of man and his domestic animals, and climatic data are usually reasonably good. The bioclimatic approach to optimum land use therefore remains a valid one.

In almost every approach to the use of land, the resolution between conflicting land uses involves also the resolution of short-term benefits or expedients, often to particular groups, as against the long-term benefits to the people as a whole. The great difficulty here is that a decision made in the short-term interest may often, in the land use context, be irreversible, so that choice is gone once that short-term decision is made. In much of S.W.Asia and the Middle East irreversible changes have in fact taken place: some land is now so degraded that little can now be done to restore it. This situation makes it all the more vital to safeguard and develop sound plans for those lands where

there is still a choice: the practical application of ecological guidelines can provide that safeguard.

REGIONAL LAND USE 'ZONING'

Zoning land in this context is aimed at establishing what is the proper use or range of uses for different land units, irrespective of the actual use to which it is now being put. Proper or optimum land use implies that land is used in such a way as to keep it under a system of sustained production without deterioration of the physical resources that make up land. Production in this sense includes the preservation of amenities (such as complete protection of areas of great scenic beauty) or the protection and management of wildlife in the context of national parks.

Most countries already possess enough data to develop at least the first stages of a zoning system. Data on climate and soils are of the first importance, plus landform and topographic information. In the present context, one should certainly add present land use (a category which should include any data on any remaining natural vegetation such as forest and rangeland), since so much of the matter of seeking optimal use of land will lie in redirecting or improving the uses to which people already put it. Most areas will have substantial soil information: indeed a great deal of time and money has been spent on soil surveys and surprisingly little of such information has actually been used—if, indeed, it was even strictly relevant—for planning or land management. It is often claimed that attempts to develop a comprehensive zoning system take too long and are too expensive to consider: in fact the bulk of the necessary data is usually available and the problem more often is that no effort has been made to co-ordinate or synthesise it for the purpose of making land-use decisions. Soil surveys in particular are too often undertaken under rigid specifications which may have no real relation to their principal objectives (Poore & Robertson 1964). The wide availability of aerial photography, now supplemented over virtually the whole of the S.W.Asia and Middle East region, by 'Earth Resources Technology Satellite' (ERTS) imagery, also means that a mass of 'remotely sensed' data is available to the planner at minimal expense.

As E.M.Nicholson says in his introduction to the papers (McVean & Robertson 1969) on which this part of the present discussion is based, 'Desert and semi-desert areas exhibit in the simplest and most direct form the influence of edaphic, biotic and human factors on plant and animal associations. Arid areas carry limited plant and animal populations belonging to a well-defined and largely specialised series of species whose distribution is often plainly traceable to obvious factors of rainfall, exposure, temperature, evaporation, soil, grazing, fuel gathering and other such pressures. Like arctic regions they accordingly offer exceptionally favourable conditions for ecological studies, even where time and resources are limited. They are equally remarkable for their suitability for mapping by means of aerial survey .. .'

'One of the aims of the International Biological Programme is to describe the ecosystems which occur in various parts of the world and to provide, for each country, an assessment of the amount and distribution of each. This has two immediate practical purposes: to provide the information needed for the rational planning of land use and to determine what natural habitats are threatened and in need of conservation. A useful first approach is to divide the country up into areas which are uniform in landform and vegetation; the types thus distinguished and the maps of their distribution can be used as a basis for any more

detailed investigation' (McVean & Robertson 1969). This was the approach adopted in Jordan, though its immediate objective—a classification of the natural pastures, a 'range classification', was much more limited. The survey was however designed in such a way that it could be used as a general land classification and so that it would later prove applicable to other forms of land use. The survey was later supplemented by G. A. Long's (1957) work on the bioclimatology and vegetation of Eastern Jordan: the two studies combined provide the essential basis for comprehensive land-use planning.

The survey covered all of Jordan east of the Jordan River. The climate of that part of Jordan (the bulk of the country, in fact) ranges from sub-humid Mediterranean to arid Mediterranean, and with large areas of desert classified as Saharan bioclimate, from cool to very warm (the terminology is that of Emberger 1955). Climate is clearly the crucial influence determining land usage, but there has been a marked degradation of conditions in the areas more favoured for human occupation, by man's misuse of natural resources. Some of this degradation has occurred over a long period: other instances are of relatively recent duration, such as the destruction of considerable areas of the remaining oak forest in the central highlands when the Hejaz railway was built, around 1916.

At the time when this survey was initiated, in 1954, the whole area—some 96,600 square kilometres in extent—had been covered by aerial photography: at 1/25,000 scale in the more valuable Western region with Mediterranean climate, at 1/60,000 elsewhere. Uncontrolled photographic mosaics, serving as base-maps, were constructed from the original material. Some very preliminary work in the field had been done in the winter of 1953/54; after this a preliminary interpretation of the photographs was made and a 'track map' prepared showing the routes to be covered on the ground in order to gain field experience of representative kinds of landform and vegetation in Jordan. A selection of individual photographic prints was made giving stereoscopic cover of a band of country on either side of each track (complete cover in the inhabited parts of the country). The field team consisted basically of two members, an ecologist and a geomorphologist, spending ten weeks in the field. Field equipment was simple: pocket stereoscopes, hand augers, picks and shovels for soil examination, and collecting equipment for botanical, geological and soil samples. The four-wheel-drive vehicles, camping gear and camp staff completed the establishment.

The team's work in the field was concentrated on collection of sufficient information to distinguish and describe individual ecosystems or biological habitat types; and to identify these, so far as possible, with characteristics recognisable on the aerial photographs. Extrapolation could then spread the results to cover the whole survey area. Because the field time available was so short, it was rarely possible to make a return visit to any area and thus all necessary information had to be collected during the one visit. Shortage of time also dictated the most elementary examination of soils. These were serious disadvantages in an area where little basic information on soils or vegetation was available, and the opportunity to have a second look can be important for many reasons. These disadvantages can be seen as such now, and should be avoided by anyone planning new studies of this kind.

The view that arid or semi-arid areas offer particularly favourable opportunities for the effective use of aerial photographs was advanced in a quotation used earlier in this paper. Certainly they do, but they also have limitations which must be recognised. Vegetation, other than forest, cannot always be directly identified even on large scale air photos. At 1/25,000 scale, for

example, plants or shrubs with a diameter of about one metre can usually be distinguished when they form distinctive patterns. (Had colour photography been available, further correlations would have been possible.) In the absence of direct identification or identification by pattern, other types of correlation—with landform or geology—had to be worked out. It is first necessary to decide on the ground what kinds of terrain or vegetation constituted a single ecosystem or habitat type and then to establish whether it could be reliably distinguished on the photographs. In this way the limit of accuracy of the method can be fixed. Properly speaking the problems should be taken in the order stated: in the survey described it was necessary, because only one visit was possible, to consider both at the same time.

Mention was made earlier about the particular problems associated with land-use planning in S. W. Asia and the Middle East because of the changes which have taken place due to human influence. As a general rule, vegetation is one of the most useful indicators of local conditions. The distribution of natural vegetation reflects precisely changes in rainfall, temperature, soil, presence of groundwater and other factors. Because some species have a very long span of life, vegetation may also give more valuable data on climate, especially in areas where year to year variation is very great, than any but very long term meteorological records. Vegetation which has been submitted to very long periods of human use, however, has usually been deeply modified and therefore only reflects present conditions. Relict species may however give evidence of its potential capacity: human interference, in semi-arid or arid regions, nearly always changes vegetation in the direction of greater aridity and a worthwhile classification system should consider not only the present state but the capacity for improvement. The need for informal field work is therefore important: fortunately there exists, in S.W.Asia, a large body of knowledge on the succession of vegetation under the influence of man.

It was striking, in Jordan, that a classification of vegetation based on form or structure can be very misleading in these circumstances. It was possible, for example, to describe two sites which were superficially similar—annual and perannial grasses, herbs and scattered scrub—but which in potential were entirely different. In one case one was describing something close to climax vegetation in a steppe situation, in the other a degraded vegetation deriving from oak and pine forest with an entirely different climate and with potential (provided the soil had not also been lost) for a wide range of agricultural, horticultural or silvicultural activities. It is at this point that the marriage between a mapped distribution of 'habitat types' and a bioclimatic classification becomes so important. The system used by G. A. Long in Jordan is that developed by Emberger (1955) in the western Mediterranean and north Africa. It relies on climatic records, as opposed to the 'life zone' system of Holdridge (1967). The Holdridge system proceeds from the premise that vegetation, especially undisturbed vegetation, gives a good measure of climatic conditions and thus of potentialities and limitations for land use. The importance of vegetation as an indicator of climate has been stressed earlier in this discussion, but in the region under consideration undisturbed vegetation is very rare and valid climatic inferences may derive from relict species (if present) and a full understanding of the effects of various pressures on vegetation. On the other hand, meteorological records are usually fairly good in this region, so that assessment of bioclimate may be more practical by means of a system like that developed by Emberger than via a system like that of Holdridge.

The advantage, in the Jordan example, of the ability to combine a bioclimatic classification with a mapped distribution of ecosystems or habitat types is

that, in the first place, effective cross-checking is possible and, secondly, that the potentialities in the various bioclimatic sub-divisions can also be more fully identified since the level of degradation—if degradation has taken place-is also known. In the sub-humid Mediterranean bioclimatic region of Jordan, for example, it is still possible to find areas of something approaching climax forest, with soil cover intact. Elsewhere, within the same bioclimatic region, almost all vegetation has disappeared and little more than a bare rock surface, denuded of soil, remains—a situation which has been described as a 'stable state of completed erosion'. Unless situations of this kind are recorded, as they were during the survey under discussion, a bioclimatic map on its own must have limited use.

Since the Jordan survey was done, nearly 20 years have passed. A great deal of additional resource and climate data has been acquired throughout the region. Moreover the advent of ERTS satellites, with virtually total and recurrent cover in both monochrome and false colour, provides a wealth of information—admittedly at a very small scale—which can be used to analyse landforms and related features. No country concerned with the long-term future of its land resources and, therefore, with the well-being of its people, should neglect the use of the wealth of available material. Supplementary work may of course be needed in varying degrees, none of it costly in terms of the issues at stake.

THE RIVER BASIN AS A PLANNING UNIT

It is not always possible or practicable, as it was in Jordan, to attempt regional surveys covering virtually the whole country at one time. Existing data, viewed in the light of national economic and social objectives, can be used to assign priorities for such studies. ERTS imagery, available at nominal cost, provides a useful means of breaking down the overall area of a particular country or region into valid planning units to which survey priorities can be applied. Validity, in this context, is taken primarily to mean the identification of organic units, whose best expression in this context is the river basin.* It is accepted, of course, that other considerations may dictate the breakdown of survey regions—provinces within a State, or States within a Federal system, for example. Nevertheless the river system is the logical unit for natural resource and land-use planning, and should be so used wherever possible.

Two examples are cited here, neither of them in fact embracing a complete river basin. One (in Pakistan) was restricted to the water-shed of a reservoir on the River Jhelum, a major tributary of the Indus: the other (in Iraq) embraced most of the River Diyala system, a tributary of the Tigris. Nevertheless, both offer some useful lessons in the objectives and methods of survey appropriate to such planning exercises.

The Diyala study (see under Macdonald in the References) was undertaken in the period 1958/60. Part of the upper catchment lies in Iran, and thus outside the scope of the study. The lowest parts consist of a level plain of alluvium, where development of agriculture via irrigation was clearly the prime usage.

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* As English-language terminology is somewhat confusing in this context, it should be explained here that 'river basin'includes the whole area drained by a river system, including the 'watershed', here used in its American usage as the upper or collecting area of a river basin. Watershed in UK usage is synonymous with 'divide' in American;'catchment' in UK corresponds with American 'watershed'.

It was in the upper and middle parts of the basin where choice was widest and where the kind of study under discussion was most appropriate. The objectives of the study were clear, and somewhat limited. They were concerned essentially with three questions: the extent of present or potential erosion in the watershed area; the nature of present forest or other vegetation cover and its management in relation to erosion control; and a study of existing agriculture and measures to be taken both to raise production and to reduce erosion. Nevertheless the main elements of comprehensive land use planning were there. Within the Diyala basin—about midway—is an important oilfield, already developed and producing.

In the upper part of the basin where, as already noted, the choice of land was widest, little meteorological data of direct relevance was available. Stations outside the area—some in lower parts of the basin—had good records at least 20 years back. It was however possible to extrapolate to some extent with the help of evidence from vegetation, though much of this had been modified by the influence of man albeit to a lesser extent than was the case in Jordan. What was clear, however, was that rainfall was very irregular, greatly affecting annual crops and hindering such measures as afforestation: a situation made still more difficult by the very great excess of evapotranspiration over precipitation in the summer months. Aerial photographs, obtained for the survey a short time in advance, were available at a scale of 1/20,000.

As a first breakdown, the area was divided into ecological zones based on vegetation characteristics. The zones were designated 'dry steppe', 'moist steppe' and established forest. The most important ecological boundary was that between dry steppe and moist steppe, two plant formations which differ greatly in their productivity and botanical composition. In moist steppe, rainfall was sufficient to maintain a continuous cover of trees, though most of these have gone as a result of human activities: in true dry steppe, the climax vegetation is grassland, the rainfall being insufficient for trees. The line between these two kinds of steppe approximates to the 300 mm rainfall isohyet, and this was probably where, originally, forest passed into steppe, through a wide zone of steppe-margin woodland. Most of the remaining established forest belongs to a dry type of the Iraq mountain forest characterised by species such as *Quercus aegilops* and *Pistacia khinjuk*. The climate under which forest exists—and would have existed—in the upper Diyala is exceptionally extreme. Under pressure, in such a climate, ground conditions change drastically in the direction of greater aridity, and an invasion of steppe species into the degraded forest is likely. Once the forest is removed it is very difficult to reestablish it: in this region degradation from woodland proceeds straight to annual grassland without the shrub stages which intervene in the Mediterranean region.

With the broad ecological zones initially determined, a further breakdown was made based on landform and geological formation. These were very significant. In the moist steppe zone, for example, the majority of the productive grassland was on conglomerate. The soil, though often not deep, is remarkably resistant to erosion, and because of this stability the conglomerate grasslands are able to withstand heavy grazing pressures. Nevertheless the effects of protection from grazing are very marked: perennial grasses became established quite rapidly and oak trees would be likely to reappear if any seed source existed. The formation known as Fars provides a striking contrast to this relatively stable situation. The rocks of the Fars beds consist of interbedded sandstones and soft clays. The landscape is composed of bare sandstone ridges and red clay badlands, where the conglomerates produce a gentler landscape of rolling rounded hills. Within the Fars formation three land forms

can be distinguished: thin soils on the exposed sandstone, clay badlands, and valley bottoms (often quite extensive) with deep alluvial/colluvial soils. The effects of human use, and the potentials for use, are therefore widely different in these two geological formations, although both may occur in the same ecological zone. By analysing and mapping these factors, the necessary information for sound land allocation is again made available.

In Pakistan (see References under Hunting Technical Services 1961), the situation is somewhat different. The particular problem—an even more limited objective—was to examine that part of the Jhelum watershed lying above the Mangla Dam (then under construction), in order to assess the effect of erosion control measures on the effective life of this very large and costly reservoir, itself part of the grand design for division of Indus waters between India and Pakistan. The survey covered an area of about 6,000 square miles, which represents about half the area of the Mangla watershed. The remainder lies across the border and thus was again outside the scope of the survey. Aerial photography at 1/25, 000 scale was made available for the most important part of the area. In contrast to the previously described study, adequate climatic data was available; a very important distinction here was between the area affected by the summer monsoon rains, which also, in the main, coincided with the area of human occupation. Much of the area surveyed is hilly or mountainous, ranging up to 15, 000 feet in height, though sizeable areas of level land occur in valleys and, in the southern parts, on the loess soils of the Potwar plateau. The rocks of the study area are mostly inherently erodable, from the unconsolidated loess of the Potwar just mentioned to the limestones and schists of Hazara and northern Kashmr which have suffered continual disturbance by earth movement. Hill slopes are often precipitous, so that the overall geological erosion hazard is high, quite irrespective of the changes brought about by misuse of the land. Human activity has had a profound effect on the vegetation, even at quite high altitudes, in most cases rendering it less effective as a soil cover. The forests in particular have taken terrible punishment.

Population in the southern part of the watershed, based on 1951 census figures, was very high, averaging about 300 persons per square mile and up to nearly 1, 300 per square mile of cultivation. At the time of the study, 1959/61, population was clearly substantially higher. Added to this large human population was a very substantial livestock population, both sedentary and nomadic—the latter summering in the upper valleys and wintering in the southern plains. All pastures were seriously overgrazed except during July and August—the wettest months—and the best were deteriorating rapidly. An earlier phase of reasonably rational land use was being overtaken by these pressures, in a situation where misuse of land could cause greatly accelerated erosion. Not only was the life of the vast new reservoir at Mangla threatened if this process continued: the whole life-support system of the watershed was in danger. For Pakistan, these areas have a double significance: for water management and control and for production of timber, fruits and livestock of types not suitable to the hot irrigated plains below.

Both present land use and land capability were studied and mapped, so that it could be demonstrated where present land use conflicted with optimum use. The system used for the land capability mapping was derived from that development by the United States Department of Agriculture, described in Robertson *et al.* (1968) The USDA system rates land, broadly, in order of ascending erosion hazard and appropriate land uses are attached to land capability classes accordingly. It is not an 'ecological' system of the kinds described in previous examples cited, but it was considered appropriate in view of the particular objectives of the study. As a supplement to this particular land capa-

bility classification, an overall map of 'erosion hazard' was produced, which clearly emphasised the dangers inherent in particular types of land use in the different major geological formations. As in the Diyala basin in Iraq, certain formations could be clearly highlighted in this context, and it was in these areas that attention to control or restorative measures was most urgent.

A series of representative sites were studied in detail, with proper land use planned and conservation measures costed. From these it was possible to cost such measures over that part of the watershed where accelerated erosion was the danger: geological erosion in the very high mountains was not controllable. Estimates of silt load saved by such measure were made, and from this it was possible to prepare an economic analysis of the effect of conservation measures on the life of the reservoir. Taking extra reservoir life as the sole benefit, the cost/benefit ratio came out close to 1 : l;not an attractive investment in financial terms. It was clear however that, taking a wider view, watershed management in this area must have substantial benefits and this survey offered a comprehensive programme for such measures.

CONFLICTING LAND USES, INCLUDING MINERAL AND FUEL DEVELOPMENT

Ecological studies of the kinds described can indicate clearly what are the best forms of land use in the long-erm interests of conservation in its widest sense. It must however by accepted that all the studies quoted were concerned mainly with what might be called the 'directly' productive uses of land. As has regrettably been the case with so many other land capability studies, wildlife conservation was not specifically included in terms of reference and thus is left only with those areas not required for anything else. It is of great importance that land capability studies are designed to include uses of land which are not directly productive, widening the whole basis of land classification so that scenic amenity, wildlife and, to a lesser extent, recreation are not relegated to what remains after 'higher' uses have been catered for. The case for protecting such areas must be balanced against the other, and apparently more attractive (in economic terms or in terms of providing a direct living for people) forms of land use. The problem centres round that of placing a proper value on such indirectly productive forms of land use, and, as will be discussed in this concluding section, finding a means of economic analysis or assessment which will give proper weight to those values. Long-term or short-term, direct or indirect benefits: how do we decide?

The resolution of conflict between different land uses may rest on economic, social or even political factors which, at any rate in the short-term, have little to do with conservation of natural resources. This is particularly the case where short-term expediency decides a change in land use which is to all practical purposes irreversible. This can apply in certain cases of opencast mining, including coal: deep mining is usually not so destructive in this sense, though the problem of waste disposal remains a formidable one. Oil production is, generally speaking, not a serious offender in this context, though a producing oilfield can of course seriously effect amenities in an area where landscape values are important. Urban and industrial development and major highways are other examples of land usage where the choice is effectively irreversible.

In none of the examples quoted has mineral or fuel exploration or development introduced a conflict of this kind. In only one was current mineral development

(oil) actually occurring and it did not introduce a serious conflict of interest. There are of course examples that could be cited elsewhere in the world where such conflict is very real. In a small, densely populated country like Britain, for example, there are real arguments for restricting even exploration in areas of major scenic beauty or in wildlife reserves—particularly in National Parks—since such areas are so limited and are, and will increasingly become, so important to the people as a whole. Once minerals are found, the pressure to extract them tends to become irresistible—which is the main reason for considering a zoning system that could actually ban exploration in certain areas. In most of S.W.Asia and the Middle East such extreme considerations need not yet apply, but it remains important to consider very carefully the implications of any development which results in irreversible destruction or degradation of biological resources.

It is in this context that we run up against problems of economic analysis. It can be argued that conventional discounted cash flow analysis, as applied to projects concerned with natural resource development, do less than justice to future environmental requirements. R. F. Stoner in an unpublished note suggests that the fault lies in treating natural assets as though they were cash: they may have to be valued in cash terms but there is no excuse for discounting their value as though they were cash, since the opportunity cost of capital varies from country to country and from time to time, whereas the value of environmental assets should not so fluctuate. Stoner goes on to suggest that discounting effectively devalues future assets—it is the ultimate weapon of the 'jam to-day' advocates. The higher the discount rate the more are assets devalued until anything that occurs in the far future can be comfortably ignored. He continues 'the difficulty … is that few of man's enterprises are entirely free from some element of damage to nature. Man is part of the natural environment and we are chiefly concerned that we do not degrade the environment for the use of man. Thus we are left with value judgements between what constitutes tolerable and intolerable damage. It may be that we should place more value on some aspects than on others: we might choose to vary the discount rate between zero and the full opportunity cost according to the importance we assign to the asset.'

Pearse (pers.comm.),in commenting on the above view, says that, whilst sharing the implied fear that natural values will be given insufficient weight vis-a-vis commercial values, the answer should be to insist on more rigorous measurement (or simply more generous treatment). To attempt to deal with the problem through the discount rate would, he feels, further distort the issue. The real challenge, Pearse suggests, is to assess the values of the natural environment, and other non-priced benefits, more rigorously. The problems of measurement are extremely difficult, especially when 'public goods' are involved, but some progress has been made in recent years in methodologies for treating them: Pearse himself has done some basic research on the question of evaluating non-priced recreational facilities. In many cases, he suggests, this involves using proxy or shadow prices, or deriving values from indirect data. Once obtained, these can be incorporated into the cost benefit scheme: the discount rate, per se,is not the major difficulty.

Pearse however agrees that a special problem arises where the decisions being taken threaten to effect permanent change to unique natural features, and that, while we are not usually dealing with irreversible change, the problem is becoming more frequent with modern technology and the scale of projects. 'Where we are not concerned with uniqueness and irreversible change,

economic analysis is adequate to the task, but when irreversible decisions are involved, standard analysis fails.'

This is the hub of the problem. We can, often using data available, undertake the necessary work to evaluate optimum land use, in ways similar to those used in the examples described. But until ecologists and economists can get together to formulate a method of analysis to deal with the kind of problem outlined in this section, decisions based on short-term expediency may continue to dominate planning, to the ultimate disadvantage of all of us.

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Session I (continued): CHANGING PATTERNS OF LAND USE AND LAND USE IN RELATION TO NATURAL RESOURCES

Summary of discussion

In response to questions, **Dr. Le Houérou** agreed that cultivation in semi-arid areas (annual rainfalls in excess of 400 mm) was not necessarily harmful to productivity or conservation of soil; indeed, in many cases, cultivation was much more productive than rangeland, even when the latter was properly managed. In low rainfall areas (annual rainfall of 100-300 mm), however, clearance of range for cultivation was invariably harmful, especially on sandy soils (because of wind erosion), shallow soils and slopes. In these areas, there was ample evidence to show that range management was more productive than cereal cultivation; the only important exceptions were low areas subjected to flooding or, of course, irrigated areas. The technology to prevent or combat desertification and salinization was certainly available, but application of this technology was all too frequently neglected.

On the subject of irrigation, **Dr. Le Houérou** stated that water logging and salinization problems commonly arose because irrigation schemes were planned by water development specialists and geologists for optimal use, regardless of technical knowledge of those who would use the water and the land. Inclusion of agronomists and sociologists in planning teams would probably result in more realistically designed schemes. **Dr. Zaidi** confirmed this view and suggested that the establishment of extension services to farmers in newly irrigated areas should be included as an additional safeguard.

Dr.Lubani considered that the only practical solution to seepage from irrigation channels was to line them. He appreciated that costs of lining were enormous but believed that the expense could be recuperated with a reasonable time by halting the staggering annual losses to productivity that were presently caused by waterlogging. **Dr. Anwar** stated that waterlogging could normally be avoided by good management. Canal lining need only be considered in very porous sandy soils. **Dr. Zaidi** felt that environmental schemes must consider not only water management and farming methods but also watershed protection and human social systems. Local, national and international environments required comprehensive treatment at their appropriate levels. International agreements were often essential. Among numerous other needs, formulation of environmental strategies required investigation to determine how local people perceived their environment and changes that were taking place or were proposed.

Professor de Vos and other speakers could not accept Dr. Anwar's suggestion that the planned use of pesticides in agriculture constituted no serious hazard. There was ample, well-documented evidence to show that even the most careful application of specific pesticides could cause environmental degradation. FAO and WHO had drawn attention to these residual, harmful effects and advocated a policy of integrated pest control, to include biological methods and limited use of pesticides. **Dr. Harrington** drew attention to the harmful effects and longevity of DDT and its ready transference to untreated areas through wind erosion. He hoped that the use of this pesticide would be rigidly restricted throughout the region. On health grounds alone, human populations were likely to be dependent, to some degree, on the continued use of pesticides, but their use required extreme care. **Dr.Shariari** felt that substantial improvement could be effected by educational programmes for farmers. The meeting

was informed that Jordan had legislation to prevent the importation of pesticides the use of which was banned in the country of manufacture, and that the vast majority of agricultural areas in Pakistan, for example, used little or no pesticides. Reference was made to international programmes (e.g. FAO and ICSU) directed to finding effective alternatives to persistent pesticides.

A number of case studies were quoted to illustrate the difficulties of reservation or development of land for wildlife purposes both in developed and developing countries. **Prof.de Vos** urged that a new land capability system for wildlife be developed, based on biotic potential, that would be more acceptable to land use planners. The most productive land for agriculture was, generally, also the most productive for wildlife. A special land capability classification for wildlife has been undertaken in Canada but proved unacceptable to economic planners, who continued to regard wildlife (though not recreation) as unimportant. In Afghanistan, which had problems of very low per capita income and poor education facilities, all development had to show an economic benefit. Wildlife was being developed through overseas tourism. **Dr. Poore** was not against use of economic arguments where appropriate, but felt that reliance on economic criteria alone could result in degradation of the resource. Furthermore, if biotic potential alone were considered, then wildlife often missed out. He felt that the correct approach was to stress the value of certain natural areas as a part of the country's unique natural heritage. In the developed world, at least, both the public and land use planners were normally ready to take an interest in uniqueness. The situation would, clearly, be different where the public was poorly educated or not even asked!

Governments may possess the information to plan sound land use but may have difficulty in effecting implementation and enforcement of these decisions, especially in remote areas. In the Middle East, private land-owners were commonly reluctant to recognize the need for conservation of wildlife and amenity, or to reduce domestic stock. **Dr. Gharaybeh** felt that much stronger persuasion was needed to convince politicians of the seriousness of neglecting disciplined land use and of the infinitely greater effort required in pre-investment surveys for projects selected for international funding than was presently employed. **Dr.Lubani** considered that small local projects for land improvement could often succeed where larger, grandiose schemes commonly failed. **Dr.Zaidi** agreed that large scale development schemes and industrial projects often utilized good agricultural land and drained human populations from rural areas, causing considerable ecological disturbance. **Prof.de Vos** believed that environmental impact statements on large projects were superior to permanent environmental committees because the former used methods and technology that were respected by economic planners.

Mr.Swift questioned the basis of present decision-making; land use planners and bureaucrats tended to make decisions as if land were presently devoid of human use—in fact, most land was already very much in use. Economic analyses were not neutral, they reflected underlying political choices and values of their users, but these were usually benefits to the State Treasury or entrepreneurs, not to the rural populations who currently used the land. Employment of these techniques can systematically exclude rural populations from decision making, in spite of the fact that these people represent the sector of the community which is directly affected. Pre-project statements should identify foreseeable impacts in ecological, economic and social fields. They should be followed by periodic monitoring and post-project audit for comparison with base-line data of the impact statement. Present planning rarely reflects the values or aspirations of the rural populations concerned, hence the

frequent local resistance to new plans. Some means must be found for rectifying these situations.

Dr. Poore considered that the solutions to many of these problems would depend on the politics, culture and education of the human communities of the countries concerned. One possible solution in cases of conflicting interests was the judicial inquiry, in which all parties concerned put their views and evidence to a neutral adjudicator who then made his recommendation to the Government. **Prof. Barth** feared that the present inability of rural populations to make their case and other groups' inability to ascertain and interpret their wishes and needs would seriously impair the usefulness of the approach in many countries within this region.

Prof. Mirimanian read a paper of measures for protection and rational land utilization in arid mountain regions*.

On the question of seed treatment to promote germination of juniper seed, **Prof. Wendelbo** said that, in Iran, extremely good results had been obtained by treatment with sulphuric acid or leaving the seed in the soil for one year. In Pakistan, **Mr. Khattak** stated that acid and heat treatment had proved unsatisfactory, but stratification had increased germination to some degree.

Dr.Poore could not agree with Dr. Anwar's suggestion that production of freshwater from the sea for irrigation purposes could bring vast areas of pastoral land in this region into cultivation. Most of these areas could not be cultivated without terracing and soil rehabilitation. Large areas were likely to remain under range use for many years to come. **Dr. Le Houérou** stated that, to his knowledge, Israeli experiments in the use of seawater for irrigation, principally of *Juncus maritimus*, had now been abandoned. Some plant species, however, in particular *Atriplex* spp., could utilize water of 25-30 millimhos conductivity (15-20 g/litre). *Atriplex* spp., were being grown under these conditions over large areas of Tunisia; these shrubs provided excellent fodder for sheep, goats and camels and had high protein content (approximately 16% of dry weight).

The use of reservoirs of underground water was referred to as a further source of irrigation water, provided the reservoir was recharged by seepage. The use of fossil water reservoirs was clearly of little use for sustained production. It was agreed that conservation of surface water was of greater relevance to the subject matter of the present meeting.

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* Reproduced in Section (ii) of the Appendix to these proceedings.

Session II: SOCIO-ECONOMIC CHANGES AND SOCIAL PROBLEMS IN PASTORAL LANDS

Background Paper No. 6,

Socio-Economic Changes and Social Problems in Pastoral Lands: Some Concrete Factors

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To identify significant socio-economic changes, and assess their effect on people and environment, it is necessary to have a clear picture of the major interdependencies between the local human populations, the natural environments and the external world, which characterize the recent and contempory structure of S.W.Asia. This picture also provides necessary premises for any formulation of development guidelines and conservation objectives.

We should note that the environments that confront us in S.W.Asia are all 'cultural landscapes', shaped by millenia of man's activity. They also provide the habitats of some of history's distinctive peoples and cultural types. Development policies will consequently be fateful for the persistence and development of unique cultural traditions as well as environments; and conservation problems do not merely entail the *restriction* of certain destructive trends in exploitation, but also the *maintenance* of certain lifestyles and resource uses that are necessary if the environment is to retain its traditional features.

These styles and uses are now undergoing change under the influence of global industrial culture by which new users and forms of exploitation are introduced, and local populations react differently to their environment. This has caused drastic changes in the environment over the last 100 years. But we are not justified in adopting a harmony model of traditional life either. The peoples of the Middle East have *not* been in ecological balance with their surroundings, as are perhaps some of the tropical non-industrial populations of man; on the contrary, they have throughout history cumulatively developed, changed and, in part, destroyed and devastated their land through their own traditional modes of exploitation. It is in this profound sense that all of S.W. Asia can be seen as a cultural landscape—the product of man's previous and sustained activities.

The activities through which man has wrought such effects on his environment have been channelled by some basic patterns of organization; these persist as structural features of the Middle East even today.

(a) Most important is the basic market organization of economic pursuits. In fundamental contrast e.g. with the subsistance herders of East Africa (Dyson-Hudson 1969), the pastoralists of the Middle East are closely tied to markets and dependent on market transactions. This implies a close interdependence with all other sectors in the regional economy; it also implies a high degree of sensitivity to world changes in prices. Thus not only do the prices of wheat, sugar and other commodities affect consumption among pastoralists; even changing fashions among upper-class women in other continents, through the world price on lamb-skins, strike at the very heart of the economy in the inner Zagros.

(b) Just as they are economically interconnected, all the peoples of the Middle East are also members of the common great cultural tradition of Islamic civilization. But within this common world, which they all share, the life situations of each individual actor differ in a number of ways which determine his understandings, interests and modes of response to change. Besides the ethnic differentiations by language and origin, important differences distinguish (i) nomads, villagers and city folk, (ii) tribal vs. state-organized societies, and (iii) participants in the different main sectors of the economy: trades, crafts, industries, pastoralism, dryland farming, irrigated farming. It is important to recognize the extent to which these distinctions cross-cut and vary—many villagers as well as nomads are organized in tribal societies; nomads are farmers, traders and craftsmen as well as herders, etc. The way in which any activity is pursued, and thus its effects on environment and on the life of the actor, is significantly affected by these important organizational and cultural differences.

The pastoral exploitation of rangelands is pursued by mixed farmers and by pastoral nomads. Management policies are determined mainly by the separate household units; and to analyse the aggregate pattern of use, and the factors that determine it, one must therefore examine the variation in interest, opportunity situations, and practices on the household level. If we understand these, we can also understand how changed circumstances elicit changed (aggregate) response, and trace increased destruction of natural resources, and increased human suffering and dissatisfaction, to somewhat more specific causes. Most important for the conservation of environment are the alternative patterns of household adaptation to seasonal and irregular *shortages* in grazing, when range management is most critical. In these, there are marked contrasts between mixed farmers and nomads. In regard to seasonal fluctuations, mixed farming is an adaptation whereby stock is maintained with the aid of supplementary and stored fodder through seasonal low periods in pasture, usually in the Middle East combined with continued grazing in the rangelands; while the nomadic adaptation is one of migration to better pastures and thereby vacating of rangeland in its unproductive seasons. As for irregular shortages, mixed farmers attempt to tide a maximum of stock through such periods by increasing productivity and dependence on the agricultural sector of the household economy; while pastoral nomads can only buffer decreased productivity by consuming capital, i.e. reducing their stock. In both cases, in other words, nomads respond to decreased pastures by reducing the load of animals exploiting those pastures, while mixed farmers are insensitive to such fluctuations and maintain a maximal load throughout.

The basis in social organization for this sensitivity of pastoral nomad populations to rangeland carrying capacity has been documented for various areas of Turkey, Iran and Afghanistan (e.g. Barth 1961, Bates 1971, 74, Tapper n.d., Swidler 1972). The seasonal adjustment of animal load to carrying capacity is most sensitively organized in terms of the Il-rah (Barth 1960), based on a tribal organization and a codification of pasture rights in terms of migration schedule. Thus groups identified as tribal segments do not own land so much as the right to occupancy of land at certain points in the annual cycle, rather as one might say that a scheduled train has the right of occupancy to tracks and stations in accordance with its schedule. The load of animals on any particular pasture will thus vary during the seasons by the succession of different flocks, belonging to different tribal segments and tribes which pass through; and these can be adjusted to the changing carrying capacity of the pastures. Variations in the productivity of pastures can also be accommodated by advanced or delayed occupancy of zones, or by the speed of passage through an

area. Tribal leaders or, lately, military officers or other government-authorized persons, coordinate and police these movements.

Long-term balance between pastures and animal population is an indirect effect of other features of organization (Barth 1964). The key precondition is private, individual ownership of animals whereby variations in each particular household flock will have direct consequences for the policies and decisions of that particular household—leading to sedentarization of some of the households during periods of stress, and thus the relief of population pressure (human, and thereby indirectly also animal). The processes are too complex to describe in detail here, and contingent on a number of simultaneous circumstances—and yet seem to operate remarkably similarly in widely separated parts (cf. e.g. Barth 1964, Bates 1974). They are, on the other hand, not characteristic of nomadic communities with mixed household economies, or practising multi-resource nomadism (Salzman 1971). Nor can such balancing mechanisms be identified among sedentary mixed farmers, where other sectors of the household economy can be drawn on to maintain viability.

This basic contrast in sensitivity to pressures on pasture resources as between the two major traditional modes of pastoral adaptation would seem to suggest guidelines also for the organization of pastoral exploitation in the future. Other considerations of a practical and economic kind likewise seem to favour a pastoral nomad pattern of exploitation in desert and mountain zones. In the former, natural grazing is so irregular as to require opportunistic movement, sometimes over long distances; whereas in mountain areas the location of natural summer and winter pastures are so far apart as to require the migration of herds. Particularly spring and summer pastures have a size and location such that migratory herds have been the only feasible instrument for their utilization.

The differences in life style between nomadic and sedentary populations also influence the effects these populations have on other natural resources, such as forests and wildlife. Tent-dwelling nomads require firewood rather than other fuels for cooking and heating, and collect this by felling brush and trees all along their routes of migration. Such activity doubtless leads to considerable forest destruction, and is difficult to control and prevent. Village-based timbering, firewood collecting and charcoal burning have no doubt traditionally been a far more important factor in deforestation; but such activities have now been much reduced because they are easier to control, and because other fuels are suitable replacements.

For wild-life, nomads may constitute a special threat since they seasonally penetrate otherwise uninhabited areas; but though they enjoy hunting the time and energy they invest in it seems to be relatively modest. My impression has been that village-based specialized hunters are in fact much more active and penetrate more completely into every faunal refuge area.

Another variable of importance is the composition of herds. Generally speaking, nomadic herds contain a greater proportion of sheep over goats than do those of sedentary villagers. This reflects the generally more favourable grazing conditions of the migrating herds; and I understand that grazing of sheep has less detrimental effect on marginal pastures than the mixed browsing of goats. But the true effects of different mixtures of sheep, goats, donkeys, cattle and camels on different pastures would need to be more rigorously evaluated.

The preceding sketch has given a culturally static picture of traditional modes of exploitation. Our next task is, on this background, to identify the major contemporary socio-economic changes that affect the modes of pasture exploita-

tion. I shall first indicate these changes under six subheadings, and then try to summarize their aggregate effects on pasture management.

(i) Increased security. With the growth of a modern political and administrative system, the security of person and property has both increased and been extended to the most remote areas. A direct consequence of this has been an increased option to utilize marginal and less accessible areas, which were formerly no-man's land, or unsettled areas with a prevalence of robber, group-self-help etc. This pacification of marginal areas has opened them up for economic use by persons and groups who can now utilize resources without endangering their life and property.

(ii) Population growth. Unless associated with a sharp decline in living standards, such growth naturally leads to increased pressure on resources. We may identify two consequences of immediate relevance to pastoralism: an increased demand for animal products such as meat, milk and butter; and an increase in the area devoted to agriculture, necessarily implying a decrease in the available pastures. Since agricultural expansion is selectively localized, it often affects mainly one phase of an annual grazing cycle, as e.g. by encroachment on spring/autumn pastures in the middle zone of mountain migration cycles.

(iii) New agricultural technology. The extension of irrigation implies an increase and dispersal of perennial fields—either in new compact areas from central irrigation schemes, or dispersed through well and pump technology. Both forms, in different ways, reduce pasture areas and create difficulties for herders, as will be discussed below. The development of agriculture also entails the cultivation of new crops, mixed cropping and crop rotation, and use of artifical fertilizers. All these changes tend to reduce the possibilities for herder-cultivator symbiosis or mutualism.

Traditional cereal crops provided animals with autumn grazing areas of stubble, fallow fields were likewise available, and the natural manure from the herds was positively valued by traditional cultivators—all of which changes with changing agricultural technology.

(iv) Land registration and land reform. The effects of these changes have generally been the establishment of smaller units of agricultural production, with greater difficulties for herders in negotiating pasture contrasts; the elimination of joint and collective rights and the freezing of rights regardless of changing patterns of need; and the elimination of certain traditional forms of grazing rights, e.g.such as those codified in the *Il-rah* (Barth 1960), designed for the practical needs of a nomadic and pastoral, rather than a sedentary and agricultural adaptation.

(v) New felt needs. These have implications both in terms of their form and their volume. Some kinds of modern needs—medical services, educational facilities—appear to have a *form* which is difficult to satisfy for families living in mobile tent camps, implying a relative hardship for the nomadic adaptation which did not exist in more traditional times. As for the volume of felt needs, the desire to purchase, enjoy and consume more goods implies increased costs per capita: quite regardless of population increase, the increased rate of consumption demands more intensive exploitation of resources to pay for consumption.

(vi) Increased government control and planning. This implies an increased interference, involvement—and contribution—by external organs and agencies in the life of every family and community. But the realization and

consummation of such interaction between the relatively powerless cultivator and herder and the relatively powerful central agencies require a social organization that is suited for both sides. Designed as they are largely on sedentary, urban and industrialized premises, these organs are variably suited—and sometimes very poorly suited—for interaction with persons and groups pursuing traditional adaptations. Yet because of their greater power, they penetrate into these traditional lives and affect possible options and choices profoundly.

What are the effects of these six major types of socio-economic changes on changing patterns of pasture use and management, and what social problems arise in their wake? The answers to these questions should consider separately the pressures on, and responses of, both sedentary and nomadic stockbreeders. Despite considerable effort on may part, I have not been able to find concrete documentation from which answers to such questions can be drawn. We have no doubt here identified a field where concrete case material, combining data from ecology, range and stock management, and social conditions and practices, is urgently needed for any kind of considered policy making. In its absence, only some very general points can be made.

Firstly, I should emphasize the total inadequacy of a concept of 'traditionalism' or 'resistance to change' to describe the response of these populations to their environment. New opportunities are sometimes seized with a speed and opportunism that is staggering to a spectator; adjustments are made to the most unfamiliar circumstances, major aspects of lifestyle are recast, and whole community and activity types that were recently fundamental to local society can disappear without trace. We see this in the remarkable adaptability of nomads and villagers to work as migrant labour—as mercenaries in the armies of the past, in other services, in the oil industry, etc.; we see it in the almost instantaneous spread in some areas of pump irrigation and other agricultural technology; we see it in the total change of some conveniently located desert nomads from camel pastoralism to smuggling and trading, or in the fiercely competitive taxi and transport entrepots in Oman where five years ago enormous traditional camel caravans monopolized the field. Most directly relevant to pasture management, we find no special attitudes reminiscent of the 'cattle complex' (perhaps exaggeratedly) ascribed to East African herders. In other words, animals seem throughout the Middle East to be treated merely as another form of capital, to be retained or converted in accordance with changing opportunities, realistic alternatives and reasonable prognoses. Not infrequently these rapid, opportunistic readjustments on the individual and household level have spelled the sudden end to traditional and glorious styles of life valued in the collective though abandoned in the particular; but even then nostalgia for what has been lost seems remarkably weak among the populations whose life has been changed—perhaps because no realistic traditional option can be identified by the pragmatic actors. The lesson from these cases should be, on the one hand, that where traditional adaptations stubbornly persist they probably do so not because of traditionalism but because persons and households see, and probably have, no acceptable alternative; while on the other hand, change and the adoption of new life styles do not imply that these life styles are more highly valued than those that were abandoned but perhaps only that they are the consequence of opportunities seized by some or many persons for short-run, immediate gains.

The most clearly identifiable factor affecting change in pasture use and management has been government programmes of sedentarization. Focusing on the problem of nomadic populations these programmes do not seem to have taken

systematic account of the pastoral sector of the regional economy or the management of pastures but have none the less greatly affected these. Not infrequently, they have led to disuse of high mountain pastures, extreme over-stocking in settled zones, and dramatic stock losses. Other aspects of human suffering and resource misuse have also frequently resulted, depending on the particular features of each concrete settlement scheme.

An aggregate effect of several of the socio-economic ehanges listed above has been a general intensification of exploitation of pastures. An inevitable consequence of population growth and rising per capita consumption, much of the progressive deterioration of the environment stems from this, but is particularly aggravated by the increased concentration, and pattern of all-year use, resulting from the shift fron nomadic to sedentary pastoralism. The same effect may be seen locally in the most arid areas, where the development of deep wells and pumps may lead to an over-concentration of nomads and their herds around such watering points.

Finally, the more complete penetration of marginal and unsafe areas with increased security entails a change in the pattern of use. By virtue of their insecurity, certain areas formerly functioned as de facto reserves of underexploited wild life and vegetation. Though this pattern has disappeared, the discontinuation of large-scale nomadism may have led to the vacation of other areas—these, however, are heavily concentrated in the high mountain zone. But as noted, to evaluate this and the other trends suggested, concrete data are absolutely essential.

Looking towards the possibilities of implementing improved range management and a defensible intensity of exploitation, some concluding observations can be made from an athropological perspective.

Pastoral activities have always been organized in such a way as to combine aspects of competition and cooperation in the harvesting of pasture resources. The 'firms' in these activities have fundamentally been family households, often tied in small labour pools of joint herding—on an equal footing, or as employers and employed shepherds. In relation to pasture resources, these units have organized their affairs in various ways, in part reflecting ecologic variables. The most extreme desert pastures have been handled anarchically, like pelagic fishing, first come, first served. The *il-rahs* of Southern Iran were comprehensive attempts—based ultimately on a balance of physical terror between tribes—at regulating and monopolizing use. Collective pasture rights e.g. on the village level may be seen as attempts on an intermediate scale at regulating competition and to some extent pasture use. But all these systems have been very weak on pasture management and optimization of use, since they always have been internally highly divided between component units with competitive interests. Even those larger collectives which monopolize pasture rights are therefore quite ineffective in formulating or executing an enlightened policy of controlled exploitation of pasture resources.

When the state develops an interest in pasture resources management, the problem it faces is thus quite as much one of designing an organization capable of implementing policy without causing human conflict and suffering, as one of designing a policy based on sound knowledge and ecological understanding. The practices whereby a multitude of tiny household units compete and cooperate to wrest profit from pasture resources are complex and variable. They are closely intertwined with other economic activities, and their manipulation is one of the techniques by which families try to cope with their problems of securing livelihood and happiness. Though not ecologically optimal, it is none

the less part of a complex, self-regulating system of critical importance to these innumerable small units. How can central authorities design a policy aiming at a collective optimum without reducing the possibilities of such small-scale units for solving their problems of individual survival and welfare? Some purely practical aspects of animal and pasture management also intervene and aggravate the problem. This can be highlighted by a comparison with agricultural extension work. Whereas agricultural policy and extension can offer the individual producer numerous aids such as better seeds, fertilizer, spraying etc., livestock and pasture agencies will inevitably show a different pattern of activities: they are easily experienced by the individual producer as interfering, and constraining him rather than offer him advantages. Amount of stock on land is regulated and limited; certain areas are reserved and controlled; owners are required to bring all their animals to certain points for inoculation or dipping, etc.

