

# Status of the Environment

## in the Occupied Palestinian Territory

**Applied Research Institute - Jerusalem  
(ARIJ)**



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Status of the Environment  
in the Occupied Palestinian Territory

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**List of Abbreviations:**

Abbreviation	Full Name
AAUJ	American Arab University of Jenin
AIDS	Acquired Immune Deficiency Syndrome
APC	Arab Potash Company
APIS	Agricultural Projects Information System
ARIJ	Applied Research Institute-Jerusalem
BG	British Gas
CAMP	Coastal Aquifer Management Plan
CBD	Convention on Biological Biodiversity
CBOs	Community Based Organizations
CCC	Consolidated Contractors Company
CEOHS	Center for Environmental and Occupational Health Sciences, Bir-Zeit University
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals
CMWU	Coastal Municipalities Water Utility
CPB	Cartagena Protocol on Biosafety
CPNP	Children for the Protection of Nature in Palestine
DEC	Dietary Energy Consumption
DSS	Decision Support System
EIA	Environmental Impact Assessments
EIS	Environment Impact Statement
EPRI	Environmental Protection and Research Institute
EQA	Environmental Quality Authority
EU	European Union
FAO	Food and Agriculture Organization
FIGIS	Fisheries Global Information System
FIVIMS	Food Insecurity and Vulnerability Information Mapping System
GCMs	Global Climate Models
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GIS	Geographic Information System
GNI	Gross National Income
GNP	Gross National Product
GTZ	German Technical Cooperation
HIV	Human immunodeficiency virus
ICJ	International Court of Justice
IMR	Infant Mortality Rate
IOF	Israeli Occupation Forces
IPCC	Intergovernmental Panel on Climate Change
IPCRI	Israeli-Palestinian Center for Research and Information
JCspd	Joint Councils for Services, Planning and Development

JWC	Joint Water Committee
JWU	Jerusalem Water Undertaking
KfW	German Development Bank (Kreditanstalt für Wiederaufbau)
kwh	Kilo Watt Hour
LPG	Liquefied Petroleum Gas
MCM	Million Cubic Meters
MDER	Minimum Dietary Energy Requirements
MDGs	Millennium Development Goals
MEAs	Multilateral Environmental Agreements
MEna	Ministry of Environmental Affairs
MLG	Ministry of Local Government
MOA	Ministry of Agriculture
MOF	Ministry of Finance
MOH	Ministry of Health
MOHE	Ministry of Education and Higher Education
MOP	Ministry of Planning
MoPIC	Ministry of Planning and International Cooperation
MOT	Ministry of Transport
NARC	National Agricultural Research Center
NEAP	National Environmental Action Plan
NGOs	Non-Governmental Organizations
NIS	New Israeli Shekel
NOAA	National Oceanic and Atmospheric Administration
NPAHR	Palestinian National Plan of Action for Human Rights
NSGB	National Seed Gene Bank
NWC	National Water Council
NWP	National Water Policy
OCHA	Office for the Coordination of Humanitarian Affairs
OPT	Occupied Palestinian Territory
PARC	Palestinian Agricultural Relief Committee
PCBS	Palestinian Central Bureau of Statistics
PCES	Palestinian Consumption and Expenditures Survey
PDP	Palestinian Development Plan
PECDAR	Palestinian Economic Council for Development and Reconstruction
PES	Palestinian Environmental Strategy
PHC	Primary Health Care
PHG	Palestinian Hydrology Group
PIES	Palestinian-Israeli Environmental Secretariat
PLC	Palestinian Legislative Council
PLF	Palestinian Labour Force
PLO	Palestinian Liberation Organization

PMU	Project Management Unit
PNA	Palestinian National Authority
POPs	Persistent Organic Pollutants
PSPN	Palestinian Society for the Protection of Nature
PWA	Palestinian Water Authority
RCMs	Regional Climate Models
TDEC	Total Dietary Energy Consumption
TFR	Total Fertility Rate
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNRWA	United Nations Relief and Works Agency
USA	United States of America
USAID	United States Agency for International Development
USD (US\$)	United States Dollar
WaSH MP	Water and Sanitation Hygiene Monitoring Project
WBWD	West Bank Water Department
WCNH	World Cultural and Natural Heritage
WFP	World Food Programme
WHO	World Health Organization
WSSA	Water and Sanitary Services Assessments
WWTP	Wastewater Treatment Plants

## Preface

Palestine, as it stands today, consists of two physically separated land masses, namely the West Bank (including East Jerusalem) and Gaza Strip with a total area of 5,661 km<sup>2</sup> and 362 km<sup>2</sup>, respectively. The once-fertile heights of Palestine have been denuded; barren lands and deserts have replaced forests and green plains. Desertification and soil erosion are evident, particularly in the Eastern Slopes of the West Bank. Polluted and salty water runs now in the Jordan River more than ever. The Dead Sea has sunk so low that it is now two separated seas and still dropping.

Palestine is characterized by the presence of two contradictory planning schemes that aim at exploiting its natural resources to serve two peoples: these are the endogenous Palestinian population and the Israeli settlers and army, which has been controlling the area since 1967. The fragile Palestinian environment has been the first casualty of this reality. It has been exposed to pressures ensuing from the practices of the Palestinian population, on the one hand, and from the practices of the Israeli Occupation, on the other hand, which have significantly contributed to changing the environmental features of the Occupied Palestinian Territory (OPT).

Lack of sovereignty over land and natural resources has denied the Palestinian people their rights to regulate land use and to manage the utilization of their own resources, without exceeding the carrying capacity of land. Without ability to regulate land use over a contiguous piece of land, natural ecosystems can not be maintained; the status of the environment can not be properly monitored; and environmental protection can not be implemented. On the other hand, the plans of the Israeli Occupation (the controlling power in the area) in the OPT have been geared by political factors, aiming at grabbing as much as possible of the Palestinian land to implement the Israeli colonizing strategy and to change the demographic characteristics.

Aerial photography of the region clearly show two contradictory types of built-up areas: the first is the Palestinian villages that are often built on non-fertile soil and promote organic extension of the landscape; and the second is the Israeli settlements that are not built in harmony with nature, illegally overlying Palestinian confiscated agricultural lands on hill tops in particular strategic areas such as the Jordan Valley, the West Bank westerns edges and the Jerusalem area. Currently, more than 207 Israeli settlements are scattered all over the West Bank, including East Jerusalem. These settlements accommodate more than 480,000 Israeli settlers. The features of housing inside the Israeli settlements differ from those inside the Palestinian built-up areas. The settlements include brick roofed villas, grassy areas and swimming pools, whereas the Palestinian houses are built with flat roofs that are traditionally used for rainwater harvesting and are often surrounded by backyard farms to meet the household needs for agricultural products. Other features, which can be distinguished include the Israeli industrial zones, military bases, and roadblocks that have been implanted all over the OPT by the Israeli Occupying Authorities. The most recent “exotic” body that was erected in the West Bank is the Israeli Segregation Wall, which has brought about major challenges to the viability, sustainability, and conservation of resources, ecosystems and landscapes.

It is obvious that the Israeli Occupying Authorities have focused on exploiting the Palestinian natural resources to ensure a good standard of living for the Israeli settlers. They have utilized the Palestinian water resources far and beyond any rational and equitable allocation system. They have established a comprehensive water network covering all parts of Israel and another efficient water network within the OPT. They have imposed restrictions that have limited Palestinians' water use at all sectors of life. And, last but not least, they have hindered the economic development of the Palestinian people and damaged their physical environment.