In the formulation of ecologic guidelines for pasture management, it is therefore particularly important that social and organizational realities are also taken into account: both feasibility and acceptability of the necessary controls and constraints implicit in such guidelines, and recognition of—and effective compensation for—the costs and disadvantages of such practices for individual households and producers affected by them.

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Session II (Continued): SOCIO-ECONOMIC CHANGES AND SOCIAL PROBLEMS IN PASTORAL LANDS

Background Paper No. 7

Socio-Economic Changes and Social Problems in Pastoral Lands

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Pastoralism is a mode of life, a dominant economy and a social structure closely interwoven with other existing modes of life and economics in a vast region of Northern Africa and South West Asia. As a dominant economy it has been developed only in the Old World (Forde 1949).

As an economy, pastoralism is a highly rational adaptation of human life to a severe environment, characterized by arid or semi-arid conditions, often drought-stricken and supporting grass vegetation. Pastoralists are nomadic people who roam after their herds in the lands marginal to those occupied by cultivators, with whom they have intimate contact. Situated as they are in between densely sedentary populations, pastoralists have had a role to play. They have always been intermediaries, a means for cultural exchange, traders, a source of rejuvenation and aspiration, and formidable links between scattered members of a big family. Indeed, they have had their deep influence in the intellectual and moral life of the whole region.

Yet, pastoral life is undergoing deep and detrimental changes which will change altogether the concepts of nomadism in the Middle East. Modern development and the concept of statehood, revolutionary methods of transport, a changing world pattern of power, the flow of a major source of energy, and unprecedented technical advancement, all these are interplaying factors in the dynamism of change which is affecting all facets of life and indeed pastoralism itself.

CONSTANT FACTORS

Before attempting to point out socio-economic changes in our region, it is appropriate to outline constant factors of the nature and social order of pastoralism. Within this framework, change is taking place and has to be catered for. The prevailing condition in pastoral regions is aridity. Water is the axis round which life revolves. Pastoralists live on the marginal land between the sown and the desert, where rainfall ranges from 0 to 100 cm annually. Vegetation ranges from steppe to a semi-desert.

Marginal rainfall is precarious and its annual variability is high. Fluctuation of rainfall is the outstanding climatic characteristic in all steppe and semi-arid land. This point has its deep effect on pastoralists, semi-pastoralists and cultivators in Northern Africa and South East Asia. Indeed, it gives rise to controversial viewpoints among climatologists, ecologists and historians. It deserves detailed research and understanding.

We witness now a 'cycle' of severe drought which strikes a vast region stretching from Senegal River on the Atlantic across the Northern Sudanese region of 'Sahel' eastward to Northern Ethiopia and the Red Sea. This prolonged drought

did not influence both nomadic and sedentary life only, but it also influenced the political system and order in the countries afflicted. This is a contemporary reminder of what has occurred again and again in this area. The only point of deviation from the ancient pattern is that pastoralists in the Sahel region, that is the coast of the Sahara are now too enfeebled and tamed to encroach on the sedentary land. But the net result seems to be the same. Drought leads to in-balance of economic life, and distribution of the socio-political order. Had it not been for a subsidiary and supplementary source of income in Middle Eastern countries, upheavals would also have taken place in them.

Huntington (1910, pp. 513-522) suggested a series of pulsatory changes of climate throughout the ages. In his assumption he made use of Bruckner's hypotheses of periodic sunspot cycles of 35 or 11 years length. It has been found however, that rainfall is variable from year to year and is not sufficiently predictable. Recent observations in Syria show that desiccation is becoming worse.

Huntington and Visher (1922) also tried to find a close correspondence between climatic fluctuations on the one hand and economic, social and political events on the other. They drew attention to the numerous ruined cities of Eastern Syria and the desert fringe of the Negeb. On the other hand, Worthington has pointed out that trade followed the same routes throughout historical times, and this may be an indication to the stability of the climatic regime in the region (see Brooke 1922, p. 144, and Brooke 1951, pp. 13-25).

It is difficult to overlook the probability that fluctuations of rainfall might have direct effects in urging the movement of the nomads on the settled agri-cultural countries. Toynbee in Brooke (1951) thinks it probable that rhythmic, alternating phases of relative humidity and desiccation were the unconscious forces of the desert on the one hand, and the assault of the nomad upon the sown on the other. The two sets of factors, however, human and physical, are so interwoven that it is difficult to tell which was cause and which the effect. Huntington and his school of thought think that physical factors paved the way to political and socio-economic events. Dryness for instance brought a fall of irrigation schemes, soil erosion, and weakness of the social order, before the assault of the invading nomads who were also urged by the same factor of dryness to seek refuge from pressing hunger.

The view is widely held that aridity or desertification is increasing over the Sudan and that desert conditions are spreading southwards. It is doubtful, however, in consideration of the complete absence of long-period rainfall records in the Sudan, if decreasing rainfall rather than destruction of vegeta-tion by over-grazing, or the drift of sand by the Harmattan, is the principal agent of desiccation.

FACTORS OF CHANGE

The prime factor of change in traditional pastoral societies and their host countries is modernization. The classic example, although often overlooked, is to be found in the modern history of Egypt. Previously, in Mamaluke times (1261-1808), the country was torn and divided among Mamaluke overlords and *'Urban sheiks'*. The fellaheen had to pay tribute to both of them. Strong con-federations of Urban in Sinai, the Eastern and Northern Delta, in the desert fringe of Upper Egypt and the oasis of Fayum, exploited the cultivators. This happened time and again in periods of political weakness as it did elsewhere in exotic centres of civilization in the Middle East (Toynbee 1934, pp. 16-17).

Mohamed Ali, founder of Modern Egypt, succeeded in eliminating this menace by a series of primitive campaigns on the Urban confederation. Thus former pastoralists, under the strong grip of a potentate, were reconciled to law and order and settled finally on the land. They abandoned their nomadic practices and became farmers. The last stroke to their former authority was given by the execution of the land reform law in 1952.

Pastoralists form a fraction of one percent of the population of Egypt now. During the last decade the Egyptian Government settled the tribes of Sinai who could be rehabilitated in mining areas and in newly irrigated areas of Wadi-el-Arish. New schemes of irrigation west of the Nile Delta will also help in sedentarizing the Awlad Ali who live on the Mediterranean littoral west of Alexandria.

The encroachment of nomadic tribes in Syria and Iraq followed, it is widely held, the Mongol invasion of the thirteenth century, which upset the irrigation system of Iraq and destroyed the flourishing Arab civilization. Little was done to modernize Middle Eastern countries under Ottoman rule. Modern states of the region inherited a heavy burden of pastoral traditional authority and unrest. In Syria, for instance, there ware 60 tribes of about 350,000 souls, or 10% of the total population, at the time of the Mandat. The Syrian Government, after independence started to solve the problem and committed itself in the constitution of 1950, article 158, to 'sedentarize all nomads' (Awad 1959, p. 2).

The Syrian Government succeeded in settling a considerable number of purely nomadic tribes. It has reduced their number to eight only. Among the settled tribes are: the Ruwala and the Hassana of the Syrian Desert; the seven Butainat and the seven Abadah in the neighbourhood of Tadmer;the Fadtan Walad and the Fad an Kharsah in the desert bordering the Euphrates; the Shammar al-Zur and Shammar al Kharsah in the neighbourhood of Deir-ez-Zur. All number about 150,000 (Awad 1959, p. 30).

The Syrian Government has wisely designated a region for the Badw,also called al Badia, where they can enjoy their legal privileges, among which is the right to carry arms. This is adequate compensation for their former power and authority.

Iraq, the former seat of prosperous agricultural civilization, has yet scarcely recovered from the Mongol invasions and has hardly begun its irrigation schemes. Consequently, nearly half of its population is still in tribal groups. True nomads, do not exceed 8% of the population, but about 48% of the sedentary population are still considered tribal. Land property in Iraq until the revolution of 1958 reflected some similarities to Egypt in Mameluke times. Grand sheiks claimed title to vast areas where their tribal groups settled in a semi-nomadic way.

The revolutionary governments of Iraq, in an attempt to secure firm authority of the state, establish more just distribution of land and achieve better use of the land, abolished special laws of tribal groups, and confiscated large tribal properties for the benefit of the small peasant. Pastoralism in Iraq was equivalent to feudalism, blackmailing and corruption (Awad 1959, pp. 31-32, Awad and Al-Tahir 1955, p. 17).

Here again modernism is antagonistic to the traditional way of pastoralism. This is a new fact which nomadic, semi-nomadic and even tribal organization has to face.

In Jordan, the question is totally different. More than 85% of the area of Jordan lies within the domain of nomadic or semi-nomadic groups. Nomads constitu-

ted about 46% of the population of former Trans-Jordan in 1922, but this decreased to 23% in 1946. With the annexation of the Western Bank of the Jordan, and progressive methods of sedentarization, the percentage of pure nomads fell to 7.3% in 1961. The number of nomads and semi-nomads is still substantial. The total number of nomadic peoples, living within agricultural regions or in the Badia, is about 175,000 souls, out of which 97,000 are pure nomads. In Jordan, as in other parts of the Eastern Mediterranean, pastoralists have lost their former power (Al-Akkam 1954,Souryani 1971).

The situation in the Sudan and even in Saudi Arabia does not radically differ. Even the Kababish of Northern Kordofan and the 100 tribes of Arabia are being transferred into a semi-settled life, having abandoned pure pastoralism and settled in villages, ploughing the land. Religious reform of the Wahabis, coupled with the stronger grip of the modern state and other factors helped to sedentarize the nomads, or to make a hijra (the name given to the journey of Prophet Mohammad from Mecca to Medina) from nomadism to sedentary life.

The second factor of change is the introduction of modern means of transport. For thousands of years, camel-drivers had a monopoly of carrying international trade through their domain. Lying where it is, the Sahara-Arabian belt separates two geographically contrasting areas with different sets of crops, and with the densest clusters of populations. All important overland routes between the Mediterranean and the Gulf, or between the Mediterranean and the Red Sea, were in the hands of caravan men. Trans-Saharan routes were similarly active between Mediterranean countries and the Sudanic belt. With the introduction of automobiles on the one hand, and new orientations of trade in tropical Africa on the other, this industry declined. Some sociologists remark that the former nomad has shifted to motor-cars, and Saudi Arabians are particularly good motorists, so much so, that they even enjoy motor-racing in the Badia. Good motor roads are the modern substitute of traditional caravan routes. But automobiles must be imported, they are no product of the pasture!

Professor Awad had rightly remarked that new means of transport such as Suez Canal in Egypt, and the Trans-Kordofan railways, created new nuclei of settlement and induced nomads to sedentarization (see also Hassan M.Ali in Awad and Al-Tahir 1955,Hafiz Wahba 1935, Twinc hell 1953, p. 81). So modern means of transportation had the result of undermining pastoral economy and encouraging changes towards sedentarization.

The third most important factor is the discovery of oil in the domain of the nomad. The nomad has come face to face with the modern age of advanced technology and science. He has been lured to abandon his former life for work in refineries, drills and pumping stations. His association with his herds has been severed and for good, and a new association is created with the machine. His economy does no more rely on herding. He does not work for his family, clan or tribe, but is a wage-earner. Deep social relations are being severed, new are taking shape. The partriarchal authority, traditionally held, is now with the state. New rules of authority, work and time are forming. Cash economy is replacing animal economy and individual initiative, and responsibility is replacing communal authority. Oil is not only a factor of sedentarization, but a radical factor in socio-economic change, creating a new society and economy.

Pastoralism, a mode of life, indigenous in Northern Africa and South West Asia has undergone deep socio-economic changes during the last two or three decades. Modern states and administrations do not conform with tribal organization and authority. Loyalty to the state and obedience to its legislation, law and order, nationalism, and modern education can only be achieved with seden-

tary populations. Modern technology is invading the age-old world of pastoralism. New codes and morals are replacing old ones. For the credit of Middle Eastern peoples, traditional periods are being passed through with the least pain and ordeal.

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Session II (continued): SOCIO-ECONOMIC CHANGES AND SOCIAL PROBLEMS IN PASTORAL LAND

Background Paper No. 8

Flexibility and interdependence in traditional pastoral land use systems: a case for the human component in ecological studies for development (Touran)

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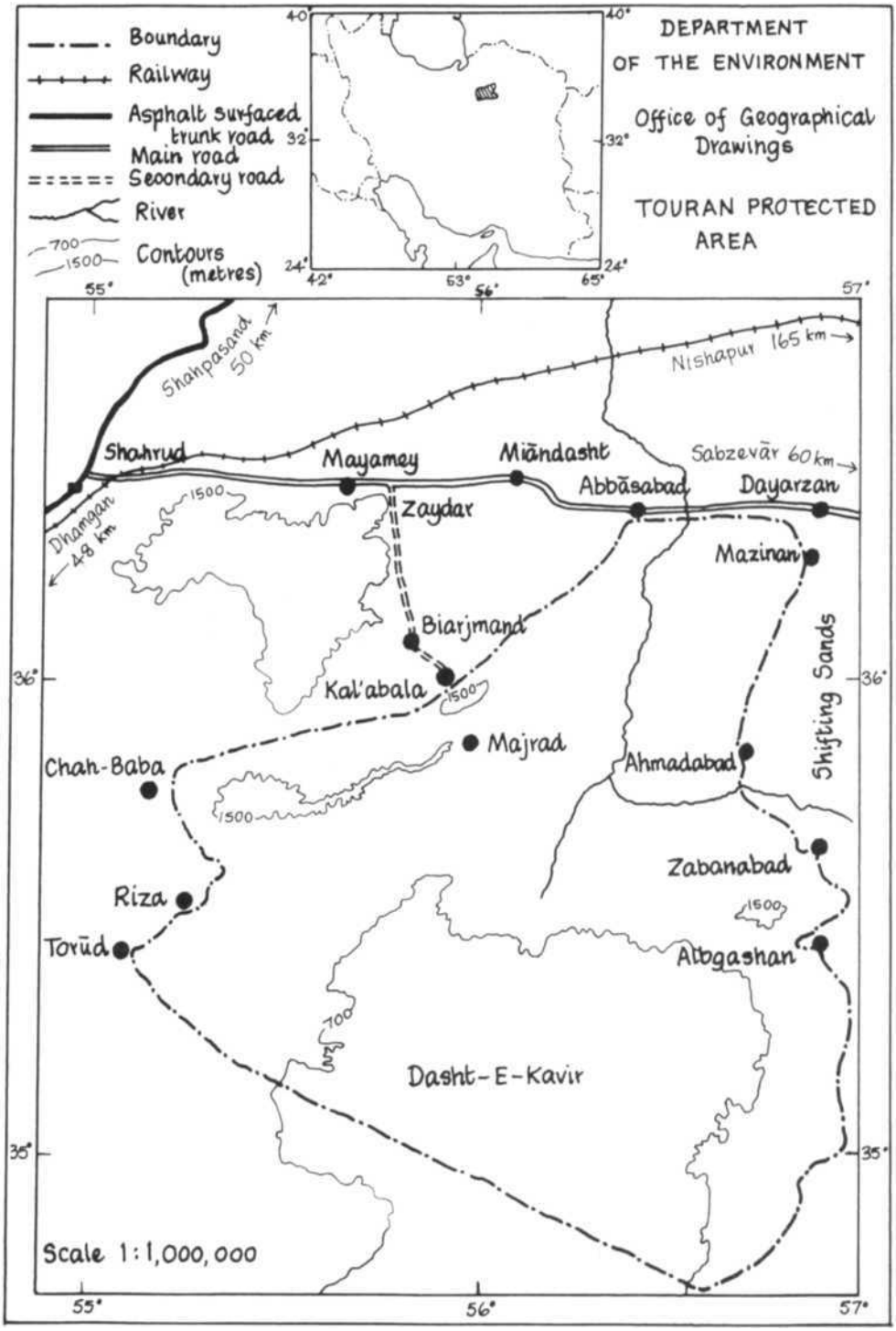
In the Touran Protected Area (TPA), which comprises over 1.8 million hectares on the edge of the central deserts of the Iranian Plateau some 500 km east of Tehran, a network has been evolved of closely interrelated land use systems, which are still minimally affected by the introduction of modern technologies. These land use systems do, however, appear to have been affected by the accelerating economic expansion and population growth in Iran, and the overgrazing that is evident in the area makes it an interesting case for consideration in the context of this meeting. Preliminary research suggests that the situation in the TPA is typical of range usage generally between the central deserts and the high Alborz mountains east of Tehran. It is worth noting that whereas Zagros nomadism has become classic in the literature little or no attention has been paid to the ecologically comparable, but sociologically very different, pastoralists who use the Alborz.

The present paper outlines the existing land use practices in and around the TPA, paying particular attention to the interdependence between them; discusses briefly their environmental effects; suggests on the basis of the available evidence the significant factors in their evolution; and looks at the ecological problems that the area now faces. Especial emphasis is laid on two points deriving from this material: the overriding need for flexibility in land use systems that must cope with aridity and face irregular precipitation and recurrent drought; and the need for closer cooperation between natural ecologists and ecologically oriented social scientists in ecological studies for development—the need, in fact,for a more comprehensive interdisciplinary approach in ecological studies.

The TPA constitutes one of the most favoured areas of winter grazing for the transhumant[1] Sangsari[2] pastoralists, who begin to move into the area in November and leave again during the month of May. The pastoral technology of the Sangsari is still largely traditional but differs significantly from the better known nomadic Zagros type. In particular, they are primarily oriented for the production of meat, with an eye to the Tehran market. The majority of their animals are a relatively short-coated breed of sheep, and their interest in goats tends to be restricted to technological rather than subsistence motives. For instance, they maintain an admixture of goats in a flock to facilitate herding, as well as to provide a better milk supply for the shepherds. They do not use tents in the winter pastures, and so have less use for goat hair. Instead they make use of specially constructed roofed pens (*aghol*) to protect the animals from severe weather in the winter—for though the margins of the *kavir*

comprise the warmest country available to them in winter, and far preferable for the season to their mountain pastures, nevertheless subfreezing temperatures and snow are normal, and protection against bad weather is considered essential. Most of the pens have been built by local villagers—probably because the Sangsari depend largely on the local population for shepherds, which is the first and major point of economic interaction and interdependence between the transhumant and the local populations. In some cases the pens are still considered the property of local individuals and a rent is paid for their use. A typical rent in 1974-5 was Rials 20, 000 for the season. The pens are built to house four hundred animals (the standard size of a Sangsari flock). They are often built in twos, and the materials used are wood, mostly (and probably originally entirely) cut in the vicinity, mud and dung. The whole is covered with dung, for warmth and water-proofing. Averaging some four feet high the pens blend with the landscape in such a way that the unpractised eye may miss them and on maps made from aerial survey they are often marked as 'underground sheep pens'. Until recently they were generally burned and rebuilt each year—which imposed a considerable burden on the perennial shrub vegetation. The availability of insecticide has made this practice no longer necessary. This burden has not been lifted entirely, since, during the summer when the pens are empty, passers-by often take dry wood from them for fuel to save the trouble of seeking dead wood for cutting green shrubs, with the result that considerable repair is often necessary in the autumn. This permanence of the pens has other disadvantages for the vegetative cover. Generally, the pens are situated some four hours sheep-walk away from a watering place (usually a shallow well in the plains or spring along the foot of one or other of the three mountain systems of the area). Except after rain or when there is snow on the ground, the flock makes roughly the same trip every other day throughout the winter between pen and water. In the present situation the winter forage is inadequate for the numbers of animals housed in the pens, and they are heavily dependent on deliveries of barley to see them through the season. Wood is also collected by the shepherds for fuel for heating and cooking throughout the winter. It is not surprising that the area around the pens and the watering places tends to be totally denuded of woody and other perennial vegetation, except for *Peganum.* However, the area of denudation is invariably much less around the pens than in the vicinity of the villages. In the spring, when warmer weather comes and the flocks leave the protection of the pens, but the high summer pastures are not yet ready, the shepherds move the flocks around in the general vicinity of the pens making better use of the rangeland, but also cutting and uprooting shrubs, not only for fuel now but also for improvising small milking pens. The same practice continues on the migration, which commences at the beginning of April east of the TPA and continues until the last of perhaps as many as a million animals leaves the area through one of three major corridors towards the end of May.

It should nevertheless be emphasised that the area as a whole is still well covered with woody vegetation. It should also be mentioned that although 1974-5 was considered a good year, following on what was considered an exceptionally good year, there were a few pens that remained unoccupied—which suggests either that there have been more animals in the area in the past or that even with the present high population of animals room is left for flexibility in the choice of winter quarters. The Sangsari flocks make the most of the spring vegetation in the TPA, and then move west and north following the spring into the Alborz mountains, arriving in their summer pastures in the first half of June. When the Sangsari flocks move out, local flocks move in. The local flocks are from villages on the edge of the area. Most of these villages


Boundary
Railway
Asphalt surfaced trunk road
Main road
Secondary road
River
Contours (metres)
700
1500
DEPARTMENT OF THE ENVIRONMENT
Office of Geographical Drawings
TOURAN PROTECTED AREA
Shahpasand 50 km
Nishapur 165 km
Shahrud
Mayamey
Miāndasht
Sabzevār 60 km
Abbāsabad
Dayarzan
Dhamgan 48 km
Zaydar
Mazinan
Biarjmand
Kal'abala
Majrad
Chah-Baba
Ahmadabad
Shifting Sands
Zabanabad
Riza
Torūd
Abgashan
Dasht-E-Kavir
Scale 1:1,000,000
55°
56°
57°
35°
36°
40°
32°
24°
42°
53°
65°

are very small (less than fifty families), and practise mixed farming. Their agriculture is on a small scale, mostly for local consumption, except for a little cotton, and including some fodder crops, but with no special emphasis on them. Their flocks, which are small in numbers by comparison and mostly goats, have been confined in and around similar pens close to the villages on the edge of the TPA through the winter, and now move out to take advantage of what is left of the spring vegetation—which the Sangsari would prefer to be left ungrazed till their return in the autumn.

The local village pastoralists tend to argue that pastoralism that is commercial or market oriented cannot deplete the range, since as soon as the range deteriorates so does the condition of the animals, and the flockowner is obliged to move them or sell them off to cover his losses. Similar arguments, phrased in terms of range evaluation by the criterion of meat or milk production per hectare, are also heard in some range management quarters. However, the Sangsari do not agree. The degree of commercial interest is certainly a factor in this difference of opinion. The Sangsari have to migrate in present conditions because of the magnitude of their operation and the productivity and gross profit margins they require for economic viability. The local pastoralists who maintain their animals in the area throughout the year manage by making do with lower profits. They do incidentally claim one advantage: that the more aromatic 'desert' pasture makes their ghee production more sought after than that produced by Sangsari sheep on the grasses of the mountain pastures.

This difference of opinion over range evaluation gives rise to some conflict, but the conflicts are generally settled with little difficulty due to the Sangsari's greater financial resources and access to authority—at the expense of the local population, who are at a further disadvantage because of their reliance on the Sangsari as a source of employment in shepherding. There is, however, one element in the population of the TPA that appears to gain nothing from the presence of the Sangsari—the Chubdari. The Chubdari are a tribal group of some sixty families in the northeast of the area, who used to migrate 50-100 km to the north of the area for the summer. In the sixties, when they lost the greater part of their animals owing to drought, they gave up nomadism and settled. The Chubdari, who are probably of Baluch origin, practise a multi-purpose pastoralism including sheep, goats and camels, mostly directed towards the small town markets on the edge of the area, particularly Sabzevar. With large numbers of animals (some individuals among them owned over 1,000 head each in the late fifties) they were obliged to migrate. With much reduced numbers after the drought (much less than 100 per family) they did not need to migrate and they settled hoping to find favour with the authorities and gain some of the facilities of settled life, e.g. medical, educational.

In 1970-71 there was another severe reduction in the numbers of animals owing to drought. Having few animals for so long the Chubdari were unable to maintain their usage rights in many of the pens and pastures that would have been essential for them previously. The Sangsari were quick to move in and after the nationalisation of range-lands in 1963, were able to obtain grazing permits to formalise their occupation. The Chubdari, who were unlettered and had little knowledge of official procedures, did not contest this process until too late. In the last four years their flocks have grown again and they are obliged to contest Sangsari rights of tenure.

It would be possible to find many more examples of startling variation in animal numbers. The range of variability in pasture from year to year because of irregular precipitation patterns, both locally and generally, leads inevitably to local and regional variation from year to year in animal numbers. This

variability can only be managed through flexibility in movement and grazing rights and economic interdependence between different populations with different but complementary land use patterns. The old system (pre-nationalisation) apparently had developed this flexibility—despite its social injustices. The new legal provisions, while far preferable in terms of social justice, are in many cases not yet being executed with due regard to the *ecological* needs for a management policy directed towards maximum sustainable production in arid rangelands.

The grazing situation in and around the TPA is complex. Traditionally its complexity seems to have allowed the flexibility of animal-rangeland ratios that are essential to both successful short term economic exploitation of arid ranges and maximum sustainable production and good range management. A few more details are necessary in order to emphasize this point. The area is used year round by a small population, and for some six months of the year by excessive numbers, which at present rely largely on barley deliveries and are the main contributors to the present over-grazing. The Sangsari enjoy relatively reliable summer pastures in the Alborz and are therefore able to keep larger numbers of animals and suffer less fluctuation in flock size. They need the TPA and neighboring areas for winter quarters for climatic reasons, and they also need shepherds and various facilities and crops from the small scattered local population. In order to maintain themselves the local populations need to pursue a multi-resource system of small scale agriculture, goat pastoralism and shepherding. Their local spring and summer pastures are unreliable. They are able to keep fewer animals and suffer more significant fluctuations in flock size, and therefore depend on other economic opportunities such as shepherding.

Continued presence of the Chubdari in the area, though at first sight it may not appear to fit with this interpretation, in fact draws attention both to the complexity of processes of interaction of more numerous pastoral groups in the area in earlier times, and to the disadvantages deriving from recent reduction in the flexibility that this interaction allowed.

The Chubdari were until recently (perhaps as late as the early sixties) one of at least two and probably three groups of nomadic pastoralists who migrated into the region in the winter—like the Sangsari except that they were tent dwellers and moved with their families and belongings. It is probably a mark of the distinction between nomad and transhumant that the Chubdari did not employ shepherds or otherwise form economic relationships with the local settled population, whereas the Sangsari in at least a few cases even intermarried and settled here.

An example of another pastoral land use pattern comes from the eastern edge of the area, which is covered by one of the larger areas of sand in Iran. Thirty four years ago the advance of the sand caused the abandonment of a small town (Khar), and within the last ten years of two small villages. Some of the population of Khar resettled in a village called Ahmadabad on the Western edge of the sand. They had been mainly pastoralists. Large expanses of the sand are now well covered with vegetation, though also strewn with potsherds, suggesting that the process of denudation has been reversed—possibly because of the cessation of charcoal burning. In all the history of the area that can be reconstructed so far, the Sangsari appear to represent the most successful example of adaptation because they have kept open an option that none of the other land use systems of the area had—close interaction with the larger economy, and control of other and more reliable pastures. However, they are now at a critical stage of development and appear to risk maladaptation perhaps

through over-reaching themselves in order to exploit that relationship and consequently losing in flexibility.

More substantial mention should be made of the role of charcoal production in the area. This was finally stopped in the sixties. General reports, and several independent pieces of evidence, suggest that shrub vegetation, especially *Haloxylon* and *Amygdalus*, has recovered appreciably since that time, and a major burden on the vegetative cover has been successfully removed. Charcoal burning was an industry that such an area could probably never support on a long term basis. However, the use of wood for local fuel consumption is difficult to prevent effectively, and it could probably be catered for through managed plantation of suitable species, around villages.

Other effects of the pastoral use of such areas include natural fertilisation by flocks (which is seldom taken account of in the literature) and trampling. So far little or nothing is understood of these effects in the area. For instance, trampling may compact the topsoil and reduce infiltration; it may break up the topsoil and increase erosion; it may also enhance the growth of annuals. It would seem that trampling is an excellent example of a factor for which more specific research is required to determine its effects in specific conditions (see Appendix and cf.Bell 1971,Pabot 1967: 85).

The traditional system allowed flexibility in grazing and watering arrangements irrespective of ownership rights. In mid-May 1974, a flock appeared unexpectedly in the area from the region of Sabzevar to the east. The season had been poor in its customary spring grazing area, and the movement had been attracted by reports of better grazing in the TPA. From the point of view of the local people (the Sangsari had left already), and on the standards of the animal densities in the area during the winter, there was plenty of room. Representatives of a nearby village immediately made a (financial) arrangement whereby the stranger flock would be allowed to graze this season. Since the flock did not have a grazing permit, its presence was technically illegal, and when the local authorities learned of the situation the flock was required to leave and the money returned.

If the Sangsari had been unable during the last 10-15 years to fill the vacuum left by the reduction of flocks on the part of other recent and present users of the area; if they had been unable to support their increased flocks with a modern fodder supply system (thus rendering themselves less vulnerable to the vagaries of good and bad years on arid ranges), the present grazing situation in the TPA would be very different. This begs the question of what does now set the upper limits on the numbers of Sangsari animals. If it is the size and quality of their high mountain summer pastures, then perhaps they are now working at optimum or maximum strength. However, there are reports that their summer pastures are suffering reduction for other reasons, and are overgrazed anyway, which suggests that it may be the efficiency of the barley distribution system or even the size of the market that ultimately sets the limits. If this should be the case, they may be at a stage of development where they will soon cease to migrate, because a fodder supply system and a rich market could render them independent of climatic conditions and variation. But whether the principles and values of the traditional system are maintained or not, and whichever way government policy works towards the maximum sustainable use of arid rangeland, the existence of the small isolated mixed farming populations will remain valuable for the maintenance of the existing human investment and for achieving the aim of maximum sustainable production from the area. Once these populations disintegrate through migration it will be difficult to replace them. Not many years ago the outlook for

maintaining them was gloomy. The rise in demand and in compensation for shepherding, however, together with the improvement of communications and the spread of services generally, gives new hope. As the industry of meat production and animal husbandry continues to grow, it should be possible to divert some of the extra income into services and facilities for the isolated areas on which it depends—especially, for example, in the fields of public health and education.

Despite its traditional aspect, therefore, animal husbandry and the man-environment relationship in the TPA is in a transitional phase. In some parts some forms of vegetative cover (e.g. *HaloxyIon*) appear to be increasing. Animal numbers may be at a peak. In some places the sand appears to be stabilizing. However, the achievement and maintenance of maximum sustainable production requires a comprehensive management policy, and such a policy, if it is to be successful, must be based on an understanding of the evolution of human interests and strategies in the present situation. These strategies include the maximisation of options in the face of unpredictable natural resources. Research so far suggests strongly that such maximisation demands flexibility in man-land relationships, interdependence between complementary land use systems, and broad dispersal of the local populations in small settlements based on mixed farming. Understanding and interpretation of the delicate interrelationship between this interdependence and complementarity of human use systems and the various ecosystems of the natural environment require close cooperation at all levels of research between natural and human ecologists.

APPENDIX

Summary of activities that have played a part in the evolution of the present vegetation in the TPA. The effects of each of these activities require careful quantitative study and assessment in the specific local conditions.

1. Cutting and uprooting of woody vegetation for fuel for:
   - domestic heating
   - domestic cooking
   - domestic bread ovens
   - village baths

   production of charcoal } discontinued
   primitive metallurgy }

   Collecting of vegetation for food and medicine

2. Domestic animals
   - grazing
   - browsing
   - interference with flow of springs
   - fertilising
   - trampling

Notes

1. 'Transhumant' is used here to denote a pastoralist who moves his flocks seasonally, but maintains a permanent fixed dwelling and does not move his

belongings or his family with his flocks. 'Nomadic' is reserved for pastoralists who move seasonally with their families and belongings, and do not maintain permanent dwellings. The term 'semi-nomadic' is not used.

2. The Sangsari are a non-tribal group of transhumant pastoralists and entrepreneurs who live predominantly in the small town of Sangesar, 18 km north of Semnan, graze their animals in the high Alborz in the summer and spread out along the edge of the *kavir* in winter from south of Semnan to Kashmar, and into the district of Gorgan to the northeast of the Alborz.

3. I acknowledge with gratitude both the support and cooperation, and the generous help and advice that I have enjoyed in the research leading to this paper from my colleagues in the Department of the Environment, and in particular from H. E. Mr. Eskandar Friouz and Dr. Fred A.Harrington, Jr. (of course I solely am responsible for the present interpretation). This research forms part of a long term interdisciplinary programme in desert ecology, recently initiated by the Department of the Environment in the TPA and its environs for the purposes of integrated ecological research, agricultural and range experimentation, and the formulation of ecologically sound management and development programmes for different land use priorities. Since the programme is still in its initial stages, the present paper may be regarded as a progress report.

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Session II (continued): SOCIO-ECONOMIC CHANGES AND SOCIAL PROBLEMS IN PASTORAL LANDS

Summary of Discussion

Professor de Vos supported the proposal that certain specialized human environments should be conserved through the establishment of cultural reserves. The idea was embodied in the biosphere reserve concept. Management of cultural resources would, of course, differ from nature reserves, where human influence was minimized. He could not agree that removal of human influence areas within the region would ultimately result in the return of pre-Neolithic vegetation. Most areas were greatly impoverished by man's activities, some plants and animals had become extinct, soils had been compacted and eroded, and evolutionary potential had consequently diminished.

Prof. El-Halwagy commented that, in his experience, pastoral nomads rarely, if ever, reduced their stock in response to droughts and grazing shortages. To the nomad, the size of his herds was an indication of his wealth and social status, he believed that the more animals he had at the beginning of the drought the more he will have at its end, and occurrences of years of low rainfall and high stock losses were accepted as normal phenomena.

Mr. Parham agreed that the introduction of modern technology and socio-economic changes to traditional pastoralism had invariably increased human pressure on the environment, insofar as the pastoralist now had greater incentive to try to adapt his physical environment to the essentially economic objectives of the new social order. These changes were here to stay, however, and he urged conservationists not to reject these new structures in their proposals but to devise new approaches to harmonize present systems with good environmental management. The main requirements for attainment of these aims were better comprehension of existing, traditional social and cultural features of the systems and a realistic, popular approach to ensuring local participation in the choice of strategy and tactics for new development.

Considerable interest was evoked by **Prof.Barth's** proposal that future conservation proposals in pastoral areas should take advantage of existing self-regulating systems (e.g. nomadism, which invokes movement of animals from an area as soon as the grazing has been utilized) and initiation of new systems that depended primarily on the adaptability of the people and their self-interest. He warned that some pastoral life styles and social organizations were quite insensitive to the environment, and existing self-regulating systems alone were rarely adequate for environmental protection, but that adoption of this approach would provide a useful starting point that should find ready, local support. Other speakers were sympathetic to the idea but not optimistic. It was thought that incorporation of self-regulating systems would certainly aid the move towards a better balance between man and nature but it was doubtful if they could contribute to the restoration of degraded soil and vegetation, which was so urgently needed.

In response to questions, **Prof.Spooner** had no precise data to offer on wood fuel consumption within his study area and was dubious about the acceptability of alternative fuels to meet fuel needs. Nevertheless, provision of alternatives was certainly feasible and should be pursued. His investigations were essentially multi-disciplinary and were aimed at the development of national management policies for optimum use of wildlife refuges, protected areas and neigh-

bouring village lands; outside reserved areas, the main objective was to promote maximum sustained production.

Dr. Lubani considered that inadequacy of management of the dry regions of the Middle East was as great a problem as the inadequacy of rainfall in these areas. River courses had been ploughed and vegetation destroyed where, in fact, ranching systems should have been developed and vegetation maintained and improved by water spreading. Nomadism was prompted by economic incentives and would prevail in the absence of government settlement schemes.

Mr. Swift questioned a number of statements in Prof. Gallab's paper; he considered that loyalty to the State was not confined to sedentary peoples and that, certainly in areas adjacent to the Middle East, imposition of sedentary life was causing hardship. The Syrian al-Badia area had been abolished in 1958. **Prof.Ghallab** conceded that many nomads were loyal to their Home State but they did not respect international boundary lines where they cut traditional migration routes. **Dr.Gharaybeh** thought that nomads rarely associated themselves with any specific area and **Dr. Lubani** stated that, in his experience, nomads settled rapidly if provided with schools, dispensaries and other amenities.

Dr. Al-Bander and **Mr. Al-Muhandis** provided details of land reform and settlement in Iraq. Since 1958, land belonging to the Grand Sheikhs had been redistributed as small holdings to tribesmen. Land had been reclaimed through irrigation and drainage networks and soil levelling, cooperatives and State farms had been established, training and education schemes had been initiated, and financial support and other incentives had been substantially increased. In some areas, such as the Gezera in Northern Iraq, tribal loyalties were still very strong and had hampered implementation of new schemes—in many cases, tribesmen had handed their newly acquired small holdings back to their Sheikhs!

Session III: WILDLIFE AS A NATURAL RESOURCE

Background Paper No. 9

Wildlife Resources: Their Present and Potential Significance to the Economy of Arid Regions of Asia.

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Arid regions in Asia have been settled for a long time. For thousands of years people have been occupied with hunting, cattle-breeding and—in river valleys—with irrigated farming. In making use of wildlife, man deliberately or unconsciously affected flora, fauna and soils.

Man influenced animals by a mere extermination and the change of their habitat. As a result, for example, in Central Asia and Kazakhstan wild horses, wild camels and other species disappeared. Vegetation was affected by excessive pasture of cattle and the felling of woody and shrubby vegetation for fuel. All this led to great changes in landscape and ecosystems of arid regions. The most disastrous were drifting sands which are set in motion by the wind. But it is man who gives them to the wind. The impact of man on the transformation of fixed sands into dispersed ones is shown by a number of authors for a great many arid areas (Obruchev 1890, Berg 1974). The resulting anthropogenic deserts differ from primary, original ones by the difficulty of their cultivation and by their 'aggressiveness' (Victorov 1969).

It should be noted that even without a negative impact of man, arid territories are of little effectiveness. Here in extreme conditions the reserve of biomass of vegetation is not large. In sandy deserts of Central Asia it does not usually exceed 50-60 cwt/ha (Basilevich & Rodin 1967).

If man does not pay much attention to the future of arid lands, they all too easily become transformed into entirely unproductive anthropogenic deserts.

SETTING UP EFFECTIVE ECOSYSTEMS IN ARID REGIONS

Nowadays man more and more intrudes upon Asian deserts and cultivates their natural resources. This process in various regions of the continent has its own specific features arising from their natural and social peculiarities. At the same time methods of cultivating and enriching natural resources in arid regions of Asia have very much in common.

The main task consists in transforming ecosystems of small efficiency into more efficient ones. We shall consider later some possible ways of effecting this transformation. Here we shall point out the distinguishing features of the artificial ecosystems which are being created from the original, natural ecosystems of arid regions.

On irrigated arid land occur what we term agrobiocoenoses. They have the characteristics of secondary elementary parts of biosphere transformed by man, in which the stability of the system depends to a great extent on the activities of people. Agrobiocoenoses are simplified systems dominated by

one crop plant or one species of animal. The biomass of this system, mainly in the form of raw materials and finished products, is extracted for meeting the needs of the people and domestic livestock. The efficiency of agrobiocoenoses depends mainly on the extent of man's impact, i.e. the technological, economic and social resources of the country.

At the same time, the transformation of arid systems of small efficiency in the interests of man must be combined with the conservation of natural ecosystems as elementary structural units of the biosphere. However grandiose the plans for the transformation of deserts, artificial ecosystems in them are of relatively small size. Both natural and artificial ecosystems, i.e. the desert as a whole, are liable to protection (Nechaeva and Rustamov 1970).

CULTIVATION OF DESERTS OF CENTRAL ASIA AND KAZAKHSTAN

Deserts of Soviet Middle East and Kazakhstan are situated deep in the Asian continent. The climate is sharply continental and dry. The average annual precipitation amounts to 160-170 mm (in the lower Amu Darya—about 75 mm). Soils are mainly fertile and the effective cultivation of these soil resources is economically of high importance. The vegetation and the animals, as everywhere in the Asian deserts, are poor but of an extremely peculiar character.

On the basis of complex scientific researches it has become possible to make up a rather complete picture of the character and dynamics of the arid landscape, to elaborate scientific principles of preserving ecosystems and their components, particularly rare species of animals and plants, and to take measures for the rational use of natural resources.

Newly constructed water systems, above all the Kara-Kum Canal named after V.I. Lenin in Turkmenistan and the canal of Golodnaya Steppe of Uzbekistan, have increasingly modified the deserts over large areas. Hundreds of thousands of hectares of arid regions have become highly fertile. For example, the crop of green maize or corn on irrigated arid lands amounts to 600 cwt/ha, and the crop of cotton up to 35-40 cwt/ha (or, on average, 28 cwt/ha).

For the last 30-40 years there has everywhere occurred a planned intrusion of man into the deserts ecosystems. In the process, great centres of industrial and agricultural production have emerged. Nowadays vast arid regions are not only pastures for sheep and camels, but the main basis of Soviet cotton growing and a great source of oil, gas and other minerals as well.

The increased pressure of man on arid regions demanded the improvement of protection of deserts as a whole. This is secured by planning operational work and by taking measures on nature conservation provided for in the laws. These laws have been adopted in all the republics of Central Asia and Kazakhstan.

Much attention is paid to desert pastures and to their even utilization without destroying them. This difficult task is being solved by the distribution of pastures between farms according to the number of cattle and the observance of pasture utilization. Simultaneously, thinned pastures are restored by means of additional sowing and regenerating vegetation. Important factors are the seasonal (autumn—winter and summer) pastures and protected zones of saxaul *Haloxylon.* Experience on many farms has shown that seeding of fodder plants by watering from artesian wells and irrigation canals and their non-irrigated culture in piedmont areas considerably improve pastures and haymowing.

In the past the thickets of black *Haloxylon* were badly damaged. They were largely destroyed in western deserts (Ustyurt, northern Aral sea region,

Sarikamish and some other areas). The destruction of *Haloxylon* desert woodland upset the soil structure (Victorov 1969). Now the *Haloxylon* is being rehabilitated and strictly protected (Pashkovskiy 1963, Yagdiev 1963), well developed thickets of it reaching a height of as much as 7-10 m in Kara-Kum and deserts of Kazakhstan.

The appearance in arid regions of very mobile motor transport, which is highly necessary for cultivating natural resources of the desert, entails destroying turf, damaging soil cover and erosion of light soil. For this reason, intensive construction of hard-surfaced roads is now under way.

A vast programme of irrigating and watering arid lands is also being realized. Among the hydraulic engineering works the Kara-Kum canal is outstanding: it crosses the desert from west to east for a distance of more than 900 km. Along this man-made river there have emerged vast agrobiocoenoses with fields, gardens, parks and settlements. The canal has vitalized hundreds of thousands of hectares of arid lands and affected microclimate favourably. It has also been possible successfully to combine irrigation with fish-breeding. Plant-eating fish (*Ctenopharyngodon idella, Hypophthalmichthys molitrix*) have become acclimatized and are reproducing well on the canal. This has increased the productivity of the artificial ecosystems as well as effectively protecting the canal from getting overgrown with grass.

The impact of irrigation and watering on arid regions is very great and of importance not only for the economy but for wildlife as well. However, improper and excessive use of irrigating water (which sometimes takes place) leads to the salinization of lands, thus considerably decreasing the productivity of the agrobiocoenoses. Great attention has therefore been paid to adjusting the flow rate strictly according to standard irrigation requirements, and also to the removal of mineralized underground water into a drainage network. One reason for the appearance of 'solonchaks' can be constantly gushing wells. The nature conservation laws in the Central Asian republics and Kazakhstan therefore provide for the prevention of this natural phenomenon.

The role of wild animals in arid regions is multiform—their excavations and soil-forming activities, their functions as reservoirs or breeding grounds for various diseases, their value as game. For all these reasons it is important not to do anything which will affect the wild animal populations in arid regions without first considering and estimating their various roles in the ecosystems and economy.

Of essential significance both in the dynamic balance of ecosystems and in the economy of man of arid regions may be wild ungulates. Thus, only so long ago as the end of 19th and beginning of 20th centuries, the Asiatic wild ass inhabited the foothill plains of Kopetdag in the vicinity of Ashkhabad and also inhabited the interior of the Kara-Kum. The reduction of the range of the species spread eastwards from the Caspian shores. Its last refuge was Badkhyz,at the extreme edge of south-east Turkmenia, although Asiatic wild ass could be seen in Kazakhstan as late as the 1930s. The main reason of its almost full extinction was cattle-raising which led to the disappearance of pastures and watering places suited to its requirements (Bannikov 1946). Of no small importance also was the hunting of the wild ass for leather and fat. Taking all this into account, the Soviet Government made a decision to put the species under protection. In 1941 there was set up the Badkhyzskiy Reserve, where the number of wild asses has now risen to as many as 980 head, i.e. 6-7 times more than at the beginning of the 1940s. In 1953, seven wild asses were brought from Badkhyz with the aim of acclimatization on Barsa-Kelmes Island in the Aral Sea, and they are now successfully breeding.

Within the last 30-40 years another ungulate—the saiga—was on the verge of full extinction. Nowadays its numbers amount to 2, 000, 000 and the annual offtake is about 500,000 animals (Bannikov *et al.* 1961). From what has been said in relation to wild ass and saiga one can see that due to the protection measures taken in good time, it has been possible to save these ungulates from annihilation and to make a rapidly vanishing animal such as the saiga into an important hunting species. To our great regret, we have not yet been able to repeat the success with gazelle (*Gazella subgutturosa*). This species has now been totally eliminated from several areas and conservation and restoration of its numbers has turned out to be a complex task. It will require great resources, expense and time. However, strict prohibition of hunting the gazelle has yielded good results. This circumstance and the satisfactory state of its numbers in certain reserves, particularly the Badkhyzkiy, are a precondition for the rehabilitation of this remarkable gazelle in the last decade.