Furthermore, the Israeli Occupying Authorities have badly neglected the management of waste in the OPT. The geographical discontinuity, created at the lands under Palestinian control through the implementation of the Israeli Segregation Plans and the construction of the Segregation Wall, has hindered the implementation of several centralized projects related to waste management. The number of the uncontrolled solid waste dumping sites increased from 89 to 161. Untreated sewage streams are flowing in wadis without any restriction. These pollution sources are causing visual distortion to the landscape and aesthetic value of the living and natural environment as well as causing health problems. They have also exacerbated the land deterioration problem. The existence of accessible and inaccessible areas for Palestinians has also made the management and conservation of natural resources a very difficult job. The prolonged years of the Israeli Occupation have converted large areas in the Palestinian Territory to deserts. Indicators of desertification appear clearly in the Eastern Slopes, which are characterized by steep slopes that have limited the agricultural activity in such zones to animal grazing. The closure of 85% of these zones by the Israeli Occupying Authorities for military purposes, has led to severe overgrazing of the remaining area accessible to the Palestinian herders. Overgrazing has resulted in the loss of the vegetation cover, soil erosion problems, and intensive desertification.

The practices of the Israeli Occupation and control used by the Israeli Authorities have systematically hindered the development of the Palestinians, contributed to poverty increase among them, damaged the environment in the process and resulted in major physical impediments towards accomplishing sustainable development in the OPT. Environmental problems, such as land degradation, deterioration of biodiversity, depletion of water resources, deterioration of water quality, air pollution, etc. have dramatically accelerated during the ongoing Israeli Military Occupation since 1967. The case of the OPT strongly illustrates the often negative relationship between occupation and environmental degradation (Figure 1). All the facts indicate that the Palestinian environmental rights have been badly violated by the Israeli Occupiers specially during the so-called "peace process".

The status of the environment in the OPT has received much less attention in the continuing debate, in regard to the Israeli Occupation. This is despite the fact that the status of environment has a fundamental role in the ability of a Palestinian state to be viable, since it provides the physical context in which society exists and it determines the extent at which society is sustainable. Restrictions on the available resources, poor management and unsustainable practices have resulted in the radical transformation of the Palestinian environment, degradation of its natural ecosystem, and depletion of its resources. When the Palestinian people are struggling for survival, it is difficult for them to think about the environment, but the environmental damages caused by the conflict will require a lot of effort, time and money to be mitigated. Moreover, with the fact that the future of the OPT is uncertain, it is increasingly apparent that the environmental situation will continue to deteriorate placing by that massive restrictions on the capacity for sustainable development, rendering a Palestinian state unviable and highly unstable. Accordingly, it is believed that mutual collaboration from all stakeholders, as well as joint environmental management on the basis of good will should be achieved, since environmental problems do not recognize political borders or geopolitical boundaries and many of them are transboundary.



**Figure 1: The organic relationship existing between environmental degradation in the OPT and the Israeli Occupation**

In 1997, the Applied Research Institute – Jerusalem (ARIJ) published a comprehensive “Environmental Profile” for the West Bank entitled, ‘The Status of the Environment in the West Bank’. The profile was prepared based on sound environmental information integrated into an Environmental Information System (EIS). It included an overall description of the state of the environment and the actions that should be considered to protect the Palestinian environment. The developed EIS was transferred to the Palestinian National Authorities to provide them with the basic information needed to develop national strategies and policies, in order to foster sustainable development in the OPT. It was, however expected that the national authorities would have cooperated and updated the relevant data presented in the EIS and produced an updated version of the “Environmental Profile” especially after the construction of the Segregation Wall, which has caused critical environmental problems and negatively affected the management of the environment at all levels. Regrettably, ten years (since 1997) passed following the preparation of the Profile and this has not been achieved.

Accordingly, ARIJ decided to take the initiative of harmonizing the new and updated physical, environmental and socio-economic data available in its databank, bridging the gaps to update the EIS, and providing a comprehensive assessment of the state of the environment in the OPT. This time the assessment was carried out for both the West Bank and the Gaza Strip, in order to bring into the forefront the political realities that have impacted the potential for sustainable development in the OPT. ARIJ is proud to present the updated environmental profile for the OPT, entitled “The Status of the Environment in the OPT - 2007”, which is developed with the support of the Swiss Agency for Development and Cooperation (SDC). This is the first time a Status of the Environment Report for the OPT as a single territorial unit is published. It is hoped that the next report will be published by the State of Palestine after its establishment.

This Profile provides a narrative, statistical and cartographic description of the current environmental status in the OPT and shows the trends of the major environmental indicators over the period from 1997 till 2007. It also includes a list of recommendations to monitor and control further environmental degradation, and to carry out restoration actions in environmental hot spots. The Profile is divided into three main parts: Part One “Land, Demography and Economic Sectors”; Part Two “Environmental Challenges”; and Part Three “National and International Aspects”. The Profile, as well as the updated EIS, will be posted on ARIJ Website, in order to make them accessible to decision makers, the public and all who can benefit from them. It is worth mentioning that a workshop targeting all the Palestinian stakeholders was organized on May 09, 2007 to present and discuss the first draft of the Profile. The workshop was fruitful and revealed the comments and remarks of the participants, which have been taken into consideration in the final Profile. Further comments, remarks and suggestions are welcomed.

Dr. Jad Isaac  
General Director

Bethlehem - West Bank  
June 09, 2007

*Chapter Ten*

*Biodiversity*

10

## 10.1 FLORA & FAUNA

### 10.1.1 Introduction

Mandate Palestine lies at a bio-geographic crossroads between the European, Asian and African continents, the Mediterranean and Red Seas, and a number of botanical zones. This bio-geographic convergence is reflected in the region's high biodiversity value. As well as a center of wild plant biodiversity, the region is also an historic center of crop diversity and cultivation. The life-sustaining crops such as wheat, barley, vines, olives, onions, and pulses, all originated within the geographical land of Mandate Palestine. The wild ancestors of these crops, which now only occur in tiny remnants of natural vegetation, represent a vital resource for future crop breeding (Hepper, 1992). Mandate Palestine also shares with Jordan and Syria one of the Earth's major geological and bio-geographical features. This is the great Rift Valley, which stretches to eastern Africa and which is currently the subject of international discussion on its potential nomination as a serial World-Heritage Site.

The natural ecosystems in Mandate Palestine provide support for human activities in agriculture, animal husbandry, forestry, traditional and pharmaceutical health products, tourism, and many others. These systems are essential also for their aesthetic and intrinsic value, and for the stabilizing effect of the ecosystems and the protection of overall environmental quality. Sustainability of agricultural production and environmental balance depends on the status of a diverse natural biota.

There are about 51,000 living species in Mandate Palestine. About 47,000 (92%) species are known, or thought to be known and another 4,000 (8%) are species that are assumed to be found or identified in the future. Heywood and Watson (1995) listed some 1,750,000 living described species, based on several sources, as the total global biodiversity. By this account, Mandate Palestine's biodiversity (including viruses) comprises about 3% of the global biodiversity. Such rich biota is composed of an estimated 2,750 species of plants in 138 families (Danin, 2004). These include 60 species of natural trees and 90 species of bushes distributed all over Mandate Palestine. They encountered 149 endemic plants that do not exist in other places in the world (ARIJ, 1997; Ishtayia, 1995).