It should be noted that in the U.S.S.R. great weight is given to the value of reserves for safeguarding primary nature complexes and as places for studying ecosystems and their components. In the territory of the Central Asian republics are no less than 9 desert reserves totalling 491, 314 hectares. They provide for the maintenance of all the main desert ecosystems, including deserts of various types, brushwood thicket on the banks of rivers (tugai) and the desert coast of the Caspian Sea. In these reserves long-term scientific researches on the productivity of ecosystems, and the ecology of individual species of desert plants and animals, are being undertaken.

Protection and rehabilitation of animal resources of arid regions are being realized not only by means of setting up protected regions but by banning or restricting hunting of this or that species as well. For example, from 1969 to 1971, in all Central Asian republics, there were adopted special government decisions, banning the annihilation of poisonous snakes (Bannikov and Rustamov 1974). There were set up snake parks, in which poisonous snakes caught in the wild on licence are 'milked', before being in due course set free again. By exporting the snake's venom in such a way we have managed sharply to cut the rate of destruction. Another measure taken was to set up temporary sanctuaries for periods of as long as 5-10 years, for rehabilitating certain snake populations.

In the deserts of Central Asia and Kazakhstan there is a long tradition of hunting. In the past it was conducted without any organization or regulation of the number of mammals, reptiles and birds hunted. Now, however, hunting farms have been set up, and timing of and quotas for hunting are well founded and restricted. The main quarry is the fox. Nearly 80 per cent of the furs held in stock are of the red fox. Of secondary importance are wild cat, corsac fox, polecat, jackal, wolf and hare.

In comparison with other natural zones of the Soviet Union, hunting resources of arid regions are poor. For the purpose of enriching these resources muskrat was introduced. For example, in Kazakhstan at the end of the 1920s top places in the value of fur production were taken by yellow souslik (34-50 per cent of the stocks in hand), steppe polecat (24 per cent) and red fox (10 per cent); by the 1960s 50 per cent of the value of fur production was accounted for by muskrat (Nasimovitch, Shubnikova & Isakov 1971). In the lower Amu Darya alone more than a million muskrat skins are stocked. Keeping of nutria semi-wild in ponds of south Central Asia has also become profitable.

The irrigation of arid lands has had a marked effect on the distribution of birds during their migration and winter stay. In all the man-made reservoirs of

Central Asia in good years no less than 800,000 ducks, coots, geese and other waterfowl spend the winter. This has now been the case for the last two decades. Wintering birds come from eastern regions of the European parts of the USSR, Kazakhstan, Western and Central Siberia (Rustamov 1972), so that the phenomenon quite naturally affects the interests of the economy of vast areas of the country. Therefore, much attention is paid to the conservation of newly founded winter staging posts. To this end on the Kara-Kum canal at Kalifskiy Lakes (103,000 hectares), an ornithological sanctuary has been set up which will in due course be transformed into a reserve (Rustamov 1974).

CONCLUSION

Plant and animal resources of arid lands play an important part in the economy of Central Asia and Kazakhstan. These areas supply valuable products, such as astrakhan furs, wool and fur-skins, meat of domestic and wild animals, fish, medicinal herbs and highly calorific fuel. If the inorganic—oil, gas, water and other mineral resources—are also taken into consideration, the present and potential significance of the resources of arid areas for the economy of the country will greatly increase.

So that these resources can serve people not only nowadays but in the future as well, they are exploited according to a plan. Thus the complex exploitation of deserts is combined with the tasks of conserving them. The nature conservation laws of Kazakhstan, Uzbekistan, Kirgizia, Tadzhikistan and Turkmenistan are specifically directed towards this aim.

The utilization of desert resources is not possible without irrigation and water. supplies. Only these measures can open up the way to the transformation of inefficient ecosystems of arid regions into more efficient ones. A vast programme of hydraulic engineering works is being carried on. Owing to this fact nearly 8, 000, 000 tons of cotton are annually grown.

For increasing the productivity of agrobiocoenoses chemical fertilizers are widely used. But if they are not used properly, the productivity of artificial ecosystems declines, wild plants and animals perish. Therefore, of great importance is a close study of biological methods of combatting agricultural pests.

Any intrusion of man upon deserts should be carried on with the least possible violation of balance in natural complexes. The negative after-effects of the use of natural resources of deserts are quite probable in future too. It is necessary to foresee and minimize them in proper time.

The emergence of new winter staging posts for birds, the improvement of fodder resources in the fields and of watering conditions for animals—are among the many positive effects of irrigation and the supply of water. These positive effects together with agricultural and industrial development must also be made to serve the aims of rational use and conservation of wildlife. This is one of the principal tasks facing us.

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Session III (continued): WILDLIFE AS A NATURAL RESOURCE

Background Paper No.10

The Present and Potential Significance of Wildlife Resources to the Economy of Iran.

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WILDLIFE:* A THREATENED RESOURCE IN ARID REGIONS

Considering the many centuries that both pastoralists and cultivators have used the arid regions of South West Asia and the Middle East, it is rather surprising that so many wildlife species have managed to survive the onslaught of man without a serious contraction of their original range or a diminution of their numbers to the point that they are threatened by extinction.

Unfortunately, this situation has changed during recent decades due to new or increasing impacts by man on the arid environment, including the ploughing up of marginal lands, new irrigation schemes and generally more intensified agricultural practices. To this should be added an ever-increasing human population pressure and, related to that, more illegal use of wildlife.

New irrigation schemes cause the removal from utilization of many of those grazing lands which are most needed during periods of drought by wild herbivores. As a result of a better control of diseases and parasites and an increasing demand for meat and milk products, populations of domestic stock have also increased, resulting in a higher grazing pressure and more overgrazing of rangelands which have already been badly depleted for many years.

It is not surprising, therefore, that particularly as a result of these various pressures, the populations of the larger wild grazing mammals and also of some game birds have been much depleted during recent decades. To counteract this trend, the Iranian Department of the Environment has set up a system of National Parks, Wildlife Parks and Protected Regions. Some of these areas have now been protected for a long enough period for certain wildlife species, such as wild sheep *Ovis ammon*, onager *Equus hemionus* and gazelles *Gazella* spp.,to have shown a decided increase.

Outside protected regions the status of certain wildlife species remains largely unsatisfactory because of continuing illegal use of wildlife.

HISTORICAL ROLE OF WILDLIFE: PAST UTILIZATION FOR SPORT AND FOOD

In the past wildlife played a more important role in Iran than it does today. Game was hunted both for pleasure and to obtain quantities of meat for human consumption. Noblemen and tribal chieftains, in particular, indulged in hunts for sport and killed large numbers of game animals. Hunting for meat and animal by-products such as hides was a regular practice of the rural population, and more particularly of nomadic tribesmen.

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* Wildlife within the context of this paper does not include fishes.

Apart from the animals which are still hunted in large numbers, such as wild sheep, ibex *Capra hircus aegagrus* and gazelles, some other species which are now threatened by possible extinction were also heavily utilized. These included the onager and the Persian fallow deer *Dama mesopotamica.* Both species were mainly shot for meat, but they were also pursued for the thrill of the hunt. Wild sheep used to migrate in large herds and these herds were often intercepted and slaughtered while on migration. In the province of Fars and probably elsewhere, local chiefs conducted gazelle hunts during the last century in which a line of beaters, placed about 150 m apart, would march forward, pushing the gazelles ahead of them. When these animals broke through the line to reach their original grazing area, mounted hunters would cut off their retreat and shoot them.

PAST AND PRESENT STATUS OF SOME ECONOMICALLY IMPORTANT SPECIES

The past and present status of some of the most important species* of wildlife is indicated in Table 1. Reasonably accurate data are available about the status of wild sheep, gazelles and Persian wild ass in the national parks and protected regions. Inaccurate data are available about such important game species as wild boar *Sus scrofa,* red deer *Cervus elaphus,* roe deer *Capreolus capreolus* and brown bear *Ursus arctos.* Similarly, the status of important fur-bearers like rock marten *Martes foina,* pine marten *Martes martes* and otter *Lutra lutra,* is poorly known.

Insufficient data are available about population trends of wildfowl. It seems likely that there are fewer wildfowl now than 15 years ago. Only in the last three winters sufficiently comprehensive counts have been made to suggest a figure for the total number of wildfowl present in Iran in mid-winter:

1971-72-2.0-2.5 million

1972-73-3. 0-3. 5 million

1973-74-2. 2-2. 7 million

These data indicate that wildfowl are an important resource in Iran, and especially in the Caspian lowlands. Shooting pressure has increased in recent years, and a switch is taking place from muzzle loaders to ready-made cartridges.

There are probably still about 450 operational ab-bandans (irrigation impoundments used for duck-hunting) in the Caspian lowlands.

In 1972, a total of 2, 424 bird shooting licences—the bulk of which were duck licences—and about 520 commercial licences for duck trapping were issued in the Caspian Zone. Some commercial licences sold for as much as $650 each, but the average cost was about $150 each. Thus there are no less than 3,000 hunters on a commercial or semi-commercial basis throughout the winter in the Caspian Zone. In addition, there are a large number of local and visiting sport hunters, who hunt mainly at weekends.

The main species taken, in order of importance, are coot, mallard, teal, pochard, shoveler and pintail. Swans, geese and flamingos are shot when available.

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* These species were selected on the basis of importance for (a) hunting, (b) meat production and (c) production of fur.

TABLE 1

Past & Present Status of Some Economically Important Wildlife Species in Iran
NP = National Park. PR — Protected Region.

Name	Past Distribution & Status	Present Distribution & Status
Ibex	Mountain ranges throughout Iran	Eliminated from very few places; total estimated population: 75,000-85,000 head. Pushed back to mountainous areas
Wild Sheep	Present in all arid steppic regions; populations may have been 3 times present population.	Mohammed Reza Shah NP 15,000-20,000 Khosh Yeilagh PR 12,000 Bamou PR 3,000 Marakan PR 5,000 Bijar PR 400 Angouran PR 1,000 Elsewhere 35,000-40,000 Total estimated population: 75,000
Goitered Gazelle	In neolithic times probably up to ten or more times the present population. Before the 1920s and 1930s the gazelle population was 3 or 4 times the present size.	All of Iran except forest, N. slope of the Alborz Mts., the Armenian massif, the central desert and Subdesert regions, and parts of the higher Zagros Mts. Mohammad Reza Shah NP 100 Khosh Yeilagh PR 50-300 Mooteh PR 5, 000 Touran PR 150 Total estimated population: 35,000
Jebeer Gazelle	In neolithic times probably up to ten or even more times the present population. In the 1920s and 1930s the population was 3 to 4 times the present size. Past distribution probably the same as present distribution.	Khorasan, Seistan, Baluchistan and Southern Fars Province; the Subdesert regions & the central deserts. Touran PR 100 Kavir PR 250 Total estimated population: 7,000
Persian Wild Ass	In all dry steppe regions. Range confined to limits of eastern basin region.	Now restricted to: Barun PR 250 Kavir PR 75 Khosh Yeilagh PR 11 Touran PR 750-800 Small populations outside these regions. Total estimated population: 1,300

TABLE 1

Past & Present Status of Some Economically Important Wildlife Species in Iran (*continued*)

Name	Past Distribution & Status	Present Distribution & Status
Wild Boar	Absent only from the most barren deserts. Formerly common to abundant in most of its range.	Locally reduced as a result of habitat changes.
Red Deer	The forested northern slopes of the Alborz Mts. Formerly common throughout its range.	Locally eliminated because of deforestation. Reasonably common throughout its range. Mohammad Reza Shah NP 1,000-1,500
Roe Deer	The forested northern slopes of the Alborz Mts. Formerly abundant in many parts of its range.	Present in most of its former range where it is common to abundant.
Brown Bear	Throughout the Alborz Mts. and in Zagros Mts.from Rezaiyeh to Shiraz. Formerly common in most of its range.	Most of original range still occupied. Locally common.
Hare	Widespread in distribution throughout Iran.	Widespread in distribution throughout Iran.
Red Fox	Common to abundant throughout Iran, except for very arid areas.	Same as past distribution, status unchanged.
Rock Marten	Possible range: mountainous areas throughout Iran (Lay 1967)	Same as past distribution, status unchanged.
Pine Marten	Possible range: throughout the forested northern slopes of the Alborz Mts.	Same as past distribution, status unchanged.
Otter	Otters seem to occur in most of the perennial streams of Iran.	Population likely reduced due to habitat changes and trapping.
Chukar (*Alectoris chukar*)	Widespread, except for forested regions & places without surface water.	Same as past distribution, status unchanged.

TABLE 1:

Past & Present Status of Some Economically Important Wildlife Species in Iran (*continued*)

Name	Past Distribution & Status	Present Distribution & Status
Pheasant (*Phasianus colchicus*)	Restricted to the Caspian Zone, N. Azarbaijan & N.E.Khorasan.	Much reduced in N.E.Khorasan & N. Azarbaijan. Still widespread & common in the Caspian Zone but eliminated from some densely populated areas.
Coot (*Fulica atra*)	Widespread in suitable wetland areas, main concentration in Caspian lowlands.	Widespread in suitable wetland areas, main concentration in Caspian lowlands.
Mallard (*Anas platyrhynchos*)	Widespread during migration, low nesting populations in Zagros Mts. & Caspian lowlands.	Same as past distribution but less common. Nesting populations threatened by overgrazing.
Teal (*Anas crecca*)	Widespread during migration, main concentration in Caspian lowlands.	Same as past distribution but less common.
Pochard (*Aythya ferina*)	A rather common migrant, main concentrations in Caspian lowlands and Fars.	Same as past distribution but less common.
Shoveler (*Anas clypeata*)	Widespread during migration, main concentrations in Caspian lowlands.	Same status and distribution as in the past.
Pintail (*Anas acuta*)	A common but not widespread migrant mainly in Fars & Seistan.	Same status and distribution as in the past.

PRESENT USES OF WILDLIFE

Stress will be laid on the consumptive uses (mainly shooting) as nonconsumptive uses (game viewing and photography) are not greatly developed as yet.

Although the use of wildlife by rural people has diminished, even today some of them remain almost completely reliant on it. These include the owners of duck pounds in the Caspian Zone and people in the Seistan area, who also use waterfowl. The Bakhtiari and presumably other tribes also use considerable quantities of other small animals, such as song birds and small mammals, for food (Harrington, pers. comm.).

Hunting of wild sheep within the reserves is conducted mainly by foreign hunters. This hunting is largely for trophies. Wild sheep photography and

viewing safaris are conducted during the summer in Mohammad Reza Shah National Park.

Iranian ibex are also hunted mostly for trophies, and photographed and viewed in organized safaris conducted in Mohammad Reza Shah National Park.

The number of wild sheep and ibex shot in Protected Regions is indicated in Table 2.

TABLE 2

The Number of Wild Sheep and Ibex Shot in Protected Regions*

	Central Alborz		Khosh Yeilagh		Parvar		Marakan		Kabudan
Year	Sheep	Ibex	Sheep	Ibex	Sheep	Ibex	Sheep	Ibex	Sheep
1969	4	5	–(6)	—	—	—	—	—	—
1970	—	9	40(10)	—	—	—	—	—	173
1971	2	25(2)*	69(13)	(2)	6	1(2)	—	—	67
1972	12	55(3)	114(14)	(2)	42(6)	—	4	6	28
1973	12	100(7)	170(14)	(1)	48(16)	—	31(4)	6	24

* Figures in parenthesis indicate number of females taken

No hunting has taken place in Bamou Protected Region and Mohammed Reza Shah National Park since 1973. Hunting by Iran Safari and Persian Shikar Companies has been permitted in the following Protected Regions: Parvar, Marakan, Central Alborz, Khosh Yeilagh and Mooteh.

The meat of wild boar is not used by most Iranians, because they are Moslems. The meat of brown bear is also not used, but not because of religious objections.

Many Iranian animals have been used for the fur trade in the past and they remain a potentially important economic resource. Unfortunately, the available statistics about export and local use of skins are inadequate and unreliable. The only source of information which throws some light on the take, local use and export, is an FAO survey based on data compiled in 1969 about the business in Teheran. The following statistics are obtained from this source:

TABLE 3

Skins of Iranian Fur-bearers locally processed in 1969

Species	Number of skins
Red fox	7,000
Stone marten	3,000
River otter	200
Leopard	200

A recent survey by the Department of the Environment among the furriers in Tehran indicates that although now illegal, a trade in fur-bearers continues unabated. The provincial offices of the Department consider illegal hunting an important limiting factor on leopard abundance outside reserves, though there is a consensus that leopard populations within reserves are increasing.

No records are kept of the take of chukars, francolins, pheasants, woodcock and snipe. The number of chukars shot must range into the hundreds of thousands.

ESTIMATE OF ILLEGAL HARVEST

In order to obtain a reasonable assessment of the value of the wildlife resource in Iran, some information should be available about the amount of illegal take. It should be understood that in the mind of many rural people there is no difference between legal and illegal harvest: all the wildlife is there to be used. Poaching, however, deprives the Department of the Environment of revenue.

It is difficult to make a reasonably reliable estimate of poaching pressure on the various game species, because insufficient information is available on the subject in the vast inaccessible areas where law enforcement cannot be very effective. Because of the high quality of their meat, poaching pressure is particularly heavy on wild sheep, ibex and gazelles, but this has not become a limiting factor to their populations. With the rapidly increasing meat prices, poachers may be more readily inclined to take a chance on getting caught.

Poaching of wildfowl is another serious problem which is liable to get worse because of increasing prices and readily available possibilities for disposing of the poached birds. The Department of the Environment is trying to combat this increasing poaching pressure by putting more and better trained personnel in the field.

POTENTIAL USES OF WILDLIFE

Unquestionably under improved wildlife management more and better use could be made of Iran's wildlife resources, resulting in a more important role of wildlife in the economy of the Nation. Both consumptive and non-consumptive uses should increase rapidly.

POPULATIONS THAT HAVE BEEN UNDER-UTILIZED

Because of lack of reliable data on the legal and illegal harvest of wildlife, and also on the annual surpluses that can be harvested, speculation about under-utilization of certain species is somewhat hazardous. It seems, however, that the following species could be better utilized, at least in certain protected areas:

(1) **Ibex**—Many ibex populations exist in inaccessible mountain ranges which are penetrated only by the occasional hunter. But even in accessible mountain ranges legal hunting is largely restricted to billies with trophy horns. Harvesting of females should be encouraged in certain ranges on an experimental basis to determine how this affects the annual surplus that can be harvested.

(2) **Wild sheep**—Research work by Valdez (pers. comm.) indicates that the net productivity* or harvestable surplus in Mohammad Reza Shah National

* Net productivity is here defined as the percentage that can be removed yearly after mortality from causes other than hunting has been deducted.

Park and the Khosh Yeilagh and Bamou Protected Regions is of the order of 20%. On the basis of his estimates at least 5, 000 head could be harvested from protected areas. Could this be the basis for a commercial cropping operation under the careful supervision of Departmental personnel ? Cost considerations would include the employment of a mobile shooting crew. As croppable populations are rather far apart, travelling expenses would be rather high. Costly cold storage requirements should be avoided as much as possible by the local slaughtering and sale of fresh meat. It seems that limited cropping operations might be justified and experiments to determine this should be encouraged by the Department. Not only the meat, but also the liver, heart, tripe and hides of wild sheep could be sold.

While game cropping may be an economically feasible proposition, it may not be an acceptable method from a social point of view. This must be carefully evaluated before a cropping project is launched. If commercial cropping is not to be allowed, more hunting by private individuals should be encouraged in protected areas, as otherwise overgrazing may become an increasing problem. The shooting of more ewes by sport hunters should be encouraged by allowing them to be shot for a lower fee, for example half the price of rams.

Valdez (pers.comm.) cautions against the year-round hunting of trophy-size rams of both sheep and ibex, as is now permitted for hunters under the guidance of experienced professional hunters, because under continuous shooting pressure the average horn length of rams has steadily diminished. For this reason he recommends that hunting be restricted to the hunting season as prescribed in the game laws.

(3) **Gazelles—**The rate at which gazelle populations have increased since their protection was initiated in game reserves is encouraging. On the other hand, outside these reserves populations barely hold their own because of poaching and habitat depletion. The existing populations of jebeer gazelle (*Gazella dorcas*) do not seem large enough to allow for any commercial utilization. O'Regan (pers.comm.) estimates that about 15,000 goitered gazelle (*Gazella subgutturosa subgutturosa*) occur in sufficient density in certain places to allow possible successful cropping. Assuming that 25% can be cropped annually, 3, 750 gazelle could be harvested. With an average adult weight of 24 kg, and a meat/bone ratio of about 50%, 44, 500 kg could be harvested per year. With a price of meat on the hoof of $2. 00 per kilo (retail), $89,000 could be realized, less shooting costs, transportation and cold storage.

(4) **Wild boar—**Reference has already been made to the little use of wild boar. As considerable numbers could be harvested annually, and as the meat and hides would fetch high prices on the export market, this is a much neglected resource.

(5) **Chukar—**Inadequate information is available about the use made of chukars outside protected game areas, but it seems that this species could be more heavily utilized. In some Protected Regions, such as the Greater Alborz and Kabudan Island, shooting pressures could be increased considerably because only a small percentage of the annual surplus is harvested.

Not much can be said about other species because of inadequate data. It appears likely, however, that in certain areas more sandgrouse and francolins could be shot. According to Harrington (pers. comm.) ducks are not shot at all in parts of southern Iran.

TABLE 4

Hunting, sport fishery and commercial licences sold in Iran* (amounts of dollars)

Year	Cost of Big Game Licence $25.92	Cost of Game Bird Licence $12.59	Cost of Sport-fishing Licence $11.11	Cost of Special Licence $14.81	Commercial licence**			Wild Animal Holding Licence $14.81	Total Income
					Fish	Wild Boar	Bird		
1969	33,677.7	105,411.1	3,670.3	21,318.5	13,733.3	3,481.4	8,047.4	44.4	189,384.1
	17. 78%	55. 65%	1.93%	11.25%	7.25%	1.83%	4. 24%	0.02%	100%
1970	46,744.4	113,635.5	3,288.8	24,591.5	14,014.8	3,355.5	3,606,6	76.0	209,313.1
	21.86%	53.16%	1. 53%	13.58%	6. 55%	1.56%	1.68%	0.03%	100%
1971	49,285.1	105,053.3	3,333.3	26,317.0	15.081.4	5,748.1	18.232.5	88.8	223,139.5
	22.08%	47.07%	1.49%	11.79%	6. 75%	2.57%	8.17%	0. 03%	100%
1972	54,903.7	103,506.8	4.185.1	27,585.8	15,633.4	2,614.8	12,891.8	76.0	221,397.4
	24.79%	46.75%	1.89%	12.45%	7. 06%	1.18%	5. 82%	0. 03%	100%
1973	59,818.8	95,716.2	4,551.8	35,946.6	20,180.7	7,125.9	22,185.1	577.7	246,102,28
	24.30%	38.89%	1.84%	14.60%	8.20%	2.89%	9.01%	0.23%	100%

* Data from 3 of the 22 Province Offices were incomplete and have not been included in this table
** The cost of commercial licences varies according to area, time and species.

PLANS FOR PHEASANT MANAGEMENT

The pheasant, once an abundant game bird in the forested zone along the Caspian sea, has decreased substantially in population due to overshooting and habitat deterioration. Under good management, consisting mainly of providing better habitat and law enforcement, populations could increase again so that pheasant shoots could be organized.

REVENUES FROM LICENCE SALES

In Table 4 the sales of hunting, sport fishery and commercial licences sold in Iran are recapitulated, and in Table 5 the number of hunting licences sold to Iranians and foreigners are given. It will be noticed that the number of licences sold to foreigners is disproportionally high.

TABLE 5

Hunting Licences Sold

	Iranian Hunters		Foreign Hunters	
	Number	Revenue in dollars	Number	Revenue in dollars
1969	65	38,757	82	14,701
1970	92	7,461	108	22,204
1971	194	12,362	230	36,871
1972	263	22,658	244	53,085
1973	178	10,322*	249	28,952*

* Decrease due to closure to hunting of Mohammed Reza Shah NP, Khosh Yeilagh PR, Kolahgazi PR and Bamou PR

TOURIST USES OF NATIONAL PARKS AND PROTECTED REGIONS

The use of national parks and protected regions by tourists is still very low, but there are indications that this use by both Iranians and foreigners will increase rapidly. Limiting factors are now mainly that the existence and value of these areas is not generally known to the public and that inadequate facilities exist for the visitors.

Mohammad Reza Shah National Park is the only park that receives a fair number of visitors so far. Information gathered during peak use in 1972 showed that 8,061 people were passing through this park in 929 vehicles in one single day. In 1973 this figure had increased on a similar day to 11, 858 people in 1,482 vehicles. The number of people that stopped in the park on the same days was 749 in 1972 and 2, 948 in 1973, and had risen to 3,200 in 1974. The primary activity was picknicking (63 per cent).

Moves are now on foot to open up Lake Rezaiyeh National Park and the Kavir Protected Region to visitors. In fact, the Kavir is already visited by small numbers of tourists during spring and fall.

IS INTRODUCTION OF NEW SPECIES OR BREEDS JUSTIFIED?

Perhaps, so far, inadequate thought has been given to the possibility of introduc-

ing new wildlife species or breeds in an effort to increase the productivity of arid range lands in Iran. Research in the semi-arid habitat should be designed to release the optimum productivity of the drought-resistant animals and the vegetation complex in a manner which ultimately will lead to the reclamation of arid areas (Crawford 1974). Animal and plant species most suited to the environment should be used. The justification for introducing new species should be that they are biologically better adapted to the climate and vegetation with respect to such factors as water balance and temperature regulation, but at the same time that they do not replace indigenous animals or seriously encroach on the niche occupied by these animals (de Vos and Petrides 1967). Caution should therefore be taken before exotics are introduced.

It is possible that the Arabian ostrich (*Struthio camelus syriacus*) if still extant and the Arabian oryx (*Oryx leucoryx*) are suitable candidate species for introduction into Iran. The ostrich may not have occurred in Iran but was present in similar habitats to those of Iran in Iraq.

Careful consideration should be given to the possibility of establishing hybrid populations between breeds of domestic and wild sheep populations in Iran, similar to what has been experimentally tried in the U.S.S.R. (Internat. Zool, Year books vols. 7, 5 and 9) and the U.S.A. Advantages of hybrid sheep as compared to domestic sheep are that they (1) produce a better quality (more lean) meat; (2) are better able to escape predation pressure; and (3) are using a wider spectrum of the available vegetation.

GUIDELINES FOR FUTURE MANAGEMENT

It seems imperative that in the future better use be made of the wildlife resources of Iran, not only from an economic, but also from a social and aesthetic point of view.

The following suggestions for future management are made:

(1) The game laws should be revised to allow the controlled harvest of fur-bearing animals. This insures the possibility of maintaining the necessary statistics on take, export and import of these animals.

(2) Statistics should be obtained on a continuing basis about the use of national parks and protected regions by tourists so that use trends can be established.

(3) The recording of licences and game shot under licences should be improved, because this is an essential wildlife management tool.

(4) As poaching is still one of the main problems, more and better trained anti-poaching personnel and equipment should be made available and trained in the principles of preventive control.

(5) Experimental cropping of wild sheep should be tried in order to determine whether cropping on a large scale would be economical.

(6) A cross-breeding programme between wild and domestic sheep should be initiated in order to produce a vigorous hybrid better adapted to Iranian range conditions.

(7) Wildlife inventories should be improved and expanded.

(8) Translocation of certain wildlife species to protected areas from which they have been eliminated should be encouraged and the possibility of re-introduction of species that have disappeared from Iran should be investigated.

(9) Research should be continued on economically important wildlife species in order to obtain better base-line data for management.

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Session III (continued): WILDLIFE AS A NATURAL RESOURCE

Background Paper No. 11

Iran: Wildlife Research as a Basis for Management:

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INTRODUCTION

A number of years ago, while Mr. Eskandar Firouz, currently Director of the Department of the Environment of Iran, was visiting in the United States, I had the opportunity to accompany him on a visit to my ungulate research area. I was explaining to him some of the finer aspects of a particular ungulate range exclosure which demonstrated rather vividly the impact of high wapiti populations on an *Artemisia*—bunchgrass community. As he surveyed the somewhat lesser density of plants outside the exclosure, I recall his comment,'... but you still have the soil and remnants of all the plants. In Iran we have not only lost most of the plants, but much of the soil as well!'

Forewarned, I was none the less somewhat unprepared for the Iranian landscapes which were to confront me a short time later. Conditioned to a similar climatic and biotic environment in the southwest United States in which resource managers show concern over the least indication of 'down' trend in the plant community, I was greatly moved by my initial impressions of a landscape ravaged by centuries of exploitation. With reference to forests and rangelands, the disparity between proper land use and current land use in this region is so great as to often render the resource manager totally incapable of communicating with the user.

Fortunately, a number of years prior to my arrival, personnel of the former Game and Fish Department had established a number of reserves for wildlife and their habitats, many of which have subsequently shown tremendous improvement in vegetation density (Firouz *et al.*, 1970). Thus there was a very real opportunity to demonstrate, by contrast, the extent of forest and range depletion outside the reserves, in a fashion similar to the aforementioned range exclosure, but on a grander scale.

Through the establishment of a number of reserves, and by placing the greatest emphasis on habitat protection, the leadership of the conservation movement in Iran had demonstrated their understanding of the first tenet of wildlife management; i.e. that wildlife cannot be profitably protected in a void—that in the final analysis the key to wildlife populations is healthy habitat.

In the number of years I have examined the greater part of Iran, I have found that viable remnants of wildlife populations exist in direct proportion to forage and habitat conditions. To those new to the Iranian scene it is simple enough to attribute population reductions, where they have occurred, to illicit hunting, ample evidence of which is easy to detect in a nation where until quite recently wildlife was considered free to be taken at all times. However, I have not yet determined that poaching is of significant concern to any Iranian species in proper habitat.

On the other hand, I am amazed at the tenacity with which some species have maintained their precarious existence in the face of recent trends in land use. Chief among such species is the Baluchistan black bear, which had not been recorded from Iran in sixty years (Birula 1912), which was considered likely to be extinct in Iran, but which remains in isolated *Prosopis* and *Pistacia* forest in Kerman and in Baluchistan, and is now the subject of a renewed preservation effort.

Of the fauna, only the Persian lion is considered extinct in Iran (the species is still extant in India). The Caspian tiger, however, is genuinely endangered and is likely extinct. In the case of all remaining faunal species, there is now room for considerable optimism.

In the following I will trace, through a few examples, the sources of the conspicuous success of the Iranian wildlife program, as well as pointing to a few deficiencies which should be rectified in the future. This paper will describe in broad terms the Iranian program of wildlife research and management, and the status of selected fauna, while emphasizing principles and guidelines which may be of use to other Eurasian and Middle East countries interested in establishing a wildlife conservation program, or strengthening an existing program.

THE LAND AND ITS FAUNA

Iran is a large (1,645,000 sq.km) and diverse country, with extensive mountain ranges, deserts, forests, plains and coast-lines. Altitudes range from —26 meters to 5, 671 meters. Minimum mean January temperatures to —12°C have been recorded in the northern regions, whereas maximum summer temperatures in Khuzestan exceed 55°C almost every year.

The mountain areas of Iran are characterized by cold winters and mild summers. The lowlands, with the exception of the Caspian littoral, are dry with high temperatures and large daily as well as annual temperature ranges. The temperatures in some lowland deserts may vary by 55°C (131°F) in the course of a year. The narrow coastal belt of the Caspian is characterized by moderate temperatures with low annual range, high humidity and heavy precipitation.

Winter to early Spring is normally the rainy season, except for the Caspian zone, where year-round precipitation is recorded. Annual quantity of precipitation ranges from over 2,000 mm in the latter areas to 10 mm or less in the desert interior.

With the above extreme variations, and taking into account the position Iran occupies as a bridge between three Faunal Regions; i.e. the Palearctic, Ethiopian, and Oriental (Darlington 1963), and four phyto-geographical regions; i.e. the Irano-Turanian, Euro-Siberian, Saharo-Arabian and Sudanian (Zohary 1973), it is not surprising that Iran possesses a wide variety of fauna, including 125 species of mammals (Lay 1967), 490 species of birds (D. Scott, pers. comm.), and a wealth of marine and freshwater fishes.

Of the faunal species, however, there is not a high degree of endemism; rather there is a strong faunal affinity with neighboring countries. For example, Iran has only one endemic bird, Pleske's Ground Jay, and perhaps no truly endemic mammal species. On the other hand, due to the destruction of wildlife in many parts of Eurasia and the Middle East, it is likely that many formerly widespread species are no longer found outside Iran in viable numbers. Such species include the Baluchistan black bear, Asian cheetah and Persian fallow

deer. Thus, Iran constitutes an excellent source of material for the restoration of depleted wildlife populations in much of the region.

PRESENT STATE OF WILDLIFE HABITAT

A thorough discussion of land use trends which have a bearing on wildlife is beyond the scope of this paper. However a few comments on the present state of the natural landscapes are given below.

The Persian Plateau region is probably in the most depleted condition, as a whole, due to the relative fragility of this arid zone. Over vast areas, grazing and shrub-cutting have eliminated virtually all plants. Substantial but decadent remnants of shrub communities can be found, especially in the northern part of this region, where certain areas are well-removed from villages and also distant from freshwater sources for domestic livestock. In general, the conditions appear to deteriorate outside the Kavir National Park and other reserves. A noteworthy trend, however, is a substantial reduction in the number of feral camels. Very abundant only five years ago, they are seen less commonly today. Most have been captured and sold, due to the increasing value of their flesh as a substitute for beef. There has been a considerable improvement in shrub densities where camels have been removed.

Conditions in the Zagros region are complex. In the southern parts of the range, the valley vegetation has been converted to agriculture or constitutes badly over-grazed pasture; whereas a significant plant cover often exists in the higher elevations. As one moves north, conditions tend to deteriorate. In the central Zagros a sizeable oak forest remains, principally in the vicinity of Kuh-e-Dinar,but the forest understory is virtually gone. In the northern Zagros, most rangeland with a soil profile has been plowed, and the grazing pressure on the remaining rangeland has removed all but an insignificant percentage of the plant cover. Soil losses are presently very high, and disastrous flooding has become an annual event.

The natural vegetation of Azarbaijan has been mostly lost, due to grazing and conversion of rangeland and forest to agriculture. The only viable remnant of the original flora, including the *Pistacia* forest, exists on the protected islands of Lake Rezaiyeh National Park.

The Caspian lowland forest has been replaced by intensive agriculture and high settlement. However, truly pristine remnants of the mountain forest exist. These have been apportioned into forest project areas, within which a rational timber harvest, it is hoped, will be conducted. The greatest need is to delimit a permanent forest edge. At this time agriculture practices are encroaching on the forest from the perimeter and from within.

Khorrassan, in northeast Iran, contains some of the best remaining wildlife habitat. The ranges show a relatively high plant cover, though often of a poor composition. The somewhat better conditions here can be mostly attributed to sparse settlement and a climate hostile to year-round grazing.

The Seistan and the eastern desert region were much-affected by a draught in 1970 and 1971, compounded by heavy livestock grazing. During that period, tens of thousands of livestock died, the famous Hamouns (lakes) dried up entirely, and such species as wild ass and gazelles vanished over wide areas. Such occasional deficits in precipitation, however, characterize arid regions. It is not likely that such devastation would have occurred if the ranges had been de-stocked during the worst of that period. Of course, subsistence grazing, which is typical of the region, gives the herdsmen no flexibility.

There has been no marked improvement in the ranges since that time, despite heavy rains in recent years.

In Kerman, some good remnants of vegetation remain, including forest species, but conditions which characterize the Plateau region prevail. In nearby Baluchistan and along the Makran Coast, much of the natural vegetation is gone. Cutting of the remaining *Prosopis* forest in the Bampur Valley is almost complete. Some excellent sand dune vegetation can be found along the more isolated parts of the coastline (Harrington 1975a).

The natural vegetation of the Khuzestan lowlands has been virtually lost, except for the important remnants of riparian forest protected within the Dez and Karkheh Wildlife Refuges.

In general, the picture is not a bright one and remains essentially unchanged since such conditions were documented in the Iran National Report to the International Conference on the Human Environment at Stockholm (Anon., 1971).

In contrast to the general phenomena, conditions have improved significantly in many reserves administered by the Department of the Environment, as described by Firouz (1974).

HISTORY AND EARLY INVESTIGATIONS

Iran has a rich wildlife heritage. The animal motif dominates in archeological artifacts dating from all early periods. The bronze and, later, gold work from Elamite times (ca. 2, 500 B.C.) onward, show a detailed knowledge of wildlife such as sheep, ibex, lions and gazelles, which would be difficult for the finest craftsmen of today to duplicate.

Excellent bas-reliefs of wildlife species remain in many places. The finest by far are the Persian fallow deer and wild boar hunts at Taq-e-Bustan, dating to the Sassanid era (ca. 600 A.D.)

Unfortunately, no Persian literature remains from those early periods, and the Greek literature sheds little light on the status of wildlife in those early days. Excavations which have been conducted with emphasis on recovering early faunal remains, such as those at Tappeh Farrukhabad in Khuzestan (ca. 5,000 B.C. to 1,000 B.C.), have so far produced only evidence of those species which have been extant in this century as well (Redding, pers.comm.).

The enigmatic Persepolis reliefs, a few hundred meters from the site of this meeting, lead one to certain speculation. On the staircase are depicted what are believed to be Ethiopians bearing an okapi, and Libyans bearing a kudu, for example. We may tentatively conclude that the early residents of Eurasia trafficked a great deal in wild animals, but no such typically-African species are known to persist in Iran today. This is perhaps the greatest historical precedent by which to oppose the introduction of exotic species.

The more recent Iranian literature, predominantly poetry, is rich in wildlife fables, but none except the hunting records of the Qajar dynasty constitute documentation. It remained for the early western travellers, e.g. Pallas (1780), de Filippi (1865), Zarudny (1904) and Birula (1912), to document the Iranian fauna.

The first attempt at a comprehensive treatise of the fauna was by the Boundary Delimitation Commission (Blanford 1876). A few but noteworthy treatises on the fauna since that time have been by Lay (1967),Missonne (1959) and

Etchecopar and Hue (1970). One must also include the botanical works of Pabot (1967) and Zohary (1963), which have been of invaluable assistance to wildlife biologists in assessing vegetation.

Since the mid-1960s, nearly all faunal studies have been conducted by, or in collaboration with, the Department of the Environment or the former Game and Fish Department.

WILDLIFE RESEARCH IN IRAN-OBJECTIVES, ORGANIZATION AND PRIORITIES

Under the auspices of the erstwhile Game and Fish Department, fish and wildlife research was conducted by the Division of Research and Development. The Environment Law of 1974 created the Department of the Environment and extended its jurisdiction to include human ecology and outdoor recreation, as well as the faunal resources. This was initially looked upon as an opportunity to merge aspects of the human environment into a natural environment framework. However, two technical divisions have been created, largely due to the influences of budgetary authorities outside the Department. Two rather distinct disciplines have thus evolved—the Division of the Human Environment, concerned primarily with the technological problems of environment, and the Division of Parks and Wildlife, which includes Fisheries and is concerned with the natural environment. The remainder of this paper will primarily discuss the activities of the Parks and Wildlife Division.

The following priorities in research and management have been established:

(1) *To insure* the preservation of all faunal components of Iranian ecosystems. This implies a determination of the well-being of each species and subsequently to place the greatest emphasis on management of endangered, threatened or rare species, in direct proportion to the seriousness of the respective species' status.

(2) *To enhance* the status of species of special ecologic, economic or aesthetic value. There is a strong traditional interest in hunting in Iran, and those in the Department place a high priority on accommodating these demands. There is less interest in the non-consumptive uses of wildlife at this time, but the Department promotes as well the aesthetic and ecologic appreciation of wildlife, with increasing success.

(3) *To promote* the integration of wildlife into rational programs of land use. This is the ultimate objective of the Department. There is some recent progress being made in this regard.

In the past, the fish and wildlife projects were organized primarily on a taxonomic basis, e.g. ornithology, mammalogy, etc. With the recent creation of a Natural History Museum, it is anticipated that taxonomic or simple inventory functions of all faunal species will be largely incorporated into a museum framework, with the Parks and Wildlife Division leaning ever more heavily toward management. This is particularly appropriate to our experience, for all research conducted by Division personnel to date would be better described as 'investigative management'. Nearly all studies to date have been of an applied nature and conducted primarily in connection with routine inventories, censuses and ecological assessments.

Wildlife research and management in Iran have proceeded on two basic premises:

(1) That there is a time lag between the onset of a research program and the application of the findings of that research which is entirely unsatisfactory

in view of the urgent need to take steps to insure the survival of Iranian fauna.

(2) That, in fact, the application of ecological principles and guidelines derived from comprehensive research in similar biotic regions, e.g. North America, is adequate to insure proper management of the Iranian faunal resources.

These two premises lead one to the conclusion that the Department must make certain ecological decisions, based upon the best information available, while striving to establish ecological parameters specific to Iran. Our experience to date has served to substantiate the above conclusion and the premises from which it derives.

THE POSITION OF RESEARCH IN THE ORGANIZATIONAL FRAMEWORK

Owing to the shortage of trained ecologists and resource managers in Iran, the personnel of the Parks and Wildlife Division have been called upon to devote a disproportionate amount of their time to administration. While this phenomenon has not been viewed as satisfactory to the most research-oriented of the staff, and indeed has led to considerable disruption of the research projects, we also recognize that it has been of considerable value to the Department in its formative stages, whereby research personnel have had a direct involvement in program development. In short, whatever the progress of wildlife research in Iran to date, it has been fully integrated into the framework of the Department of the Environment. One can view the conceptual position of research as somewhat ideally located, central to a circular pattern of policy formulation, legislation and enforcement, organization and administration, resource management, education, and program evaluation and planning. I would like to discuss briefly the contribution research and research-oriented personnel make to each of these categories.

Policy Formulation

The success of any natural resource program depends upon the early establishment of workable policies, based upon ecological principle, but taking into account local attitudes, ethics, and political, social and economic factors. In Iran, one must take into account a number of loosely-related factors, from Moslem dietary law as affecting harvest of wildlife, to provisions of recent land reform legislation which have wide bearing on resource use.

A true conservation ethic has not yet emerged which might otherwise contribute to policy formulation. Yet I find a somewhat inscrutable but deep interest in, and enthusiasm for, wildlife among the members of all social strata, from pastoralists to the most highly educated. This phenomenon has no contemporary explanation, and must almost certainly derive from an earlier cultural period. I find a real sympathy for the need to prevent the extinction of any species, with no recourse to rationalization of such a viewpoint on my part. The greatest interest in wildlife relates to hunting, of course, and current policies must reflect this interest. Ownership of wildlife is retained by the state, due primarily to the provisions of land reform, which nationalized most forests and rangelands. Since most wildlife now resides on national lands, the Government holds wildlife in trust for all its citizens. Where harvest of species is justified, first preference is given to the individual sport hunter, as the most equitable and rational means of distributing the resource.

The ecological importance of all wildlife species is promoted, hence the wide-

spread destruction of predators has been discouraged. Bounty systems, poisoning, and widespread killing of predators have never been encouraged. Perhaps as a result of this policy, we have not seen in Iran the disastrous outbreaks of rodents which characterize neighbouring Afghanistan, where avian and mammalian predators have been depleted (Petocz,pers. comm.). Exotic fauna has been discouraged for the most part, and overwhelming emphasis has been placed on management of the indigenous fauna, toward perpetuating ecological equilibrium.

Legislation and Enforcement

Policies such as those mentioned above constitute a basis for comprehensive legislation. The Iranian Game Law and its attendant regulations, first passed in 1956, has undergone considerable refinement, and is now promulgated into the comprehensive Environment Law of 1974. It incorporates civil as well as criminal penalties for violations. At this time all mammals are protected, in that each can be taken only by permit issued at a Departmental office which will specify date, area, species and number. Limits are determined by members of the Division of Parks and Wildlife and, in practice, no permits will be issued for the less numerous species. Likewise, all but 14 species of Iranian birds are now protected. Of reptiles, the crocodile, monitor lizard and sea turtles are fully protected. There is a general closed season, from 21 March to 21 June, which generally coincides with the incubation period for most birds, and the parturition period for most mammals. During that period taking of fish is allowed, but taking of wildlife is not permitted, and no one may possess a firearm in the field, except for landowners who have received special permission to take specified birds or mammals which threaten their crops.

The efficacy of the enforcement program has been highly variable, depending upon the initiative of individual enforcement personnel. It is generally recognized that game laws are inherently un-enforceable,due to the complexities of the atmosphere in which pursuit of violators is conducted. In other words, the odds are strongly against apprehending a significant percentage of violators. Emphasis, then, should be placed on preventing violations and creating an atmosphere of public good will, thus public support, rather than apprehending violators. There is a growing awareness of these principles among the enforcement staff. Even the most conservative of the enforcement personnel will admit, after some introspection, that no substantial increases in wildlife populations can be attributed to protection where the Department has made no progress in curbing deleterious land use practices. Further, the existence or absence of illicit hunting has been largely immaterial to wildlife increases where deleterious practices have been curtailed. In short, the contribution that enforcement personnel have made to curbing hunting on a national scale has been minimal, but the contribution they have made to habitat protection, hence the increase of wildlife populations, has been considerable indeed.

One should not question the possibility that certain vulnerable species could be eliminated with no recourse to habitat destruction. But one should question the ability of law enforcement personnel, alone, and operating without a base of public support, to prevent such elimination in the long term.

Thus, the efforts of enforcement personnel should be largely directed toward ameliorating habitat conditions, safeguarding species which are vulnerable at all times (certain plains species, perhaps), or during particular times in the species' life cycle (e.g. anadromous fishes, spawning sea turtles), while serving

to encourage rational harvest levels and furthering public support for conservation programs.

Organization and Administration

An understanding of the above is manifested in the recent re-organization of the Game and Fish Department to form the Department of the Environment, plans for which were proposed by research personnel. Classification of personnel also reflects a need to broaden the duties of the enforcement staff. The two former classifications, 'Game Guard' and 'Game Officer', are now 'Environment Guard' and 'Environment Officer', respectively, and their duties are gradually being broadened to include public service responsibilities.

We anticipate that National Park administration will eventually constitute a separate Division, but at the inception stage whereby most emphasis is on planning, it has been deemed essential to retain Parks under the direct supervision of ecologists.