As in so many countries, the biodiversity in Mandate Palestine is threatened by human activities. Natural ecosystems are destroyed to make way for agricultural, industrial, or housing developments; and growing population pressure has led to unsustainable utilization of natural resources and pollution of the environment. However, due to the belligerent military Occupation, environmental management in (OPT) is complicated and hampered. Furthermore, Israeli Colonization policies have added to population pressure, as settlements continue to grow in the Occupied West Bank. Straining of natural resources, environmental pollution, and the construction of settlements, the bypass roads, and the Segregation Wall have all created further land fragmentation and ecosystem destruction. Thus, the Israeli Occupation (of the West Bank, including East Jerusalem, and the Gaza Strip) amplifies and exacerbates existing environmental problems, and hampers and impedes efforts to ameliorate them. If steps are not taken to overcome this problem, environmental degradation will continue and worsen in the Occupied Palestinian Territory (OPT) and as a result many unique species may be lost.

### 10.1.2 Plant Diversity in the OPT

#### 10.1.2.1 Distribution of Major Plant Families

The vegetation cover in the OPT consists of a variety of plant formations, ranging from dense forests to thin patches of desert herbs, passing through different forms of woodland, such as maquis, garrigue and

batha. The OPT is comprised of five main agro-ecological zones: the Jordan Valley, the Eastern Slopes, the Central Highlands and the Semi-coastal Plain (West Bank), and the Coastal Plain (Gaza Strip). Climate varies abruptly between these different zones, despite their small geographic area. And so, flora and fauna vary accordingly, although there is also a good deal of overlap in species distributions between the different zones. The areas of greatest plant diversity are the Central Highlands and the Coastal Plain. The presence of such a variable plant formation of trees, shrubs, and herbs, which survive in different environmental conditions, indicates the diverse genetic background that they possess.

There are 93 major forests in the West Bank and 13 in the Gaza Strip, covering about 230 km<sup>2</sup> and 2 km<sup>2</sup>, respectively. Forests cover approximately 4 % of the total area of the West Bank and 0.6 % of the Gaza Strip. In addition, the total area of nature reserves in the West Bank and Gaza Strip is about 774 km<sup>2</sup>, forming 12.8% of the total area of the West Bank and the Gaza Strip.

The West Bank and the Gaza Strip contain 2076 species of plants (ARIJ, 2006). 1959 species (in 115 families) are growing in the West Bank and 1290 species (in 105 families) are growing in the Gaza Strip. The most dominant families in both areas are the Papilionaceae, Compositae and Graminae (Figure 10.1). The families' composition and distribution differ from one geographical area to another, since the ecosystems are different.

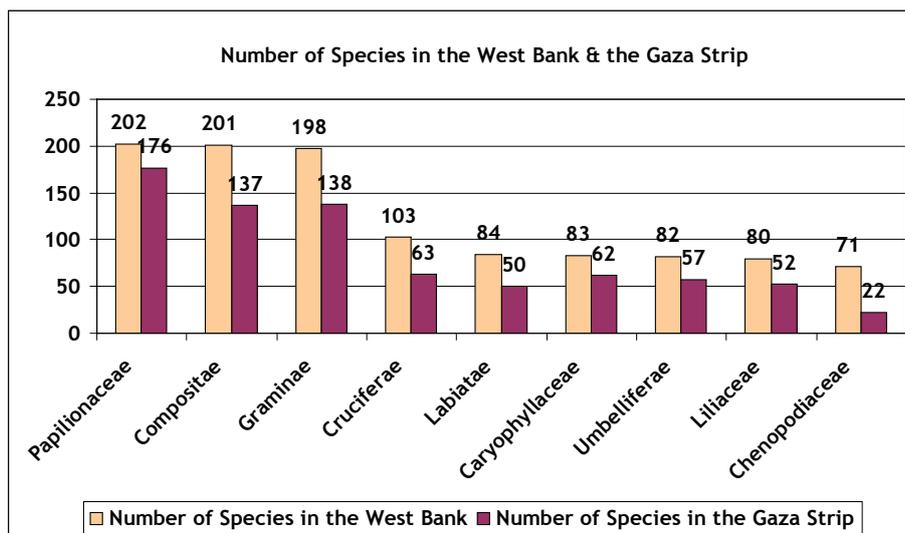


Figure 10.1: Dominant families and their species inhabiting the West Bank and the Gaza Strip

There are 16 families that grow in the West Bank but not in the Gaza Strip, such as Pinaceae, Lauraceae, Cynomoriaceae, Plantanaceae, Moringaceae, Menispermaceae, and others. There are also 5 families that grow in the Gaza Strip but not in the West Bank, including Hydrocharitaceae, Ophioglossaceae, Nymphaeaceae, Lentibulariaceae, and Callitrichaceae. Examples of common plants in the West Bank and the Gaza Strip are: *Pistacia palaestina*, *Olea europea*, *Quercus calliprinos*, *Pinus halapensis*, *Anemone coronaria*, *Artemisia herba alba*, *Calendula arvensis*, *Chrysanthemum coronarium*, *Avena sterilis*, *Adonis cupaniana* (Photo 10.1).



Photo 10.1: *Quercus calliprinos*

### 10.1.2.2 Endemic Flora

There are 102 endemic species (in 28 families), forming 5% of the total species, of which 12% are rare endemic species. Up to 92 endemic species (in 26 families) are growing in the West Bank, forming 4.7% of the total species, and 30 endemic species (in 18 families) are growing in the Gaza Strip, forming 2.3% of the total species. Most of the endemic species growing in the West Bank belong to Compositae family that constitutes 12.8% of total endemics. Most of the endemic species growing in the Gaza Strip belong to the Papilionaceae family (13.3%). Examples of the endemic species growing in the West Bank are *Capparis spinosa* (Capparaceae), *Suaeda palaestina* (Chenopodiaceae), *Origanum dayi* (Labiatae), and others. Examples of endemic species growing in the Gaza Strip are *Erodium subintegrifolium* (Geraniaceae), *Iris atropurpurea* (Iridaceae), *Paronychia palaestina* (Caryophyllaceae), and others, (Zohary and Michael, 1966, 1972, 1978, 1986; Feinbrun-Dothan, Avinoam, 1991; Shmida, 2006).

### 10.1.3 Diversity of Fauna in the OPT

As a result of its geographical position, the OPT has a vast variety of wildlife. There are an estimated 30,904 species (PCBS, 2005; ARIJ, 2006), of which 30,000 invertebrates, 427 birds, 297 fish, 92 mammals, 81 reptiles and 7 amphibians (PCBS, 2005; ARIJ, 2006). Mainly, the Palestinian Fauna is considered vagile, as it is hard to confine a species to be restricted to a particular locality within the OPT. Thus, they are categorized to a greater extent to different zoogeographical regions on the basis of their origin and distribution, being contingent upon suitable substrates and habitats. The main zoogeographic origins of Palestinian mammals are Palaeartic, Palaeotropic, and Cosmopolitan.

#### 10.1.3.1 Avifauna

The position of Historical Palestine, and its varied ecosystems and climate result in relatively high bird diversity. More than 510 bird species have been recorded in Historical Palestine, by which 427 species have been stated to occur within the West Bank and the Gaza Strip. They belong to 193 genera, classified within 68 families and 24 orders. The largest family in the OPT is Sylviidae, with 59 species and subspecies (ARIJ, 2006). Birds are further classified into 5 groups, based on their seasonal behavior. These groups are residents, winter visitors, summer visitors, migrants, and vagrants. Some species may be represented in more than one of these groups, such as the Lesser Kestrel (*Falco naumanni*).

The resident birds live all year round and breed in the OPT. A total of about 88 species resides in the West Bank and the Gaza Strip, including House Sparrow (*Passer domesticus biblicus*), Golden Eagle (*Aquila chrysaetos homeyeri*), and Palestinian Sunbird (*Nectarinia osea osea*). The wintering birds (about 207 species), arriving in the West Bank and the Gaza Strip mainly from Europe and central and northern Asia, stay only for winter and then migrate elsewhere to breed. Summer birds comprise about 73 species in the OPT. They nest and breed in spring and summer but migrate back to their wintering territories in fall. They include Olivaceous Warbler (*Hippolais pallida elaeica*), the Swift (*Apus apus apus*), and Sooty Falcon (*Falco concolor*) (Hadoram Shirihai, 1996).

The migrant birds, on the other hand, are birds that pass over or stop in the OPT only to rest and feed, and then follow their usual migrant destination. About 274 species migrate through/over the West Bank and the Gaza Strip, during their migration seasons (August-November and March-May). Honey Buzzard (*Pernis apivorus*) is an abundant diurnal passage migrant over most parts of the OPT. The OPT also hosts around 130 vagrants, where about 73 species have been recorded to come to the OPT accidentally and at irregular intervals. Major examples of these vagrants are Rustic Bunting (*Emberiza rustica rustica*), Cape Verde Petrel (*Pterodroma feae*), and Red-Billed Tropicbird (*Phaethon aethereus indicus*).

### 10.1.3.2 Mammals

Mammals in the OPT represent the second largest class after birds. So far, 92 terrestrial species have been recorded in Historical Palestine, belonging to 7 orders. These include Insectivora (3 families), Chiroptera (8 families), Carnivora (5 families), Hyracoidea (1 family), Artiodactyla (3 families), Lagomorpha (1 family), and Rodentia (7 families) (Mendelsohn & Yom-Tov, 1999).

### 10.1.3.3 Herpetofauna

Amphibians and reptiles make up an important component of the Palestinian ecosystem. Most of the Palestinian Herpetofauna are of Mediterranean or Saharo-Arabian zoo-geographic origin. In the OPT, the amphibians are represented by 2 species, belonging to the order Urodela, and 5 species, belonging to the order Anura. Recently, the Amphibian population has been decreasing as a result of habitat loss, particularly swamp drainage. Reptiles have scaly skins and have no need for water for breeding. They are represented in the OPT by 81 species classified into three orders: Testudines (turtles), Sauria (lizards), and Ophidia (snakes) (Photo 10.2).



Photo 10.2: *Testudo graeca*

#### 10.1.3.4 Invertebrates

The invert-fauna of Historical Palestine is very diverse in its forms and colours. Unfortunately, very few studies on invertebrates in Historical Palestine have been conducted. However, around 30,000 species of invertebrates have been estimated to occur in Historical Palestine. Invertebrates vary from simple organisms, such as sponges and flatworms to complex animals, such as Arthropods and Mollusks. These diverse fauna of worms, butterflies, beetles, bees, ants, spiders and snails are considered of great direct or indirect importance to the ecosystem. Some are part of the food chain to other living organisms or an agent in different biotic processes.

Snails and slugs are widespread all through the OPT. They fall under the class Gastropoda, comprising about 100 species. Another common species are the spiders and scorpions, which are represented by the class Chelicerata. Examples include the most venomous scorpion, Palestine yellow scorpion (*Leiurus quinquestriatus*), and *Chaetopelma aegyptiaca* (one of the biggest spiders). Some other classes of species that are widespread over the OPT and can be seen by the unaided eye are Diplopoda (Millipedes), Chilopoda (Centipedes), Malacostraca (Pill bugs, slaters and woodlice), Oligochaetes (Earthworms), and Hirudineans (Leeches).

#### 10.1.3.5 Fish

A total of 297 species of fish share recorded in the OPT. Of these, 12 freshwater species have been stated to occur in the River Jordan and inland water-bodies. 16 fish species from the Red Sea have been found in the Mediterranean Sea after migrating through the Suez Canal, and around 186 species of Mediterranean origin (PCBS, 2005). These fishes belong to around 22 orders of the classes Actinopterygii (Ray-finned fish) and Elasmobranchii (skates, rays and sharks). The largest order is the Perciformes, which comprises fish of both marine and fresh water.

#### 10.1.3.6 Introduced Species

A reintroduction program provided by the Israeli Nature Reserve Authority was set up to reintroduce some of the wild locally extinct species of Historical Palestine. These include the Fallow Deer (*Dama dama mesopotamica*), Roe Deer (*Capreolus capreolus*), the Wild Goat (*Capra hircus*), and the Arabian Oryx (*Oryx leucoryx*) and the Onager Wild Ass (*Equus hemionus*). A new family, Capromyidae, of the species Coypu (*Myocastor coypu*) was introduced to Historical Palestine during the 1950s (Mendelssohn & Yom-Tov, 1999).

#### 10.1.4 Pressures on Biodiversity in the OPT

Sovereignty over natural resources is one of the key elements for any nation to achieve sustainable development and sound environmental management. The case of Palestine is different than other nations as it passes from occupation to liberation over different periods and phases. Without the ability to regulate land use over a contiguous piece of land, natural ecosystems can not be maintained, the status of the environment can not be properly monitored, and environmental protection can not be implemented. The existence of accessible and inaccessible areas for Palestinians made the management and conservation of natural resources a very difficult job. The plans of the Israeli Authority (the controlling power in the area), have systematically hindered the development of the Palestinian society and have also damaged the Palestinian environment. All these practices have created a geographical discontinuity at the lands

of the OPT. This discontinuity has resulted in a major physical impediment towards accomplishing sustainable development in the OPT.

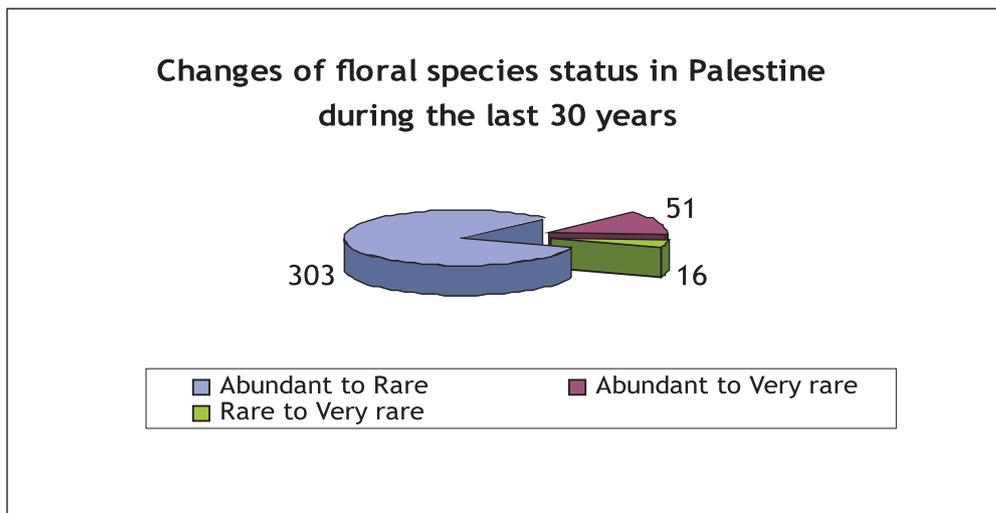
During the Israeli Occupation, several laws have been issued for the protection of natural resources. However, those laws implemented in the OPT gave Israel the full control over Palestinian natural resources, mainly land for security reasons, as Israel claims. The outcome of Israeli laws that were passed for the Occupied West Bank could be assessed from the huge area of land that has been confiscated. Due to such policies and military regulations, there has been an increased rate of destruction, loss of green areas, and reduced biodiversity in the Palestinian ecosystem. In addition to the closure of grazing areas, several military bases have been established, causing changes in the topography, natural stream flow routings, and increased soil erosion (Map 10.1).