Resource Management

Apart from the role research personnel have played in management of the reserves and other Departmental management programs, they continually assess the prospects of integrating wildlife values into other government programs. To date success has been limited, but the trend is encouraging. Department fishery biologists serve as advisors to the Ministry of Rural Cooperatives, which has undertaken large-scale fishery programs in artificial reservoirs. The aim is to provide a much-needed protein source and renewed livelihood for former pastoralists. Jones (1971) has pointed out that the Caspian forest projects, if properly managed, can usefully incorporate wildlife in their planning. In brief, opening up the forest canopy will create a flush of understory species of benefit to wildlife such as red deer and pheasants, which will thrive if livestock grazing can be regulated. There is much sympathy for this approach among the leadership of the project areas. In one such area, permission has been granted to the Department to undertake an intensive pheasant management program, including the cultivation of food plants for pheasants within the forest plantation zone.

The Department has cooperated with the Khuzestan Water and Power Authority on several projects, including the management of herbivorous fishes to control vegetation in the irrigation canals. A rational harvest of those fish will also increase national protein consumption.

The prospect of integrating wildlife into range management programs is less encouraging at this time. As Dasmann *et al.*(1973) point out, very little can be done to improve the condition of the rangeland unless control can be obtained over the number of animals grazing or browsing on the areas. The pertinent authorities in Iran have not yet developed a workable approach to de-stocking Iran's ranges to achieve vegetation improvement, although they acknowledge that livestock production in Iran could be substantially increased subsequent to improvement of the ranges.

Education

The Department has established two schools, which in the past were intended to produce enforcement personnel—a 90-day in-service training school, and a two-year Environmental College. The curricula have been expanded to include

broader training in natural resource management. Personnel of the Parks and Wildlife Division have written, approved, translated or otherwise prepared most of the reference material, and have contributed the greater part of the technical course presentation. I might add that 20 candidates from Afghanistan have recently graduated from the 90-day school.

Regrettably, there is no suitable curriculum for prospective research personnel. A four-year curriculum is in the inception stage under the guidance of A. de Vos of FAO. The greatest handicap is a shortage of instructors, and as a partial solution, five U. S. Peace Corps volunteers with advanced degrees in resource management have been recruited into the Parks and Wildlife Division to conduct research and to instruct in the natural resources curriculum on an equal-time basis.

Two candidates from within the Division have been sent abroad for advanced degrees in natural resource management this year and others, it is anticipated, will be sent later in the year.

Public Education

The Department has made a truly significant effort toward Conservation Education. At this time the Department publishes a monthly magazine, *Game and Nature*, to which the research staff has an opportunity to contribute on a regular basis. A number of films have been prepared in cooperation with the Ministry of Arts and Culture, and with foreign film groups. These have been very well received by the public. The Division of Parks and Wildlife now has an active interpretive staff, which in the short term is preparing conservation education materials, but in the long term will participate in outdoor interpretive programs in the National Parks.

Program Evaluation and Planning

Due to its rapid rate of growth, the current conservation program requires continual assessment. Members of the research staff occupy positions on all planning boards, e.g. the reserve planning board. However, the primary instrument in program evaluation is the Division's monthly report, into which recommendations for program revision are incorporated and distributed to all Department units.

WILDLIFE MANAGEMENT AND RESEARCH IN IRAN-PROGRESS AND PLANS

Before I discuss wildlife management in Iran, it is first necessary to describe the discipline. From the foregoing, and the subsequent, it should be obvious that the number of man-induced factors which can have an impact on wildlife are extremely numerous. Also, it should by now be obvious that overwhelming emphasis must be placed on habitat. For example, most ungulate biologists recognize that, to successfully manage the resource to which they are entrusted, they should become plant ecologists as well as zoologists, because a disproportionate amount of their time is spent in analysis of vegetation. This need for a multi-disciplinary knowledge, which includes a knowledge of the social sciences and the communicative arts as well, loosely defines the concept of wildlife management. Broad recognition of the concept at this time is largely confined to North America, to one or two of the Central European countries, and to Iran.

Firouz (1974) has described the recent status of certain wildlife species, and has presented a tabular distribution of selected fauna. In the following I would like to describe the management strategies for the major faunal groups.

Ungulates

The management program in which the Department takes greatest pride is that directed toward the Persian fallow deer. This species was formerly widespread in Mesopotamia and surrounding regions, but was reduced in recent times through loss of habitat (Harrington 1975b), and was thought to be extinct in 1949 (Whitehead 1950). The species was re-discovered and is now recovering under intensive management.

Firouz *et al.* (1974) have documented the re-discovery of the deer in the Karkheh Region, the capture and transfer of deer to form two breeding nuclei- one in Germany and the other in northern Iran. The Iranian breeding herd is enclosed in Dasht-i-Naz, a 55-hectare forest enclosure, in which the deer are maintained in a semi-wild state, because it is intended to eventually release surplus animals to the wild. The herd has grown to 27, including four fawns produced thus far this Spring (Hess,pers. comm.). Personnel are now evaluating prospective release sites within or near their area of past distribution. Chief among these is Ashk Island in Lake Rezaiyeh, which would actually constitute a larger breeding enclosure.

No accurate census has been made of the wild population in the Dez and Karkheh Wildlife Refuges, owing to the dense vegetation, but the collection of shed antlers suggests a population of about thirty in the Dez Refuge.

The Department, in keeping with an original agreement, received seven deer from the German zoo in 1973. These have increased to eleven in Dasht-i-Naz. However, in the early stages of the program, the only male sent to Germany died two years later. In the interval between the death of that male and the receipt of a replacement from the Karkheh river, the German authorities crossed the two Persian females with a European fallow deer male. An unknown number of hybrids was produced. Unfortunately, in the absence of breeding records, in view of certain morphological differences, and in view of other discrepancies, there is serious reason to doubt the purity of the eleven 'German' deer in Dasht-i-Naz and those remaining in Germany. They are being held apart from the known-pure deer and, regrettably, will become permanent display animals, with no plans to return them to the wild.

Our experience has thus shown that while breeding compounds or zoos can be of extreme value in preserving rare species, extreme care must be taken, and hopefully such efforts can be placed under the strict control of ecologists, rather than zoologists in general, or zoological park personnel.

The other two native species of deer, the roe and red deer, are plentiful in suitable reserves in the Caspian forest. In addition, relict populations of roe deer exist in the Zagros, near Lake Marivan, as determined by antler recoveries. In the current year, we plan to restore red deer to the Mian Kaleh Wildlife Refuge, from which they were extirpated, but within which conditions are being ameliorated through habitat protection.

The acquisition of two aircraft by the Department greatly enhanced our knowledge of desert ungulates in a relatively short period of time. The largest population of Persian wild ass exists in the arid Touran Protected Area in northeast Iran. The population has been estimated at 750 over a wide area (ca. 2, 000, 000 hectares).

Other viable populations exist in the Kavir National Park, in Fars, and perhaps in Kerman. Today confined largely to the desert rim, they doubtlessly enjoyed a much wider distribution in the past. Pallas (1780) described the type specimen from Ghazvin, in what was likely good steppe habitat at that time. But for his observation and those of subsequent travellers, the extent of the habitat of this species in Iran would remain unknown today. This is but one example among many in our experience which suggests that we must draw conclusions very cautiously from studies of depleted populations.

To establish the suitability of upland steppe habitat for this species, eleven wild ass were transferred from the Touran Protected Area to Khosh Yeilagh Wildlife Refuge in 1973. Four emigrated almost immediately, and seven remain today. They have taken up residence in rolling *Artemisia* habitat, though there is no barrier to prevent them from returning to desert habitat some 30 kilometers to the south. Provided the females successfully reproduce this year, the population will be augmented by another transplant, aimed at establishing a sizeable herd in a short period of time. Indeed, if we are to again see the herds of hundreds reported in the past, we must encourage populations in areas of good vegetation, which will support such herds.

The two forms of gazelles, the goitered and the jebeer, are plentiful and the subjects of intensive studies at the moment. The two species are almost wholly allopatric throughout their respective ranges in Iran. The 100 mm isohyet describes a rather excellent boundary between the distributions of the two species in the Plateau Region. The jebeer gazelle occupies the drier habitat. This gazelle also occurs on Persian Gulf islands which are thought to possess no fresh water. Incomplete data (O'Regan, pers. comm.) suggest this species may show a variable fetal rate and/or dioestrus, depending upon forage production as determined by precipitation. It is hoped that studies of the physiology as well as the ecology of this species may prove useful one day to the economics of the nation. Harvest of such highly adapted species may well prove to be the most rational use of the desert resources.

The wild boar remains plentiful to abundant in remaining forests and wetlands, but has not received the attention that it apparently deserves in view of its importance to the forest ecosystem. In the early days of the reserve program, boars were reduced through cropping programs. However, preliminary research, supported by current European studies (Dzieciolowski, pers. comm.) indicate the importance of the pig in enhancing regeneration of forage plants of benefit to other wildlife. Also, studies reported by the above investigator have shown the value of pigs in suppressing forest insects. The mechanism seems to be associated with rooting of leaf litter in winter, whereby pupae and larvae of hibernating insects are exposed to the elements and subsequently destroyed. We are testing this theory with exclosures in Mohammed Reza Shah National Park.

By far the best-studied (Decker and Kowalski 1972, Valdez 1975) as well as the most numerous of Iranian ungulates are the many forms of wild sheep. We hope that studies will be of ultimate benefit in establishing guidelines for wild sheep throughout the world, many forms of which are becoming increasingly rare. The Department has entered into cooperative research in sheep physiology, nutrition and reproduction with the International Sheep Breeding Group. The ultimate intent is to produce a larger and more adaptable domestic/wild hybrid with better meat quality and/or higher reproductive rate than seen in Iranian domestic breeds.

The Persian ibex, or wild goat, is the subject of studies under a special pro-

ject. Populations of this species are believed to be near range capacity throughout their wide range in Iran (Darehshuri, pers. comm.).

Larger Carnivores

Of the great cats, the lion is extinct in Iran, as mentioned in the opening remarks. The last of this species in Iran was observed in 1942 (Heaney 1944). There are hopes of restoring the species to Iran, in the Arjan National Park, once the habitat and hence suitable prey species, such as the wild boar, have recovered. The demise of the tiger might have been predicted 100 years ago, as the primary habitat of the species was lost to agriculture development in the Caspian lowlands. Despite attempts to locate tigers in Iran, the last reliable record was in 1958 (Shadlu, pers. comm.). However, if the species can be located, the Mian Kaleh Wildlife Refuge and/or Mohammed Reza Shah National Park may now constitute suitable sites for restoration. The ubiquitous leopard is plentiful in a number of reserves of the Department, and frequently encountered elsewhere.

The cheetah occupies a position between the above extremes. Numbers of this species were estimated at 100 to 200 on the Plateau four years ago (Harrington 1971), and this estimate remains acceptable today, though extremely difficult to substantiate in that vast region. It is likely that cheetahs were never particularly abundant in this arid region, owing to the low density of vegetation compared to parts of Africa, for example. Cheetahs are now known from seven reserves and show up occasionally elsewhere. The largest population doubtlessly occurs in the Khosh Yeilagh Wildlife Refuge, where nine were observed in a two-hour period (Valdez, pers. comm.), though total numbers are difficult to ascertain. The regularity of observations, including a high percentage of cubs, gives reason for cautious optimism with respect to the future status of this species. In the final analysis its survival depends on our degree of success in managing its prey, the wild sheep and gazelles.

The brown bear remains common in the Zagros and Alborz ranges, in direct proportion to the quality of the forest. The Baluchistan black bear is now known from four locales in Kerman and Baluchistan (Joslin, pers. comm.). An attempt will be made to ameliorate conditions in a selected area, to promote the survival of this species.

Wolves are plentiful to common in the reserves, and frequently observed outside the reserves. There is no evidence that they are adversely affecting prey populations. Quite on the contrary, the wolf and other large predators may be largely responsible for the fact that we do not normally see over-populations of ungulates in the reserves of the Department. Thus we have not normally observed the attendant range destruction which often characterizes National Parks elsewhere. The single exception is the island of Kabudan, in Lake Rezaiyeh National Park, where high populations of wild sheep, in the *absence* of any predators on the island at the time, caused severe range damage. Leopards have since been introduced onto the island, and perhaps other large predators such as the cheetah and wolf will be introduced as well, to study these inter-relationships.

Waterfowl

With the exception of substantial breeding colonies of flamingos, pelicans and shelducks on e.g. Lake Rezaiyeh (Savage 1964) and Marbled Teal in Khuzestan, Iran must be regarded as largely a critical transition or wintering area for

wildfowl of the Western Siberian-Caspian-Nile population. A comprehensive inventory of Iranian wetlands has been made (Scott, unpubl.).

To assess the wintering populations, personnel of the Department have conducted ground and aerial censuses in the whole of the nation's wetlands for the past four years. Those counts suggest a more or less stable wintering population, but with distribution of the birds highly variable depending on winter moisture conditions. However, the future status of Iranian wildfowl will be much affected by the policies of countries to the north and south of Iran. Accordingly, the Department has encouraged international agreement in the management of wetlands and waterfowl, and thus promoted the 1971 Ramsar (Iran) International Conference on Wetlands and Waterfowl. Iran has also entered into a bilateral agreement with the Soviet Union. That agreement concerns waterfowl in a larger framework of Nature Conservation.

The program of waterfowl ringing has this year been enlarged to include a full-time ringing project, to enhance, we hope, our knowledge of waterfowl migrations.

A large number of Ab-bandans (water impoundments) are at this time being maintained by private individuals for commercial harvest of waterfowl. The full impact of this operation has not been fully assessed. However, the Department has purchased eight of the more important of these, and it is likely that in the long term commercial hunting can be phased out in favor of individual hunters as contributing to a more equitable distribution of the resource.

The Department has this year purchased heavy machinery and farm equipment, and the Refuge Management Section of the Parks and Wildlife Division has been created. We are commencing a program of habitat manipulation for waterfowl, at Mian Kaleh Wildlife Refuge and elsewhere, on the model of certain large North American Waterfowl Refuges, which combine natural habitat and the farming of food plants for waterfowl.

Game Birds

Gallinaceous birds such as Chukar Partridges, See-See Partridges, Common Partridges and Quail, and the several species of sand-grouse, are abundant and constitute an important economic resource of the nation. The status of the Houbara Bustard seems to be improving under the protection of desert reserves. Large wintering flocks were seen this past winter, in southern Fars and along the Persian Gulf coast, though the total population has not been assessed, and the species merits more attention. The status of the Great Bustard, while less encouraging, is not alarming. Detailed counts of the species in the northeast this year suggest that birds wintering there number in the hundreds, rather than thousands as formerly supposed. Flocks numbering up to 27 were seen. The resident population in western Iran totals perhaps fewer than 200, and sites are being evaluated to create a special refuge for this species. The pheasant remains plentiful, and the above-mentioned farm machinery is being applied to habitat development programs intended to produce large harvests on two units of 48 and 1600 hectares, respectively.

Small Game Mammals and Furbearers

The use of traps for the capture of wildlife, including furbearers, has been banned since the inception of the Game Law. Sale of the most common furbearers remains legal, and they can be taken presumably by shooting. How-

ever, it was recently determined that Tehran furriers are quite illegally dispensing free poison to prospective fur suppliers. Thus the trapping program is under re-assessment, and it is likely that registered trap-lines will be permitted as more selective and less damaging to the resource.

Many of the lesser carnivores, such as the jackal, red fox, Ruppell's fox, stone marten and jungle cat remain abundant; otters and badgers are common; while the status of the Blanford's fox, Corsac fox, manul cat, caracal lynx, and honey badger are less known. The sand cat has not yet been documented from Iran, although residents of the plateau region have described the species to me. Members of the Carnivore Unit have refined a 'photographic trapping' technique used in earlier Department investigations, and have placed a renewed emphasis on documenting the status of these species.

The hare is common to abundant, depending on the quality of habitat. Due to its intermediate position in Moslem dietary law, it is not commonly eaten. This is perhaps unfortunate, for studies have shown its extreme efficiency in conversion of range forage to protein.

A study of the Persian squirrel has just been undertaken. Emphasis has been placed on studying the squirrel in relation to forest regeneration in the Zagros Mountains; i.e. the role which the squirrel plays in establishing *Quercus.*

Freshwater Fish

The Department has created a number of 'Protected Rivers' for fish management, primarily for trout. This concept, however, has proven to be largely indefensible. The category is superfluous, since trout are fully protected by law. More importantly, there were no provisions for watershed protection, which, in the final analysis, is the most important consideration in Iranian fisheries management. Further, the concept has proven to unnecessarily restrict the harvest of such prolific species. Indeed, members of the fishery unit, supported by several years of stream evaluation and population assessment, recommended a total removal of restrictions on trout fishing in certain waters. This concept, while certainly justified ecologically, was considered too advanced in an over-all conservation context at this point in time. Hence, limits and seasons, while greatly liberalized, have been retained.

Departmental policy normally excludes exotics. The single exception to that rule is rainbow trout, which were brought into the country quite some time ago. While priority is given to management of the indigenous brown trout, two commercial fish hatcheries have been rearing rainbow trout for a number of years. The Department occasionally purchases a number of this more easily propagated species for introduction into waters which possess no significant populations of brown trout.

The Department has used rainbow trout to good effect in its Nour Lake fishery program. This lake was formerly barren of fish, due to its shallow depth and a four-month ice cover. However, the lake has a rich population of crustaceans, which, we recognized, would support phenomenal growth of trout, but for the danger of winter-kill. Trout were introduced and at the same time 'helixers' and compressors installed to maintain open water in winter. Growth of fish has been remarkable, with a mean condition factor of 1. 9 (Nehring 1974), heretofore unreported for this species. The program, of course, constitutes a totally artificial situation, with machinery supporting the fishery. However, it demonstrates an innovative approach to protein production and sport fishing which could be applied to many similar areas.

An inventory of freshwater fish of Iran has been conducted. In the process, a new form of trout has been described, but at the time of this paper remains unnamed (Boencke, pers. comm.). This is the Ligwan Chai Trout, restricted to the river of the same name in Azarbaijan. Its morphology suggests a lacustrine evolution, hence it is apparently a relict of Lake Rezaiyeh, presently too saline to support fish. Its status in the above watershed is precarious, due to the instability of the soil, and we intend to proliferate the populations of this trout by introducing a number into a suitable stream in the Zagros or Alborz mountains.

Marine Species

The Department is a relative new-comer to the marine sphere, having only recently extended its jurisdiction into the Persian Gulf by virtue of a legal mandate to administer marine parks and abate pollution of the marine environment. However, for the past four years, we have conducted flights along the shore-line and thus have documented distributions of shore birds, marine mammals and marine reptiles (Harrington 1975a). Sea turtles remain abundant. During the recent surveys, we saw a mean of 4. 7 per kilometer in suitable waters, with densities as high as 30 per kilometer in some areas. Whales and porpoises, species unknown, are common as well. Dugongs have not been observed to date.

The Department administers five coastal marine reserves, and five additional such reserves have been proposed. At this time roughly 80 percent of the coastal mangrove is protected, owing to our recognition of the importance of that species to the marine ecosystem.

Other Species

The above concentration on the larger or economically valuable species does not imply that the Department does not place strong emphasis on the species, but rather that certain species are more receptive to conventional management methods and better known. Indeed, the Department has established a policy which encourages and hopefully insures the existence of every Iranian faunal species. The strategy to accomplish that objective, however, is to insure that a viable remnant of each species is represented within the reserve system. To the extent of our knowledge, that has been done.

SUMMARY AND CONCLUSIONS

From the foregoing it should be apparent that the Department of Environment of Iran has undertaken a comprehensive program of wildlife research and management. Having taken action to insure the survival of species, it now remains for the Department to refine the program in terms of priorities presented earlier. There are certain research requirements which are evident, and I herein take the liberty to distinguish between research opportunities and research needs.

In view of the large reserve system created by the Department of the Environment, and the high populations of a variety of wildlife species within many of these, there is a great *opportunity* to study a wide range of species about which relatively little is known. With 57 total personnel in the Division of Parks and Wildlife, versus 62 reserves, 125 mammal species and 490 bird species, not to mention other vertebrates and invertebrate fauna, it is clear that we haven't the capability within the Division to cover the scope of possi-

bilities which exist today. There is a real opportunity for the biological community to field a vast number of studies in Iran, under somewhat ideal conditions. The Department has encouraged collaborative biological investigations of any nature, while funding only those of high priority.

Research *needs* are those questions which have arisen or which remain, to which answers are urgently required in order to properly manage the resource. The most obvious need on a global scale is to undertake comprehensive multi-disciplinary studies of Iranian ecosystems as models for this part of the world.

More applicable to the moment, however, is the urgent need to study the physiology of Iranian ungulates in relation to the nutritive value of the flora. Such studies would establish the nutritional requirements of the animals, on one hand, and the capability of various plants to meet those requirements, on the other. Thus, comprehensive guidelines for range analysis can be developed. This most fundamental information has yet to be determined in Iran. So far only Weende analyses of selected plants of the Central Province have been conducted (Malekpour, pers. comm.).

Our botanical knowledge is so far totally insufficient. Not only do we have very little information on phytosociology,but we have yet to see a complete taxonomic work on the flora of Iran; All other requirements wane in the face of such a fundamental deficiency.

Clearly, the Iranian universities must assume a greater role in faunal research. At this moment they assume almost none. Ideally, personnel of the Department would conduct research of an applied nature, while that of a more basic nature could be undertaken by the universities. In the process we would begin to cope with the shortage of highly-qualified researchers.

Within the Department, there is now a need for research personnel to assume a higher degree of autonomy. It would be highly useful to develop research facilities in the provinces apart from the enforcement facilities, and furthermore to place all intensive management areas directly under the supervision of technical, rather than enforcement personnel.

In terms of the future outlook for the Department, and hence for wildlife, the prognosis is excellent in my opinion. In the short term, the only danger is that the Department, owing to a shortage of trained resource managers, may become too law enforcement oriented. Experience in the western world has shown that once that it allowed to happen, it takes a full generation to place the program once again on an ecological footing. In the long term, the continued success of the wildlife program in Iran depends upon maintaining and refining the existing reserve program while striving to extend the efficacy of the program outside the reserves and promoting a broad conservation ethic among the people of Iran. The National Park system is perhaps the best means available to do so. The improved standard of living and a growing literacy rate would seem to hold promise in this regard.

In terms of renewable natural resources in general, it is clear that the Iran of the Achemenians, the capital of whom lay a short distance from this meeting site, was an infinitely more wealthy nation than the Iran of today. This applies as well to neighboring countries, I'm sure. The approach taken to wildlife management and nature conservation in Iran holds much applicability to the management of wildlife resources in other countries, but it is also applicable to other natural resources here and elsewhere. By making use of guidelines already well established, and by continually refining these to fit the local

situation, much progress can be made toward the management of natural resources in this region.

ACKNOWLEDGEMENT

I would thank all the members of the Division of Parks and Wildlife, whose work I have liberally mentioned throughout this paper. Without their dedication and enthusiasm for nature, this would have constituted an entirely different document indeed.

I should mention that comments presented in this paper represent my interpretation of current phenomena in Iran, and do not necessarily reflect official government policy.

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Appendices

I. Scientific names of animal species mentioned in the text.

Persian lion	*Panthera leo persicus*
Caspian tiger	*Panthera tigris virgata*
Leopard	*Panthera pardus*
Cheetah	*Acinonyx jubatus*
Jungle cat	*Felis chaus*
Manul cat	*Felis manul*
Sand cat	*Felis margarita*
Baluchistan black bear	*Selenarctos thibetanus*
Brown bear	*Ursus arctos*
Wolf	*Canis lupus*
Jackal	*Canis aureus*
Red fox	*Vulpes vulpes*
Ruppell's fox	*Vulpes ruppelli*
Corsac fox	*Vulpes corsac*
Blanford's fox	*Vulpes blanfordi*
Badger	*Meles meles*
Otter	*Lutra lutra*
Stone marten	*Martes foina*
Honey badger	*Mellivora capensis*
Persian wild ass	*Equus hemionus onager*
Wild boar	*Sus scrofa*
Goitered gazelle	*Gazella subgutturosa*
Jebeer gazelle	*Gazella dorcas fuscifrons*
Okapi	*Okapia johnstoni*
Kudu	*Tragelaphus strepsiceros*
Red deer	*Cervus elaphus*
Wapiti	*Cervus canadensis*
Roe deer	*Capreolus capreolus*
Persian fallow deer	*Dama mesopotamica*
European fallow deer	*Dama dama*
Wild sheep	*Ovis ammon ssp.*
Persian ibex (wild goat)	*Capra aegagrus*
Hare	*Lepus capensis*
Persian squirrel	*Sciurus anomalus*
Dugong	*Dugong dugon*

White pelican	*Pelecanus onocrotalus*
Greater flamingo	*Phoenicopterus ruber*
Shelduck	*Tadorna tadorna*
Marbled teal	*Anas angustirostris*
Chukar partridge	*Alectoris chukar*
See-see partridge	*Amnioperdix griseogiilaris*
Common partridge	*Perdix perdix*
Quail	*Coturnix coturnix*
Pheasant	*Phasianus colchicus*
Great bustard	*Otis tarda*
Houbara bustard	*Chlamydotis undulata*
Pleske's ground jay	*Podoces pleskei*
Marsh crocodile	*Crocodilus palustris*
Grey monitor lizard	*Varanus griseus*
Brown trout	*Salmo lrutta*
Rainbow trout	*Salmo gairdneri*

Session III (continued): WILDLIFE AS *A* NATURAL RESOURCE

Background Paper No. 12

Pakistan: Status of Wildlife and Research Needs.

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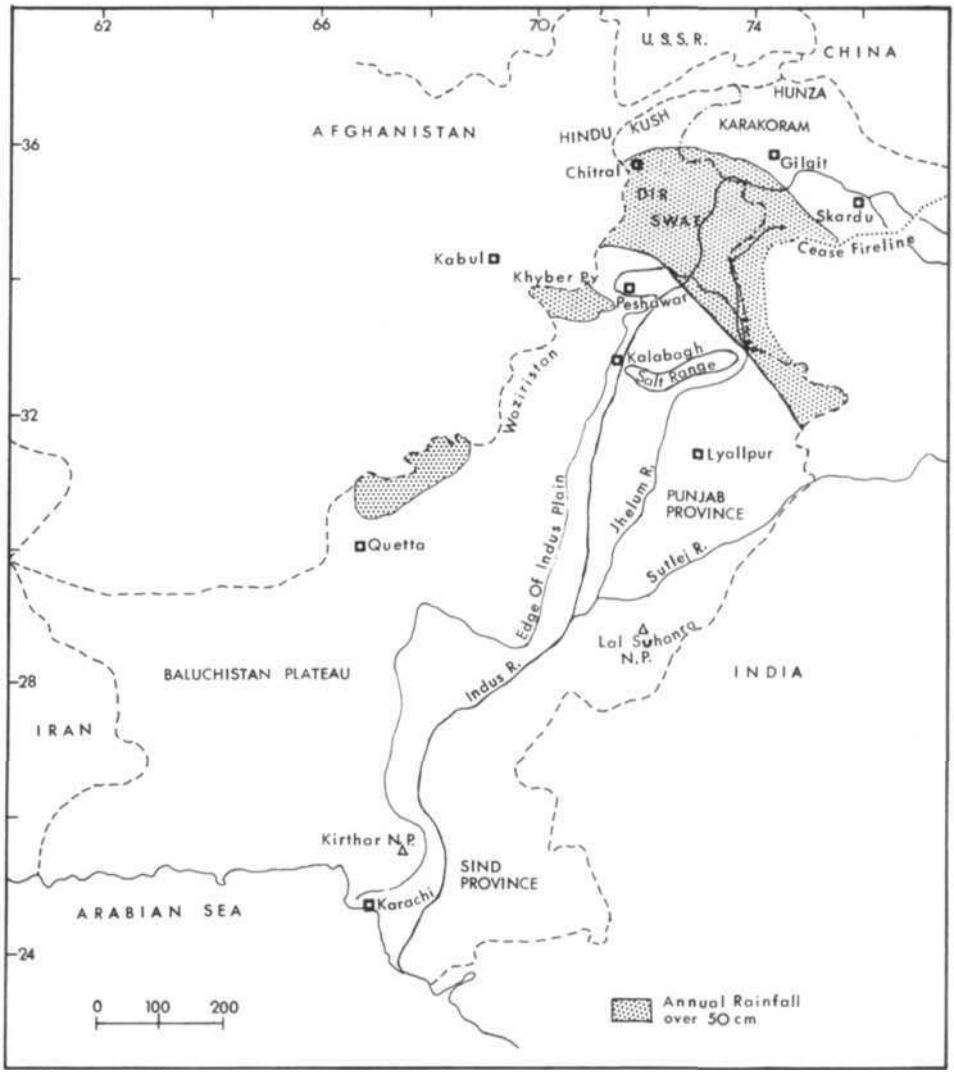
Surveys of wildlife in semi-arid and arid regions usually conclude that native animals have declined in recent years as a result of excessive hunting and habitat destruction. This discussion concerning Pakistan takes up the same refrain. A main reason for describing a world-wide situation once again but in a local context is that each country has political, social and wildlife problems uniquely its own.

For over two years I have been doing research on wild sheep and goats in Pakistan. This report concerns itself mainly with large mammals, not only because I am most familiar with them but also because their status and condition often reflects the concern with which a country treats its natural resources.

The physical features of Pakistan have been described in several books (Johnson 1969, Ahmad 1969) and a brief resume suffices here. Pakistan (including Pakistan-held Kashmir) has a human population of about 65 million in an area of some 775, 000 sq. km. Most of the country is arid with an average annual rainfall of 50 cm or less (see Fig. 1). Of the three major natural areas, the Indus Plain is the most densely settled, the population varying from about 25 persons per sq.km in the deserts to over 500 per sq. km in those parts where irrigation permits intensive agriculture. The original subtropical thorn steppe vegetation of *Acacia, Zizyphus* and other trees has been largely cut and the area converted into fields and wastelands. West of the plans rises the vast Baluchistan Plateau which stretches into Iran and generally lies at an altitude of over 1, 000 m. Huge sandy expanses are broken by rugged and barren ranges, most of them devoid of trees except for occasional *Acacia* and *Pistacia,* and, at high elevations, *Juniperus.* Precipitation is scanty, an average of 25 cm or less per year, locally some of it as snow. The human population is sparse with fewer than 10 people per sq. km, many of them nomadic and semi-nomadic pastoralists. North of the Indus Plain are high mountains—the Himalayas, Karakorams, Hindu Kush and other ranges. The summer monsoon reaches the southern parts of these mountains in such districts as Dir, Swat and Hazara, making them relatively lush. An average of 100 to 150 cm of precipitation falls there per year, and forests of oak and conifers grow on the slopes. Pakistan has a forest cover of only 3% and most of it occurs in this area. The soil being fertile, many people have settled in the hills, cut the trees and converted the slopes into terraced fields. Farther north, beyond the effects of the monsoons, the mountains are arid and cold, with precipitation less than 50 cm and temperatures down to —10°C in the lower valleys in winter. The slopes are largely treeless, covered with barren scree and *Artemisia,* and higher up, where melt water from the snow provides moisture, with alpine scrub and meadows. Almost every level piece of ground and every alluvial fan at the mouth of streams up to an altitude of 3, 400 m is irrigated



and cultivated, and domestic stock may be grazed as high as 4,700 m near the limit of vegetation.

Status of some wildlife species

The status of a species influences the kind of research that can and should be done. For some species, such as the lion*, tiger, great one-horned rhinoceros and swamp deer, it is too late for research in Pakistan, the animals having been exterminated between the 16th and 20th centuries. The cheetah, Indian wild ass and Kashmir stag may have joined these vanished species, but a survey is needed to find out if a few animals are left.

*Scientific names of animals are given in Appendix A.

The remaining species fall into two categories, namely (1) those rare to uncommon whose survival is threatened in Pakistan, and (2) those which are still fairly widespread.

(1) Grimwood estimated in 1969 that fewer than 200 blackbuck remained in the deserts of eastern Pakistan, and in 1974 the status of the species seemed to be even more precarious. To insure the survival of blackbuck in the country, ten animals were brought from Texas in 1970 and released into an enclosure in the Lal Suhanra National Park. The nilgai and great Indian bustard have also neared the vanishing point. These species need protection more than study at present.

Several species are scarce and often localized in distribution but so little is known about them that not much can be done in the way of active conservation until surveys are made to find out where animals still exist and in what numbers. In this category belong the musk deer, goitered gazelle, Eurasian otter, lynx, caracal, leopard, Baluchistan black bear (although I doubt that the animal represents a valid subspecies of the Himalayan black bear), marsh crocodile and gharial. The dugong has not been reliably reported in Pakistan but a few may occur near the Iran border. The status of the Indus River dolphin is also unknown, although a viable population is said to occur in the Indus near Sukkur. The western tragopan pheasant belongs on this list, too. This bird may have a wider distribution than the report by Wayre (1973) suggests, but its numbers in such areas as Indus and Swat Kohistan remain unknown. Lack of precise knowledge about a species should of course not preclude legal action to protect it. The decline of brown bear has been so drastic in recent years that legal help should precede a survey. In the 12, 000 sq.km large Chitral district I found evidence for only two bears in 1973. Cubs are captured and sold at high prices to gypsies and other itinerant peoples who train the animals to dance. The snow leopard has also become rare. With its prey species decimated by man, the snow leopard has to kill domestic stock for food and is consequently shot. An intensive survey in 3000 sq. km of Chitral during February 1974, revealed 4 to 5 snow leopards. Probably fewer than 250 of the cats survive in Pakistan.

Confined to about 55 sq.km around the Kilik and Khunjerab passes of northern Hunza, the Marco Polo sheep is one of Pakistan's rarest and most spectacular animals. Heavily hunted in recent years, the animal has become only a sporadic visitor to the country, spending most of its time in the Sinkiang Province of the People's Republic of China, where it is protected. Equally localized in distribution is the bharal which in Pakistan occurs only in the upper Ghujerab and Shimshal valleys of Hunza. Tibetan wild asses are said to stray into the same two valleys from China.

Hog deer are largely confined to reed beds and thickets along large rivers such as the Indus. Populations are now small and scattered and hence vulnerable. For instance, during the floods of 1973 many deer were killed by villagers in Sind Province when the animals concentrated on the few remaining pieces of high ground.

(2) Several kinds of hoofed animals are still widespread and sometimes locally abundant. But a measure of the general reduction in numbers is the fact that herds of some species contained over a hundred individuals as recently as 25 years ago, whereas today scattered herds with fewer than 10 animals are the rule.

Indian gazelle have a wide range, but they are now sparse because their preference for open and fairly level terrain makes them vulnerable to shooting

from vehicles. Goral occur in the forested hills north of the Indus basin, in unknown numbers, and wild pig inhabit the plains along the major rivers, sometimes in substantial numbers because Muslims disdain their meat.

Of the three subspecies of urial in Pakistan, the Afghan urial (*O. o. cycloceros*) is the most common, still being found west of the Indus throughout the uplands south from about the latitude of Peshawar city. Perhaps 2, 000 Punjab urial (*O. o. punjabiensis*) persist in the Salt and Kala Chitta ranges between the Indus and Jhelum Rivers. Some 500 of these are well protected in the Kalabagh Reserve. Farther north, in Chitral and Swat, and along the Indus and its tributaries in Gilgit Agency, is the Ladak urial (*O. o. vignei*). This subspecies has been almost exterminated, with most of the surviving ones located along the Indus and Shyok Rivers between Skardu and the cease fire line with India. Certainly fewer than 1, 000 Ladak urial exist now in Pakistan.

Wild goat are found in many Baluchistan ranges south of Quetta, as well as in western Sind, where a fine population of 400 to 500 animals is protected on the Karchat Hills in Kirthar National Park. Another goat, the markhor, occurs on many mountains from about 30°N. latitude northward. Once abundant, the species has been so decimated that populations are now small and isolated. The taxonomy of the species remains unsettled. The animals with straight horns, the so-called Sulaiman and Kabul markhors living south of 35°N. latitude, can be regarded as one subspecies (Schaller and Khan 1975). These markhor are threatened, possibly fewer than 2, 000 surviving, most of them in Pakistan and a few in Afghanistan. Farther north is the range of another subspecies, the Kashmir and Astor markhors, characterized by flaring horns. This subspecies ranges from eastern Afghanistan eastward into Pakistan where it occurs in Chitral, Dir and Swat districts and in the Gilgit Agency. Some 500 to 600 of these markhor survive in Chitral. There are at least twice as many flare-horned markhor as straight-horned ones in existence. To some extent protected by inaccessible habitat, the Siberian ibex is still found at high altitudes, above 3, 000 m, in the northern mountains and in the Safed Koh range west of Peshawar. Unrestricted shooting by the military and villagers has decimated the species, but no total estimate of numbers can be made, except for Chitral where there are probably fewer than 1, 500.

Two large carnivores, the striped hyena and wolf (2 subspecies), are widely distributed in the more sparsely settled parts of the country though they are nowhere abundant. With the former nocturnal and the latter highly mobile, there is little accurate information about them, nor about the Himalayan black bear which inhabits the forests north of the Indus Plain.

Green and Pacific ridley turtles nest on several beaches along the coast, including one beach within the city limits of Karachi, but no attempt to census these reptiles has yet been made.

The main conclusions which can be drawn from this brief overview are that little precise information is available for most species and that the status of many is critical. Among the large mammals only the Afghan urial, wild goat, and ibex are sufficiently abundant and widespread that a broad management program can at present be considered.

CURRENT AND RECENT WILDLIFE STUDIES

Wildlife research in Pakistan is now at a level which was reached in North America over 40 years ago and in East Africa 20 years ago. Since local universities are not ecologically oriented in their teaching and research, and

government organizations, such as the Zoological Survey of Pakistan and the provincial forest departments, lack trained field biologists, little intensive wildlife research is likely to be initiated unless foreign institutions contribute personnel and funds. The best general sources of information about the habits of Pakistan's large mammals remain old compendia (Blanford 1888-91) and hunting accounts (Burrard 1925, Stockley 1936,Maydon 1937).

The survey expeditions led by Mountfort (1969) and the work of Roberts (1967 a, b; 1969, 1972, 1973) renewed interest in the wildlife of Pakistan, not only by local organizations but also by foreign investigators. A few general surveys to ascertain the status of species have in recent years been conducted. The World Wildlife Fund Pakistan, established through the efforts of C. Savage, supported several brief studies by Z.B.Mirza (Mirza, unpubl. reports; Mirza and Waiz 1973). The Baluchistan Forest Department initiated a broad wildlife survey, first by M. Ali (1969) and currently by H. Ali, and the Punjab Forest Department estimated urial numbers in the Salt Range. The Wildlife and Forest Department of Sind censused wild goat and, in collaboration with the IUCN, prepared a management plan for Kirthar National Park (Holloway and Khan 1973). Brief surveys have also been conducted by foreign investigators, among them F.Koning and his associates from Holland, who tallied waterfowl, and Wayre (1973) who visited the Kaghan Valley in search of western tragopan. Grimwood (1969) checked on the general status of some species in addition to his duties as FAO wildlife adviser to the government.

There have been only two intensive studies on large mammals. Taber (1965, 1967) spent 7 months around Lyallpur in 1963-64, studying wild pig, a project he plans to continue in the near future. During part of 1970 and from 1972 to 1975, Schaller, with the help of several persons, made extensive surveys and detailed studies of several species of wild sheep and goat (Schaller 1973, Schaller and Mirza 1971, 1974, Schaller and Laurie 1974, Schaller and Khan 1975).

In contrast to this meager research effort, Petersen and Casebeer (1971) list about 350 major references to studies on large East African mammals, all pertaining only to ecology, food habits and population dynamics, and most—about 300—published between 1960 and 1970.

Research needs

Conventional wisdom often has it that conservation problems can be solved by biological research. While it is true that research can define problems and suggest courses of action, usually little can be accomplished without proper legislation, adequate administrative arrangements, and the cooperation of the local population. Each wildlife problem must thus be viewed in its biological, legal and social contexts.

Legislation. Wildlife in Pakistan is under the jurisdiction of the provinces, except for some areas, such as the Gilgit Agency, which are administered by the central government. In addition, large tracts in the western part of the country—for example, Khyber, Kurram and Waziristan—are considered to be Special Areas, areas where tribal laws apply in most matters. The legal status of wildlife thus differs widely. Sind Province has an active wildlife department and a good ordinance, whereas Baluchistan functions under the inadequate Wildlife Protection Ordinance of 1959. Chitral,Dir and Swat were converted from princely states into districts of the North-West Frontier Province in 1969 but the provincial wildlife ordinance had not been extended to

these areas by the end of 1974.* Gilgit Agency uses the 1912 ordinance of British India, which as with most old ordinances is concerned mainly with establishing bag limits. However, by order of the Finance Minister shooting was banned in Gilgit in 1973. The tribal areas remain lawless with respect to wildlife, any person being permitted to shoot any animal regardless of season, sex and age.

Laws cannot, of course, become effective unless enforced at the local level. Such enforcement has been extremely bad, and only in the past few years have some provinces, notably Sind and North-West Frontier, made a sustained effort to halt illegal shooting by appointing wardens and by prosecuting offenders. Except in tribal areas, the staff for effective protection has been available but the incentive to enforce laws has not. It is not coincidental that some of the best wildlife areas in Pakistan are or were private reserves—Kalabagh, Chitral Gol—whose owners had a personal interest in the animals.

Land use. Any wildlife conservation program forces one to examine the whole land-use pattern. Except on the Indus Plain, where irrigation permits intensive agriculture, most arid areas of Pakistan are suitable mainly for pastoralism as a means of subsistence. Overgrazing by livestock, coupled with cutting the sparse tree cover for firewood, has lowered the productivity throughout the region. Vast areas are being converted into desert, the grass cover already less than 10%, much of it *Cymbopogon* which has spread at the expense of more palatable species. Such overgrazing not only creates plant communities which are less preferred and less productive but also causes erosion and leaching of nutrients from the soil, which in turn reduces the protein level, the forage quality, of species.

With respect of wildlife, the land should be apportioned into two types: reserves and management units:

Wildlife reserves. Pakistan needs an extensive network of well maintained reserves, as Grimwood (1969) and Mountfort (1969) have stressed, a network which includes samples of all the various habitats and their associated fauna, including predators such as wolves and leopards. At present there are two national parks, Lal Suhanra and Kirthar†, and many small reserves, about 50 of them in Sind, Baluchistan and Punjab alone. Most reserves are so in name only, many containing little wildlife and almost all heavily used by the local people. Ideally livestock grazing, woodcutting and other such activities should be prohibited in sanctuaries, but this can sometimes be done only if the local people are compensated in some way, as for instance, by being given access to other areas or provided with an alternate means of making a living. Where this is not possible, the conflict between the needs of man and wildlife must be reconciled. Research can indicate how this might be accomplished. For example, domestic goats and wild goats eat essentially the same forage—although no quantitative studies have been done on this, yet competition may be reduced by the fact that herdsmen tend to keep their flocks away from the steepest terrain where wild goats are often found. After studying food habits

*Both Baluchistan and North-West Frontier provinces expect to pass new ordinances in 1975.

†In January, 1975, the Prime Minister also proclaimed the Khunjerab National Park, 2, 200 sq. km in size, in northeastern Hunza. The park was officially gazetted on 29th April 1975.

and movement patterns of domestic and wild goats, it may be possible to divide a proposed reserve into sectors, some for exclusive use by wildlife, others where controlled livestock grazing is allowed. Most reserves must be established not for direct monetary benefit, which at any rate would be small in view of the unspectacular nature of most wildlife in Pakistan, but as last refuges for animals and plants, as repositories of genetic stock in the event that some day the species may be needed to revitalize this plundered land.

Some species are as yet not safe in reserves, and an immediate research need is to find suitable areas in which they can be preserved. Pakistan is so large and the terrain often so rugged that traditional kinds of surveys, such as making foot transects, are too time-consuming. The plains and mountains should be sampled from small airplanes, a rapid and accurate technique if done systematically. This method has been highly developed in East Africa (see Sinclair 1972), and could just as efficiently be used for some species in Pakistan if the government were to ease its flying restrictions. Iran has several planes and trained wildlife personnel to fly them, whereas Pakistan does not. Cooperation between the two countries might be considered on this point.

Management units. Pakistan has large forest departments but few forests; yet, paradoxically, it lacks range management departments though much of the country consists of rangelands. There is little intensive research on land use problems, an FAO project in Sind being an exception (see also McVean and Robertson 1969). Urgently needed is an integrated program of range management, one that includes grassland experts and wildlife biologists. Satellite photographs would provide a rapid means of conducting the initial phases of such a range resources survey. The carrying capacity of the grasslands in terms of both domestic and wild stock must be known. This requires accurate censuses, data on the amount and kind of forage removed by each species, using techniques of analysis such as those employed by Casebeer and Koss (1970) and Field (1972) in East Africa, figures on the number of kilograms of forage needed by an animal per day, and other data. Berwick and Jordan (1971) did a valuable project of this type in the Gir Forest of India. They found that about 90% of the annual grass production in the area was removed by herbivores, all but 4% of it by livestock. Even a good range will deteriorate if more than 60% of annual production is cropped.

While range managers assess productivity and devise means of speeding the recovery of grasslands, others must find socially acceptable means of inducing local people to implement the suggestions of the range specialists and to discover incentives, financial or otherwise, that would stop the indiscriminate shooting of wildlife. In this the assistance of tribal chiefs, village councils and locally powerful individuals is essential, for their word in many areas is still law. I think it would be possible with local cooperation to establish wildlife management units on village grazing lands. Livestock could be restricted and removed from limited areas and wildlife species, such as wild goat, ibex and urial be permitted to increase. A certain percentage of the crop could then be shot annually, either for meat or sport, all proceeds from the sale of special licences and meat to go directly to the community, without the government acting as financial intermediary.

A program of restoration requires a study of the remnants. Needed is the kind of information that will enable wildlife populations to reach and maintain optimum levels, i.e. a study of food habits, population dynamics, movements, etc. Simple criteria must be found by which even a relatively untrained person can rapidly evaluate local conditions, such as the condition of the population

and by inference the habitat. For instance, body weight and number of young are useful indicators of environmental quality. The habitat in the Mohammad Reza Shah National Park in northeastern Iran is generally in good condition. Urial males there weighed 57 to 83 kg and there were 1. 5 young per adult female just after birth, with many twins and a few triplets (Decker and Kowalski 1972). In contrast, in the more arid heavily grazed Salt Range of Pakistan, urial males weigh only about 40 kg and there are 0.5 to 0.7 young per adult female, twins being rare and deaths of newborns common. Although two subspecies of urial are involved, range conditions probably cause these differences.