Biodiversity is under threat from a variety of pressures, which are further worsened by the ongoing conflict. During times of the ongoing conflict, focus has been shifted away from sustainable management of natural resources and nature protection to other issues. Generally speaking, biodiversity is under a serious threat due to human activities, disrupting the ecosystem of the land. Common species are under a serious threat of becoming rare, and rare species are disappearing altogether. Habitats are getting fragmented resulting in a serious loss of biodiversity. Another possible yet realistic danger is the viability of species. Fragmentation of habitats and the seclusion of species, mainly as a result of the Israeli segregation walls and settlements, are definitely affecting genetic exchange.

Of all global problems, it is widely believed that species' extinction can have the most serious consequences - and it is irreversible. The problem is especially acute in Historical Palestine. This is due to the fact that the country's limited size, momentum of development, population growth and other reasons have made the protection of precious natural resources and open space landscapes especially difficult.

Plant species in the OPT are becoming increasingly rare, due to the ongoing destruction of their natural habitat, the over-harvesting of wild species, and the detrimental climatic and environmental changes. The plant genetic resources of the OPT are constantly declining over the years. Of the surveyed 2076 plant species growing in the OPT, it was recorded in local literatures that 636 species are listed as endangered, of which 90 species are very rare. It is also contended by experts that urgent conservation measures are required for more than 40 species (Sultan, 2001).

It was also found, through a survey done by ARIJ, in 2006, that during the last 30 years, 370 species have changed their status to become rare or very rare in the OPT (Figure 10.2). On the other hand, around 22 terrestrial animal species are under the threat of extinction. They include 5 species of mammals, 5 species of Herpetofauna, and 12 species of birds (PCBS, 2005). Also, around 56 Mediterranean fish species (26% of the total fish Fauna of the Gaza Strip) are considered to be threatened (Ali, 2002). As a result, it is predicted that in the OPT, a number of species will disappear within the next 10 years, unless urgent measures are taken to protect, preserve, and develop their utilization. Degradation of plants' ecosystem in the OPT threatens the existence of Fauna. On the other hand, fragmentation of the landscape disrupts migration and genetic contiguity, and threatens the viability of populations. So, the main threats to the Palestinian Fauna are the anthropogenic pressures on plants, animals and ecosystem.



*Figure 10.2: Changes of Floral Species Status in the OPT during the Last 30 years*

The rapid increase of both population and urbanization in the country has great impacts on natural resources putting additional pressures on land and natural habitat and the development of resources to meet market demand and to satisfy the rising human needs. The growing population will use the scarce resources causing a major threat to the small natural areas in the West Bank and the Gaza Strip. Gaza Strip, for example, has aggravated problem since the dense population in a small geographical area putting a strain on all natural resources. Solid waste is building up; raw wastewater is leaching into the sea, the building on the shore with its environmental impact, over fishing and the potential for offshore extraction of gas.

The uncontrolled disposal of the large generated quantities of domestic, industrial and medical wastewater and solid waste as well as the use of pesticides and the depletion of water and wildlife resources are adding pressures on the environment that pose great pollution threat and endanger public health.

Habitat destruction comes from a broad range of sources. These include unplanned urban expansion, overgrazing, and over-exploitation; deforestation and unplanned forestry activities; desertification and drought; invasive alien species; pollution and contamination; accidental mortality; and hunting. This is in addition to the political status, including the division of Palestinian accessible areas, land confiscation, and the Israeli settlements and Segregation Walls. Not to forget that biodiversity is also being threatened by lack of enforcement of laws and policies concerning its better management and conservation and the limited documentation or research done on natural resources, carrying capacity, conservation programs, responses to threats, and others.

Such factors have been causing huge changes in plant and animal species composition, distribution and density, and thus the loss of such valuable heritage. Those problems have caused drastic changes and have left deep traces on the landscape, natural resources and vegetation of the area. At the moment there is hardly any natural undisturbed vegetation in the area. In addition, such pressures on the integrity of ecosystem and on stability of natural resources increase the risk of losing the livelihood, the historical, cultural, environmental, and economical values of the Palestinian biodiversity. This is despite the fact that these costs are difficult to quantify, or may indeed be immeasurable and irreplaceable.

### 10.1.5 Biodiversity Indicators for Sustainable Development in the OPT

Indicators and monitoring of biodiversity are important topics in recent political discussions. Chapter 40 in Agenda 21 calls for the development of indicators of sustainable development. In 1995, the Commission on Sustainable Development (CSD) approved a work program on indicators of sustainable development. The Convention on Biological Diversity, ratified by the European Union and its member States, constitutes a formal recognition of the alarming loss of biodiversity and the importance of its monitoring. The third Conference of the Parties to the Convention on Biological Diversity was held in Buenos Aires in November 1996. At that meeting the Parties adopted two formal decisions which reinforce country's need to develop a mechanism to monitor biological diversity and to develop indicators to assess progress. The BSAPP (Biodiversity Strategy and Action Plan) that was developed in 1999 has stressed the importance of monitoring the Palestinian biological diversity components. As a response to all these decisions ARIJ has developed Palestinian biodiversity indicators to monitor status, pressures and response to biological degradation.

**Table 10.1: Main Biodiversity Indicators for Sustainable Development in the OPT**

	Title	Description
<b>Ecosystem / Habitat</b>	<i>Indicators of Pressure / Threatening Processes</i>	
	Habitat alteration and land conversion from its natural state	Deforestation: 59% since 1970 (MOA, 1999) Uprooted Trees: 794162 trees since 10 years. (ARIJ GIS, 2006).  Palestinian Built up area: increased by 21.3% in West Bank (last 5 years) (ARIJ GIS, 2006), and 41.9% in Gaza Strip (Isaac, J. et al, 2006) Israeli colonies area: increased by 16.5% (last 5years) (ARIJ GIS, 2006)
	Aquatic habitat destruction	Over-fishing: <ul style="list-style-type: none"> <li>• 33.8% rare fish of total fish species in Gaza</li> <li>• 8.5% are very rare fish of total fish species in Gaza (Ali M., 2002)</li> </ul> Pollution: 70-80% of the domestic wastewater produced in Gaza reaches the environment untreated and discharged into the Mediterranean Sea (UNEP, 2003)
	<i>Indicators of State / Loss of Biodiversity</i>	
	Total vegetation cover	Total natural vegetation area forms 25.88% of total West Bank and Gaza Strip area (ARIJ GIS, 2006)
	Total forest area	Total forest area forms 1.42% of total West Bank area (ARIJ GIS, 2006).
	Protected areas	Total nature reserves area forms 12.8% in the West Bank and Gaza Strip (ARIJ GIS, 2006).
	<i>Indicators of Response / Biodiversity conservation and management</i>	
	Afforested areas	Total afforested areas forms 4.1% in West Bank and Gaza Strip
	Forest conservation	No Conservation programs
	Marine protected areas	Three natural reserves are located in the coastal area of Gaza Strip including with a total area estimated by 30 km <sup>2</sup> .

Table 10.1 Continued

Species	<b>Indicators of State / Loss of Biodiversity</b>	
	Extinct, endangered, and vulnerable species and Ecological communities	<ul style="list-style-type: none"> <li>• Rare species: 303 species (14.7% of total species)</li> <li>• Very Rare species: 67 species (3.23% of total species)</li> <li>• Endemic Species: 102 species (4.9% of total species).</li> <li>• Endangered Endemic Species: 47.1% Low frequent species, 11.8% Rare species, 5% Very Rare species</li> </ul>
	<b>Indicators of Response / Biodiversity conservation and management</b>	
	Identification procedures	No detailed procedures for identifying endangered, rare, and threatened species were developed
	Existing strategies	Existing strategies for <i>in situ</i> / <i>ex situ</i> conservation of genetic variation are mentioned in BSAPP (Biodiversity Strategy and Action Plan for Palestine, 1999).

Investigating the indicators, it was found that the Palestinian landscape, ecosystems and vegetation have been subjected for changes on a large scale. The rate of natural destruction in the OPT is much higher nowadays with the appearance of new challenges facing biodiversity, as indicated earlier. It is worth mentioning that Palestinian sustainability is inextricably intertwined with the political reality witnessed in the OPT. Hence, the compilation of such data also serves to highlight the tangible and factual damages incurred on the OPT under Israeli occupation and continuing exploitative policies.

### 10.1.6 Relevant International and Regional Conventions and Treaties

The legal political status of the Palestinian people and its government is complicated. **Formal recognition of Palestine as a state has not taken place yet, although the PNA has a special status in the UN system.** Palestine has not been asked to officially ratify the international conventions drafted on global environmental issues. *All the same, Palestine has been “deemed associated with a State that has ratified international conventions”.* This recognition has enabled the Palestinians to actively participate in almost all of the activities of international agencies and bodies like any other State. Within this context, the PNA is preparing the ground for building a modern State that would implement the international standards and principles related to the environment.

Many of the biodiversity conservation challenges in the OPT (for example, desertification, sustainable management of water, forests and rangelands) are regional in extent, giving special importance to the potential role of multilateral environmental agreements (MEAs). Although the Palestinian Authority is unable to adhere directly to such treaties, there are clear environmental benefits from participation, not only for to the OPT, but for the region as a whole, as well as for the global community.

The following are those conventions where Palestine was identified and its flora or fauna were listed for protection.

<b>Table 10.2: The Major International and Regional Conventions and Treaties</b>	
<b>Relevant Major International and Regional Conventions and Treaties</b>	<b>List of included Palestinian Species</b>
<b>CITES (THE CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES )</b>	<p><b>Amaryllidaceae</b> (<i>Galanthus fosteri</i>, <i>Sternbergia clusiana</i>, <i>Sternbergia colchiciflora</i>, <i>Sternbergia lutea</i>);</p> <p><b>Orchidaceae</b> (<i>Ophrys umbilicata</i>, <i>Ophrys umbilicata</i>, <i>Ophrys umbilicata</i>);</p> <p><b>Primulaceae</b> (<i>Cyclamen coum</i>, <i>Cyclamen persicum</i>, <i>Cyclamen persicum</i> var. <i>Autumnale</i>, <i>Cyclamen persicum</i> var. <i>persicum albidum</i>)</p>
<b>IUCN (Red List of Threatened Plants)</b>	<p><b>Fauna:</b> <i>Ablepharus rueppellii</i>, <i>Acanthodactylus beershebensis</i>, <i>Ammomanes deserti</i>, <i>Ammoperdix heyi</i>, <i>Aquila pomarina</i>, <i>Aythya nyroca</i>, <i>Botaurus stellaris</i>, <i>Bufo viridis</i>, <i>Calopteryx syriaca</i>, <i>Cercomela melanura</i>, <i>Chalcides guentheri</i>, <i>Chlamydotis undulata</i>, <i>Circus macrourus</i>, <i>Corvus ruficollis</i>, <i>Crex crex</i>, <i>Daboia palaestinae</i>, <i>Eirenis lineomaculatus</i>, <i>Emberiza cineracea</i>, <i>Falco biarmicus</i>, <i>Falco naumanni</i>, <i>Francolinus francolinus</i>, <i>Gallinago media</i>, <i>Grus grus</i>, <i>Gypaetus barbatus</i>, <i>Gyps fulvus</i>, <i>Hirundo obsoleta</i>, <i>Hyla arborea</i>, <i>Lacerta laevis</i>, <i>Larus audouinii</i>, <i>Lutra lutra</i>, <i>Macroprotodon cucullatus</i>, <i>Micrelaps muelleri</i>, <i>Neophron percnopterus</i>, <i>Numenius tenuirostris</i>, <i>Oenanthe leucopyga</i>, <i>Onychognathus tristranii</i>, <i>Ophiomorus latastii</i>, <i>Passer moabiticus</i>, <i>Platyceps collaris</i>, <i>Puffinus griseus</i>, <i>Rana bedriagae</i>, <i>Rhinotyphlops simonii</i>, <i>Sphenops sepsoides</i>, <i>Strix butleri</i>, <i>Telescopus hoogstraali</i>, <i>Tetrax tetrax</i>, <i>Torgos tracheliotos</i>, <i>Trachylepis vittata</i>, <i>Trapelus savignii</i>, <i>Triturus vittatus</i>, <i>Turdoides squamiceps</i>;</p> <p><b>Flora:</b> <i>Juniperus oxycedrus</i>, <i>Ballota saxatilis</i> ssp. <i>Brachyodonta</i>, <i>Daucus carota</i> ssp. <i>Gadecaei</i>, <i>Hypericum thymifolium</i>, <i>Origanum syriacum</i> var. <i>bevanii</i>, <i>Retama raetam</i> ssp. <i>Gussonei</i>, <i>Thymbra spictata</i> var. <i>intricata</i></p>
<b>FAO IUPGR (International Undertaking on Plant Genetic Resources)</b>	<i>Atriplex halimus</i> , <i>Lolium temulentum</i> , <i>Medicago sativa</i> , <i>Melilotus albus</i>
<b>Euro-Mediterranean Partnership</b>	<i>Agricultural and fishery products of interest to both Parties</i>
<b>Jordanian Palestinian Economic Protocol</b>	<i>Goods and commodities that could be imported from Jordan and vice versa</i>

### **Institutional arrangement and responsibilities**

*The Environmental Quality Authority (EQA) is responsible for:*

- Implementing the Biodiversity Convention
- Coordinating all programs related to environment implemented by other agencies
- Formulating and implementing policy plans and programs related to the conservation of biodiversity
- Formulating regulations and creating guidelines on the environment
- Carrying out studies, research, surveys, publication of extension materials, and conducting training programs related to the conservation of biodiversity

*The Ministry of Agriculture (MOA), another partner with responsibility for the protection of biodiversity, undertakes the following:*

- Formulating policy and plans related to natural resources and land use management;
- The Rangelands and Forests Directorate (RFD) at the MOA is responsible for the management, control, utilization and conservation activities of national forests and to improve and manage protected areas;
- The National Agricultural Research Centre (NARC) is presently working in developing seed gene bank;
- The Extension and Applied Research directorate has also planned to establish a new field gene bank where fruit trees are grown for the preservation and rehabilitation of existing types.

Registered environmental related local NGOs address a variety of issues in this area. Although most NGOs are not involved in conservation management activities, many of NGOs are initiating public awareness programs to raise an understanding of the need to conserve biodiversity and use biological resources in a sustainable manner and income generation activities based on biodiversity.