If a species is to be harvested on a sustained yield basis, it becomes necessary to be able to predict accurately the number of animals that can be removed each year. This can present problems because birth and survival rates may vary considerably from species to species and season to season. The markhor goats in the Chitral district show relatively constant rates probably due to the predictability of the food supply in spite of seasonal variation in it:

Date	No. young per 100 adult females	No. yearling per 100 adult females
December 1970	130	50
December 1972	130	56
January 1974	137	54

The mortality rate of young was about 60% between the ages of 6 and 18 months, most deaths probably occurring in winter when snow covers much of the forage. On the other hand, wild goats, studied in the desert environment of Sind, may show marked annual fluctuations in the number of surviving young:

Date	No. young per 100 adult females	No. yearling per 100 adult females
September 1972	44	62
September 1973	19	42
October 1974	38	21

Most deaths occurred shortly after birth. The amount of rainfall and hence nutritious green forage just before the rut in September seemed to have a profound influence on wild goat reproduction. In drought years fewer young seemed to be conceived and more young died soon after birth the following spring than in years with normal rainfall. This suggests that it may be possible to predict from the amount of summer rainfall each year how many young will survive the following year.

Although the management of large mammals has been emphasized, partridges and other gallinaceous birds would lend themselves well to harvesting on a sustained yield basis by licensed hunters. Villagers could, for instance, convert pieces of wasteland into good grey partridge habitat merely by permitting a little cover to grow.

Migratory bird species represent more complex problems. Many ducks, demoiselle cranes and houbara bustards, to mention only a small sample, breed in the U.S.S.R.but spend the winter in Pakistan. Conservation must, therefore, become a cooperative effort not only between these two countries, but also with the People's Republic of China, India and Afghanistan, through

which the birds may pass. But even on its own, Pakistan could do research, such as making counts and plotting migratory routes, and initiate a more vigorous conservation program. The latter might include a prohibition against further draining of marshes and lakes used by waterfowl and halting all houbara bustard hunting until an adequate survey has ascertained the actual status of the species.

To outline land use problems and enumerate research needs for wildlife in the arid zone of Pakistan seems in some ways redundant, for similar comments have been made about arid lands in other parts of the world, whether they be in the United States or Kenya. One need only glance through the symposium on wildlife management and land use in East Africa (de Vos and Jones 1968) for verification on this point. Information on many species is already available. Someone concerned with ibex can turn to Heptner *et al.* (1966) and Nievergelt (1966) for basic information; whoever intends to manage chukar will find Christensen (1970) a good source. Each wildlife community is, of course, to some extent unique, but the wildlife literature is now so comprehensive that for any proposed program there will be specific publications which can help define the problem, suggest the direction of research, provide examples of the kind of data that must be collected, and even present needed answers. Wildlife officials in Pakistan work almost in an intellectual vacuum, either unaware of published information or unable to obtain it. I met not a single person who knew details of the wildlife research program in neighboring Iran. To devise a better system of communication between countries would seem to be a basic research need.

The collection and dissemination of information, the promotion of technical assistance from abroad, and other conservation matters are the responsibility of a central government advisory committee. A Wildlife Inquiry Committee existed from 1968 to 1971, but it accomplished little. In 1974, a National Council for the Conservation of Wildlife was established and it is hoped that it will implement and sustain a dynamic, country-wide natural resource policy. Pakistan has during the past few years become aware of its wildlife heritage and several important measures have been taken to insure its survival. Punjab and Sind provinces now have their separate wildlife departments, the Pakistan Forest Research Institute offers a conservation course, the killing of snow leopard and the export of its skins is prohibited, and reserves are being established, to name a few measures... But in a country whose range lands are deteriorating into deserts, its wildlife vanishing, and its human population increasing at the rate of 27% every 10 years, the need for further action is imperative.

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Appendix. Specific names of animals mentioned in the text.

Lynx	*Felis lynx*
Caracal	*Felis caracal*
Lion	*Panther a leo*
Leopard	*Panther a pardus*
Tiger	*Panthera tigris*
Snow leopard	*Panthera uncia*
Cheetah	*Acinonyx jubatus*
Striped hyena	*Hyaenahyaena*
Wolf	*Canis lupus*
Eurasian otter	*Lutra lutra*
Brown bear	*Ursus arctos*
Himalayan black bear	*Selenarctos thibetanus*
Wild ass	*Equus hemionus* and *Equus kiang*
Great one-horned rhinoceros	*Rhinoceros unicornis*
Wild pig	*Sus scrofa*
Musk deer	*Moschus moschiferus*
Swamp deer	*Cervus duvauceli*
Hog deer	*Axis porcinus*
Kashmir stag	*Cervus elaphus hanglu*
Indian gazelle	*Gazella gazella*
Goitered gazelle	*Gazella subgutterosa*
Blackbuck	*Antilope cervicapra*
Nilgai	*Boselaphus tragocamelus*
Goral	*Nemorhaedus goral*
Bharal	*Pseudois nayaur*
Wild goat	*Capra hircus*
Ibex	*Capra ibex*
Markhor	*Capra falconeri*
Urial	*Ovis orientalis*
Marco Polo sheep	*Ovis ammon polii*
Dugong	*Dugongdugon*
Indus River dolphin	*Platanista gangetica*
Great Indian bustard	*Choriotis nigriceps*
Houbara bustard	*Chlamydotis undulata*
Western tragopan	*Tragopan melanocephalus*
Chukar	*Alectoris chukar*
Grey partridge	*Francolinus pondicerianns*
Demoiselle crane	*Anthropoides virgo*
Marsh crocodile	*Crocodilus palustris*
Gharial	*Gavialis gangeticus*
Green turtle	*Chelonia mydas*
Pacific ridley turtle	*Lepidochelys olivacea*

Session III (continued): WILDLIFE AS A NATURAL RESOURCE

Summary of Discussion

In response to questions, **Prof. Rustamov** stated that the sandy soils in south western U.S.S.R. contained a proportion of finer particles of silt. To reclaim these areas and improve their physical, chemical and biological properties, the areas are irrigated and Alfalfa and Sudan grass are planted. In a short time the soils accumulate organic matter, nitrates and phosphates, and are then used for the cultivation of cotton. Annual rainfall is in the region of 160-170 mm and cultivation areas are irrigated from underground water. Desert pastures are maintained by strict regulation of numbers of grazing animals and grazing rotations. Over-used pastures are restored by sowing fodder plants and irrigated from Artesian wells or canals. Irrigation must be restricted as over-watering causes salinization.

Introduction of the musk rat into the southern U.S.S.R. had been successful, but coypu rats (nutria) were killed by frost. A number of speakers drew attention to the dangers of introducing exotic species of wildlife without exhaustive studies of the species and its possible effects on the habitat and existing wildlife in the area of introduction. **Prof.de Vos** commented that the musk rat was considered a menace in the Netherlands because of its propensity for undermining dykes; large sums had been spent on its control.

Dr.Barzani referred to the difficulties of wildlife conservation in the arid desert regions of Iraq, where precipitation was low and irregular, soils were shallow, wind erosion a constant problem and vegetation extremely sparse. Ten to fifteen years ago, as a soil surveyor, he regularly saw numerous herds of gazelle but now it was unusual to see one animal in a month. **Dr. Lubani** recognized the need for habitat protection but felt that much stronger action was required to restrict hunting. He suggested that hunting of many species should be banned for ten years and hunting of others, such as gazelles, should be restricted to no more than ten per cent of the populations. **Prof. Nader,** however, considered that regulation should vary with the status of the populations, which in some areas were still numerous and could be subjected to controlled hunting, whereas in other places the same species required total protection. **Dr. Harrington** regarded the status of wildlife populations as indicators not only of land capability but also of land use, or mis-use. In Iran, as in Iraq, wildlife has disappeared where the land has been abused—to attribute such losses to overhunting was to avoid the real issue.

Mr Swift asked if wildlife poaching in Iran was commercial or subsistance hunting. If the latter, then it could be claimed that anti-poaching operations were wresting a local resource from the people for the benefit of foreigners, which might help the country as a whole but certainly not the local people. **Prof. de Vos,** believed that most poaching was subsistence hunting, but rural people had to observe the law, just as urban dwellers. Visitors' use of wildlife need not clash in any way with local use. **Dr. Harrington** stated that the Government held wildlife in trust for all its citizens; the only practical way of ensuring an equitable distribution of the resource was through the use of hunting licences. **Prof. Spooner** contended that conservation must take account of the economy of isolated human populations. Game meat was traditionally a significant component of these peoples' diets and they should have rights and opportunities for cropping. Licensing systems did not always provide equal distribution of opportunity. Hunters in isolated areas might not have the means or,

because of social and economic pressures, might not have access to the licence-issuing authority. **Dr. Harrington** could not accept this view-point. The Game Law permitted any Iranian resident to purchase, from local district offices, an annual licence for RIs. 1500 (equivalent to US$ 23) and to take, for example, two wild sheep or ibex per day and a virtually unlimited number of certain game birds and waterfowl. A local licence holder could take legally thousands of kilos of game meat per year. There was evidence to suggest that rural populations were presently taking a high proportion of the utilizable wildlife resources.

Mr. Skogland described the hunting system for visitors in Afghanistan which employed local people as guides and porters and provided them with more money than they could earn from stock raising. The markhor was threatened by overhunting by local people because of the prestige attached to killing one, but most wild ungulates were under pressure from competition with stock rather than poaching.

Prof. Barth felt that the discussion on poaching and controlled cropping of wildlife was in danger of generalizing from specific cases and circumstances that differed greatly. Hunting gazelles with automatic weapons from vehicles and shooting a few animals for local consumption were both examples of poaching, but their ecological effects were substantially different. Under certain circumstances there was a case for accepting local subsistence hunting, as being analagous to natural predation, with provision for monitoring and analysis of resulting data. The social and economic circumstances surrounding control and conservation effort vary from country to country. The possibility, and need, for significant income from trophy hunting in Afghanistan was clearly of a different order to that in Iran.

Whilst accepting an overall need for wildlife conservation, **Dr. Anwar** and **Prof. Ghallab** considered that it should not be pursued at the expense of human life and welfare. Productive areas should be devoted to agriculture, and wildlife restricted to areas of lower productivity. These views were criticized by a number of speakers. **Mr. Gilbert** considered that it was not a question of supporting either man or wildlife, both must be supported, their needs were interdependent and inseparable. Domestication of animals and plants and their management were continuing processes and plant and stock breeders had constantly to go back to wild stocks for new genetic material. **Prof.Nader** suggested that meat production from wildlife could, in some areas, produce a greater quantity of higher quality food than cultivation on poor soils or husbanding one or two species of domestic stock, which could not utilize the variety of niches available to whole ranges of wild species. Meat was only one of many values of wildlife. **Dr. Poore** supported these remarks. Generalization and oversimplification of ecological problems should be avoided, each case needed to be examined on its merits. The conservationists' main concern was for man and his welfare. Human influence could be extremely destructive and vast areas of marginal land had been degraded, primarily by agriculture. Really intensive agriculture commonly demanded massive additions of energy, but natural areas can produce a range of utilizable products for man with little or no addition of human industry. Nature reserves preserved a total range of the natural potential of the area; conservation of these genetic resources could be vital to ourselves and our successors. Human civilization might bear little resemblance to its present form if our ancestors had destroyed the ancestral strains of wheat and rice.

A number of speakers stressed the importance of wildlife education for all age levels of the public. Delegates from Iran and Iraq referred to wildlife films

that their agencies had produced for dissemination through the mass media. Trained manpower in these fields was usually in short supply, but incorporation of local advice into international programmes, particularly in education, was essential.

In **Mr. Khattack's** opinion, Dr Schaller's paper on the status of wildlife and research needs in Pakistan was rather pessimistic and he greatly regretted that Dr Schaller could not be present to take part in this discussion. He went on to describe recent developments in wildlife conservation in Pakistan. The Provincial Government of Sind had had a new Wildlife Conservation Ordinance since 1972; the Baluchistan and Punjab Ordinances were introduced in 1974. Separate Wildlife Departments had been created in Punjab and Sind, whilst the North West Frontier Province had a separate Wildlife Wing to the Forest Department. The Pakistan Forest Institute at Peshawar, was now introducing wildlife courses for serving forest officers; selected officers were being sent on university courses overseas. The Institute and a number of overseas research organizations were initiating field studies on selected species. All hunting had been banned for two years in 27, 000 sq. miles of the northern region. Four national parks, nine game sanctuaries and 22 game reserves had been established to date. International trade in wildlife and its products was being brought under strict control, active public relations campaigns were in progress and a National Council for the Conservation of Wildlife in Pakistan had been established in 1974, to provide overall coordination of Central and Provincial Government effort.

Two other participants (**Mr.Skogland** for Afghanistan and **Mr. Topcuoglou** for Turkey) provided brief summaries of the wildlife management situation in these countries. In Afghanistan, an FAO/UNDP project on conservation and management of wildlife had been started in 1973. Two overseas biologists (soon to be increased to four) were presently engaged in surveys and establishment of reserves, principally where utilizable populations of wild ungulates occur. Details of the trophy hunting programme had already been described. One national park and a waterfowl reserve have been established to date. Afghan field personnel are undergoing wildlife training in Iran. Fellowships for training of graduate personnel in overseas universities will be available within the next few years. A Wildlife Conservation law has been in effect to control hunting and trade since 1974. In Turkey, the Ministry of Forests is responsible for wildlife conservation. The National Park Section has established a range of national parks, wildlife reserves and historic sites. A number of the principal parks and reserves have master plans. Several large mammal species have been over-exploited in the past and, in addition to reserves, a series of breeding enclosures have been established for these animals, for ultimate release in the wild. Inventories and study programmes are being pursued by government and university personnel.

Session IV: CONSERVATION OF BIOTIC COMMUNITIES

Background Paper No. 13

Iran: Concepts of Biotic Community Reservation

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INTRODUCTION

The Department of the Environment of Iran, into which the former Game and Fish Department has been incorporated, administers 62 reserves for protection of the floral and faunal resources of Iran. This system of reserves, created over a 19-year period, now constitutes one of the most comprehensive programmes for nature conservation in Asia and the Middle East. Over the years, the system has undergone considerable modification owing to the advances in our knowledge, substantial socio-economic changes within the nation, and the ever broadening responsibilities of the Department with respect to land use. At this time, however, we are confident that present classifications, criteria and management strategies are adequate to insure proper resource protection within established and proposed reserves, to safeguard viable remnants of Iranian ecosystems, and to accommodate a wide range of anticipated demands.

This paper proposes to trace the evolution of the reserve system, to present current classifications and criteria, and to describe current management strategies in a fashion which will, hopefully, provide guidelines for the states of this region which recognize the need for nature reserves. It is not the intention to describe in detail Iranian reserves. Such an undertaking is beyond the scope of this paper and of the meeting at which it is presented. Nor is it the intent of the paper to dwell upon the need for, or rationalization of, the reserve system. The current literature contains ample justification for biotic community reservation in Asia and the Middle East. It is intended, however, to augment and supplement the extant literature in presenting a workable approach to nature protection in the Middle East and much of Asia and to present the philosophy of our programme, tempered with a few practical examples.

It is not claimed that the existing reserve system is complete or fully functional. The quality of the reserves varies greatly, from that of strictly protected reserves, with a minimum of disturbance, to a number which have been only conceptually identified, depending primarily upon date of establishment. Furthermore, re-classification of the reserves is not complete, due to the rather recent passage of the Environmental Law, which contains the current classification system. Our present reserves are being reviewed in terms of criteria presented below, and action is being taken to insure that each reserve meets criteria appropriate to the most applicable category.

HISTORY OF THE RESERVE SYSTEM

Firouz *et al.* (1970) have described the early history of the Iranian reserve system and the legal history of wildlife protection in Iran. For millenia the

natural resources of Iran had been exploited with little or no consideration for the future. Aided by an abusive technology, this environmental deterioration accelerated markedly during the past few generations. The destruction of forest, range and wildlife resources was, by the mid-1950s, of such intensity as to alert a group of conservation-conscious individuals who, encouraged by H.I.M. the Shahanshah, and led by his younger brother H.I.H. Prince Abdorreza, initiated measures for the preservation of Iran's wildlife and its habitats.

The first conservation law, passed in 1956, created the Game Council of Iran. In view of the large size of Iran, and the limited funds at the disposal of the Game Council, it was recognized that if a significant percentage of the available resources was allocated to areas of special importance from an ecological point of view, the efficacy and success of the conservation effort would be greatly enhanced. Thus was born the concept of 'Protected Regions'. In these regions hunting was prohibited unless a special licence was obtained from the Game Council. Utilization of range-land and forest incorporated within their confines was subject to restriction promulgated by that organization and the Ministry of Agriculture and Natural Resources.

Proposals for the creation of 'Wildlife Parks' were advanced in later years, shortly prior to the submittal of a new bill to Parliament, which when enacted into law in 1967, created the erstwhile Game and Fish Department of Iran. That law incorporated and clearly defined the concepts and legal aspects of both Wildlife Parks and Protected Regions.

In brief, Protected Regions were created to provide conditions conducive to the regeneration and amelioration of representative habitats and/or endangered species. Such regions were also envisaged as centres of breeding stocks for the repopulation of wildlife species that were on the wane in adjacent areas. Any part of Iran could be declared a 'Protected Region'. The presence or absence of a human population was legally immaterial, but in practice an effort was made to exclude villages and other habitations. Restrictions on hunting or fishing were enforced, while grazing, woodcutting and the like were curtailed in accordance with regulations enacted jointly by the Department and the Ministry of Agriculture and Natural Resources.

The 'Wildlife Park' classification was applied to those reserves within which human habitations and exploitation of resources had been excluded through a process of up-grading 'Protected Regions', and to smaller reserves which were under the ownership or full control of the Department. In short, 'Wildlife Parks' enjoyed much the same status as National Parks elsewhere, except for provisions for regulated sport hunting.

By 1973, eight Wildlife Parks and 37 Protected Regions had been created. Recovery of vegetation and attendant wildlife populations were by now well advanced in many of these. In terms of resource protection, the reserve classifications and strategies had proved to be adequate. However, certain demands were emerging which suggested the need for new categories: they may be summarised as follows.

(1) **Outdoor Recreation and Education** The increasing standard of living in Iran had brought with it a demand for non-consumptive outdoor reaction. Then, as, now, on an average summer weekend an enormous number of private automobiles (now estimated at 80, 000) and an unknown but large number of buses and taxis departed from Tehran, destined for recreation sites. A similar pattern was emerging throughout the country with urban residents fleeing the cities at week-ends. Approximately 2, 500 persons per day visited our Mohammed Reza Shah National Park during the past summer, and demand

is expected to increase ten-fold in the next five years. The wildlife reserves constituted a vast resource for recreation and the promotion of concepts of conservation. Unfortunately, there were no outdoor recreation funds at the disposal of the Game and Fish Department, and the Department did not have either the resources or personnel infrastructure to cope with the problems associated with such high visitation. The primary consideration was to accommodate visitors selectively while insuring adequate resource protection.

(2) **Research and Base-Line Monitoring** The result of over a decade of ecosystem protection in many of the reserves had by now produced conditions which, it was recognized, would serve as models for this part of the Eurasian Continent. Classifications and/or zoning plans were necessary to insure that certain areas received the recognition and future protection which they deserved. It was clear that many Iranian reserves merited inclusion in the World Heritage, MAB and similar programmes.

(3) **Wildlife Protection, Harvest and Management** The conservation movement in Iran began with strong emphasis on wildlife management. It was intended that a large number of reserves should continue to be managed on a primary use basis for wildlife. Such areas included habitats for the propagation of endangered species, waterfowl refuges, endangered habitats and numerous areas intended to be managed for optimum wildlife harvest. In many of these, a degree of manipulation had proven of extreme value in enhancing wildlife populations. It was deemed essential to designate reserves in which such manipulation was justified, in opposition to the aforementioned categories in which natural processes should govern.

(4) **Plant Protection and Plant Succession** The improvement in vegetation conditions in a number of reserves became a source of surprise, often even to the most optimistic of our staff. For example, approximately 22, 000 hectares of moving sand dunes existed in the Kavir Protected Region at the time of its establishment. Following eight years of protection from grazing, such species as *Haloxylon ammodendron* and *Stipagrostis plumosa* had pioneered the area. Not only has 80 percent of the sand been stabilized, but in parts the once-barren area is taking on a savannah appearance. Only the largest of dunes contain no vegetation, and these we hope to retain as such for their spectacular aesthetic appeal. Our calculated 'treatment' cost, which entailed only protection from grazing, has been about six cents (U.S.) per hectare per annum. Conventional sand dune treatment costs elsewhere in Iran have occasionally exceeded $500 per hectare.

Thus, we have defined the concept of 'Trust Lands', i.e. lands which are of strategic value to the nation, which are badly degraded at this time, but which can be rehabilitated on an economically-extensive basis primarily through natural processes.

(5) **Multiple Land Use Models** As indicated previously, it is widely acknowledged that many reserves administered by the Department have provided ample protection of the natural resources they contain. Unfortunately, conditions outside the reserves, often severely exploited on a subsistence to highly intensive basis, continue to deteriorate. It is recognized that the nation lacks at this time sufficient resource managers to cope with these problems on a national scale. In addition, the convening of the Persepolis meeting serves to underscore the fact that parameters do not yet exist to insure rational use of natural resources in the Middle East and South West Asia.

While the Department of the Environment has been singularly successful in managing 'Single Use' reserves, i.e. nature sanctuaries, the success of any

Iranian organization in managing areas on a multiple use basis has not been particularly remarkable to date. Nevertheless, a number of our reserves today offer an opportunity to serve as land use models, containing as they do a wide spectrum of land use practices. We recognize that this is an urgent need in the country at this time.

CURRENT RESERVE CLASSIFICATIONS AND CRITERIA

We believe that the nature reserve requirements of the nation fall into four general categories:

(1) Large areas of outstanding national significance, within which outdoor recreation, education and research should receive high priority.

(2) Relatively small areas or remnants, containing outstanding or unique examples of floral, faunal or geological phenomena.

(3) A variety of areas in which wildlife management is of prime consideration.

(4) Areas of importance which are in need of substantial amelioration, or within which guidelines for multiple use may be drawn.

After considerable deliberation to determine nomenclature which in Persian would convey the proper ecological connotations, the following names were chosen to represent the respective categories: Park-e-Melli (National Park); Asar-e-Tabii-ye-Melli (National Nature Monument); Panahgah-e-Hayat-e-Vahsh (Wildlife Refuge); and Manteqe-ye-Hefazat Shode (Protected Area). This classification, presented to Parliament and approved in the comprehensive Environment Law of 1974, departs somewhat from conventional terminology, including that of IUCN. However, one must recognize that conditions vary greatly from nation to nation, and it seems most appropriate to develop classifications which convey the proper connotation in the language of the particular country, and which assign a sufficient degree of prestige to each category. Indeed, in Iran, there remains some difficulty with the most conventional classification, namely National Park. Most citizens, and this applies to many other countries as well, associate 'Park' with the urban environment. This, however, is being remedied through education.

In subsequent discussions, we shall refer to the English translations, although the reader must bear in mind that a great deal of the ecological or cultural connotation is lost in translation.

Figure 1 (p. 152) shows the present reserves, and the proposed category of each.

The definitions and criteria for the respective reserve categories are as follows:

National Park

Definition: National Parks are relatively large areas of national significance representing outstanding examples of Iran's Natural Heritage, and which have been (a) placed under the administration, management and control of the Department of the Environment, the boundaries of which must not be altered, nor any portion be subject to alienation except by competent legislative authority; (b) set aside in perpetuity for the preservation, protection, and conservation of outstanding natural animal and plant species, habitats, geological features, natural geography and landscapes, and spectacular scenic beauty,

for the benefit, education and enjoyment of the people of Iran in a manner consistent with the preservation of the values of the resource for scientific, cultural, educational, inspirational, and interpretive purposes. When occasionally outstanding historical, archeological*, or anthropological remains or sites are found within and forming part of the significance of the park, these features or sites may be protected as part of the resources of the National Park; (c) in which opportunities exist for visitors to develop an understanding and appreciation for the values of natural history and outdoor life in a manner which allows for perpetuation of the inherent values of the Park.

Criteria expressing the national significance and integrity of a park and reasons for its establishment are ascribed to those regions which have the following features: (a) possessing a natural character sufficiently superior in quality and beauty to make imperative its preservation for the enjoyment, education and inspiration of all people; (b) having unique scenic, geomorphological and landscape features; (c) possessing diverse and/or unique examples of biotic communities, ecosystems and processes; and (d) a sufficiently comprehensive unit and size to permit public use, management, research and zoning activities while allowing for the primary function of preservation and protection of the natural resource.

In addition, the significance of the park is enhanced by the existence of one or more of the following features: (a) possessing historical, archeological or anthropological features of outstanding national significance; (b) possessing unique flora or fauna of value to the nation; (c) containing relatively pristine remnants of the regional flora representative of a particular geographical zone; and (d) constituting a land unit widely acknowledged to be representative of an Iranian province or region and thus deserving of protection to perpetuate the natural characteristics of that province or region.

With the passage of the Environment Law in 1974, all 'Wildlife Parks' automatically became 'National Parks'. Therefore, two small reserves, Dasht-i-Naz and Khoshkedaran, of 55 and 227 hectares, respectively, became 'National Parks'. These do not meet the above criteria, however, and will become, it is proposed, a Wildlife Refuge and National Nature Monument, respectively (see below). Bamou, near the site of the Persepolis meeting, was a Wildlife Park and also became a National Park with passage of the Law. However, unless it is modified to meet National Park criteria, it will become a Wildlife Refuge.

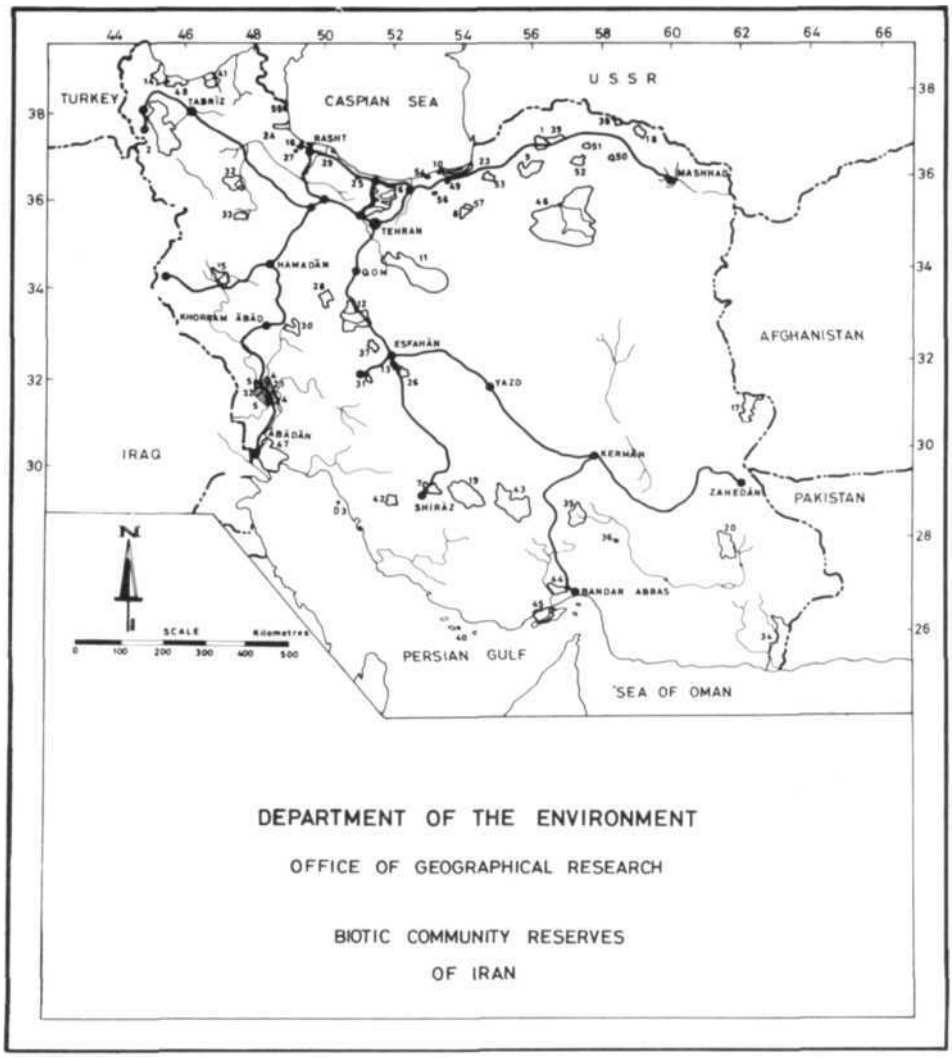
While we have not defined a minimum size for National Parks, no reserve presently under consideration for this category is less than 15, 000 hectares in size.

Among the eight proposed National Parks now approved by the Environmental High Council, are Mohammed Reza Shah, our first reserve, containing a diversity of flora and fauna unique in the Middle East; Lake Rezaiyeh and its uninhabited islands; the aforementioned Kavir reserve; and, of course, Arjan. The latter reserve has many constraints facing it at the present time, but it is somewhat unique in its potential and in view of the fact that it has become the focal point of a national commitment to nature conservation.

National Nature Monument

Definition: Small areas of land, air, and water which have been designated for

* It should be pointed out that the Department of the Environment does not have jurisdiction over historical and archeological sites.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YAZD
AFGHANISTAN
ABÃDÃN
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DEPARTMENT OF THE ENVIRONMENT
OFFICE OF GEOGRAPHICAL RESEARCH
BIOTIC COMMUNITY RESERVES
OF IRAN

	Name of Reserve	National Park	Protected Area	Wildlife Refuge	National Nature Monument		Name of Reserve	National Park	Protected Area	Wildlife Refuge	National Nature Monument
1	Mohammad Reza Shah	91895				31	Tang-e-Sayad		40800		
2	Lake Rezaiyeh	483000				32	Angouran		98875	12700	
3	Khark & Kharku			2438		33	Bijar		46500		
4	Dez		14975			34	Bahu Kalat		594750		
5	Karkheh		16587			35	Khabr-va-Rouchoon			169200	
6	Cental Alborz	203000	215450	50	4750	36	Mehrouyeh			6250	
7	Bamou	47440				37	Ghamishloo			37000	
8	Parvar		37937			38	Sarani	17800			
9	Khosh-Yeilagh			150595		39	Ghorkhod	34000			
10	Dasht-e-Naz			55		40	Sheedvar			160	
11	Kavir	609438				41	Arasbaran		34145	38520	
12	Mooteh		134910	163250		42	Arjan	65750			
13	Shah-Kuh		26650			43	Bahram-e-Gour		384560		
14	Marakan		92715			44	Geno	82400			
15	Bisotoun	30000	91937			45	Hara	82360			
16	Siahkesheem			3515		46	Touran		1410750	431250	
17	Hamoun			180000		47	Shadegan			290000	
18	Tandoureh	53780				48	Kiamaki			84400	
19	Bakhtegan			310458		49	Semeskandeh			937	
20	Bazman		324688			50	Shah-Jahan		28000		
21	Dez			3837		51	Salook		16000		
22	Karkheh			1538		52	Miandasht			52000	
23	Miankaleh			68800		53	Jahan-Nema		30650		
24	Lisar		31250			54	Fereidoonkenar			90	
25	Khoshkedaran				227	55	Astara			949	
26	Kolah Ghazi	48000				56	Babolkenar		1133		
27	Selke			360		57	Dodangeh			6700	
28	Haftad-Gholle		82125								
29	Amir Kelayeh			1230			Total Area:				
30	Oshtrankooh		93950				7509239	1848863	3639337	2016062	4977
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Sep 1975

ALL AREAS GIVEN IN HECTARES

preservation, protection and management for the values inherent in their natural, physical or artificial state. The objective is to secure preservation of a special site, area or living species of flora or fauna which illustrate outstanding examples of typical as well as unique or unusual phenomena of the nation's geological natural history. Such sites or areas may or may not be opened to visitors depending on the requirements of the feature(s) for protection and preservation. Where feasible the area or site may be open to visitors for viewing, interpretation and education, in a manner appropriate to maintaining the natural values and integrity of the monument. Some sites, because of their unique, fragile or scientific character, shall be closed to all public use and may be available only for specific scientific or educational purposes.

Prospective sites for this classification have no minimum size, but boundaries shall be described which are sufficient to insure the integrity of the features within the site. The following criteria shall assess the representative and unique nature of a site for national significance: (a) outstanding geological formations, land-forms or features significantly illustrating geologic processes; (b) specialized physiographic areas or extreme environmental conditions; (c) zoogeographic features unique to the distribution and survival of the associated flora and fauna; (d) evidence of geologic history representing important points in the evolution of plants and animals; (e) aquatic ecosystems containing unique or unusual characteristics and associated flora and fauna; (f) terrestrial ecosystems containing representative, unique or unusual characteristics and associated flora and fauna; (g) a habitat supporting a vanishing, rare, endangered or restricted species; (h) examples of scenic grandeur and high aesthetic appeal; (i) individual specimens or groups of specimens representing the nation's zoologic, botanic, geologic or cultural natural history.

At this time, only one existing reserve is proposed to be classified under this category. This is Khoshkedaran, a 227-hectare stand of *Alnus subcordata,* representing the last significant remnant of this once-extensive Caspian lowland forest. This category, however, was not particularly appropriate to the earlier classification system, and personnel of the Parks and Wildlife Division are currently evaluating literally hundreds of sites, many of which are appropriate to this new category. Among the sites which seem especially appropriate for protection at this time are (to name only a few) a relict forest of *Cupressus sempervirens;* several nature sanctuaries near the larger cities; an active volcano; a mud volcano; a stand of *Lilium ledebourii;* and a tar spring.

Wildlife Refuge

Definition: Wildlife refuges are areas of representative habitat types set aside for (a) the conservation and management of native wildlife and the protection and management of its habitat to include an area or areas involving feeding, breeding, spawning, resting, wintering, staging, shelter and other needs of wildlife, and the enhancement or restoration of these lands and water areas; (b) within which hunting, fishing, trapping, poisoning, killing or capturing of wildlife or collection of flora or other objects is prohibited except where such activities are consonant with scientific and management purposes; (c) where settlement and human activity shall be restricted, eliminated or prohibited as regulated by the Department of the Environment; and (d) in which recreational use by the public shall be secondary to the primary purpose of management for wildlife and vegetation enhancement or restoration.

An area suitable for establishment of a wildlife refuge is a land unit of any size

and typified by one or more of the following criteria: (a) wetlands of national and international significance displaying the highest biological productivity of faunistic,floristic, limnological, hydrological and ecological importance; (b) coastal marine areas, beaches, tidal flats, or inland bodies of marine waters containing sea birds, oceanic mammals or reptiles; (c) seasonal refuges for concentrations of native species, migration routes, breeding, feeding or winter wintering areas; (d) habitats capable of supporting an unusual diversity of species or communities; (e) areas containing vanishing, rare or endangered species or assemblages of species; (f) habitats suitable as managed game ranges, game breeding areas or fenced enclosures, for the enhancement of species whose survival or recruitment may be in jeopardy or requires special management; (g) habitats not reasonably suited to the production of domestic livestock but which may produce a harvest of wildlife species, as the most rational resource use of the area; (h) habitats which traditionally have supported heavy use by the hunting public and which therefore should be managed intensively in order to continue to support a significant wildlife harvest.

Of the 27 reserves which are proposed to fall into this category, one or more of the above criteria applies to each. At the present time approximately three quarters of the wetland areas of the nation fall under the jurisdiction of the Department of the Environment. It should be observed, however, that in accordance with the provisions of the new Environmental Law *all* wetlands will be administered by the Department of the Environment. Most of these will fall under the Wildlife Refuge category, although Arjan marsh and Parishan Lake, surrounded as they are by terrestrial sites of spectacular aesthetic and ecologic appeal, obviously merit inclusion in the National Park category. Our Dasht-i-Naz reserve, under intensive management for the rare Persian Fallow Deer *Dama mesopotamica,* and the Dez and Karkheh reserves, which contain the last remnants of the wild populations of this species and its riparian habitat, will also fall under this category. Several reserves presently open to controlled sport hunting (all prospective National Parks have of course been closed to hunting) will continue to be managed for optimum harvest of species of high economic value under this category. One reserve, Mian Kaleh, uniquely enough, fits all the criteria for this category! This reserve encompasses Gorgan Bay and its brackish and fresh-water marshes, seasonal mud flats suitable for the establishment of saline-tolerant food species, and the Mian Kaleh peninsula with its extensive sand dunes and psammophilic vegetation. It contains high populations of waterfowl, game birds, large mammals and other species. Under proposed management plans, we feel the reserve will support a number and diversity of species rarely seen elsewhere, while accommodating reasonable public recreation on the beaches as well.

Protected Area

Definition: Lands which, owing to their strategic value to the conservation of the nation's natural resources, are to be managed in a manner what will prevent degradation or, if already degraded, can be rehabilitated primarily through natural processes. Protection, management and restoration of plant and animal life and the maintenance of the natural state will be afforded the highest priority in providing conditions conducive to the regeneration and amelioration of habitats and species. Protected Areas may be established to serve a multitude of environmental conservation and protection needs. The Master Plan for a particular Protected Area may reflect a multiple or integrated approach or may reflect the need for zoning along a limited or single use approach. Within the framework of multiple used objectives, the

Department of the Environment will have the authority to set up specific regulations for the management of the natural resource.

Protected Areas have an important function in the role they can play in meeting scientific, economic, educational, cultural and recreational needs. Such areas are irreplaceable for studies of various ecosystems and of fundamental importance to the protection of natural biotic units representing major biogeographical regions and characterized by distinct flora, fauna, vegetation types or combinations of these. Criteria for the Protected Area category are numerous. However, since this concept is peculiarly Iranian, having evolved in the course of our experience in Middle East and Eurasian ecosystems and land use problems, we believe it is appropriate to enumerate all of these criteria, so that the scope and intent of this category will be fully understood. One or more of the following criteria may apply to the area:

(1) Applied research on specific land management problems and alternatives to deleterious land use practices.

(2) Measuring the effects of management practices on soils, productivity, pathogens, water yield, pollution and other factors.

(3) The protection and preservation of unique, unusual or representative flora and fauna as gene pools.

(4) The maintenance of successional development and natural components of ecosystems and as comparisons to resource management practices.

(5) Site in which the significance of man's influence on natural ecosystems can be observed and measured, and preserved for interpretation either by comparison of natural communities with others or in which details of human influence have been recorded.

(6) Containing significant evidence illustrating important scientific discoveries or educational functions.

(7) Demonstrating well-developed, diverse or unusual community structure and habitats.

(8) Significantly illustrating the process of succession and restoration to natural conditions following disruptive natural or man-made change.

(9) A biota of relative stability maintaining itself only under extant and/or prevailing conditions.

(10) A habitat supporting a vanishing, rare, endangered or restricted species or a relict flora or fauna persisting from an earlier period.

(11) A seasonal haven for concentration of native animals.

(12) Containing species at the extremities of their ranges.

(13) Exhibiting flora and fauna with unique anatomical, physiological and behavioral characteristics and adaptations for survival.

(14) Illustrating unique breeding and population strategies of a species.

(15) Illustrating unique feeding and energy strategies.

(16) Exhibiting outstanding geological formations or processes, or prehistoric evidence of life on earth.

(17) Of scenic grandeur, high aesthetic value or unique natural landscape features.

(18) Containing highly unstable or fragile soil, hydrologic or vegetation characteristics and within which, therefore, it can be demonstrated that the national interest is best served by excluding commercial development or land use practices.

(19) Severely eroded, channelled or depleted soil or in which vegetation has been severely depleted and which has severe climatic, hydrologic or edaphic constraints which prevent rehabilitation by conventional methods except at prohibitive cost. Site, therefore, in which the national interest is best served by excluding land use practices for a specified or undetermined number of years, until natural processes provide rehabilitation of soil or vegetation.

(20) Site peculiarly representative of a particular regional climate, soil or flora and, therefore, within which it is appropriate to exclude all land use practices, to establish a foundation for future comparisons against which to measure regional trends in pollution, soil losses or other environmental degradation.

As can be readily seen, there is considerable overlap in criteria between this and other classifications. This is due to the fact that various constraints will often inhibit and prevent commitment to the degrees of protection required under other categories, and thus the designation of Protected Areas will provide suitable preemptive safeguards for such sites. It will be understood that such an area will therefore often be in a special category for 'upgrading' to other reserve classifications in accordance with the applicable criteria. Especially worthy of note in this regard is the fact that one type of reserve may well be established within the confines of a lower grade area; e.g. a National Nature Monument or a Wildlife Refuge within a Protected Area. The very large Touran Protected Area is perhaps an apt illustration here. It has been selected as a prototype arid lands research area in which an attempt will be made to develop guidelines for rational use of the Iranian plateau region. At the same time the creation of a Wildlife Refuge has been approved within this Protected Area, encompassing perhaps a third of the area of Touran.

Further, where necessary and possible, we hope to surround National Parks eventually with buffer zones of Protected Areas, in which development can be regulated to avoid constraining influences in close proximity to the Parks.

Table 1 presents an abstract of comparisons between reserve categories. Other classifications which have been considered, such as Forest Parks, Historical Parks, Recreation Parks and the like, either do not fall under the jurisdiction of the Department of the Environment, or can be treated under the aforementioned classification system by careful attention to zoning.

Five marine reserves exist under the Department's present system of reserves, and five others have been proposed. Tied as they are to adjacent terrestrial areas, they will also be treated in accordance with the above classification system.

Biotic Community Reserves managed by other organizations warrant brief mention here. These include the Imperial Hunting Reserve near Tehran. Established sometime between 1792 and 1830, under the reign of Fath Ali Shah, this rather large reserve is presently managed by the Imperial Court for the Royal Family and their distinguished guests. Neglected at times in the past, parts of the reserve have within the past six years been protected from grazing as well as from unregulated hunting. Thus the reserve contains

TABLE 1.

Abstract of the Comparative Features of the Classification Categories

National Park	Wildlife Refuge	Protected Area	National Nature Monument
Special Character:			
Outstanding example of the Nation's geologic, ecologic, geographic and and scenic features of national significance.	Areas of representative habitat types supporting populations and species of wildlife significant to the Nation.	Lands of strategic conservation value set aside for the protection, management and restoration of plant and animal life in a manner that will prevent degradation.	Special feature of interest as a site, object, process or biota illustrating typical, unique or unusual phenomena of geological, scientific and/or historical natural history interest.
Purpose:			
Set aside in perpetuity for preservation, protection, conservation and enjoyment in a natural condition.	Enhancement, preservation, protection or restoration of native wildlife and its habitat in an optimal condition.	To provide conditions conducive to the conservation, regeneration or amelioration of habitats and species for their scientific, economic, educational, cultural and recreational values.	To protect and preserve the scientific and special interest feature in a natural or near-natural condition and, where feasible, allow for viewing and interpretation in an appropriate manner.
Management:			
Minimal measures necessary for the essential conservation of the values of the natural conditions and	Vegetation, animal life or terrain may be managed or modified to enhance the survival or recruitment of a particular wildlife or	Zoning provisions for land use, designed to improve the natural condition and character of the reserve.	Essentially unspoiled natural example under the influence of natural forces. Manipulation of the environment may be necessary to

integrity of the park and the prevention of damage from visitor use.	plant species of concern. Enhancement of the natural ecosystem shall be considered the primary management function.		neutralize unnecessary influences, to perpetuate a rare or particular species or object, or to better expose a feature for study or interpretation.
Size:			
Relatively large area of a sufficiently comprehensive unit, to allow both for public use and also for continuing representation and protection of a diversity of resources and values.	Land unit representing species needs comprehensively or as an interconnection of units.	Relatively large area dependent upon the ecological character of the reserve and the units of zoning against man-influenced disturbance.	No minimum size. Sufficient to insure the integrity of the values contained within the site.
Use:			
Non-consumptiveuses. Natural outdoor recreation experience with development facilities necessary for resource protection, public safety, and interpretation as determined by zoning.	Regulation in space and time of compatible recreational pursuits and consumptive practices.	Natural outdoor recreational pursuits and regulation of the limits, methods and types of exploitation as determined by zoning.	Dependent upon the requirements of the feature(s) for preservation and protection. Controlled, interpretive public viewing and private ownership.

substantial populations of such species as wild sheep, Persian ibex and partridges. Vegetation recovery shows much promise in certain areas.

The Ministry of Agriculture and Natural Resources maintains a number of Forest Parks, designed primarily for picnicking. While heavy use has eliminated the understory of these reserves, they constitute important remants of the Caspian lower forest belt genera, such as *Quercus,Acer, Zelkova* and *Parrotia.*

ZONING AND MASTER PLANS

We recognize that each reserve may perform a multiplicity of functions. Once a reserve has been judged appropriate to specific criteria, the next step is to develop a zoning plan intended to assure that long-range planning objectives will be met consonant with the designated purpose of the reserve, and the optimum use of the land and resource. Zoning plans are not unalterable, but changes should only be made after thorough study and evaluation. It is recognized that there may be certain features or conditions within a reserve which are not fully understood or assessed in terms of their uniqueness and importance. As additional studies are carried out, new zoning plans may be proposed and implemented.

Zoning plans of the Department of the Environment are aimed at identifying natural and cultural features, topographic and hydrographic boundaries and landscapes, identifying limits on facilities and activities for visitor use, administration, research, management and public use; defining lands suitable for visitor use and development; defining what land should not be developed due to significant or unique resources; designating limits and modes of access, and circulation patterns; providing a basis for policy decisions, management and operations; and ensuring adherence to the highest quality of the environment in balancing use, management and preservation. Table 2 (on pages 162 and 163 below) presents the zoning categories for National Parks and National Nature Monuments. It will be noted that Strict Nature Reserve or Nature Reserve, in the IUCN sense, constitutes not a reserve, but a zone within a reserve, in the Iranian classification system. National Parks are considered our highest reserve category. However, various zones within other categories of reserves may equal National Parks both in terms of the protection afforded to these and their ecological value. Indeed, it is intended that the same zone categories be treated equally, and irrespective of the reserve classification within which they fall.

Zones for Wildlife Refuges are identical to those of National Parks and National Nature Monuments, with the additional classifications of (1) Management Zone, in which land treatments are conducted by the Department, and (2) Public Use Zone, in which farming, grazing, cutting or other land use activities are permitted and sometimes encouraged to enhance the wildlife values of the reserves.

Zones for Protected Areas are under consideration and have not been approved at this time, since the nature of Protected Areas is highly complex, and the full scope of these has not yet been properly evaluated.

RESOURCE MANAGEMENT AND STRATEGY

The Department of the Environment places overwhelming emphasis on natural

processes. It may be said that major emphasis in the reserves is placed on vegetation protection, for this has served both to stabilize soil and watersheds and to enhance the terrestrial and aquatic faunal populations while also obviously serving to protect remnants of the national flora.

Much has been written of late on the need for multiple use as the only workable approach to nature conservation in developing countries. We believe that for a variety of socio-economic reasons such an approach would have been unsuccessful in the formative stages of the Iranian reserve programme. In short, our strategy, and our source of success to date, has been to develop single or priority-use reserves, whether for ecosystems and/or wildlife, to insure preservation of the resource. Having succeeded, we feel, in protecting viable populations of plants and animals, we are now turning our energies to integrating wildlife into multiple use land practices. Through the application of existing legislation, and the cooperation of the Ministry of Agriculture and Natural Resources, the Department of the Environment hopes ultimately to ameliorate conditions in the interspaces between reserves, in order to avoid genetic isolation of plant and animal populations.

Selected comments on resource management guidelines for the various reserve categories:

In National Parks, management activities for the purpose of maintaining the desired flora and/or fauna essential to the conservation of the values of the park are permitted in designated zones. Management activities may include the removal of animals, the removal of undesirable vegetation, the use of controlled burning or grazing, water,fire and erosion control and other management practices; all of which, however, are aimed at maintaining the natural resource. All such activities shall be under the supervision of and shall be executed by the personnel of the Department and subject to the approval of competent scientific authorities established within the Department.

In some Parks it has been deemed valuable to maintain vegetation of certain zones in various successional stages, in order to retain successional species of plants and animals which would otherwise disappear as the Park approaches climax. Chief among these is Mohammed Reza Shah National Park. In the lower limits of the forest, farmland expropriated some 20 years ago has been succeeded by meadow and scrub vegetation, which are likely to be succeeded by decidous forest if not managed in the meadow stage. Certain such meadows have been deemed essential to the over-all feeding strategies of Park wildlife.

For National Nature Monuments to possess national significance, the area of site must present a true, accurate and essentially unspoiled natural example of the process, feature or biota which are under the influence of natural forces. Manipulation of the environment by competent scientific authority may be judged acceptable in order to neutralize unnatural influences, to perpetuate a rare or particular species, or to better expose a feature for study or interpretation.

Management of Wildlife Refuges involves the full collection and application of biological information for the purposes of increasing the number of individuals within species and populations of wildlife up to the optimum carrying capacity of their habitat and maintaining such levels. This may involve the entire range of activities that constitute a modern scientific resource programme including research, census, law enforcement, habitat acquisition and improvement, and education. Management implies when necessary the periodic or

TABLE 2.

Zoning Classifications, National Parks and National Nature Monuments

Management Category (Zone)	Natural Character	Management Objectives	Use, Development and Access Activities
I Strict Nature Reserve	Undisturbed natural state of pristine character, natural processes allowed to occur. Special features or ecosystems of significant scientific merit, uniqueness or sensitivity. Plant types, habitats, watersheds or research areas.	Manipulative practices prohibited except when judged indispensable for the safeguard and existence of the preserve. Natural processes in the absence of direct human interference. Non-disturbing research studies by special permit. No alteration of ground cover or hydrology.	Controlled access. Exclusion of public. Development facilities prohibited. No vehicle or trail development.
II Nature Reserve	Natural appeal of the park, optimum conditions of vegetation, animal life and terrain. Outstanding natural features of scenic interest and scientific value which derive their values from the maintenance of the natural character of the area. Transition between strict zone and low-use zone. Natural character dominates physical development.	Limited management and modifications for optimum conditions of a feature or process. Primary purpose is protection and perpetuation of natural conditions. Continued existence of indigenous animal and plant species is assured through management practices. Research.	Controlled public access by interpretive naturalist activities, special interest and educational groups by written permit. Use consistent with capacity and natural condition. Day use activities only, involving nature observation, view points and walking trips. Access trails undeveloped. Nc development facilities or physical in-place interpretive devices. Vehicle road access prohibited.

III Low Intensity Use	An area of varied and interesting natural attractions, high scenic interest and adaptable to low-density sustained visitor use patterns. Rates and type of use consistent with carrying capacity in maintaining the natural character of the park. Wildlife habitat is plentiful and natural processes dominate the character of the area.	Research as a basis for management and interpretive programs. Applied manipulative practices to control accelerating erosion, epidemic diseases, insects or pests, and fire suppression or fire hazard reduction. General management practices as outlined in the management plant. The area delineates the limits of existing and potential facility development.	Development facilities necessary for protection of the resources, public safety and interpretation. May require certain types of construction such as trails, paths, primitive campsites, roads, parking lots and drainage systems to reduce unacceptable impairment of the landscape. Complementary uses of higher density such as sightseeing, hiking, photography, nature study and picnicking. Numbers limited by facility developments. Interpretation by physical aids, naturalists, self-guiding literature, etc. Trail access and provisions for interior use.
IV High Intensity Use	Attractive natural surroundings and orientation point to special interest features. Site is adaptable to man-made influences. Accommodation to high density use through management provisions. Site necessary for visitor access to the circulation system for park operations to protect, present to the public and study the park resources. Includes maintenance and utilities, boat docks, research and interpretive facilities, and lands needed for development purposes.	Carrying capacity, management and interpretive research activities; manipulative practices will be necessary for protection, maintenance, replacement or removal of vegetation, soil or other site features, quasi-natural with pleasing transition to natural zones. Park image operations and general management practices as outlined in the management plan.	Facilities necessary for administration, operation, maintenance, protection and presentation of park values through a natural outdoor recreation experience. Interpretive facilities to orient park visitors and enhance their education. Access by park transportation. No provisions for artificial recreational developments. Facilities for visitors comfort and safety.

total strict protection of species or populations as well as regulated, sustained harvesting in accordance with the dictates of proper wildlife management. Engineering and agricultural practices, mowing, livestock grazing, burning, manipulating water levels, vegetation or topographic manipulation, planting, cultivation and harvesting of grains and other crops related with habitat improvement, shall be influenced by an ecological approach and intensity. Refuge management will be based on the policy that refuges should serve as show places for a variety of wildlife and vegetation types, and enhancement of the natural ecosystem should be considered an essential component of the primary management function.

In Protected Areas, land use activities involving exploitation or alteration of the natural environment shall be zone and regulated so as to produce a minimum impact on the total effective natural character and resource values of the Protected Area. Regulations shall define the limits, methods and type of exploitation, including the removal of vegetation and wildlife, agricultural and pastoral activities, removal or exploration of mineral resources, public works construction, and residential, commercial or industrial occupations. Where exploitation and private rights exist, management should be directed to applied research, to specific land use problems and alternatives to existing land use. Land use designed to improve the natural character and condition of the reserve should be encouraged to include agricultural practices of value to wildlife, afforestation, range rehabilitation, seed and gene pool development, wetland rehabilitation, and touristic and visitor-use developments.

Establishment, Up-grading, and Amelioration of the Reserves

Recommendations for the establishment of reserves or changes in reserve classification are prepared by the Division of Parks and Wildlife, reviewed by all appropriate Divisions of the Department of the Environment, and presented to the High Council of the Environment for approval (see Environmental Protection Act for composition of the High Council.)

This arrangement ensures that all government organizations with jurisdiction over or interests in lands proposed for protection will have an opportunity to assess the prospective impact on resources administered by their organizations. Where land acquisition is essential, legal negotiation is necessary (see Law).

Control of grazing and forestry within the reserves is determined by regulations adopted jointly by the Forest and Range Organization of the Ministry of Agriculture and the Department of the Environment. Control of mining, likewise, is determined by agreement between the latter Department and the Ministry of Economy. Control of water resources must be approved by the Ministry of Energy. Thus, regulation of the reserves of the Department of the Environment becomes a multi-disciplinary affair of the highest order, although objectives may often be somewhat single-purpose oriented.

The amelioration of a reserve implies a constant assessment of conditions and treads within each reserve. Appendix I is a standard evaluation form for conditions affecting the classification integrity.

Personnel and Training

With a new law which vastly expands the jurisdiction and mandate, and with new reserve categories implying new responsibilities in outdoor recreation and management, the Department of the Environment is undergoing a transi-

tion of tremendous proportions. Many of the greatest problems are internal. In general terms, the Department has a highly conservative, law enforcement oriented personnel. Indeed, much of that which has been accomplished to date is due to a high degree of dedication on the part of members of the Enforcement Division. However, the Department is gradually changing from a strictly regulatory agency to one which is also public service oriented. Sources of many of the necessary personnel categories do not exist in the country.

The in-service training programme and Departmental College are being modified to accommodate these changes; i.e. the three-month 'Environmental Guard' curriculum and the two-year 'Environmental Officer' curriculum are being broadened to incorporate training in park management and education principles. Under the direction of FAO, a four-year curriculum in environmental conservation is in the initial planning stages under Tehran University. The Department is developing cooperative education programmes with several other Iranian Universities, and several candidates are being sent abroad for post-graduate work. In addition, several prospective reserve administrators are receiving In-Service training in the Division of Parks and Wildlife.

SUMMARY AND DISCUSSION

In the foregoing, we have attempted to describe the development of the reserve system administered by the Department of the Environment in Iran. While much remains to be accomplished, progress is being made steadily toward a truly comprehensive system of biotic community reservations. The programme was too late to preserve the Asian lion in Iran, the last specimen of that species having been seen in 1942. The Caspian tiger, too, may be gone, for our intensive studies have failed to produce concrete evidence of tigers since 1958. It is likely that viable populations have not existed for two decades or more. Save for those two species for which protection came far too late, no other species in Iran, we feel, is truly endangered at the present time. But for this reserve system, however, and its supporting legislation, and taking into account trends in the Middle East today, it is likely that dozens, if not hundreds of species of plants, birds, fish, mammals and reptiles would otherwise be extinct by this time.

Many developing countries have proceeded on the basis that wildlife must be rationalized on an economic basis (cropping for food and fibre, etc.) or on the basis of its recreational value. In few of those countries has such an approach been successful. In Iran, while acknowledging and promoting the economic and recreational values of wildlife and nature, we have proceeded with the reserve system on none other than an ecological basis. We make it quite clear that the foundation of the Iranian reserve system is the preservation of a rich national nature heritage. This approach is gaining increasing support within the country, and in the final analysis is sufficient rationalization. Today, this system, though requiring much modification and improvement, constitutes a vast resource for recreation and aesthetic education, for economic returns and for research and the establishment of land use guidelines for much of the Middle East and Asia.

ACKNOWLEDGEMENT

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Appendices

APPENDIX 1: EVALUATION FORMS FOR CONDITIONS AFFECTING THE CLASSIFICATION INTEGRITY

I. Value Base for Judging Present and Future Impact of the Value Limitations Affecting the Classification

Rating Value	Weighting factor
0	Not applicable—absent at present time
1	Compatible—having no serious short term or long term effect on the resource or the integrity of the reserve.
2	Moderate—causing some but not serious change in the resource or integrity of the reserve.
3	Severe—serious effect and modification of the resource and reserve integrity.
4	Threshold—modification to the extent that recovery via natural processes is not feasible and integrity has been lost.

APPENDIX 2: MANAGEMENT CATEGORIES OF ACTION

Identifier	Management Category
a	redefine boundaries
b	purchase or expropriate lands
c	enforce existing regulations
d	new legislations and laws
e	terminate contracts or redefine
f	cooperative action with other agencies
g	limit or change land use practices
h	resettlement of human inhabitants
i	require feasibility and impact studies
j	enforce control over planning and implementation
k	incorporate resource management measures
l	statement of policy
m	enact easements or leases
n	research
o	master planning
p	zoning
q	develop visitor-use facilities
r	public relations and education

APPENDIX 3: SUMMARY VALUE OF THE VULNERABILITY OF THE SYSTEMS

Surface Water	Well-Being				
Soil	0	1	2	3	4
Vegetation					
Wildlife					
Scientific Resources					
Visual Resources					

CONDITIONS AFFECTING CLASSIFICATION INTEGRITY Categories	Present within the Reserve	Strong outside influence	Present impact	Future impact	Management action required	Comment - Analysis
Land Transformation						
human habitation						
buildings						
industrial sites						
airport—airway						
highway						
road						
trail						
bridges						
railroad						
transmission lines						
pipelines						
corridors						
communication systems						
fences and other barriers						
canals						
dams and impoundments						
recreational facilities						
erosion control						
terracing						
cut and fill and drainage						
reforestation						

CONDITIONS AFFECTING CLASSIFICATION INTEGRITY (continued) Categories	Present within the Reserve	Strong outside influence	Present impact	Future impact	Management action required	Comment-Analysis
Species Needs Not Represented or Inadequately Represented						
habitat requirements–feeding, breeding, moulting, resting, etc.						
shelter						
water						
winter range						
sensitivity to disturbance						
over-grazing						
over -population						
soil nutrient depletion						
watershed protection						
regeneration						
competition						
vigor						
disease						
law enforcement						
Modifications						
exotic flora and fauna						
biological controls						
alteration of ground cover						
modification of habitat						
alteration of ground water hydrology						
alteration of drainage						
river flow modification						
irrigation						
burning						
noise						
pollution						

CONDITIONS AFFECTING CLASSIFICATION INTEGRITY (continued) Categories	Present within the Reserve	Strong outside influence	Present impact	Future impact	Management action required.	Comment-Analysis
Resource Extraction or Processing						
blasting and drilling						
surface excavation						
well digging and fluid removal						
dredging						
exploration						
lumbering						
fishing						
hunting						
grazing						
fuel collecting						
farming						
feed lots						
dairies						
energy generation						
mineral processing						
chemical use						
refineries						
food processing						

Session IV (continued): CONSERVATION OF BIOTIC COMMUNITIES

Background Paper No. 14

International Reserves, Biosphere Reserves and the World Heritage

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The different approaches to conservation of natural ecosystems represented by International Reserves, Biosphere Reserves and the World Heritage, and how these approaches might relate in achieving their common objectives, are discussed in this paper. Basically the emphasis of each programme is that:

International Reserves represent a recognition that the historical fact of frontiers and boundaries can be a hindrance to conservation of ecosystems and species and that people are trying to eliminate what are after all administrative barriers.

Biosphere Reserves represent efforts of countries to extend their cooperation to help develop a world-wide network of protected areas for the conservation of ecosystems and species diversity and for use of these ecosystems, in a programme of education, research and monitoring. The programme emphasizes that we must 'keep our options open' by preventing on a global basis the depletion or destruction of the genetic diversity of life. We must also gain more knowledge about the structure and function of ecosystems in order to do this.

The World Heritage concept is based upon the recognition that certain areas are of such value internationally that their protection should be supported both by the nations concerned and by the international community. It also recognizes the totality of the environment—cultural, historical and natural—and the need to relate these elements in a programme to give long-term legal protection to areas of such unique value that they are a part of the heritage of all mankind.

INTERNATIONAL RESERVES

A Cherokee Indian woman was once caught fishing inside a prohibited area in the Great Smoky Mountains National Park, North Caroline, U.S.A. When told by a ranger that she was just inside the park and could not fish there, she said to him that she doubted if the fish recognized the boundary line. She then moved just over into the 'legal' area and proceeded to catch fish which were probably in the park minutes before. Such cases support the saying that nature knows no boundaries. Certainly there are many instances where conservation of ecosystems and species, especially of migratory ones, must involve the cooperation of more than one administrative authority or government.
The Convention of Wetlands of International Importance especially as Waterfowl Habitat, adopted by the International Conference on the Conservation of Wetlands and Waterfowl at Ramsar,Iran, in 1971, recognizes the importance of such international cooperation in Article 5 which states:

'The Contracting Parties shall consult with each other about implementing obligations arising from the Convention, especially in the case of a wet-

land extending over the territories of more than one Contracting Party of where a water system is shared by Contracting Parties.

'They shall at the same time endeavour to coordinate and support present and future policies and regulations concerning the conservation of wetlands and their flora and fauna.'

This important International Convention for which Unesco is Depository comes into force four months after seven States have either signed without reservation, ratified or acceded. By 7 April 1975, six States had done so. (Two more accessions brought the Convention into force on 21 December—*Ed.*)

Recognition of the need by countries to cooperate in solving conservation problems that flow across international boundaries has led to the establishment of a number of international parks or reserves. Examples of some of these include the Waterton-Glacier International Peace Park between the United States and Canada; the High Tatra National Park in Czechoslovakia bordering with Tatra's National Park in Poland. Another good example of international cooperation in conservation and research is in the famous Bialowieza forest which lies on the Polish-Byelorussian border. In East Africa, Serengeti National Park in Tanzania cooperates with the adjoining Masai Mara Game Reserve in Kenya. Recently further mechanisms for regional and international cooperation on a coordinated system of national parks and reserves in Eastern Africa were agreed upon at a regional meeting sponsored by IUCN and held at Serengeti National Park, Tanzania, 14-19 October 1974.

The need for establishing additional border reserves is illustrated by an example given recently in an article on National Parks in Arab Countries (Ghabbour 1975). This example is the Gebl Elba region between Egypt and Sudan on the Red Sea.

'It has the only Acacia forest in Egypt, and represents the northernmost advance of steppe-dry woodland vegetation with its associated Ethiopian fauna in Africa. This region needs a maintenance system with vigilant supervision from both sides of the border, in the manner of the High Tatra Mountains between Czechoslovakia and Poland. It is sparsely populated and almost unfrequented by outsiders. If it is not declared as a national park soon, it may be lost in the future as more and more nomads cut down its trees for charcoal.'

Although Dr. Ghabbour's observations on the need for protection of other areas do not apply specifically to international parks or reserves, they also should be quoted.

'Certainly, every Arab country has its own areas harbouring unique plant and animal species, individually or in association, which could be selected as national parks, and in many cases should be established as such. The northeastern mountains of Iraq have an unusual southward extension of the more northerly Palaearctic flora and fauna. Muscat has the vegetationally rich Gebl Akhdar. The two Yemens have the Asiatic extension of the African biota. The whole of southern Arabia bears many relics of the Guinean-Malayan equatorial rain-forest which it bridged in the Miocene and probably in some moist Pleistocene spells. Egypt has the Delta lakes where Palaearctic migrant waterfowl concentrate on their migration routes. Libya has *Pinus halepensis* in its own Cyrenaican Gebl Akhdar. The more western Arab countries have valuable forest resources of oaks and pines that are matched nowhere else in the Arab countries in their

scale and diversity. These are meant to show only some of the more obvious examples of potential national parks and reserves towards the establishment and maintenance of which every effort must be directed.'

BIOSPHERE RESERVES

Every domestic plant and animal we use comes directly or indirectly from the wild. We know that in the future we will continue to need sources of genetic materials from the wild, but the value of natural areas for conservation of genetic materials is still not generally appreciated. Their importance is emphasized by a panel of experts on MAB Project 8 'Conservation of Natural Areas and of the Genetic Material They Contain' (Unesco 1973).

> 'Nature reserves are increasingly becoming the main sanctuaries for wild biota. The reduction of species diversity is depriving not only ourselves, but all future generations of living resources essential for the economic, environmental, cultural and scientific existence of man. This attrition, proceeding with increasing rapidity, may become irreversible within a mere generation or two. Whatever our own attitudes, our clear responsibility towards the future is, at the very least, to "keep options open" and to prevent, to the best of our ability, the depletion or destruction of the genetic diversity of life.'

In recent years there has been a great deal of interest in the potential for synthesizing genes and in storage of genetic materials. The experts for MAB Project 8 are not very hopeful about such solutions. They compare gene synthesis as a scientific and technological feat to Sputnik and Apollo 8, which, like them, the experts say 'will not greatly contribute to the earth's resources.'

While existing organisms can be stored, there are serious problems here too for there is no way to know what materials should be stored over the long term. Those that are stored have their evolution halted and according to the experts 'species which fail to evolve may find themselves in trouble when again asked to exist in an environment which is likely to have significantly changed during the period of storage.'

'The remaining, and apparently best, alternative appears to be the conservation of sufficient natural ecosystems so that a significant proportion of Earth's plant and animal species can continue to exist surrounded by and in harmony with man's continuously changing civilization.'

The panel agree therefore that a global network of 'biosphere reserves' should be established to conserve 'adequate examples of all important and representative biome subdivisions' and to use as baseline areas for scientific studies on the structure and functioning of ecosystems.

The need to establish a world-wide network of national parks and reserves has long been a central concern of IUCN in cooperation with the World Wildlife Fund. IUCN also has a key role in the formulation and implementation of this new project on biosphere reserves. The idea of biosphere reserves received official endorsement in November 1971, when the International Coordinating Council on MAB agreed that there was a need to establish an international network of protected areas or 'biosphere reserves' and therefore proposed to assist governments to identify, to set aside and to manage the areas needed for such a network.

The concept of biosphere reserves was further elaborated at a task force meeting held at Unesco headquarters, Paris, in May 1974, when criteria and

guidelines for the choice and establishment of these reserves were developed (Unesco 1974). Then in September 1974 the programme was actually implemented when several nations announced at the Third Session of the MAB International Coordinating Council in Washington, D.C., the proclamation of a number of biosphere reserves. To date approximately 50 countries have agreed to participate in the programme. Eight countries have proclaimed areas as biosphere reserves and others have nominated potential areas or requested assistance in surveys and selection of areas. Several regional conferences on the procedure for the establishment and management of biosphere reserves are planned, and regional surveys to identify areas suitable for establishment as national reserves and biosphere reserves are also being conducted by IUCN with the support of UNEP and Unesco. IUCN has surveys underway or recently completed in Eastern and Western Africa, Central America, and in Northern and Western Europe, and there is also a project to identify critical marine habitats of the world.

What is a biosphere reserve ?

A biosphere reserve is an area designated by an appropriate government authority for long-term protection of important ecosystems. The reserve can include either natural ecosystems where human influence is relatively slight or modified areas which have long-established patterns of stable use, or it can contain degraded areas of scientific value for the species involved and for the study of processes of recovery.

The biosphere reserve will be large enough to give the best possible assurance that the ecosystems and the diversity of species involved can be conserved on a long-term time scale.

Biosphere reserves are defined as having three basic purposes or objectives:

(1) Conservation or preservation—'to conserve for present and future use the diversity and integrity of biotic communities of plants and animals within natural ecosystems, and to safeguard the genetic diversity of species on which their continuing evolution depends';

(2) Research and monitoring—'to provide areas for ecological and environmental research including, particularly, baseline studies...', and

(3) Education—'to provide facilities for education and training'.

The core of a world-wide biosphere reserve programme will be a network of natural areas representative of the biotic provinces of the world, including their major subdivisions and transition zones. The system for classification of natural regions, *Biotic Provinces of the World* (IUCN 1974), provides a starting point for identifying natural regions. Other more detailed classification schemes will be used for identifying representative ecosystems on a local or country basis.

Relationship of Biosphere Reserves to National Parks

Certain large national parks or reserves, because of their representativeness or biological significance, may be fully suitable for designation as biosphere reserves, and countries are encouraged to designate such areas to participate in the international programme.

These reserves would then, under national administration and control, participate in a co-ordinated, world -wide programme of conservation and research

which should greatly strengthen national efforts in this field. The programme can be characterized as follows:

First: It is a systematic effort on a global basis to inventory, identify, manage and protect the important and representative natural ecosystems in each country, and to create a coherent and representative system of baseline areas for use in research and monitoring. It should be viewed not only as part of the development of natural resources of a country, but as part of the planned development of the resources of the biosphere.

Second: As a part of MAB, the biosphere reserve programme is a basis for other projects concerned with research on the effects of human activities on a variety of ecosystems. The governmental nature of MAB and the shared involvement of countries in the planning, organization and operation of regional and international projects make the programme particularly relevant to the problems of development in most countries.

Third: The reserve concept is flexible enough that it can suit the widely differing needs of countries. It includes modified or degraded areas which retain the potential for conservation of genetic diversity but which would not normally be suitable for national parks. The biosphere reserve, for example, could include an entire island which has long been occupied and used by man in a stable and productive way, and which will continue to be used in the same manner as a function of its status as a biosphere reserve. It could also include certain areas which have become degraded, e.g. by overgrazing, but which can be restored. Such areas have value as research sites for studies on recolonization, land stabilization and restoration of genetic diversity.

The advisability of such a flexible concept of biosphere reserves has been criticized by persons who favour a system of strict nature reserves. Ray (1975), however, discusses key points in support of the biosphere reserve concept. He suggests that even though we succeed in setting nature reserves aside and overcoming the obstacles, 'our victory may be pyrrhic'.

> 'It is not sufficiently appreciated that such action will result in only limited ecosystem process preservation. The real use of such areas may not be preservation, but may lie in the monitoring of man's actions through modification of them. Research and monitoring in natural areas must determine which of man's actions are compatible, which prohibited, and which to be modified. The standard must clearly be ecological, not socio-economic, and these determinations must be made on site-specific basis.'

He also suggests that with regard to monitoring of man's activities the needs of developed and lesser developed nations converge.

> 'There is a great difference between developed and lesser developed nations in their approach. The former tend to be "preservationist" and the latter seek "development". But with regard to monitoring of man's actions, their needs converge. The Man and the Biosphere Project 8 on "Conservation of Natural Areas and the Genetic Material they contain" clearly recognizes this and has made an effort to define "biosphere reserves", which I find to be the closest present approximation between reserve purpose, ecological reality and the desire of many nations to monitor and control development. But it must also be emphasized that these reserves do not replace the older "park" definition; rather they augment the park concept.'

THE WORLD HERITAGE

The world heritage concept has been called 'an idea that challenges the spirit' because there is international acceptance that throughout the world there exist natural and cultural areas of such unique value that they are truly a part of the heritages not only of the individual nations but of all mankind (Train 1972).

The 'natural heritage' is defined by the Convention for the Protection of the World Cultural and Natural Heritage as:

> natural features consisting of physical and biological formations or groups of such formations, which are of outstanding universal value from the aesthetic or scientific point of view;
>
> geological and physiographical formations and precisely delineated areas which constitute the habitat of threatened species of animals or plants of outstanding universal value from the point of view of science or conservation;
>
> natural sites or precisely delineated natural areas of outstanding universal value from the point of view of science, conservation of natural beauty.

Each State Party to this Convention is obligated to do all it can 'to identify, protect, conserve, present, and transmit to future generations the cultural and natural heritage'. This will involve measures such as developing adequate conservation policies, staffing, research, legal measures, financing and training to achieve this goal.

An Intergovernmental Committee, called 'the World Heritage Committee' shall define the criteria for the properties to be included in a 'World Heritage List' and a 'List of World Heritage in Danger'.

It is clear that biosphere reserves which protect representative or unique natural ecosystems could fall under the definition of 'natural heritage'. It also appears that the programmes will have similar approaches in education, training and research to achieve their objective. The World Heritage Convention could provide a very adequate framework in which certain categories of biosphere reserves could be included. Article 13 of the Convention refers to the need to give international assistance to the 'property most representative of a natural environment'. The list of endangered natural heritage areas, and the machinery provided for channelling international assistance to those areas, would be an extremely useful complement to the biosphere reserve scheme.

This Convention will be in force three months after 20 States have deposited instruments of ratification, acceptance or accession, and as of 7 April 1975, 12 States had taken this action. It is hoped that many governments will become parties to the Convention, and that it will be in force in the very near future.

CONCLUSION

Each country should be encouraged to develop its own national system of protected areas among which certain ones that meet MAB standards should be designated biosphere reserves. Inventories should also be initiated in select areas which could be included in the World Heritage list. Inter-country co-operation will be necessary in many instances in the selection, establishment and management of reserves. This co-operation could be between countries which share common interests and problems along boundaries.

The biosphere reserve network could serve as an effective means of co-operation among countries in the same or in different regions for countries which wish to exchange technology, information and personnel in the field of conservation and research.

Similarly, continental networks such as the proposed system of European reserves and the existing Antarctic system can also benefit by designating some reserves as part of the larger network of biosphere reserves. The same would apply to the wetlands system under the Wetlands Convention. Recommendation 11 of the Ramsar Conference states 'that wetlands in all parts of the world should be brought within the scope of the MAB Programme'. Some of them should be included on the World Heritage list.

The need for conservation and research programmes such as the ones discussed here is evident. Since their general aim is to conserve the most valuable natural areas and to secure results through research which may be turned to acoount in the rational management of the environment, they should be in line with the current concerns of government. But there are many practical difficulties in implementing programmes of this scope. Without the understanding and help of political leaders who will have to accept and defend the programmes, their potential can never be realized. Without suitable numbers of trained personnel the potential of these networks of reserves can never be fully realized.

UNESCO, FAO, IUCN and UNEP are working toward overcoming some of these difficulties by planning and co-ordinating their assistance to countries to establish and manage reserves and to conduct associated research and education programmes. But the greatest problem of all is the lack of funds. Funds are insufficient and will likely continue to be until governmental and organizational priorities are changed. These changes are not likely to be made until more people are convinced that conservation of natural areas and of the genetic material they contain is not a luxury, but is of vital interest to nations and to the world.

If, in fact, living resources essential to our existence are being destroyed to the point of no return, we have no choice but to change the priorities.

SUMMARY

The different approaches to conservation of internationally significant natural areas as represented by International Reserves, Biosphere Reserves and the World Heritage are discussed in this paper. Each of the subject areas is described and the potential relationship of biosphere reserves to the Convention for the Protection of the World Cultural and Natural Heritage after the Convention comes into force is discussed.

The core of the biosphere reserve programme is to develop an international network of representative natural areas for conservation purposed and for baseline research and monitoring in association with other projects of the Programme on Man and the Biosphere (MAB).

It is concluded that these programmes with their combined aims to conserve the significant natural areas of the world and the genetic materials these areas contain and to secure results through research which may be used in the rational management of the environment, should be in line with the current concerns of government.

However, it is recognized that there are many practical difficulties in implementing programmes of this scope. The greatest problem of all is the

lack of funds for establishment and management of reserves and for setting up the necessary research and training programmes. This problem will be overcome only when there is general recognition that conservation of natural areas is not a luxury but is of vital interest to nations and to the world.

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Session IV (continued): CONSERVATION OF BIOTIC COMMUNITIES

Summary of Discussion

In response to questions, **Dr. Harrington** stated that the ownership of the biotic community reserves in Iran varied with their categories. All National Park land was owned by the Government but land within the other three categories could be partially or wholly privately owned. With improved standards of living, many rural subsistance activities are declining in viability. Resettlement of tenant farmers from areas required for reserves therefore normally involves their incorporation in a regional development scheme, such as the Dacht-i-Ari Agro-Industry Development Programme. High numbers of visitors did pose problems in certain areas; for example, in the Mohammed Reza Shah National Park, a car park had been built for 160 cars, whereas, nowadays, 1600 vehicles were commonly parked in the area at week-ends. Large numbers of visitors to Lake Rezaiyeh National Park were using the regular lake ferry as a means of sightseeing—two boats are now under construction for tourist purposes. Picnic and overnight camping facilities were being established but it was intended to keep intensive tourist development outside the Park's boundaries.

Dr.Gharaybeh asked why related Government agencies that were responsible for range management and agriculture in areas surrounding the reserves or within Protected Areas had apparently made little progress in promoting multiple purpose, sustained use of land, to complement the aims of the reserves. **Dr. Harrington** thought that the main problem had been lack of trained personnel—only some half-dozen qualified range managers were in government service at the present time. In agriculture, much emphasis had been placed initially in agro-chemistry, and intensive research and management, when greater concentration on extensive range management would probably have been more appropriate to the country's needs.

Mr. Gilbert referred to a meeting of representatives of international organizations that was to begin in Morges on 29 May ±J75, one of whose objectives was to develop the basis for a global network of protected areas and to assign responsibility for co-ordination between the organizations concerned. **Mr. Khattak** welcomed this news; many governments had increasing difficulty in distinguishing fields of interest and responsibility among the different international organizations now involved. **Prof.de Vos** stated that UNDP Country Representatives acted as co-ordinators for the UN Groups and they and their Programme Officers could answer inquiries on these subjects. **Dr.Lubani** made the plea that in programmes for conservation of natural areas and natural resources, man should be recognized as an integral component of the ecological system and his right to use these resources should be respected.

Session V: CONSERVATION OF ANIMAL AND PLANT SPECIES

Background Paper No. 15

Conservation of Threatened Vertebrates and Plant Communities in the Middle East and South West Asia

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INTRODUCTION

The main object of compilation of inventories and the collection and analysis of data on threatened species is to provide a basis for corrective action to ensure their survival and restore their productive status in the wild.

IUCN's Red Data Book volumes on mammals, birds, amphibians and reptiles, and freshwater fishes provide summaries of status and conservation requirements for vertebrates considered to be under some threat of extinction throughout their world range. Work started on similar compilations for Angiosperms and Gymnosperms in 1969, but this is a monumental task and, at the present time, there are no data in this form for the Middle East and South West Asia. The IBP/CT check sheet survey, which for many countries provides data on biotic communities, and includes reference to rare species, has incomplete coverage for most of this geographical region. As far as the writer has been able to ascertain, no other national or international inventories of threatened plants of relevance to this region have been published.

In consequence, the content of the present paper suffers inbalance. For vertebrates, it provides a list of threatened species (excluding marine species), analysis of their current status and discusses measures for their conservation; but for the plant communities, it confines itself to enumeration of threats and possible strategies for compilation of inventories and conservation action.

In the present context, the Middle East and South West Asia are taken to comprise all countries or states from Egypt, in the west, to Afghanistan and Pakistan in east, and from the south western states of the U.S.S.R. (Armenian, Azerbaizhan, Georgian, Tadzhik, Turkmen and Uzbek S.S.R.s) in the north, to the Yemen People's Democratic Republic in the south.

THREATENED VERTEBRATES—INVENTORIES AND STATUS

Most of the content of this section is based on analysis of information contained in the IUCN Red Data Book and subsequent revisions for vertebrates (Goodwin & Holloway 1972; Vincent 1966;Honegger 1975;Miller 1969).

Thirty-three taxa (species and sub-species) of mammals, 6 birds, 5 amphibians and reptiles, and 5 freshwater fishes that occur within the Middle East and South West Asia are considered to be under some threat of extinction throughout their world range. The world distribution of twenty of these mammals (60% of the total) and one of each of the birds, amphibians, reptiles and freshwater fishes is confined to within this region.

The term *threatened* is used as a collective expression for all species included in the Red Data Book. Within the Book, species are categorized according to

assessment of their current proximity or vulnerability to extinction. In summary, the three major categories are:

endangered taxa, which because of critically low numbers and continuing depletion are considered to be in immediate danger of extinction,

vulnerable taxa, which because of serious depletion and continuing decline are considered likely to enter the endangered category unless remedial measures are taken, and

rare taxa, which because of small populations, either localised within a restricted geographical area or thinly scattered over a more extensive range, are considered to be at risk.

It should be noted that endangered and vulnerable species whose status begins to improve are normally retained in these categories until recovery is judged to be sufficient to justify their transfer.

The annex to this paper lists all the threatened vertebrates for this region and in each case provides—its status category, the total number of countries in which it is found, and the countries of the Middle East and South West Asia in which it occurs. Certain subspecies of the leopard, wild ass, and markhor* are regarded as endangered, whilst the remaining subspecies of these animals are categorized as vulnerable. In these cases, the vulnerable subspecies are grouped under the full species, and the South West Asian countries listed against them refer only to the distribution of the vulnerable subspecies.

The list comprises 30 taxa of endangered vertebrates, 17 vulnerable, and 2 rare. The proportions are roughly comparable to other regions of the world, but the condition of many of the endangered animals, even by threatened species standards, is unusually precarious. Approximately half of the endangered taxa of mammals and birds each have populations that probably number less than 500 individuals within this region, and five of them (Caspian tiger, Sinai leopard, Syrian wild ass, Arabian oryx, and Arabian ostrich) are believed to have been reduced to a mere handful of individuals, or may already be extinct in the wild.

Although a number of mammals and birds have disappeared from within the boundaries of certain countries of this region, only two subspecies of mammals are known to have become extinct since 1600 A.D., namely, the Egyptian wild boar (*Sus scrofa sennaarensis* Gray, 1868) and the Bubal hartebeest (*Alcelaphus buselaphus buselaphus* Pallas, 1766), which became extinct early in the present century (Goodwin & Goodwin 1974; Vincent 1965). Poore (1971) has suggested that two revolutions in land use have occurred within South West Asia, the first in the Neolithic and the second at the present time. It is conceivable that the number of extinctions within the past century has been depressed by extinction of less resilient species during the Neolithic.

A surprisingly large proportion of the threatened mammals (57% of the total) occur in high, or moderately high altitude habitats: mountain grasslands or forests (snow leopard and musk deer), high altitude steppe (marmot), woodland scrub and rocky areas at high elevations (some subspecies of leopard, wild dog, tahr and all markhors), and arid uplands, foot hills and degraded thorn scrub (bear, lynx, some subspecies of leopard and wild ass, hartebeest and slender-horned gazelle). Arid and semi-arid plains areas provide another major habitat for threatened mammals (some subspecies of wild ass, oryxes, addax and most of the gazelles). The remaining habitats comprise riverain

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* Scientific names are listed in the annex to this paper.

forest (tiger and two deer) and aquatic areas (dolphin and desman). The wolf can occur in practically any of these habitats.

Threatened bird habitats divide into: wooded and mountainous areas (four taxa), and arid plains (ostrich and bustard). Amphibian and reptile habitats are either aquatic (frog and crocodilians), or semi-arid scrub areas (monitor lizard and python). Four of the fishes are lake forms, one is a river species.

Virtually all of the threatened vertebrates have been adversely affected by modification of their habitats, and by the human disturbance which accompanies it. High altitude areas have been degraded by timber cutting, fuel collection and stock grazing. In semi-arid and arid uplands and plains the threats are similar but infinitely more acute. Riverain forests have been subjected to especially strong pressure, not only by timber and fodder cutting, but also by clearance for agriculture and by grassland burning. Aquatic habitats have suffered similar damage together with impoundment of streams and rivers, pollution, and swamp drainage.

Other examples of habitat impairment include depletion of the natural prey of wild predators (by hunting or reduction of forage through over-grazing), disease spread by stock (Indian wild ass) and loss of habitat to introduced wild animals (Russian desman) or predation by introduced species (çiçek).

With few exceptions, the threatened vertebrates in this region have been commonly subject to over-exploitation. Most of these species are large and provide readily utilizable or desirable products, such as furs, skins and hunting trophies (predatory mammals, ungulates, crocodilians and snakes), meat (ungulates and gallinaceous birds), musk-pods (musk deer), and oil (dolphin). Even the marmot is hunted for its fur, meat and fat.

The larger carnivores and herbivores are also killed because they compete with stock for grazing (ungulates), because of depredations on stock (carnivorous mammals and raptors), which are commonly accentuated by depletion of wild prey, or because they are considered a danger to human life (tiger and snakes).

As a result of protection, a few vertebrates, such as the Persian fallow deer, the Asiatic cheetah and the onager (*Equus hemionus onager*) are steadily increasing and the decline of others has certainly been halted in parts of their range (e.g. marsh crocodile and bactrian deer) but, to date, there have been no population recoveries sufficient to merit the removal of an animal from the threatened lists.

THREATENED PLANT COMMUNITIES-STATUS AND INVENTORIES

The Red Data Book volume for Angiosperms (Melville 1970) and subsequent revisions includes no threatened species for the Middle East and South West Asia, but the present number of sheets probably represents less than one per cent of those that will ultimately find a place in the Book, and there is little doubt that a considerable number of threatened plant species occur in this region.

There are numerous references to the rapid and continuing degradation of indigenous vegetation in these areas. Examples include degradation of semi-arid and arid rangelands in the region as a whole (FAO, 1974), denudation of about all woody growth in many forest climax regions of Afghanistan, Iran, Iraq and Turkey, following centuries of grazing, tree-lopping, fuel collection and, in Afghanistan, charcoal production (Freitag 1971; Guest 1966; UNESCO

1969); serious degradation or modification of steppe in Anatolia through grazing, cultivation (particularly through extension of dry farming and deep ploughing) and pasture improvement (Davis 1971;Zohary 1971; P.Davis, B. Mathew, R. Melville, pers. comms.); and in limestone areas of Afghanistan from overgrazing and fodder collection (Freitag 1971; Hedge & Wendelbo 1963).

More specific threats to certain groups of species can be posed by commercial collection of bulbs and rhizomes for horticulturists. Collections have been taking place in Turkey for many years and, more recently, in Afghanistan. Certain species of *Chionodoxa* and *Iris* are now under considerable pressure from this source (B. Mathew, C. Grey-Wilson, pers. comms.).

Poore (1971) has enumerated the results of widespread degradation of vegetation in this region: dissection of original zones thus restricting movement of natural populations, modification of vegetative age structure and composition through disturbance and the alteration of wild animal populations, production of completely new types of secondary vegetation and changes in proportions of plant communities.

It may be questioned if relatively undisturbed areas of vegetation still remain for conservation purposes. Freitag (1971) states that, in Afghanistan, remnants of less disturbed vegetation are more common that is generally appreciated, particularly in areas of low human population density, because of lack of water or steep or broken topography (parts of Hindu Kush) and through traditional protection of edible seed producing woodland (e.g. *Pistacia vera* and *Pinus gerardiana*) and vegetation around tombs and shrines. He considers that after centuries of heavy use, many species are naturally resilient to disturbance and the detrimental effect on ground vegetation of destruction of open woodland in semi-arid regions is much less than would result from loss of closed-canopy forest in more humid areas. In Pakistan, riverain islands have been identified as another source of comparatively undisturbed vegetation (Zeller & Beg 1969).

Assessment of status and compilation of inventories of threatened species is a time-consuming task, conservation problems in this region are urgent and the survival of many species could be assured by protection of a range of relatively undisturbed, representative samples of a country's major ecosystems. Selection of a range of such sites has already been submitted for Egypt as a contribution to the IBP/CT check sheet survey (G. L.Radford,pers. comm.). Vegetation surveys have been undertaken in many parts of this region, the entire area is covered by a 1:5 million scale vegetation map (UNESCO, 1969) and maps of vegetation zones on larger scales exist for Iran, Israel, Lebanon, Jordan, western Syria, Turkey and U.S.S.R. The use of these maps as a base, supplemented by identification of relatively undisturbed areas and addition of azonal vegetation areas (e.g. cliff faces, marshes, screes, saline flats, etc.) could provide a very useful approach to species, including threatened species, conservation.

A refinement to this approach, which would reduce the risk of excluding rarities from the reserve system and aid selection of priority areas for reservation is to adopt the strategy now in use for the compilation of the Red Data Book volumes on Angiosperms and Gymnosperms, namely of preparing inventories of endemic species. This exercise should be followed by a rapid assessment of the condition and trend of their habitats. Identification of areas particularly rich in endemics and under particular pressure would provide an immediate priority listing of potential reserves.

Considerable information already exists within this region for such compila-

tions and selection of areas for reservation. The most important phytogeographical region in the Middle East and South West Asia in regard to richness of flora and numbers of endemics is the Irano-Turanian, which occurs over large areas of Iran, Iraq, Israel, Jordan, Syria and eastern Turkey, and is represented to a more limited degree in Egypt and Arabia (Zohary 1971). New compilations or revisions of existing Floras are being undertaken for Afghanistan, Arabia, Egypt, Iran, Iraq, Israel, Jordan, Lebanon, Turkey and the Armenian and Georgian S.S.R.s. In Turkey, of 2625 species described in 1971 in its new Flora, approximately 30% are endemic. Concentrations occur principally in mountainous areas, notably the Cilicean Taurus (Davis 1971). The Armenian/Anatolian district has an extremely rich flora and comprises an outstanding centre of speciation (Zohary 1971). Many regions of Iran (particularly the Hyrcanian Forest) and Afghanistan (particularly the Afghan Mountains) have also been shown to have a high number of endemic plant species, the percentage in the latter region being between 30-50% of the total. The Zagros Mountains are considered to be richer in this regard than the Elburz Mountains (Wendelbo 1971). In Iraq, the richest endemic region is in the north-west (Guest 1966). The other phytogeographical region with a high proportion of endemics is the Mediterranean; it occupies a relatively narrow belt along the Mediterranean Sea and is primarily represented in this area in Anatolia, and Syria, Jordan and Israel (Zohary 1971).

CONSERVATION OF THREATENED VERTEBRATES AND PLANT COMMUNITIES

Comprehensive programmes for species conservation require formulation of policies, establishment of administrative structures, organization and training of staff, passage of legislation and an active education programme. Detailed consideration of these subjects, however, is considered to be outside the scope of this paper.

Recent information on the legal status of species in some countries within the Middle East and South West Asia is lacking, but according to information currently available, about two-thirds of the threatened vertebrates are totally protected by law in at least one country within this region. The proportion is low compared with many other parts of the world. The Baluchistan bear, some subspecies of leopard and several of the gazelles apparently lack legal protection at present.

Enforcement of protection is no easy task in isolated areas where numbers of enforcement officers are limited. Control of trade in wild animals and plants is easier in that inspection and controls can be concentrated at trading points. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973) is designed to restrict trade in threatened species and their products and to keep account of depleted species that have entered into commerce. Most of the threatened vertebrates that are likely to enter into international trade in the South West Asian region are included in one or other of its appendices; the only plant taxa of relevance to this region that are included are all members of the Orchidaceae and *Cyclamen* spp., trade in which must be subject to regulation. There is provision for regular revision of the lists. Only the Arab Emirates of the countries within this region has ratified its adherence to the Convention to date (April 1975).

Effective, long-term conservation of a species requires adequate protection of its environment. Approximately half of the total number of threatened vertebrates occur in one or more national parks or related reserves in this region. Some subspecies of leopard and wild ass, many of the gazelles and other plains

ungulates, and most of the threatened birds, do not presently occur in reserved areas.

In the 1975 United Nations list of National Parks (IUCN, 1975) five countries from this region have national parks that comply with the UN criteria; they are Iran: 12 parks (1,005,000 ha); Israel: 3 parks (30, 500 ha); Pakistan: 1 park (308, 000 ha); Turkey: 10 parks (164, 000 ha); and the south western Republics of the U.S.S.R.: 32 parks (844, 500 ha). All of these countries have other types of reserves in addition to these parks. Afghanistan, Jordan and Lebanon are known to have parks and reserves, or projected reserve areas, that are not presently included in the UN list.