*The Applied Research Institute-Jerusalem (ARIJ)*

- Support the development of national plans and strategies concerning Palestinian biodiversity conservation.
- Establishment of Herbarium unit
- Conduction of Flora & Fauna databases
- Preservation of PGR's Seeds
- Inventing Palestinian forest trees
- Research biodiversity indicators, pressures and necessary responses



## 10.2 MARINE RESOURCES

### 10.2.1 Introduction

The OPT has access to the marine environment via the 42 km long Mediterranean coastline of the Gaza Strip. Following the Gaza-Jericho Agreement of 1994, previous restrictions on maritime access were lifted, and Gaza was granted territorial waters, as well as access for fishing to a zone extending 20 nautical miles off shore. That is with 1 mile and 1.5 mile wide closed border zones, along the Egyptian and Israeli sides, respectively. The Gaza coastal basin is bounded by the Nile Delta to the south, and by the Haifa coast to the north, forming the south eastern corner of the Levantine Basin.

The Gaza Strip is comprised mainly of sand-dune and coastal-plain environments. It experiences a temperate climate with hot, dry summers and mild winters. Between 61-75% of rainfall in the Gaza Strip is lost via evapotranspiration, and it is estimated that only 2.5% enters the sea in the form of runoff via wadis and streams (Isaac et. al., 1994; Homer-Dixon and Kelly, 1995). There are three significant wadis, which dissect the Gaza Strip and drain into the Mediterranean. Wadi Gaza is the largest and most important, Wadi Beit-Hanoum, and Wadi El-Salqua. The influx from the wadis varies seasonally, with the highest levels coinciding with the winter rains.

The shoreline of the Gaza Strip consists of beaches, sand dunes, coastal cliffs, and built-up areas, particularly in the Gaza City region. The land area of the coastal zone covers approximately 72 km<sup>2</sup>. Prior to the Israeli disengagement in 2005, 48 km<sup>2</sup> of that area was occupied by illegal Israeli settlements (Ali, 2002). Of particular ecological importance is the presence of marine angiosperm *Posidonia Oceanica*, reported to be present in the near shore waters of the Gaza Strip, to a depth of 35-40 m (Hosh, 1995). *Posidonia* meadows are perhaps the most productive marine ecosystem in the Mediterranean, supporting very high population densities of epiphytic Flora and Fauna, and providing shelter and foraging areas for many commercially important fish species (EUNIS, 2006).

Current uses of the marine environment are dependant on an acceptable level of cleanliness of both the waters and sediments. The beaches are one of the few recreational areas available to the residents of the Gaza Strip, and potentially may be exploited by the tourism industry to bring more revenue to the local economy. Offshore, the fishing industry is also reliant on the health and productivity of the marine environment. Fish has traditionally been a mainstay of the Gazan diet (Feidi, 2000), and with the current depletion of poultry supplies caused by the threat of Avian Flu (WFP, 2006), the pressure on fishery resources is even greater. The relatively recent discovery of natural gas reserves within Gazan offshore waters prompted British Gas (BG) International to sign a 25-year agreement with the Palestinian Authority to “establish a Palestinian gas industry by conducting exploration, field development, and building gas pipeline infrastructure” (BG Group, 1999). So the Gaza’s marine environment contains, potentially, a very lucrative exportable resource, and the exploitation of which, brings its own environmental concerns.

### 10.2.2 Ecology of the Marine Environment

The near shore seabed of the Gaza Strip’s slopes is with a gradient around 1:100. The coastal shelf (to almost 100 m depth) is 28 km (15.1 nautical miles) wide at the southern boundary of the Gaza Strip, and 14 km (7.6 nautical miles) in the north. After the 100 m depth contour, the sea bed drops more steeply. The benthic substrate is mainly sand with occasional rocks and some muds (Ali, 2002).

The marine area of the Gaza Strip is part of the Southern Levantine Basin, characterised by high salinity

(up to 39.5 psu), high temperature (up to 29° C) and extreme oligotrophy (Ali, 2002). The predominantly anti-clockwise cycling of water in the eastern Mediterranean causes the prevailing current along the Gaza coast to flow to the north; a fact of great significance to the people of the Gaza Strip. This same northerly current was historically a conveyor of significant amounts of terrigenous (transported) sediments and organic matter from the Nile River.  $43 \times 10^9$  m<sup>3</sup>/yr freshwater discharge, carrying 140 million tons of mud and silt, are used to nourish the Levantine Basin seasonally (Ben Tuvia, 1983). This boosts both plankton densities and fisheries yields (Oren, 1969; Azov, 1991). Following the operation of the Aswan Dam in 1965, the volume of water discharge from the Nile decreased 10 fold, with a corresponding decrease in nutrient-rich sediments (Kashef, 1981; Azov, 1991).

The Levantine basin, and indeed the eastern Mediterranean as a whole, only undergoes one significant phytoplankton bloom per year, peaking in April, with a maximum productivity approaching 500 mg/cm<sup>2</sup>/day (based on SeaWiFS data, 2005). Mean annual productivity is in the range of 10-20 g/cm<sup>2</sup>/yr (Berman, et al. 1984), making this area the least productive of the whole Mediterranean basin. As primary productivity is related to the carrying capacity of an ecosystem for supporting fish resources (Pauly and Christensen, 1995), the very low primary productivity of this part of the Mediterranean basin is an important consideration with respect to the fishery demands of the Gaza population.

As mentioned earlier the nearshore waters of the Gaza Strip are home to *Posidonia oceanica* meadows (Hosh, 1995; WFP, 2006). However, Ali (2002) stated that “sea grass species are not present in the sea of the Gaza Strip, because the sea bed in this area is not sheltered”. *Posidonia* meadows are very important habitats, supporting a diversity of over 200 other species. However, *Posidonia* meadows are susceptible to pollution and disturbance. Severe benthic disturbance, as is caused by bottom trawling, will cause destruction of areas of *Posidonia*, and fragmentation of the meadows. Higher than natural levels of organic matter in the water column, as that may be caused by the input of untreated or partially treated sewage, can trigger a bloom in faster reproducing epiphytic communities. This can reach a level, where *Posidonia* suffers from leaf fragility and reduced light availability (Cancemi et al. 2003), which leads to a corresponding reduction in primary productivity. Given the ecological importance and the fragility of *Posidonia* habitats, it is very important to notice that the ambiguity, concerning its presence or absence in the Gazan waters, is removed with some urgency.