Most national parks and some reserves exclude all forms of destructive human interference and provide protection for all their animal and plant components. Many other reserves provide protection for wild animals only, and there is a very clear need to extend this protection to the flora and create more reserves specifically for plant conservation. Examples of localities that contain numerous endemic plant species, are under considerable human pressure and would therefore merit early reservation of sample areas, are: ground vegetation and shrubs of *Cedrus deodara* forest in Paktia Province, Afghanistan; steppe and mountain areas around Erciyas Dag and Bolkar Daglari in south central Turkey; and many foothill regions of the Fertile Crescent from the Anti-Taurus to Hakari and south to Shiraz, in which a number of reserves already exist (P.Davis, C. Grey-Wilson, B. Mathew, pers. comms.).

Rehabilitation programmes, involving captive breeding of threatened vertebrate species and their subsequent re-introduction into the wild, are in progress in Iran, Pakistan and Turkey. The Arabian oryx, the subject of a capture operation in Oman, is thriving in captivity but no suitable re-introduction area has been selected to date.

Iran and U.S.S.R. have recently signed an agreement for joint action on anti-pollution measures for the Caspian Sea, which contains 54 species of fish, including 33 endemics (Firouz 1974). A number of countries are actively co-operating in international programmes to conserve wetlands (Project Mar) and inland waterways (Project Aqua) and in the FAO programme for preservation of primitive cereals through seed bank storage at Izmir.

In summary, therefore, considerable progress is being made on the conservation of threatened species within some countries, but conservation initiatives in others are still relatively few. With some notable exceptions, this reluctance to act on conservation problems appears to be particularly marked in arid and semi-arid areas of this region. Vegetative productivity in these areas has been reduced by centuries of heavy use and may fluctuate violently as a result of periodic droughts. Human pressure on these resources is substantial and governments are undoubtedly reluctant to set aside large reserves, which largely exclude local human use, or to protect wild animals that may compete for grazing or prey upon domestic stock.

Whilst there is a need for conventional species protection and inviolate reserves in these areas, there is, equally, a need for greater flexibility, to involve more conservation through management that would demonstrate the benefits of better land use and allow for active involvement of local people.

The biosphere reserve concept is in accord with such an approach and should find application within this region. Biosphere reserves are to be established for conservation, restoration and study of representative ecosystems. They comprise a protected core area and a buffer zone in which management, re-

search and controlled utilization would be practised. They may cover both natural and semi-natural ecosystems including those maintained by long-established land use practice (UNESCO 1974).

Topics that would merit further study or the implementation of pilot management projects within biosphere reserve buffer zones or adjacent areas are range management programmes with a wild herbivore cropping component, and include study of utilization of native fodder plants, which are better adapted to arid areas and frequently have higher nutritive values than introduced species (Al-Ani *et al.* 1971). The re-introduction of threatened species into these protected and rehabilitated areas should have high priority. Several of the presently threatened herbivores, such as the addax and oryxes, have high reproductive potential and are admirably adapted to arid environments. In large areas, studies should be initiated on the possibilities of cropping wild fur-bearers, or of regulated sport-hunting as is already practised in certain countries within this region. Part of the licence fees from visiting hunters might be made available for local community development projects.

Projects that have been initiated in certain parts of the region and which might have wider application include the re-establishment of experimental areas that employ early farming methods (Israel) and which could conceivably be combined with a scheme for conservation of primitive cereals, and intensive range management schemes in areas adjacent to national parks, as a means of relieving, and ultimately eliminating, human pressure in the park by drawing the human occupants into improved range areas (Pakistan).

Many tourists who visit national parks are conservation-oriented and there appears to be no reason why conservation/management projects of the type described should not be included in regulated tourist circuits.

Education projects in support of conservation programmes are essential within the region as a whole.

SUMMARY

Threatened vertebrates within the region are identified and their current status is reviewed. Threats to plant communities are enumerated and strategies for inventory compilation and conservation initiatives are considered. A concluding section discusses conservation measures, to date, and suitable approaches to future needs, particulary in arid areas.

Thirty-three species or subspecies of mammals, six birds, five amphibians and reptiles and five freshwater fishes occur within this region and are currently considered to be under some threat of extinction throughout their world range. Virtually all of them have been affected by habitat degradation and most have suffered from over-exploitation. With some few exceptions, there has been little evidence of population recoveries in recent years.

No inventories exist for threatened plants in this region. The compilation of national lists of endemic species and rapid assessment of the condition of their habitats is suggested as the most effective means of identifying threatened species and producing priority areas for protection.

Several countries have made considerable progress in the establishment of comprehensive national park systems, and similar initiatives in the remainder would be very desirable. Whilst some conventional, inviolate reserves are essential, conservation through natural resource management will probably have greater change of success, particularly in arid areas where pressure on

resources is often intense. Application of the biosphere reserve concept would be in accord with this approach.

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Annex

Threatened Vertebrates in the Middle East and South West Asia

Listed in systematic order and excluding marine species

N.B.: The following lists show, for each animal, its status category (E: endangered; V: vulnerable; R: rare), the total number of countries in which it is found (figure in parenthesis), and the Middle East and South West Asian countries in which it is believed to occur (Af: Afghanistan; Ba: Bahrain; Eg: Egypt; In: Iran; Iq: Iraq; Is: Israel; Jo: Jordan; Ku: Kuwait; Le: Lebanon; Om: Oman; Pa: Pakistan; Qa: Qatar; SA: Saudi Arabia; Sy: Syria; Tu: Turkey; UR: Armenian, Azerbaizhan, Georgian, Tadzhik, Turkmen and Uzbek SSR's; UA: United Arab Emirates; YA: Yemen Arab Republic; YP: Yemen People's Democratic Republic).

MAMMALS

l. V.	*Desmana moschata*	Russian desman (1) UR
2. V.	*Marmota menzbieri*	Menzbier's marmot (2) UR
3. V.	*Platanista indi*	Indus dolphin (2) Pa
4. V.	*Canis lupus*	Wolf (34) Af: In: Iq: Is: Jo: Le: Pa: SA: Sy: Tu: UR
5. V.	*Cuon alpinus*	Asiatic wild dog (15) Pa: UR
6. E.	*Selenarctos thibetanus gedrosianus*	Baluchistan bear (2) In: Pa
7. R.	*Felis caracal michaelis*	Turkmenian caracal lynx (1) UR
8. E.	*Panthera tigris virgata*	Caspian tiger (3) Af: In: UR
9. V.	*Panthera pardus*	Leopard (59) Af: In: Iq: Pa: UR
10. E.	*Panthera pardus nimr*	South Arabian leopard (14) Om: SA: YA: YP
11. E.	*Panthera pardus tulliana*	Anatolian leopard (7) In: Is: Jo: Le: Sy: Tu: UR
12. E.	*Panthera pardus jarvisi*	Sinai leopard (2) Eg: SA
13. E.	*Panthera uncia*	Snow leopard (7) Af: Pa: UR
14. E.	*Acinonyx jubatus venaticus*	Asiatic cheetah (5) Af: In: Pa: SA: UR
15. V.	*Equus hemionus*	Asiatic wild ass (8) In: UR
16. E.	*Equus hemionus khur*	Indian wild ass (2) Pa
17. E.	*Equus hemionus hemippus*	Syrian wild ass (2) Sy: Tu
18. V.	*Moschus moschiferus moschiferus*	Himalayan musk deer (6) Pa
19. E.	*Dama mesopotamica*	Persian fallow deer (2) In: Iq
20. E.	*Cervus elaphus bactrianus*	Bactrian deer (2) Af: UR
21. E.	*Oryx leucoryx*	Arabian oryx (1) Om
22. V.	*Oryx dammah*	Scimitar-horned oryx (8) Eg
23. V.	*Addax nasomaculatus*	Addax (7) Eg
24. E.	*Alcelaphus buselaphus tora*	Tora hartebeest (3) Eg
25. E.	*Gazella subgutturosa marica*	Sand gazelle (3) Jo: Ku: SA
26. E.	*Gazella dorcas saudiya*	Saudi Arabian gazelle (6) Iq: Is: Jo: Ku: SA: Sy

27. E. *Gazella gazella arabica*	Arabian gazelle (7) Eg: Is: Jo: Om: SA: YA: YP
28. E. *Gazella leptoceros*	Slender-horned gazelle (6) Eg
92. E. *Hemitragus jayakari*	Arabian tahr (1) Om
30. V. *Capra falconeri*	Markhor (4) Af: Pa: UR
31. E. *Capra falconeri megaceros*	Kabul markhor (2) Af: Pa
32. E. *Capra falconeri jerdoni*	Straight-horned markhor (2) Af: Pa
33. E. *Capra falconeri chiltanensis*	Chiltan markhor (1) Pa

BIRDS

1. E. *Struthio camelus syriacus*	Arabian ostrich (1) Jo
2. V. *Geronticus eremita*	Waldrapp (3) Tu
3. V. *Gypaetus barbatus meridionalis*	African lammergeyer (8) YA: YP
4. E. *Tragopan melanocephalus*	Western tragopan (2) Pa
5. V. *Catreus wallichii*	Cheer pheasant (4) Af: Pa
6. E. *Choriotis nigriceps*	Great Indian bustard (2) Pa

AMPHIBIANS & REPTILES

1. E. *Discoglossus nigriventer*	Israel painted frog (1) Is
2. E. *Crocodylus palustris palustris*	Marsh crocodile (5) In: Pa
3. E. *Gavialis gangeticus*	Gavial (4) Pa
4. V. *Varanus griseus caspius*	Central Asian grey monitor (4) Af: In: Pa: UR
5. V. *Python molurus molurus*	Indian python (5) Pa

FRESHWATER FISHES

1. E. *Salmo platycephalus*	Ala balik (1) Tu
2. R. *Stenodus leucichthys leucichthys*	Belorbitsa (2) UR
3. E. *Acanthorutilus handlirschi*	Çiçek (1) Tu
4. E. *Tylognathus klatti*	——(1) Tu
5. V. *Kosswigichthys asquamatus*	Scaleless killfish (1) Tu

Session V (continued): CONSERVATION OF ANIMAL AND PLANT SPECIES

Background Paper No. 16.

Endangered Flora and Vegetation, with Notes on Some Results of Protection

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INTRODUCTION

It should be made clear that the author is a botanical taxonomist with only fairly general knowledge of the flora of Iran, but with a specialist's knowledge of a certain number of families and groups. There are still many parts of Iran that he has not seen. He is not a conservationist by profession or main interest, and is not well versed in the different conservation plans and projects of Iran.

In many regions of Iran the degradation of the vegetation has, due to cultivation, grazing and collecting of fuel, reached a stage one would believe was beyond repair. Over vast stretches one meets a bleak country without trees and shrubs and with hardly any other vegetational cover. Erosion, moving sand, lack of fuel and good grazing make life hard for the local population.

It is difficult in many cases even to guess what the original vegetation of a particular area has been. Most probably the evergreen oak forests of the Zagros Mountains in the west and southwest of Iran have had a much wider extension into areas which are now covered by dry steppes. Juniper forests may have played an important role in many rather dry mountainous areas where not a single tree can be found at present. In the central plateau and bordering mountains, species of *Pistacia* may have formed open forests over rather wide areas now giving the impression of being sub-deserts. Many shrubs must have formed thickets giving a completely different outlook to the present day landscape. Also many different natural steppe associations which have disappeared or exist only as more or less strongly altered remnants must have given a rather luxuriant impression compared to the depressing uniformity of the *Peganum harmala*—or *Alhagi camelorum* —stands of today. A more detailed description of the vegetation of Iran is given by Zohary (1973).

At present there is an intensive study of the flora of Iran going on with Vienna as the main centre. Here 'Flora Iranica' is published with Professor K. H. Rechinger, the leading authority on the flora of Iran, as the editor and main contributor. So far 110 families have been published (Rechinger 1963-), 10 more are in print and a number in preparation. Probably a little more than half of the species have been treated. But Iran is a vast country with a flora probably consisting of some 6, 000 species, so we are still very far from having the detailed knowledge of the flora that we have in e.g. Britain, Central Europe and Scandinavia. Obviously nobody has a chance of really knowing at this stage what species of the flora are endangered and what species may already have disappeared.

ENDANGERED SPECIES

The different species that make up the flora of a given area may, apart from natural reasons, disappear because certain habitats are being cultivated,

because of overgrazing that alters the competitive conditions, or, for trees and shrubs, because of a combination of cutting and grazing that makes regeneration impossible. At the present level of destruction in Iran there is no doubt that many species are endangered or have already disappeared. It is interesting to note that a number of species—even conspicuous ones—collected in the last century and in the beginning of this century are known only from the type specimen or a few herbarium sheets. Several explanations may be given but one could be that grazing is so much more heavy now that these plants have become very rare. As the flora of Iran is very rich in local endemics with rather specialized habitats, the danger that such species will disappear under the present circumstances is great.

A very spectacular lily (*Lilium ledebourii*) is one of the very few species of Iran which we feel is really endangered. It is at present known from only one locality in Iran, in the province of Gilan. Outside Iran it is known only from the neighbouring areas of Lenkoran of the Soviet Union. Growing among grazed shrubs about 1200 specimens are scattered over an area of about 1 sq. km. Visiting the locality in 1974, we found that all tops of the plants projecting beyond the shrubs had been bitten off so that not a single capsule was developing. Intensified grazing or cultivating of this land close to a village would easily lead to the lily disappearing. Measures have been taken this spring (1975) to enclose a certain area and thus protect the lily. One also has to hope that this lily will be found in other places.

Some species may be endangered due to local use of them as food, medicine or as sources of other useful products. Corms of native *Crocus* species, probably *C. haussknechtii* and *C. cancellatus,* are roasted and eaten by the local population. With their conspicuous flowers they are only too easy to discover. *Allium elburzense,* of the same genus as that to which leek and onion belong, is endemic to the central part of the Elburz Mountains. It was described botanically only a few years ago but is obviously well known to the local people who use the leaves for salad. Although as a specialist on the genus I have only come across it as scattered specimens in the field, it is sold in great quantities in the bazaars of Shemiran of northern Tehran.
During early summer one will find in the bazaars and florist shops of Tehran the beautiful yellow, pink or white spikes of *Eremurus stenophyllus, E. persicus* and *E. olgae* respectively, offered for sale in great quantities. It is said that *E. persicus* which not too many years ago was a common plant around Esfahan has now become scarce. Lorry loads of these plants are dug up and sent to Tehran. There is a parallel to what happened to be the most popular of all spring flowers in southern Sweden, the early little blue-flowered *Anemone hepatica,* which due to over-collecting disappeared completely in many places around the big towns and finally had to be protected by law. This commercial collecting is already a problem, depriving the countryside of a colourful feature, and one should try to stop the sale of these plants. But things may get worse. Commercial collecting on a large scale of bulb plants for export has long been a problem in Turkey. Professional collectors by help of locally hired workers have virtually cleared large areas of bulb plants which were, and still may be, exported by lorry loads. Iran is rich in species of genera like *Tulipa, Fritillaria, Eremurus, Hyacinthus,Iris* and others which are very popular among gardening plant lovers. It might be wise to establish regulations against large scale collecting and export of such plants before the problem arises.

BOTANICAL ASPECTS OF PROTECTED AREAS

Through great foresightedness the Iranian authorities have during the last

years protected enormous areas, near to 8 million hectares, in different parts of the country (Firouz 1974). Iran is in this respect well ahead of other countries of South West Asia. The protection has within a short span of time resulted in a remarkable recovery of the animal life (Firouz 1974). As regards flora and vegetation the documentation is however, regrettably poor.

During 1974 the author had the opportunity to make several short trips at different times of the season to two of the more interesting of the protected areas, the Kavir Protected Region and the Mohammad Reza Shah National Park. Both areas are now uninhabited and all grazing and collecting of fuel has been stopped for several years. It may be of interest to take a look at what is happening with the flora and vegetation of these two areas.

The Kavir Protected Region (ca. 610,000 ha), situated on the north-western margin of the Kavir, the great central desert of Iran, was in a very poor state when the protection was established (Firouz 1974; 13). This was due to overgrazing by camels, sheep and goats and collecting of plants for fuel and other purposes. Superficially the vegetational cover was more or less gone. The area is very hot during the summer with temperatures reaching well above 40 °C, and it has a low rainfall (exact figures are not available). The altitude varies from 700 m up to the 2015 m summits of the Siah Kuh Mountains. There is a great variation in habitats: salt flats, sand dunes, gently undulating country with more or less gravelly soil, lava rocks and special soils rich in gypsum or iron as well as wet ground around a number of springs with brackish water. A provisional list of the flora of the area contains 270 species of higher plants (Rechinger and Wendelbo, in preparation) and there is reason to believe that the total number will rise to more than 300 when the whole area has been properly investigated.

During the years of protection the vegetational cover must have changed immensely. Seeing the area now one gets the impression of varied vegetation and a rather rich flora—natural conditions taken into consideration. In April-May especially, the many annuals make a colourful display. There was, however, a remarkable difference between the number of annuals in 1974, which was a good year, and 1975, which had a dry spring and delayed rains. The autumn aspect with large areas green from the many chenopods is fascinating.

Large flats with a distinct white salt crust have a vegetation of scattered low shrubs on small mounds. The main part of these shrubs are *Halostachys belangeriana* of the Chenopodiaceae, but there also occurs one still not identified species of each of *Sueda* and *Tamarix,* of similar size and habit as the *Halostachys.* The latter at present reaches a height of 1. 5 m and has woody branches 2-3 cm in diameter. Left undisturbed it may develop into a small tree of 3 to 4 m. The villages, outside the area, are not far away and undoubtedly these shrubs once were a valuable source of fuel, but uncontrolled use nearly made them disappear. An interesting lesson to be learned is that what appears to be an extremely bare landscape probably could produce a certain and continuous supply of fuel if treated with care. The production per hectare and year may not be large but under such circumstances little is certainly better than nothing.

It will be interesting to follow the development of this *Halostachys* association, partly to see at what speed and to what ultimate size the individual shrubs grow, partly to see whether other plants gradually will fill the area between the shrubs now practically devoid of plants. Information of practical interest to be gained is naturally how the plants occurring on these salt flats can be used in the regeneration of vegetation on similar and otherwise completely useless land in other, populated areas.

A comparatively large area with sand dunes ESE of Siah Kuh also gives the impression of a remarkable regeneration of the vegetation. Some years ago this area was nearly devoid of plants and the sand was on constant move. Today a number of shrubs and herbs are becoming established, seedlings are sprouting everywhere and the vegetational cover has already become dense enough to stop most of the shifting of the sand. The main shrubs are saxaul (*Haloxylon persicum* and *H. aphyllum*) now reaching 1. 5-2 m in height. The shrubs are of young age with stems not reaching more than about 2-3 cm in diameter. *Haloxylon persicum* may, according to Iljin (1936: 311) reach a height of 5 m and have a stout rugged stem, but *H. aphyllum* also may grow into a small tree. In the Soviet Union the saxauls form a kind of forest which, due to their importance as a source of fuel, is subject to a special branch of forestry. The wood is hard and heavy—sinking in water. In Iran the best charcoal is said to come from saxauls. Well grown specimens of saxaul are probably hardly to be found in Iran at present. Again, uncontrolled use of a plant has led to disastrous results—shifting sands and no fuel.

Among other shrubs of importance in this sandy area can be mentioned *Astragalus squarrosus, Calligonum persicum* and *Salsola arbuscula,* all white-stemmed shrubs reaching from 0. 5 to a little more than 1 m in height. Seedlings of these are plentiful. A number of herbs may be equally important to stabilize the sand. Especially frequent is the small tufted grass *Stipagrostis plumosa,* a most beautiful plant with its long silvery white awns waving in the wind (cf. Firouz 1974: photo p. 13). Also the larger *Stipagrostis pennata* and the two perennials *Convolvolus eremophilus* and *Haplophyllum glaherrimum* are important. Interesting are the rather numerous annuals belonging to the Cruciferae, Boraginaceae but above all the Chenopodiaceae: *Horaninovia aptera, Cornulaca leucacantha, Anthochlamys multinervis, Agriophyllum minus* and *Salsola* cfr. *aperta.* How and where could all these species survive the former hardships? We shall never know which ones did not survive. In different parts of Iran a lot of foreign plants are being introduced to stabilize sand dunes. Why not take the trouble to really study the native plants and their possibilities? One should also not forget that annual and perennial herbs could be as important as the shrubs.

In the lower part of gently sloping ground with gravelly soil a rather pure *Seidlitzia rosmarinus* association gives the impression of good recovery. *Seidlitzia,* a low shrub of the Chenopodiaceae, was used for making soap and most probably also collected for fuel. Wide stretches of more or less flat ground with stony-gravelly soil is dominated by the low shrubby *Artemisia 'herba-alba'.* On the slopes of Siah Kuh, the central mountain range of the area, the man-sized broom-like *Amygdalus scoparia* is plentiful in small valleys. Here and there one may also find small stunted specimens of *Pistacia khinjuk* and *Celtis tournefortii.* These two latter small trees are especially important as they indicate that once the slopes of Siah Kuh may have had an open forest or at least copses in the most favourable places. The forest had no chance to survive as the nearby caravanserai needed a lot of fuel.

The Mohammad Reza Shah National Park (ca. 92, 000 ha), situated in Gorgan in northeastern Iran, is very different from the Kavir Protected Region due to a much higher rainfall. Much of the area is covered by broadleaved decideous forest with oak (*Quercus castaneifolia*), hornbeam (*Carpinus betulus* and *orientalis*), *Zelkova crenata,* several species of maple (*Acer* spp.), linden (*Tilia begoniifolia*), elm (*Ulmus* sp.), *Parottia persica* and several others. When the area was protected the forest was still intact and the trees are in many parts of considerable size and age. Firouz (1974: 40) recorded 'zelkovas,

oaks and maples between 450 and 500 years old and over 40 metres high'. The species must be *Zelkova crenata, Quercus castaneifolia* and *Acer velutinum.* The forest in many parts gives the impression of being virgin.

In drier places in the higher regions one finds forests or rather remains of forests of juniper (*Juniperus excelsa*). Still one can see how these trees have been badly destroyed by cutting of stems and branches. In the open stands with no protection against the burning sun the seedlings seem to have great difficulty in establishing themselves, and regeneration must be slow.

In the driest part of the Mohammad Reza Shah National Park the dry steppe dominated by *Artemisia 'herba alba'* is the most frequent community. Compared to grazed neighboring areas it is obviously doing very well and one starts wondering what the climax vegetation will look like; maybe the juniper will gradually cover this area also. The flora in spring and early summer is colourful and rich with many species of *Astragalus* (the largest genus in Iran), spiny *Acantholimon* and *Acanthophyllum* and thistlelike *Cousinia,* all typical Iranian genera. Especially impressive is the more than 2 m tall *Dorema hyrcanum,* one of the Umbelliferae. There are a number of bulb and corm plants like *Tulipa micheliana, T. montana, T. polychroma, Fritillaria gibbosa, Gagea reticulata, G. chomutovae, Allium turcomanicum, A. rubellum,A. helicophyllum, Eremurus inderiensis, E. kopetdaghensis, E. olgae, Crocus michelsonii, Iris kopetdagensis, I.fosterana, I. acutiloba* ssp. *lineolata.* Many of these species were thought to be rare, and a species like *Tulipa micheliana* may become rare again due to a somewhat surprising threat. The numerous boars obviously find the bulbs of this species a great delicacy and dig them up in great quantities.

In higher areas, 1600 m and above, the small valleys have copses of a small-leaved maple (*Acer turcomanicum*), a wild species of pear (*Pyrus boisseriana*) and 2-3 species of each of bush honeysuckle (*Lonicera*), hawthorn (*Crataegus*), *Cotoneaster* and *Rosa.* In these copses one also finds an otherwise rare plant like *Fritillaria raddeana—a.* close relative of the crown imperial—by the thousands. The open slopes have a dense cover of grasses and herbs. It is really a most unusual experience for a botanist in Iran, or any other part of South West Asia for that matter, to literally wade in vegetation. The composition of the flora, however, still shows a clear influence of man.

Just as the snow is melting a beautiful little orange-yellow brown-striped crocus (*Crocus almehensis*), endemic to this park, is flowering together with the deep purplish *Iris reticulata* and the pale bluish *Hyacinthus litvinovii,* sometimes coming right out of the snow.

A transitional zone between the deciduous forest and the dry steppe at present has a dense impenetrable cover of the terribly spiny shrub *Paliurus spina-christi.* It is possible that this zone was covered with hornbeam which was destroyed by cutting and grazing. Then the steppe took over. After grazing was stopped the deciduous forest could not regenerate and *Paliurus* got its chance. Gradually this shrub will give shelter and shade for young growth of the trees and be replaced by them. Similar conditions we find in the inner drier parts of many of the valleys leading to the Caspain.

From a botanical point of view it is promising indeed to see the result of only a few years protection from grazing. But it is very important that this is followed up by an intensified botanical study of at least a selected number of the protected areas. The flora must be properly recorded by competent taxonomists. This is of basic importance for work on recording the different stages in the development of the vegetation, mapping of vegetation as well as

ecological and detailed sociological studies. The naming of plants has to be done in collaboration with a herbarium with a series of specialists on the larger and more difficult groups like *Astragalus, Cousinia, Acantholimon* and *Gramineae* to mention some. No single botanist can manage to cover all these groups and give reliable names.

What is lost of the flora and of vegetational types one can never get back, but there is reason to believe that within the protected areas spread all over Iran, climax vegetation near to the original one (climate has probably not changed very much for thousands of years) will gradually develop. Due to the serious destruction of the soils this will, however, take many years. Endangered species will again flourish and get a chance to spread into neighbouring areas.

With the clear policy drawn up for the protected areas by Firouz (1974) in his admirable little book, there is every reason to be optimistic as to the future of the flora and vegetation, now that they have good sized refuges.

CONCLUSIONS AND SUMMARY

Most of the vegetation of Iran has been changed very much and impoverished due to cultivation, cutting and especially overgrazing which has reached an intolerable level. Little is known about what would be the climax vegetaion of the different areas.

The study of the flora has not yet reached a level where one can tell which species are really endangered, although there are indications that some may be. Certain plants are overcollected because of their value for food. Regulations should be enforced to at least stop large scale commercial collecting of decorative plants. Special problems are connected with the many local endemics which easily may become lost if their habitat is disturbed in some way.

Extensive areas have recently become protected. Visits to the Kavir Protected Region and the Mohammad Reza Shah National Park show a promising and remarkably quick recovery of vegetation and flora when grazing has been stopped. One will, however, never know what became lost during the previous periods of destruction. The present protected areas should be supplemented with some smaller areas that are known to have a rich flora, are rich in endemics or have unusual ecological conditions due to, for example, special soils or rock like gypsum and serpentine. These latter areas often have very specialized or unusual endemics. All the protected areas will function as natural refuges and gene banks, where different vegetational types, local species and special gene combinations of more widely spread species are conserved. They will form nuclei for spreading of plants into surroundings areas. They may also become of practical importance providing gene material for future breeding programs in agriculture, horticulture, forestry and pharmacology.

Studies of the regeneration of vegetation under different conditions will certainly be of importance for reclamation of land in other areas. Using a variety of native plants in the right way might give interesting results, avoiding use of foreign plants and chemicals.

The protected areas will have great educational value as demonstration areas for students in different fields and in educational programs for farmers and nomads especially if, as planned, these areas are supplemented with areas of controlled grazing.

More attention should be paid to the botanical aspect of the protected areas from the recreational point of view. Booklets showing the more conspicuous species should be provided for each of the areas.

In order not to split the available resources, it is proposed that the scientific study of the flora and vegetation should be concentrated to a few selected areas like the Kavir Protected Region, the Mohammad Reza Shah National Park and possibly the Arjan International Reserve. The study of other areas will then have to be taken up later. The importance of having a good staff of taxonomists to do the basic work of collecting and naming plants must be stressed. It is a simple but much neglected fact that work on ecology, sociology and mapping becomes meaningless if the plants involved are not correctly named.

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Session V (continued): CONSERVATION OF ANIMAL AND PLANT SPECIES

Background Paper No. 17

New Developments in Wildlife Conservation for South West Asia and the Middle East

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In considering ecological guidelines for wildlife conservation, it is helpful to remember that deliberate action to attain wildlife conservation is a form of management, and that managerial data-handling and decision-making techniques have shown significant advances in the past few years. Our ecological guidelines then, should not exist in a vacuum, but should be so conceived as to constitute integral parts of the managerial process. In the past, conservation biologists underestimated the validity of their own information, and overestimated that of the various sorts of managers who daily made the decisions which affected the landscape—the landscape which comprises the total of all wildlife habitats. Now, methods are rapidly developing for the integrated manipulation of data of quite different sorts: for example biological, sociological and economic (Anon. 1974). It is the responsibility of the biologist to provide quantitative data, but I believe that one should go further and provide qualitative judgements as well. The following discussion, which stresses some new developments relevant for wildlife conservation management, is directed toward that end.

The great twin problem of the present era is to work out a viable long term relationship between human populations and their habitats such that man's biotic associates do not perish in the process. One contribution to this effort is the continual search for concepts and techniques, wherever they may have been developed, which are applicable to a particular geographic region: in our case South West Asia and the Middle East.

The present review, then, draws what seems novel and relevant to wildlife conservation in arid and semi-arid regions into a broad framework, from which it attempts to develop useful generalizations as guidelines for a comprehensive and effective programme of wildlife conservation beginning with biology, recognizing cultural elements, and finally seeking integration in a planning framework.

THE UNIT OF SPACE/HABITAT IN WILDLIFE CONSERVATION

The biology of wildlife populations established the geographical framework which each population requires for survival. That wild animals do not recognize political boundaries is a truism, but it is frequently forgotten that they do not recognize ecological boundaries either. There are two reasons for this: seasonal needs and learned behaviour; our first practical possibility today is to let the population tell us how it uses the landscape, to follow the movements of marked individuals. From studies of banded waterfowl in North America, for example, we know that many species depend upon not a national, but a continental range, within which sub-populations with different management prob-

lems exist. Similarly, waterfowl nesting in subalpine and subarctic parts of Asia, winter in warm lowlands within our immediate region of discussion.

On a smaller continental scale, the houbara bustard (*Chlamydotis undulata*) nests in one group of nations, and winters in another. Threats to the continued existence of this species could potentially be found in either seasonal habitat, or on the migration route that links them together.

Each seasonal habitat is really a mosaic of habitat fragments. As a habitat is further fragmented, the sub-populations within those fragments become separated from one another, and each sub-population contains fewer individuals. It is as if each sub-population lived on an island. As time goes on, some islands disappear, others grow smaller. Genetic pathologies of smaller populations begin to crop up. These are counterbalanced by the passage of 'new blood' from one population to another. But the ability of individuals to move from one population to another depends on their degree of mobility, the distance separating the islands, and the presence of connecting bridges.

These considerations have recently been brought together in a useful conceptual and mathematical framework as a theory of island biogeography (McArthur and Wilson 1967). Developed from data on oceanic islands, these concepts have been applied to isolated mountain peaks and, more and more, to isolated units of habitat on the mainland. Briefly, it is generally found that small islands and islands distant from others support the fewest animal species. Smallness apparently has an effect in itself, and not only through a reduction in habitat diversity. This is an unexpected finding. Also unexpected is the high rate of extinction of island populations. As a recent reviewer says (Simberloff 1974:178):

> '... local extinction and immigration are relatively frequent events. Both species number and species composition result from interactions of several concurrent equilibria, though departures from one or more of the equilibria frequently arise from singular events such as introductions or geological changes.'
>
> 'Even more important than an increased understanding of oceanic island biotas is the realization that many habitats are somewhat insular and their biotas are in equilibrium just as are those of oceanic islands. We can therefore use island biogeographic theory to further our understanding of a variety of evolutionary and ecological phenomena, and even to aid in the preservation of the earth's biotic diversity in the face of man's ecological despoliation'.

When we conceive of an island population of a species as but a part of a larger whole of the range of that species, we see that the relations of that island population to the total population have a great deal to do with whether the island population does or does not survive. In practical terms, this may mean that for some species in a particular well-guarded ecological reserve, let us say, there is no real hope for survival unless the reserve is enlarged or travel-ways linking the reserve to other parts of the species range are maintained.

The mechanism which predisposes a population for extinction or survival is genetic. If the environment is highly stable, it is advantageous for the individuals to produce uniformly highly adapted young. In such a population there will be a low amount of genetic variability (heterozygosity). If, however, the environment is unstable, or shifting in character, then there is a premium on genetic variability, which increases the chances that some of the young will be adapted for the new conditions (Chitty 1967).

Genetic variation is manifested in many ways, including the morphological characters which have long been used in taxonomic discrimination. But morphological characters are also influenced by such immediate factors as nutrition, so that the genetic effects tend to be confused with a great deal of biological 'noise'. Some measure which strikes closer to the gene would be more useful. Genes function by influencing enzyme systems in a highly specific way. A measure of variation in a given enzyme, then, is a direct measure of gene function, and a direct reflection of gene potentiality. Variability at one genetic locus is reflected in variability within an enzyme function. Variability within an enzyme function can be measured through electrophoresis (Smithies 1955) combined with chemical staining methods (Hunter and Markert 1957).

In the populations of plants and animals that have been studied, it has generally been found '... that a high level of genetic variation is maintained as a normal equilibrium condition ...' (Bonnell and Selander 1974: 908). For example, in the southern elephant seal *Mirounga leonina* (McDermid *et al.* 1972) found five polymorphisms among 18 proteins sampled for each of 42 individuals.

In contrast, a population which has been seriously reduced may suffer a loss of genetic variation. The northern elephant seal *Mirounga angustirostris,* sampled for 21 proteins from each of 159 individuals, displayed not one polymorphism (Bonnell and Selander 1974).

Another application of this method is to trace genetic changes within a single population. For example, Redfield (1973) found that the level of genetic variation among yearling blue grouse (*Dendragapus obscurus*) increased with population density, as populations built up on new habitat. This could be interpreted to mean that genetic variation is associated with ability to colonize successfully, an important consideration in selecting stock for transplantation.

Other applications of genetic information to conservation problems would be the interpretation of the relation between population size and genetic variation, and the biological effects of 'joining' isolated populations through genetic exchange.

The space frame for one species is continental, for another regional, for another local. That much is apparent today. With time and work, particularly with individually marked animals, the understanding of the necessary space-frame for effective conservation can be improved everywhere. At present the use of tiny radio-transmitters is yielding such information in many parts of the world.

THE UNIT OF TIME/GENERATION IN WILDLIFE CONSERVATION MANAGEMENT

There must be a time-frame, too, for wildlife conservation. For the survival of a population, the individuals must reproduce, and the habitat must be perpetuated. Conditions for reproduction and the establishment of young, both animal and plant, vary widely with environmental conditions. In arid and semi-arid regions, with their wide fluctuations in available soil moisture and ground-surface temperatures, this is particularly clear. In a recent workshop devoted to the interactions of herbivores and plants in arid lands, this concept was proposed as a principle of management.

The unit of time in management is the generation-length of the longest-lived dominant organism in the biota (*Taber 1975*).

This statement is useful as a first approximation. It focuses attention on the

need to replace each generation with another. The key event is not production of seed, but survival of young organisms to reproductive age. In arid lands this is often linked to the occurrence of unusually wet years.

Since management, including wildlife conservation management, is often concerned with production, the time-frame needs to be adjusted for optimum productivity. It is evident that in physiologically 'old' organisms, one observes a decline in vigor and productivity. This could have significant management implications. At the present time, for example, mule deer *Odocoileus hemionus* are generally declining throughout the western United States. This may well be linked to the senescence and resultant low productivity, of the woody plants which provide their winter forage. If the annual production of the plant, through flowers, fruits, or leafage (rather than the physical provision of shade or nesting sites), is important to the maintenance of the carrying capacity of the habitat, then the unit of time in management should not be the generation-length, but rather the time from seedling establishment to the end of optimum productivity. This is the rotational period of the forester, a value which tends to grow shorter as more is learned about productivity and the managerial techniques for its encouragement.

These considerations are not confined to arid lands, by any means. At the present moment, for example, a population of the snow goose *Chen hyperborea* is moving from its wintering grounds along the Pacific coast of North America to its nesting grounds on Wrangel Island, in the Siberian arctic. Year after year this population has shown a failure—virtually a complete failure—in reproduction. Each year the adults grow older. Each year some individuals die or become too old to breed. If there is not soon a successful reproductive year, this population will become extinct. And yet the annual exploitation of this population through shooting on the wintering grounds, has been continued. The management plan has been based on the unstated assumption that reproduction is successful every year. An improved management plan would have included the possibility of reproductive failure, and provided strong measures for protection of the broodstock through each year of the reproductive failure. Even though the loss of any given sub-population may not mean the extinction of the species as a whole it means the extinction of the traditions that have been instrumental in fitting that sub-population to its particular geographic range.

THE USES OF BIOTIC DIVERSITY IN WILDLIFE CONSERVATION MANAGEMENT

Thus far, we have developed two biological dimensions, space and time, and have seen that to deal effectively with problems in wildlife conservation we need to construct a managerial framework which gives ample scope to both. The next important consideration is species diversity. Each species is, to some extent, influenced by other species. Examples abound, including cases of competition, domination, transmissal of disease, predation and changing the habitat for better or worse. Any change in the population of one species will influence other species, in a ripple effect. For example, it might be doubted that predation upon an herbivore population would really have much effect on the biota as a whole, merely taking off some of the annual surplus. But field experiments have shown that predation, bearing most heavily on the dominant herbivores, permits less dominant herbivores to become more abundant (Paine 1966). The same principal can be applied to plants; grazing of dominants encourages increase in subdominants. Long ago Charles Darwin observed: 'If turf which has long been mown, and the case would be the same with turf closely browsed by quadrupeds, be let to grow, the more vigorous plants

gradually kill the less vigorous, though fully grown plants; thus out of twenty species growing on a little plot of mown turf (three feet by four) nine species perished, from the other species being allowed to grow up freely.'

From the foregoing it is evident that the opportunities for biotic manipulation—to achieve managerial objectives through the interactions between species-are greater the greater the diversity of the biota. This can be considered another ecological guideline: encouragement of species diversity is a high conservation priority. The more species survive, the greater the managerial possibilities for fruitful manipulation. Therein lies the pragmatic rationale for the prevention of biotic extinction, locally and globally. The economic and effective way to carry out managerial conservation is to guide existing ecosystems in desired directions.

An example of the uses of diversity has emerged over the past few years from intensive studies of food selection by herbivores in relation to the phenology of the various forage species. Usually, it is found that herbivores shift from plant to plant in a sequence which follows the pattern of sequential plant development. Herbivore choice depends upon the presence of a variety of plant species, and the ability to choose results in a higher plane of nutrition. It follows that the greater the species diversity, the greater the range of choice and the greater the nutritional quality of the intake.

From the biological point of view, there are no species which are intrinsically useless or undesirable. Conversely any species may on occasion come in conflict with particular human interests. The framework of wildlife conservation management should include solutions for these local pest problems. Interestingly enough, we find our entomological colleagues approaching the same position from the opposite direction. Chemical pest control has enjoyed many successes, but there have also been failures and a mounting public concern about contamination. This has stimulated interest in what is termed 'integrated control', which is described as follows (van den Bosch *et al.* 1971:378):

> 'Integrated control is a pest population management system that utilizes all suitable techniques either to reduce pest populations and maintain them at levels below those causing economic injury, or to so manipulate the populations that they are prevented from causing much injury. Integrated control achieves this ideal by harmonizing techniques in an organized way, by making the techniques compatible, and by blending them into a multifaceted, flexible system (Smith & Reynolds, 1966). In other words, it is an holistic approach aimed at minimizing pest impact while simultaneously maintaining the integrity of the ecosystem'.

Two things are evident: that this approach is as compatible to vertebrate as to invertebrate populations; and that the complexity of the ecosystem is a measure of the potential variety in mechanisms of control.

When the organisms which make up a biota have long been associated together, an equilibrium of sorts is established among them, an equilibrium frequently perturbed by climatic fluctuations and similar influences. Still, through study the biologist can learn how the parts and processes inter-relate and eventually be able to predict the consequences of various perturbations. Earlier, I suggested that biologists were better qualified to integrate such predictions in the managerial framework than they, in their modesty, supposed.

Now, however, suppose that a new dominant organism is introduced into the biota. This is not only a major perturbation, it is a new sort of perturbation. Its consequences flow not from long-observed phenomena, but from novel

phenomena, since it is itself novel and a part of the oscillations toward a new equilibrium. Similarly, the novel factor may not be a new organism, but a new sort of perturbation—a contaminant, perhaps. The point for our discussion is this: predictability has been weakened, and with it has been weakened the ability of the biologist to contribute usefully to the managerial matrix.

This has obvious negative implications for the introduction of exotic organisms. Case histories of the deleterious results of exotic introductions abound, but what is less frequently realized is the importance of time in permitting the establishment of new biotic equilibria and, with them, the potential for accurate and hence managerially useful predictions.

PLANNING DECISIONS AND WILDLIFE CONSERVATION

On a region-wide scale, one can plan for the general conservation of wildlife through such measures as the control of excessive depredations by humans and their domestic animals, by the restoration of watershed quality, by the encouragement of recovery from excessive use of plant communities and by the reduction of excessive contamination of environments. But since the individual wildlife species differ in their habits and requirements, the time inevitably comes when a given decision will favor one group of species and act against another.

Several recent developments contribute toward the resolution of this problem. The first comes to grips with the fact that there is a mosaic of administrative systems and objectives over any region, and that the pursuit of multiple objectives is compatible with this reality. For us, the region supports real or potential wildlife populations, and our objective of wildlife conservation should be integrated with other managerial objectives to the fullest possible extent. A first step is to display the array of systems and objectives. An example is provided by K. Miller (1974), who considers *Alternative Methods for the Management and Development of Natural and Cultural Resources to Achieve Primary Conservation Objectives* (see Fig. 1 overleaf). Such a scheme provides a broad regional framework while focussing on the nodes at which particular types of conservation objectives can be sought.

Beyond the general statement of the desirability of the simultaneous pursuit of different objectives, one comes to the particular situation in which a selection must be made between alternative decisions—the common condition of the natural resource administrator. Our example comes from the context of the management of publicly-owned forests in the U.S. Here there has long been a rule that 'multiple use' should prevail, but this rule in itself has not provided a basis on which to make every managerial decision. Wildlife values have been particularly difficult to deal with, since there are so many species and since so many different sorts of values can be attributed to them.

The forester has a number of managerial techniques at his disposal. These include such things as thinning, fertilization, the use of fire, the choice of species for replanting, reduction in 'weed' species, and so on. If his only objective is the maximum production of wood, it is easy for him to select the proper strategy. But when an additional objective is 'wildlife enhancement', he is frustrated. Obviously, the term 'wildlife' is too all-inclusive to be successfully treated in the managerial framework. One solution has been termed the *featured species* plan; here the broad term 'wildlife' is narrowed to 'featured species'. The featured species is chosen from the whole fauna which is potentially compatible with the landscape unit in question. Once it is chosen, of course, it will be found to be accompanied by a cluster of other species

Figure 1.
Alternative methods for the management and development of natural and cultural resources to achieve primary conservation objectives

Primary Conservation Objectives	Alternative Management Systems											
	National Park	National Monument	Scientific or Biological Reserve	Wildlife Sanctuary	Resource Reserve	National Forest	Game Reserves, Farms & Ranches	Protection Zones	Recreation Areas	Scenic Easements & Rights-of-Way	Cultural Monuments	Watershed programmes River Valley Corporations
Maintain sample ecosystems in natural state	+++	+++	+	+++		+	+	+	+	+	+	+
Maintain ecological diversity & environmental regulation	+++	+++	++	+++	+++	+++	++	++	++	++	++	++
Conserve genetic resources	+++	+++	++	+++		++	++	++	++	++	++	++
Provide education, research & environmental monitoring	+++	+++	+++	+++		+++	+	+	+++	+	+++	+
Conserve watershed production	++	++	++	++		+++	++	+++	++	++	+	+++
Control erosion, sediment & protect downstream investments	++	++	++	++		+++	++	+++	++	++	+	+++
Produce protein from wildlife; sport hunting & fishing						+++	+++					+
Provide recreation & tourism services	+++	+		+		+++	+		+++	++	++	+
Produce timber & forage on sustained yield basis						+++		+				+
Protect sites & objects of cultural, historical, archaeological heritage	+++	+				++			+		+++	+
Protect scenic beauty & green areas	+++	+++	++	++		++	++	++	+++	+++	++	++
Maintain open options; management flexibility; multiple use					+++	+++						+++
Stimulate rational use of marginal lands & rural development	++	++	++	++	+	+++	+++	++	+++	++	++	+++

+++ primary objective for management of area and resources.
++ not necessarily primary, but always included as an important objective.
+ included as an objective where resources and other management objectives permit.

which will also benefit from conservation measures directed toward it. Once agreement has been reached concerning the identification of the featured species, then an integration of the twin forestry and wildlife objectives in a single managerial plan becomes feasible (Zeedyk and Hazel 1974). The featured species approach to wildlife conservation deals with landscape units as they are managed for other primary purposes, and thus fits well with the holistic national mosaic of wildlife habitats described by K. Miller (above).

The question of how to choose the featured species from the array of possible choices has been approached within the land use planning context. Here the problem is to evaluate the relative importance of preserving or losing a particular biota through the preservation or elimination of a block of habitat (Garcia 1974). The system devised to deal with this problem produces a rating for regional importance. It assigns positive values for wildlife diversity, wildlife abundance, degree of rarity (i.e. regional uniqueness) and degree of interface (i.e. importance in conjunction with other units of habitat). The latter two categories are weighted more heavily than the earlier two categories. This system can readily be adapted to any particular cultural situation, with its particular scale of value. It can also be adapted to the choice of a featured species for any particular unit of landscape. This is done through recasting the four categories above in appropriate ways, so that they become: the ecological importance of this species through its influence on other species; the economic and ecological importance of higher or lower numbers of this species; the relative rarity of the genepool represented by this species; the potential of the landscape unit in question to provide for the total needs of the species.

It is obvious that the application of these decision-making aides will vary in scale, a large scale being necessary for one group of species and a small scale adequate for another. However, such groupings are relatively easy to establish. Once they are established, then the systems described, or others like them, will make possible the continuum of decisions necessary for effective wildlife conservation management.

SUMMARY

Ecological guidelines for wildlife conservation will be most useful if integrated with other human uses of the habitat. It is useful to have realistic frameworks for space and time, the former based on animal movement and population size, and the latter on generation or rotational span. Genetics of small populations, now more readily studied, have applications for dwindling, isolated habitats and their wildlife populations.

Alternative strategies in wildlife conservation are proportional to degree of biotic diversity, so that diversity is managerially desirable, both to increase and to control wildlife populations. Management success requires predictability, which is related to degree of biotic equilibrium; equilibrium is upset by addition of new species or new environmental pressures, and predictability suffers.

Integration of wildlife conservation with other sorts of management requires establishment of priorities, and is greatly facilitated by a focus of emphasis on particular wildlife species. Current methodologies toward these ends are described.

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Session V (continued): CONSERVATION OF PLANT AND ANIMAL SPECIES

Summary of Discussion

Several speakers stressed the urgency of action to conserve threatened species. The reduction of a species to very low numbers, aside from the physical threat of extinction, involved grave danger to its genetic integrity and the possibility of the survivors following a new evolutionary course in recovery.

Another subject on which there was general agreement was the urgent need for much greater effort in the field of plant conservation. Both papers on threatened species had referred to the high degree of endemism in several major areas of this region, and there was a serious danger of very considerable losses within the next decade unless speedy action were taken. **Prof. Wendelbo** drew attention to the further need for basic service institutions in botanical and related ecological studies. The present shortage of taxonomists in Iran and neighbouring countries was seriously retarding the speed with which botanical inventories could be compiled, as a basis for conservation effort and other scientific work. **Dr. Le Houérou** commented that taxonomists appeared to be in short supply even in Western Europe, and **Prof. Nader** stated that whilst the taxonomy of the larger vertebate animals in the Middle East was reasonably well covered, that of the smaller vertebrates was still extremely sketchy. **Dr.Shahriari** hoped that more Fellowships could be made available to fill these gaps in trained personnel.

Whilst recognizing the difficulty of maintaining small areas in an undisturbed condition, **Prof. de Vos** felt that much could be done to improve the conservation of threatened plants by the creation of a network of relatively small reserves in selected areas. **Dr. Bokhari** was dismayed by the absence of regeneration of *Quercus brantii* in the Arjan International Reserve and suggested that experimental plantations raised from seed collected from parent trees in the area should be considered. Similar experiments might be extended to *Juniperus, Amygdalus, Crataegus* and *Cerasus* spp. Other speakers took the view that whilst remnant natural forest or other vegetation existed, effort should be concentrated on promoting natural regeneration by more intensive protection or site manipulation before resorting to planting.

Prof. Barth suggested that where conservation of pristine nature was impossible, there could be considerable scope for restoring natural resources by incorporating the skills and potential of local people. The proposal would require careful planning and education. If human populations must be moved to meet conservation objectives, adequate compensation should be made to enable them to maintain their skills and re-establish an equivalent life elsewhere. It was the group and not separate individuals that were to be re-established and this involved a conscious effort to maintain the identity and life style of the group. **Dr. Lubani** strongly supported the statement in Dr. Taber's paper that ecological guidelines for wildlife conservation would be most useful if integrated with other human uses of the habitat.

Dr.Poore drew attention to the need for international cooperation in the protection of migratory animals, such as wildfowl in Asia, and of wild species subjected to excessive pressure through trade, such as the commercial collection of wild bulbs and corms in Asia Minor. He stressed the importance of government adherence to the international conventions on Convention on Wetlands of International Importance, Especially as Waterfowl Habitat (Ramsar, 1971) and International Trade in Endangered Species of Fauna and Flora (Washington, 1973).

Ecological Guidelines for the use of Natural Resources in the Middle East and South West Asia

1. Each country should prepare and publish widely policies for the sustained wise use and restoration of its renewable natural resources, and should give firm political support to implement these policies.
2. Capability should be assessed separately for each possible use or value of land, for example: potential for mineral extraction, agriculture, timber production, range management; suitability for settlements, roads, dams, tourism; intrinsic value for conservation as examples of ecosystems, to preserve genetic resources of plants and animals, as beautiful landscapes, or as sites of historical or archaeological value. Conservation of soil, water, vegetation cover and genetic diversity must be an essential consideration. Any further constraints on particular forms of land use should also be identified.
3. Except where it can be shown to have been absent, human activity should always be taken into consideration as an integral component of ecosystems and of ecological processes, and the human component of an ecosystem should be seen as a product of the history of human adaptation in a larger ecological context.
4. Parallel and comparable to the need to conserve genetic diversity in flora and fauna is the need to maintain diversity in human land use systems. Every effort should therefore be made to avoid measures that would involve the displacement or disintegration of viable populations. Further, where such displacement or disintegration is unavoidable or inevitable, the land use system, environmental knowledge and heritage of the human population should be carefully considered in its rehabilitation.
5. Before embarking on any programme of use of conservation of natural resources it is desirable to conduct in-depth research on:
   (a) the attitude of the affected human population towards various aspects of their environment so that the significant environmental variables are properly identified; and
   (b) on the perception of environmental hazards, be they natural or man-made, so that the measures of loss and benefit employed by the population affected by these hazards are identified and evaluated.

   In such researches, geographers, anthropologists, social psychologists and other specialists involved in perception studies must be associated, if locally available.
6. When they are not already available, national and regional resource surveys should be undertaken as soon as possible to provide the facts, for example: on social and cultural resources and existing land use systems of the region, climate, topography and land form, soils, vegetation, flora and fauna, mineral resources and hydrology. These surveys should be interdisciplinary and should lead to the formulation of integrated development plans, according to the potential of the land.
7. Where slopes are so steep or unstable that disturbance would lead to soil erosion and accelerated runoff, protection must be the primary aim of management. Such areas may be used for harvesting forest produce or

other use (in accordance with Guideline 5), provided it does not interfere with the primary function of protection.

8. In considering any change of land use or management within a catchment, prime consideration should be given to effects on the quality and quantity of water and the periodicity of discharge.
Adequate provision must be made for safeguarding and perpetuating water supplies for domestic, food, power and industrial requirements.

   Multiple use of the water resource should be consistent with the objectives and provide for present and future fishery, wildlife and recreational needs.

9. Where there are areas which are ecologically or historically outstanding, their protection should have priority, as far as possible, over other forms of land use; examples are significant archaeological sites or high concentrations of endemic plants.

10. Development of land should be planned within the constraints that are set by fluctuations of climate.

11. Every effort should be made to learn the maximum from the history of human adaptation in an area (through intensive research in the disciplines concerned with human adaptation, e.g.human biology and anthropology) before the introduction of exotic components and of ready-made solutions derived from work on related problems in alien areas. Careful attention should be paid to possible factors of human physiological adaptation to climatic extremes, properties of soil and water, and microflora and parasites.

12. As local use by man of natural resources such as medicinal plants, for example, is based on an intimate knowledge of the environment and such knowledge has been accumulated through generations, great care should be taken to record, document and evaluate this information for possible future use.

13. Since the morale of a population is a significant component in its ecology, every effort should be made to associate local populations in the planning and implementation of programmes aimed at the improvement of their habitat.

*14. Every effort should be made to encourage the concentration of dispersed human populations in hilly and arid zones, by discouraging emigration to towns and cities, and increasing the range of economic opportunities and social services in rural areas.

15. Efforts to restore increased biological productivity to degraded land must be done in such a way as to retain and develop traditional users' skills, so that they can use the areas once restored.

16. Interdisciplinary preinvestment studies, 'environmental impact assessment' or other appropriate means, should be used to evaluate the likely

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* The original Guideline prepared by the Drafting Committee read as follows: Every effort should be made to maintain and, in some cases, increase the degree of dispersal of human populations in arid zones, by discouraging emigration to towns and cities and increasing the range of economic opportunities and public health facilities available in rural areas.

IUCN and FAO representatives and some other technical advisors were unable to accept the Guideline as reformulated by the meeting.

effects of alternative courses of action on the region in question and its peoples.

17. New settlements, roads, industry, engineering works and other such development should, as far as possible, be sited in areas where:

    (a) environmental conditions are most favourable for them;

    (b) their local effects can most successfully be absorbed.

*18. Every effort should be made to see that development in an area is started with such skilled manpower as is available and that the project is maintained satisfactorily when it is completed.

19. Arrangements should be made, as part of the planning process, to monitor and evaluate the results of any major development and the effects caused by it. The results of this evaluation may be used, if necessary, to modify the course of development and will provide experience to guide future ventures. Significant variables should be observed and the effects of development evaluated.

20. When planning for any change of use in existing range lands, through extending agricultural activity, inserting new watering points for stock, or adopting measures which involve changes in settlement pattern, very careful consideration must be given to the effect of these measures on surrounding range lands.

21. Reafforestation should be clearly recognized as a means of rehabilitating degraded rangeland. Trees and shrubs can provide, during droughts, fodder of high protein content that is palatable to livestock; they may ameliorate micro-climate, reduce wind and water erosion and provide shelter for man and stock; they can protect and improve soil fertility and structure; and can provide fuel and building materials. Irrigation may be considered for the establishment of shelter belts in areas with low water tables.

22. Where vegetative cover is threatened by the collection of shrubs for fuel, measures should be taken to establish, in the environs of villages, stands of trees and shrubs for domestic fuel needs, and to regulate their exploitation.

23. Where the modification of land use patterns or natural ecosystems involves translocation of animal or plant species, due consideration should be given to such factors as the role of animal vectors in the transmission of diseases and parasites.

24. Species of animals and plants that are considered to be under threat of extinction should receive priority in conservation programmes. National development plans should take strict account of areas in which these species occur and avoid, or seek to reduce, all forms of interference and disturbance of these sites.

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*The original Guideline prepared by the Drafting Committee read as follows: Before any development is started, care should be taken that the resources of institutions and of skilled manpower are available to carry through the development to sufficiently high standard, and to maintain it satisfactorily when it is completed.

IUCN and FAO representatives and some other technical advisers were able to accept the Guideline as reformulated by the meeting.

25. Early consideration needs to be given to the compilation of national inventories of threatened species of animals and plants, which should include international co-operation in compilations of regional and international inventories. These lists will serve to identify not only individual species in need of action to ensure their survival but also biotic communities of particular ecological significance that require study and protection.

26. Where inventories of certain classes of threatened species already exist, as in the case of world threatened vertebrates, Governments should, as a matter of urgency:

    (a) provide legal protection for these species, with adequate provision for enforcement of the law;

    (b) reserve samples of the species' habitat of sufficient size to maintain the integrity of the area in perpetuity and provide for year-round movement of the species; and

    (c) initiate ecological studies of the species to guide management practices and additional rehabilitation programmes, as necessary.

27. Where inventories of certain classes of threatened species do not presently exist, as in the case of most plants and lower animals, Governments should establish a range of reserves to cover major natural vegetation types, which will provide sanctuaries for samples of most of their fauna and flora within their national boundaries. Particular attention should be paid to known centres of endemic species. This reserve system can be subsequently enlarged and refined as inventories of threatened species are compiled and additional areas for conservation attention are consequently identified.

28. Uncontrolled commercial collection of bulbs, rhizomes, and roots of wild plants for food, medicinal, decorative, horticultural or other purposes can threaten this resource. Collection should be regulated and, in the case of rare species, should be prohibited.

29. A high priority should be given to the preservation of faunal and floral components of all ecosystems. To that end, policies should be established to preserve viable populations of all native plants and animals, and reserves should be created to encompass substantial samples of representative plant and animal communities.

30. Reserves should be of sufficient size to ensure that genetically viable populations of the fauna and flora can be maintained, and should have boundaries which will ensure the integrity of features within them.

31. In the creation of reserves, special attention should be paid to zoning plans intended to ensure that long-range planning objectives will be met consonant with the designated purpose of the reserve and the optimum use of the land and the resource.

32. The wise use of waterfowl resources depends upon regional cooperation in order that wintering, staging and breeding grounds are protected. Accordingly, international agreement on the management of wetlands and waterfowl should be encouraged.

33. In management and/or rehabilitation of wildlands, first preference should be given to the use of native species of plants and animals as contributing to greater ecological stability. Exotic species of plants and animals should be discouraged unless they are proved to have qualities superior to those

of native species and justification for the introduction of such species is supported by proper ecological research.

34. The possibilities should be investigated of reintroducing species of plants and animals into areas from which they have disappeared. Reintroduction operations should be preceded by ecological investigations.

35. Poaching is a continuing problem and better law enforcement and education is required to solve it.

36. The physiology of wild ungulates in relation to the nutritive values of the flora should be studied to establish the nutritional requirements of the animals, on the one hand, and the capability of various plants to meet these requirements, on the other, in order to develop comprehensive guidelines for range analysis.

37. When an area has been protected, care should be taken to follow up, record and evaluate the changes that are occurring in flora, fauna and ecological conditions (soils, micro-climate, water relations, etc.).

38. Efforts should be made, based on statistical data, to forecast trends in use of national parks and other protected areas, in order to balance demands against the capability of the reserves to accommodate them.

39. Legal provisions for the harvesting of wildlife should pay particular attention to providing equal opportunities to isolated rural populations.

40. Each country should have a range policy in harmony with water development, soil conservation, social structure and training policy, and including marketing, legislation, fiscal policies and credit facilities. It should have an administrative structure sufficient to apply this policy.

41. Rational use of rangeland implies complementarity between range areas and cultivated land (both rainfed and irrigated). An important contribution to this complementarity should be the growing of fodder crops and also trees and shrubs that may be used for fodder. Such fodder production allows destocking, fattening operations, and the establishment of feed reserves for drought periods.

42. In order to facilitate the management of resources in bad years every effort should be made to maintain and increase the flexibility and range of economic options open to existing small isolated human populations in arid lands.

43. It is urged that wild genetic stock should be used to develop more adaptable and resistant hybrids and new domestic strains that could well make better use of the range resource.

44. Improper use of fertilizers may be hazardous. Its side effects require evaluation. These hazards can be especially significant in the vicinity of aquatic ecosystems.

45. Because of the known harmful unintended effects of pesticides and the danger of creating resistant strains of pests, broad spectrum and persistent pesticides should be replaced by more selective and non-persistent chemicals. Methods of biological and integrated pest control should be encouraged.

46. Where national policy determines that certain traditional uses of land are no longer viable, or where land use patterns have emerged which pose a threat to the ecological stability of a region, every effort should be made to incorporate the associated human populations into traditional and/or revitalized enterprises which are economically and ecologically valid.

Recommendations

1. Endorsement of Regional and International Recommendations for Conservation and Development in the Middle East and South West Asia

Being cognizant of recommendations made at recent regional or international meetings, namely:

FAO/UNESCO/UNEP Regional meeting on the formation of a co-operative programme on research training and management of grazing lands in North West Africa (Sfax, 1975)

FAO 7th Session of the Near East Forestry Commission (Baghdad, 1974)

FAO/UNEP Expert consultation and General conference on ecological management of arid and semi-arid rangelands in Africa and the Near and Middle East, EMASAR (Rome 1974 and 1975)

UNESCO Man and the Biosphere, MAB 3 International Working Groups on the impact of human activities on grazing land ecosystems (Montpellier, 1972 and Hurley, 1974)

UNESCO/ECOSOC Meeting on obstacles to development in arid and semi-arid zones (Paris, 1975)

UNEP/Iran Government Regional conference on de-desertification and arid lands ecology (Tehran, 1975)

Having examined the various recommendations that were made at these meetings that are of direct relevance to the main objectives of the present meeting; **The Meeting on Ecological Guidelines for the Use of Natural Resources in the Middle East and South West Asia,** at Persepolis, Iran, on 30 May, 1975

Endorses these recommendations and expresses the hope that they will be implemented, whenever and wherever possible, by UNDP/UNEP and the Specialized Agencies.

2. Regional and National Networks of Protected Areas

Noting the recommendations of numerous international meetings and, in particular, those of the UN Conference on the human environment (Stockholm, 1972), the 2nd World Conference on national parks (Grand Teton, 1972), the 11th General Assembly of IUCN (Banff, 1972), the 7th Session of the FAO Near East Forestry Commission (Baghdad, 1974), and IUCN/Iran Governments Regional meeting on marine parks and reserves in the Northern Indian Ocean, including the Red Sea and Persian Gulf (Tehran, 1975); **The Meeting on Ecological Guidelines for the Use of Natural Resources in the Middle East and South West Asia, at Persepolis, Iran, on** 30 May, 1975

Recommends that the countries of the Middle East and South West Asia should take urgent cooperative action to establish regional and national networks of protected areas covering all the most important ecosystems and natural areas in the region.

3. Range Development Centre for the Middle East

Recalling the recommendation of the FAO/UNEP EMASAR Conference (Rome, 1975) and of the UNEP/Iran Government Regional Conference on de-desertization and arid lands ecology (Tehran, 1975);

Taking account of the suggestion of the Imperial Government of Iran on the subject of range development; **The Meeting on Ecological Guidelines for the Use of Natural Resources in the Middle East and South West Asia,** at Persepolis, Iran, on 30 May, 1975

Endorses the proposal to establish a Range Development Centre for the Middle East.

4. **Training in Natural Resource and Environmental Management**

Convinced that insufficient training facilities and teachers in natural resources is one of the most serious constraints to the management and development of such resources in the Region;

Recalling recommendations on training in natural resource and environmental management made at meetings of the FAO Near East Forestry Commission (Baghdad, 1974), the UNEP/Iran Government Regional Conference on de-desertification (Tehran, 1975), the FAO/UNEP EMASAR General Conference (Rome, 1975) and the MAB 3 International working groups (Montpellier, 1972 and Hurley, 1974);

Aware of the need for increased numbers of trained peronnel at different levels of wild land management, and the necessity of developing regional training institutes;

Noting, with appreciation, the offer of the Pakistan delegation to make available the facilities of the Pakistan Forest Institute, at Peshawar, as a possible training centre for the region in forestry, range management, watershed management and wildlife conservation; **The Meeting on Ecological Guidelines for the Use of Natural Resources in the Middle East and South West Asia,** at Persepolis, Iran, on 30 May, 1975

Draws attention to the need for strengthening existing natural resource training institutions and the creation of new ones with the aid of international assistance and the organization of regional training courses and seminars on environmental management;

Recommends that training should include learning to work in interdisciplinary teams; and

Suggests that IUCN and other concerned international agencies should consider the availability of natural resource training facilities at the Pakistan Forest Institute, Peshawar, in their overall conservation programmes.

5. **Environmental Education**

Recognizing the vital significance of public awareness and support in environmental conservation; **The Meeting on Ecological Guidelines for the Use of Natural Resources in the Middle East and South West Asia,** at Persepolis, Iran, on 30 May, 1975

Recommends that environmental education should be emphasized throughout the different educational levels from school to university; and

Urges the use of the mass media (newspapers, radio, television) to illustrate the importance of natural resource conservation.

6. **Taxonomy**

Appreciating the basic importance of taxonomy for the applied sciences and the scarcity of taxonomists in the region; **The Meeting on Ecological**

Guidelines for the Use of Natural Resources in the Middle East and South West Asia, at Persepolis, Iran, on 30 May, 1975

Recommends that every possible support should be given to further education, training and research in this field and to the publishing of works that facilitate naming of plants and animals, such as keys for determination, regional monographs, floras, faunas, and so on.

7. **Regional Institute for Natural and Human Ecology**

Realizing that human activity is invariably an integral component of ecosystems and of ecological processes; **The Meeting on Ecological Guidelines for the Use of Natural Resources in the Middle East and South West Asia,** at Persepolis, Iran, on 30 May, 1975

Recommends that efforts should be made towards establishing a regional institution for training and research in natural and human ecology.

8. **Pesticides**

Aware of the environmental problems that can be caused by use of broad spectrum and persistent pesticides; **The Meeting on Ecological Guidelines for the Use of Natural Resources in the Middle East and South West Asia,** at Persepolis, Iran, on 30 May, 1975

Recommends that countries of the region should not use pesticides that are banned in the country of manufacture.

9. **Universities and Environmental Research**

Considering the importance of research in guiding environmental management;

Aware of the shortage of trained research personnel; **The Meeting on Ecological Guidelines for the Use of Natural Resources in the Middle East and South West Asia,** at Persepolis, Iran, on 30 May, 1975

Recommends that Universities should be encouraged to accept a greater role in environmental research and that co-operation between universities and resource agencies should be improved.

10. **Technical Improvements in Range Management**

Recognizing that technical improvement of range management may be achieved in many complementary ways; **The Meeting on Ecological Guidelines for the Use of Natural Resources in the Middle East and South West Asia** at Persepolis, Iran, on 30 May, 1975

Recommends that careful attention be directed to employment of the following techniques:

(i) range development through rotational or deferred grazing which adapts stocking rates to carrying capacity;

(ii) management of herds in association with range management (including improved nutrition, better health care, retention of an adequate proportion of males, proper culling and timely selling);

(iii) water development in conjunction and in harmony with the management of other resources such as rangelands, which will reduce dissent between owners of the water and land tenure;

(iv) use of crop and industrial residues (such as cotton seed cakes, peanut cakes, sugar molasses, bran, brewery draft and slaughter house

residues) in livestock feeding for meat production, fattening and to promote destocking;

(v) use of fodder shrubs and trees.

Resolution

The Meeting on Ecological Guidelines for the Use of Natural Resources in the Middle East and South West Asia, held at Persepolis, on 24-30 May, 1975, expresses its gratitude to the Imperial Government of Iran and to H.E. Eskandar Firouz, Director of the Department of the Environment, for the hospitality offered, the excellent arrangements made for the field excursions, and the technical preparations made for the Meeting.

It wishes to acknowledge the leadership role of the Department of the Environment in the Near East and South West Asia in regard to the protection and management of the natural environment, and more specifically the setting aside of an International Reserve, of National Parks and of other reserves.

In particular, it notes with appreciation the great increase in carrying capacity of protected areas and the valuable lessons that may be learned from these achievements in the more effective management of wild land to maintain its potential.

The Meeting recognizes the role that the Department plays in the training of technical and other personnel and the assistance it has given in this regard to Afghanistan, and it hopes that the Government of Iran will offer training facilities to other countries in the Region.

Appendices

Section 1

Conservation of Vegetation, Flora and Fauna as a Part of Land use Policy*

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Summary

The particular problems which face conservationists in South West Asia are outlined. The means available are discussed and a system of priorities similar to a land capability classification devised.

Aims

There are two possible ways of approaching an effective policy for the conservation of plants, animals and the complexes which they form: one of these is to conserve a representative sample of the various ecosystems which occur in any area; and the other to maintain a satisfactory population of all the taxa of plants and animals in the area, defining satisfactory as somewhere in that wide range of abundance between ensuring survival on the one hand and preventing the organism becoming a pest on the other.

A complete provision for conservation should include both of these elements. The former should enable the populations to be safeguarded of most of the smaller, more insignificant and lesser known organisms that cannot, from present knowledge, be safeguarded by the latter. And the second should provide for more widely ranging or migratory species whose requirements pass the bounds of single ecosystems. Both of these aims imply certain judgments of quality and quantity. How does one interpret representative? At what level of population is survival endangered or does an organism become a pest? What is meant by *all* taxa?

As all measures for conservation of wildlife** have an effect on and may often compete with other aims which human societies consider socially or economically desirable, these judgments cannot be made without considering briefly the purpose of wildlife conservation; and they cannot be divorced either from the social priorities and the land use of any country at any time.

Purposes of Wildlife Conservation

There are a number of reasons for advocating policies for wildlife conservation. Some of these are of general validity, others apply only to some situations; the importance given to each varies from society to society, but taken together they add up to a convincing case in all societies.

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*Reproduced from *Plant Life in South West Asia* (1971). Eds. Peter H. Davis, Peter C. Harper and Ian C. Hodge. Botanical Society of Edinburgh.

**Used as a convenient term to include all species of wild plant and animal and the ecosystems they compose.

As a Resource: In many areas of the world natural vegetation or populations of wild animals are still the most important natural resource for use by cropping or grazing. If used wisely they can produce a sustained yield with little input of capital and at the same time conserve soil and assure a sustained water supply. Much of the arid and semi-arid regions of south-west Asia fall in this category and, in a very large part of it, the resource—of forest, scrub, grazing-land and of mammals and large birds—has been very seriously depleted by misuse. The aims of conservation here coincide with those of good land management for the production of food and raw materials. At a later stage of economic development the sustained cropping of a natural resource is often replaced by artificial systems even in marginal areas—by reseeded pasture, or *Eucalyptus* plantations, for example. At this stage of technological advance, it often happens that changes in social outlook and economic opportunity make these natural areas valuable as an amenity—as an important element in the scenic beauty of a landscape (the spring flowers in the Mediterranean lands) or as an attraction for specialised tourism or recreation, as the National Parks of East Africa.

Scientific: The world in which we live is still substantially natural and wild organisms are an essential background to it. This is obvious in the large areas of land still occupied by natural or semi-natural vegetation; but it is also true in areas of intensive cultivation which depend on populations of soil micro-organisms for the continuing health of the environment and which can be greatly affected by the balance between pests and their predators.

The maintenace of diversity in ecosystems buffers them against violent oscillations. In short periods of time and in small areas this is a matter of keeping, as far as possible, a variety of organisms or a mosaic of communities; but, in the long term, stability will be increased and some insurance will be provided against violent changes by preserving in the world the greatest range of genetic variability to be drawn on as and when circumstances require.

It is also useful to look upon conservation as 'keeping options open'. The social and economic preferences and priorities of this generation or century are rarely those of the next; by ensuring effective conservation, one can also try and ensure that as wide a choice is open to future generations as is available to us.

Scientific study: An understanding of ecological processes is important if we are to be able to manage ecosystems and if we are to be able to predict the consequences of our actions. Apart from the intellectual stimulus of research in the processes of ecology and evolution, the understanding of these processes is becoming more and more crucial as our need to manipulate and manage natural systems becomes greater. Linked to this is the need for wildlife and natural situations as material for education.

Standards: Wild systems and populations can also be used as standards against which to measure changes. Their value for this purpose is increasing as the effects of man on his surroundings become more intense and more pervasive. Small areas of relict vegetation and soils, such as I have seen for example in various parts of Cyprus, can give a remarkable insight into how much has been destroyed over millenia by ill-advised land use and what could with time and care be restored. A knowledge of natural populations and their normal fluctuations can also give a standard against which to judge, for example, the effects of persistent organochlorine pesticides.

Ethical: Finally there is an ethical argument, that it is wrong and degrading to man knowingly to exterminate any other living organism—an argument which

might be deployed with different force however to the elephant and the crocodile, the Lady's Slipper Orchid or the plague bacillus!

The Problem of Conservation in south-west Asia

Taking a broad view, it is likely that there have been two revolutions in land use in South West Asia—the first in the Neolithic, the second taking place now. Before the Neolithic the land must have been covered by a pattern of zonal vegetation, forests, steppe, semi-desert and desert—a pattern shifting slowly in response to climatic change and geological and geomorphological processes; there would also have been smaller areas of azonal formations, cliffs, screes, sand-dunes, saline flats, marshes, etc. If we were to design a wildlife conservation policy for the area as it was then, it would have a very different shape from any that we might design today.

The millenia since the beginning of the Neolithic have brought a far-reaching dissection and modification of this pattern; the most important of these due to human activity though there has probably also been simultaneous natural climatic and physiographic change.

The kind of processes which have taken place are the following:

(1) The increasing dissection of the areas of original zonal vegetation thus restricting the free movement of populations within the original vegetation type.

(2) The modification of the original vegetation itself by cropping and disturbance which has altered its specific composition and its age structure.

(3) The cropping or altering of the balance in wild animals with presumed secondary effects on the ecosystem.

(4) The production of completely new types of secondary vegetation by regular grazing, burning or soil disturbance.

(5) A radical change in the proportions of different communities and the relative abundance of species, especially in areas of higher rainfall. Stable communities of relatively long lived species (for example the forests) have decreased and been replaced by communities regularly modified by interference, the 'climax' by the 'seral'. This has led to the formation of new combinations of species in readily recognised communities, to the increase of ephemeral plants at the expense of long lived perennials, and to the evolution of new taxa.

These events have certainly led to striking changes in the pattern of ecosystems, though the historical details are often uncertain and the relative contributions made by man and by changing climate are also by no means clear.

The hand of man can be seen almost everywhere in South West Asia. Wherever there are cultivable soils in areas of sufficient rainfall they have been cultivated; so have those to which irrigation water could be brought by the engineering ability of the time. Accessible forests have been altered and often destroyed by extraction of timber, burning and grazing. All land has been grazed except that which is so far from permanent or temporary sources of water that it proved impossible to keep flocks in its vicinity. Many of these operations have led to serious erosion and depletion of the resources of soil, water storage, vegetation and animals. During the course of it species have been exterminated and certain ecosystems have undoubtedly totally disappeared.

Up till the middle of the nineteenth century the extent of this change was limited by engineering ability, techniques of cultivation, transport, irrigation and the natural restraints of war, famine and disease on the growth of population. The remaining vegetation could then be grouped into four categories (as it still can be to a considerable degree): fragments of undisturbed zonal vegetation; fragments of undisturbed azonal vegetation, cliffs, landslips, unstable alluvia, marshes, fens, bogs, areas of impeded drainage, dry, unstable or infertile soils and other local and unusual conditions; vegetation composed mainly of native species characteristic of particular kinds and intensities of human activity—grazing, mowing, coppicing—in which the native fauna or flora is the crop; and weed vegetation incidental to the cultivation of an introduced crop.

Mutatis mutandis it is probable that the species and ecosystems present in the middle of the nineteenth century had been present in varying proportions for several thousands of years, and it would be realistic to use these rather than the presumed original ecosystems as the basis of our conservation policy; but it would be reasonable also to attempt to restore the presumed original cover in some suitable localities. It should be emphasized, however, that in many respects the ecosystems that survive are the accidental by-products of a long period of land use by man.

We are now in the throes of a second revolution in land use which is as far reaching in its effects as that of the Neolithic. It is this that makes it imperative to take action quickly by incorporating the needs for the conservation of ecosystems and of flora and fauna into national land use planning. The rationale for this is by no means straightforward, however.

The changes that are taking place in the countries of South West Asia now parallel those of the agricultural revolution and industrial revolutions in western Europe, but the whole process is being telescoped. There is some local urbanisation, industrial development and exploitation of mineral resources (and the areas occupied by these are likely to grow in future); but the influence that, more than any other, is changing the landscape is the greater efficiency of agriculture and forestry by intensification of cropping, irrigation and drainage.

As long as the principal aim of the systems of farming or forestry remains cropping on a sustained yield of the native vegetation or fauna, the aims of land improvement and of wildlife conservation largely coincide. The improved management of native forests is quite compatible with the conservation of wildlife, although there is still need to set aside some sanctuary areas where the interests of wildlife are paramount.

The native vegetation is likely to remain the primary resource in many areas for a long time yet. Where it has been impoverished and depleted by years of misuse, it can only recover if rested; if this is to be done without hardship to local inhabitants, the productivity of other areas must be increased to compensate. Balanced schemes for the improvement of grazing lands and forest, linked to greater efficiency of production on fertile soils can lead to an enhanced standard of living, permanently improved natural pastures and soil fertility, and the conservation of wild life. Any measures of this kind must, however, be ecologically sound. Great damage can be done by imperfectly considered changes.

Examples of measures which have gone wrong are the provision of additional wells in semi-desert grazings without adequate control of their use or of the management of the surrounding pastures. This leads to deterioration of vege-

tation by overgrazing. Ploughing of huge areas of *Artemisia* steppe in Jordan in the hope of obtaining an arable crop has led to the virtual destruction of grazing resources.

But there are other circumstances where the improvement of agriculture or forestry competes with conservation of wildlife; this happens when the natural resource is replaced by an artificial one. To a greater or lesser degree drainage, irrigation schemes, breaking virgin soil, reseeding pasture and plantation forestry do this. So does the replacement of traditional arable farming by intensive farming supported by all the resources of modern technology.

Where wisely applied, there is no doubt that all these changes increase food supplies and increase national incomes; but in these changing circumstances the aims of conservation of plants, animals and ecosystems will no longer be met as an incidental to land use policies directed exclusively to other ends. To be effective they must be adopted in their own right as a part of land use policy. If this is not done there will be permanent loss. The various needs can only all be met if there is a well planned allocation of land to particular uses (zonation) and if we know to what extent uses of the land compete with one another or are compatible.

Means Available for Conservation

What means are available for conservation?

(1) First there is the possibility of direct legislation to protect species or groups of species. Such are the game laws which operate in many countries or, for example, laws governing the export of organisms or the products of organisms (skins, feathers, etc.). Legislation to prevent or control pollution is also necessary.

(2) The second main means of conservation is by the planning and control of land use.

Let us examine in turn the means of operation and likely effectiveness of each of these alternatives.

Legislation for species: If legislation to protect species is to be successful, it is important that the organisms should be easily recognisable and that the laws should be enforceable. Such legislation is seldom successful unless there is a body of informed public opinion that recognises that its aims are reasonable. For this reason legislation to protect plants is only generally successful in countries with a relatively advanced standard of living and of education. These means have certainly been most successful in providing for the larger mammals and birds. They often incorporate, in game laws, the notion of sustained yield cropping, an argument which can be fairly generally understood and appreciated.

The argument is sometimes advanced that the protection of species can be provided for adequately in botanical gardens or zoos. There is no doubt that both gardens and zoos can be valuable as a last resort, but, apart from the very considerable practical difficulties and expense of conserving more than a small proportion of species in this way, such artificial means are no substitute for maintaining populations of plants and animals in natural or near natural conditions.

Conservation by land-use planning and control of management: The conservation of areas of land, however, or of populations which depend entirely on

particular methods of land management raises different problems. Legislation to provide for national parks or nature reserves, to be managed primarily for the conservation of natural ecosystems, is probably the most satisfactory single means of providing adequate protection for these; and many countries have enacted such legislation.

But only a small proportion of species can be dealt with by specific legislation and only a small area of country can be laid aside to be managed primarily in the interests of fauna and flora—yet much of the richness of wildlife in any country is not in areas specially reserved and is thus as an incidental to other forms of management. This can only be provided for by influencing the use and the management of the land in such a way that these populations can survive.

There is growing evidence that effective conservation can only be provided by assessing the particular interest of any piece of land for wildlife and giving due recognition to this value in planning and land management. A beginning could be made by attempting to produce a land capability classification for wildlife parallel to those produced for agriculture and forestry. The categories of such a classification might be as follows:

Categories of Land Use in Relation to the Conservation of Flora, Fauna and Ecosystems

(1) Natural ecosystems, unmodified or hardly modified by human activity. (A sample of these should be maintained inviolate; if disturbed, their integrity is seriously and perhaps irreversibly impaired.)

(2) Semi-natural ecosystems in which conservation should be the primary purpose of management, but which are consistent with or depend on other forms of land use in varying degrees. (Areas in which animals or plants are cropped as a resource should be included here.)

(3) Areas which should not necessarily be conserved as total ecosystems, but which are necessary to provide for the whole or part of the life cycle of particular organisms.

(4) Areas in which other uses should predominate, but in which the conservation of wildlife can be ensured by various management expedients.

(5) Areas in which the wildlife interest is so low or other uses are of such importance that conservation of flora and fauna should be confined to ensuring the health of the land and preventing irreversible deterioration.

This would provide a hierarchy of categories starting from those where the principal purpose of use is conservation and other uses are only compatible with it under very strict control, if at all; passing through categories where other uses increase in importance and conservation decreases; and ending with those where other uses entirely predominate.

Such a scheme would reflect the realities of the situation. Legislative control would be required for categories 1-3; but in category 4 the requirements of conservation would have to be met by financial incentives or by education. All categories should be recognised in schemes for land use planning or development.

To what extent would measures of this kind provide for the stated aims at the beginning of this paper?

Areas should be selected for categories 1 and 2 in such a way that all the

more important ecosystems are included and, as far as is practicable, the variation within them. In practice, vegetation formations and associations are used rather than ecosystems, for no satisfactory classification of ecosystems exists.

In the first instance vegetation is probably the best measure to use for this purpose. By protecting sufficiently large samples of vegetation types it is likely that the smaller and less migratory organisms will be incidentally protected; and it is those that it is difficult to provide for in any other way. In selecting areas to be managed as reserves it is necessary to start from the basis of the best available classification of vegetation, and choose areas in such a way that every unit is provided for. Only in this way is it possible to ensure that the coverage is adequate—though of course the result will only be as good as the classification on which it is based.

A choice of areas in this way does not necessarily provide for the conservation of the larger animals, especially those which have a large range or are migratory. These have to be considered on their individual merits. The choice of areas of vegetation types may often be qualified so that it provides at the same time for animals with a large range; but the problem of migratory species is different. Hence a knowledge is needed of the biology of these species, the routes they follow and their requirements at each stage of feeding, rest, shelter and breeding sites, and a chain of refuges should be established to provide for these. These will constitute category 3. The areas chosen and the restraints placed on management may well not be the same as those needed for the conservation of vegetation types, but often the requirements will overlap. This kind of measure has been used for wildfowl where a great deal of information is already available on which a sound choice of refuges can be based.

A representative series of samples of category 1 land should in every country be protected as strict nature reserves and it should be recognised in land-use planning that this is their primary use. Disturbance of such areas should be as little as possible. It should also be recognised that their value depends on their integrity. It is possible to reconstruct a fertile farm or a productive forest or a beautiful landscape but once an original natural ecosystem has been disturbed it cannot be perfectly recreated.

Areas of this kind are already extremely rare in many parts of the world. Their value to science depends upon them remaining undisturbed, for it lies not only in the fact that by protecting such areas all the species that are in them are also conserved but also in the fact that they are examples of whole ecosystems and of the kind of relationships which are found within systems in dynamic equilibrium. As such areas are by definition in equilibrium they should, if large enough, require little scientific management, but no nature reserve of practicable size will remain in its original state through periods of climatic change unless there is free migration of species across its borders; to this extent no discrete nature reserve can ever be fully effective. Many may, therefore, require some management to retain the qualities for which they were selected.

As we have seen many of the types of vegetation and ecosystems with which we are most familiar and in which many plant species are now most common are communities produced by the long continued and more or less even application of some human use. A representative sample of those should be chosen as category 2, the remainder falling in category 4.

Many of the secondary steppes of the Middle East are produced and maintained

by grazing; the garigue and batha of the Mediterranean by cutting, grazing and burning. A whole pattern of vegetation has been produced which depends for its maintenance on the continuation within limits of a similar intensity of pressures. These vegetation types are often worth conserving for their own intrinsic interests and also as a habitat of many species which may well be much commoner here than they ever were in the original and undisturbed vegetation. Any particular locality is likely to have had a chequered history of modification, destruction and recovery, and the survival of species has been due to their power of dispersal when habitats have been temporarily destroyed or their ability to survive when conditions have become unfavourable. They have depended on a pattern of land use which has not involved such drastic or rapid changes that species establishment and survival have proved impossible.

If samples of such vegetation are to be protected they must be managed in a way similar to that that has maintained them in the past. As long as the prevailing form of land use remains unaltered, this is easy and indeed no special measures for conservation need be taken; but as land use becomes more intensive active steps must be taken if these habitats are to remain.

Priorities

The main impetus for conservation of wildlife must come from within each country, if it is to be successful. Indeed many of the countries in south-west Asia have taken some steps to ensure the conservation of their wildlife; but it is questionable whether the measures are adequate to counter the great changes of land use that are in train.

The most urgent priority is to provide for the protection of undisturbed ecosystems that are likely to be destroyed (especially if unusual or unique) and for the conservation of species of animal or plant which are in danger of extinction. Special legislative provision can usually be made for both of these. But no legislation can be effective unless the means are there to apply it, and any sites or species protected are only likely to survive if there is both the will and the knowledge required to manage them. Responsibility for conservation should therefore be vested in some executive department of Government backed by sufficient knowledge to select areas wisely and to design and execute plans for scientific management.

The best means, however, is to ensure that due consideration is given to the conservation of flora, fauna and ecosystems in any plans for changes of land use or for development. This does not mean of course that wildlife conservation should invariably have priority, but that there should be a plan for conservation and that this should be given due weight in reaching any decision. Two kinds of measure are necessary: a well-considered plan for the conservation of wildlife in each country; and a requirement to examine the ecological consequences of any large scale development projects or any fundamental changes in land management before deciding to go ahead. This will not only enable damaging changes to be avoided but will allow positive provision to be made for conservation. International organizations can often provide technical assistance and advice at this stage.

In particular the International Biological Programme has been carrying out a survey of ecosystems which should be conserved, against which can be matched those that are properly protected. This'could serve as a basis for action in each country when it is complete. Its value will depend, however, on its com-

pleteness and full data are therefore required from all countries in the region.*

Whether conservation succeeds or not is, in the last analysis, completely dependent on public opinion. This can only be ensured by education into the values of conservation for the environmental, social and economic health of the region. Steps cannot be taken too early to develop this sense of responsibility of man for his whole surroundings.

*The survey is being continued in a modified form by IUCN in collaboration with UNEP, FAO and Unesco to provide a basis for action throughout the world.

APPENDICES

Section 2

Measures for Protection and Rational Land Utilization in Arid Mountain Regions

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As is well known, land resources are the foundation of mankind's existence. But, in connection with the present widespread development of industry, science and technology, the interrelationships for man and nature, as reflected in the conservation and rational utilization of land resources in mountain and arid regions, give grounds for serious alarm.

As a result of ploughing up of natural vegetation on mountain slopes, diminution of mountain forests, irrational utilization of lands, and overgrazing and over loading of pastures by cattle, hundreds of millions of hectares have under the influence of water and wind been destroyed or undergone erosion or lost their productivity and become unfit for use. It is enough to note that during the last century alone we lost more than 25% of arable lands, producing wheat, corn and other foodstuffs. At present according to FAO every year throughout the world 6-7 million hectares of cultivated land are destroyed. Throughout the world great rivers every year carry away an enormous amount of soil, containing millions of tons of organic matter, nitrogen, phosphoric acid and potassium, so essential for the production of bread and other foodstuffs.

As a result, throughout the world for the production of bread are cultivated only 10-11% of lands, while all lands suitable for agriculture including natural pastures amount to 28-30%. It is necessary also to remember that mountain and arid country pastures, due to overloading, irrational pasturing and absence of reclamation, have often deteriorated, and valuable feeding grasses have been replaced by less valuable species. Furthermore, as a result of mountain forest diminution and ploughing up of natural vegetation, the physical properties of soils are spoiled and they lose their water absorbing and matter holding capacity. The water regime has therefore become worse and drought recurs more often, while the material carried down in the floods destroys valley lands and the fauna and flora deteriorates and some of the more valuable and rare species disappear. This state of affairs can be seen in many countries and regions of the Middle East and South West Asia.

For these reasons, in the U.S.S.R. special attention is at present being paid to the problems of soil erosion, rational utilization of land resources and increasing productivity. It is recognized that soil erosion in particular is the greatest disaster and can do enormous damage to the national economy of a country. According to the decisions of the Soviet Government for improving the protection and for more rational utilization of semi-desert soils in arid and mountain regions in the U.S.S.R., measures taken include the reclamation and irrigation of arid soils in the southern republics, afforestation of many mountain slopes, artificial re-sowing of pastures, and application of special protection for beautiful mountain landscapes and so on.

In all the Soviet Republics the scientific Institutions, on the basis of the

government's decision, have been investigating these problems and techniques and making suggestions to the state and collective farms, including a wide range of measures to promote the rational utilization of the threatened lands and to control soil erosion and protect mountain slopes with the help of cultivation of drought-resistant trees and plants. Thus in the mountain protection department of the Central Laboratory on Nature Conservation, we have worked out complex methods of safeguarding and using mountain soils, covering all relevant agrotechnical, forestry and hydrological aspects, properly linked with one another and aimed at getting the best possible return from the land. A few details of our investigations of the more important measures taken may be quoted. On the basis of a very thorough study, soil maps of several collective farms in the Lake Sevan basin have been made on the very large scale of 1 : 10, 000. This is sufficiently detailed to allow every part of the land to be described and assessed, so that in the light of the natural and economic conditions, appropriate measures can be devised. The latter include—crop rotation, contour tillage, strip-cropping, horizontal ploughing, banking and terracing of slopes, deep furrowing, crossing of ploughlands, through-shape earthing, sowing with perennial grasses, creation of granular soil structure with the help of polymers, removal of stones, application of fertilizers, planting of land-protecting forest belts, regulation of flood waters, afforestation of ravines, reclamation of gullies and transforming them into land which can be cultivated, construction of water retaining channels and artificial water basins, regulation of pasture carrying-capacity, application of enclosures (or sheep-fold) methods of pasturage, building special tracks for cattle movements, and so on.

The practical results of these measures have been good, with positive improvements in the productivity of the land in the general interests of agriculture and wellbeing of the people.

The other very important problem, which affects the interest of many mountain countries in the region, is that of restoring the juniper forests and thus reducing erosion. Juniper is a very valuable drought-resistant plant, which several centuries ago occupied far more of the mountains of the southern arid regions of the U.S.S.R., Iran, Afghanistan, Turkey and Pakistan than at present. It is specially useful for its ability to protect the soils on the mountain slopes and improve water and climate conditions. But its natural restoration is virtually impossible, while artificial restoration is faced with great difficulties, due to the extremely poor germinating power of juniper seeds.

However, much work is now being done on juniper planting problems in various Soviet republics, such as Armenia, Azerbaijan, Kirgizia and Turkmenistan: the bio-ecological properties of the species are becoming better understood, the following, according to our investigations, being the most promising: *Juniperus polycarpos, foetidissima, oblonga, sabina, turkestanica* and *seravshanica.*

In the work on water conservation of the mountain protection department of our central laboratory we are trying various ways (heat, water, chemicals, X-ray) of growing more suitable juniper seeds; the seeds are first planted in cardboard pots, the young seedlings are then planted out in the nursery, and at 1-2 years old the final transplantation to the natural sites selected on the southern slopes of some of the Armenian mountains, is effected. The rapid growth of juniper from seed in the Armenian S.S.R. which has been achieved by these methods, has been in our experience extremely satisfactory.

In order to enhance the economic value of the juniper forests, we are interplanting a number of other very drought-resistant trees or bushes, for instance *Hippophae, Berberis, Rosa, Pistacia, Spiraea, Amygdalus* and introduced

Robinia pseudoacacia, several of which are valuable as sources for vitamin and medicinal production, bee-keeping and so on.

The successful solution of this problem of restoring juniper forests on the bare arid mountain slopes and raising the productivity of land resources is a very important international problem and, if it is to be properly solved calls for coordinated efforts between neighbouring countries, and mutual exchange of information about results, achievements and experiences. For this purpose, we would advocate the establishment under IUCN auspices of a special 'Juniper committee' with a membership drawn from all the countries in which the restoration or promotion of this species calls for particular attention and the aim is to secure the protection of eroded mountain arid slopes, increase their productivity and generally serve the best interests of our respective countries and their peoples.

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