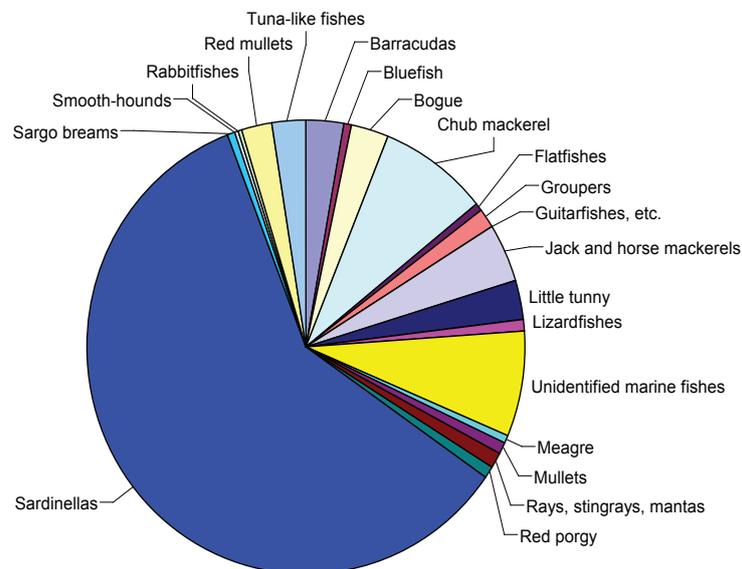
### 10.2.3 Coastal and Marine Resources

#### 10.2.3.1 Fisheries

Historically, the fishing industry was a very important contributor to both the food security and economy of the Gazan population. High value demersal species formed the main exports to foreign markets, whereas pelagic landings were consumed locally. During the past 40 years of Israeli Occupation of the Gaza Strip, the fishing industry has been very erratic; a result of varying restrictions on access to the sea granted to the fishing community by the Occupying Forces. Since the Oslo accords signed in 1994, the Gaza Strip has had legal access to fish in an area extending 20 nautical miles offshore. This included closed border zones of 1 and 1.5 nautical miles along the Egyptian and Israeli sides, respectively. However, continuing Israeli imposed restrictions mean that it has been very rarely possible for Gazan fishers to utilise the whole area. Indeed, even today, following the “full withdrawal” of Israel from the Gaza Strip, the continuing near shore military presence restricts the fishers to a zone extending only between 6 and 12 nautical miles from the coast (OCHA OPT, 2005). Israeli Forces imposed a complete ban on fishing between September 24th and October 9th 2005, depriving the Gazan fishermen of a peak productivity season. The current limit on the fishing zone is 6 nautical miles (WFP, 2006).

Between 2000 and 2004, the size of the Gazan fishing fleet has not increased significantly, with only 2 more boats being recorded. However, over the same time period, the number of recorded fishermen increased by 693 (Ali, 2002). In fact, the number of boats has remained fairly stable since 1983, whereas the number of fishermen has risen sharply since 1988 (Ali, 2002). The largest fleet is concentrated in the Gaza Governorate, and the only registered trawlers fish from there. This is a result of the Gaza City having the only significant dock facilities capable of handling larger vessels. There are plans to construct a new port in the Gaza Governorate, which could lead to a dramatic increase in trawler capacity.

The sardine (*Sardinella aurita*) is, by far, the most important species in the Gaza's fishery, in terms of overall catch weight (Figure 10.3). There are two peaks in fishery productivity; one in spring and the other in autumn. These coincide with the seasonal migrations of fish stocks between the Nile Delta and Turkish waters, which occur in April and October (OCHA OPT, 2004, 2005, 2006). *Sardinella* populations have a very short doubling time of less than 15 months (Fish base, 2006). However, juvenile *Sardinella* remain in near shore nursery areas until maturity, when they move offshore to join the adult stocks. The restrictions on the Gazan off shore's fishing access, and the corresponding drive to intensive near shore fishing methods, mean that the populations of juvenile *Sardinella* are particularly vulnerable to overexploitation.



**Figure 10.3:** Annual catch composition of the Gaza fishery made up from the mean weight of annual catches between 1996 - 2004 (FAO, 2006).

*Sardinella* comprises a far less significant proportion of the Israeli fishing fleet's catch. Since 1970, the proportion of *Sardinella* in Israeli catches has fallen from approximately 30% to around 2% (FAO, 2006). Interestingly, the data for Gazan fisheries indicates that, since the start of data availability in 1995, *Sardinella* has fairly consistently made up around 60% of the total catch. This clear cut difference between Israeli and Gazan catches would suggest that Israel has been gradually shifting focus away from *Sardinella* in favour of targeting other fish species, while the Gazan fishery has remained predominantly *Sardinella* based. This difference could be a consequence of the different environments available to both Israeli and Gazan fishing fleets. The Israeli fleet is able to target pelagic and deep water fish, and to fully take advantage of the seasonal migrations of fish between the Nile Delta and Turkish waters. Whereas the Gazan fishing effort is concentrated in a narrow coastal belt, currently extending only 6 nautical miles offshore, with negligible access to deep water and the migrating shoals. A consequence of the high demand and limited resource availability was that the price of sardines doubled from 15 NIS/kg in January 2006 to 30 NIS/kg in March 2006.

### 10.2.3.2 Recreation

A Mediterranean beach, nearly unbroken for approximately 45 km, is a valuable asset to the recreation and tourism sector of any country. Unfortunately for the Gaza Strip, the present political climate excludes virtually all international visitors, and tourism to this site is predominately local based. As virtually the only accessible open space in the Gaza Strip, the beach is a popular destination for family outings. Formerly, the Wadi Gaza and associated wetland and salt marshes provided a valuable recreation resource. The present levels of environmental degradation and urban expansion in this area mean that this site no longer provides such a service.

### 10.2.3.3 Shipping and the Proposed Gaza Port

At present the only real maritime access for the Gaza Strip is from the small port in the Gaza City, used by small fishing vessels. During the Sharmesh-Sheikh Agreement signed in 1999 between Israel and the PLO, the construction and operation of an international seaport in the Gaza Strip was agreed upon. An area of land 5 km south of the Gaza City has been designated for the construction of the seaport (Isaac et. al.,2006), which will be large enough to allow for access of the international shipping industry with the future State of Palestine. In 2000, Israel effectively stopped progress on this front by preventing the transportation of construction materials. Following the Israeli pullout from the Gaza Strip, an agreement between both sides, on the 15th November 2005, stated that construction of the seaport could commence. However, following the PLC (Palestinian Legislative Council) elections, the Israeli Government has stopped talks with the Palestinian Authority on this issue, and so still no progress has been made (OCHO OPT, 2006). The construction and eventual operation of a seaport in the Gaza Strip will open the future State of Palestine for trade with the international community. This means that terrestrial border closures by the Israeli authorities will no longer cause significant amounts of produce to spoil. It also means that trade can be conducted directly with source countries rather than having to go through Israel.

## 10.2.4 Conflicts and Possible Resolutions

### 10.2.4.1 Fishery

The Israeli control of all movement across the borders of the Gaza Strip means that Gazan fishing products destined for export are frequently not allowed out. This results in large quantities of goods spoiling and having to be discarded; wasting the time, effort and resources of all persons involved in their production, processing and transportation. In former times, there was a high demand for *Sardinella Aurita* by the Israeli canning industry, and economic returns from this fishery resource were favourable. However in recent years external demand for this product has waned to such a level that even if exports were possible, the financial returns would barely make it worthwhile.

In order to fully assess the sustainability of the Gazan fishery, a thorough investigation into the demographics of the exploited resource populations is required. Perhaps the most important factor, determining the future sustainability of the Gazan fishing resource, is that of access. Currently, Israeli restrictions limit fishing to the very near shore waters, if at all. A consequence of this is decimation of stocks of sheltering juveniles and of breeding adults, thus removing the possibility of future generations or subsequent breeding attempts. In order that the Gazan fishing industry may target legitimate, sustainably exploitable fish populations, it is imperative that the fishing fleet is allowed uninterrupted, year round access to the migratory routes 12 nautical miles offshore. Not only is this important to the Gazan fishing fleet, but relieving the pressure on breeding and juvenile stocks in the near shore waters will benefit fish stocks in

the wider Levantine Basin as a whole. It will be impossible to achieve this without Israeli co-operation, and so it is critically important that the Palestinian and Israeli authorities, along with the international community, focus on this matter with some urgency.

#### 10.2.4.2 Recreation

The Gaza Strip contains two major areas which offer potential recreation resources, which are the Mediterranean coast and the Wadi Gaza system. Clearly the first concern as to whether these resources may be exploited as a means of generating revenue through tourism (domestic and international) is that of security for the Gaza Strip's population. The current situation in the Gaza Strip does not allow any form of recreation or tourism. However, assuming that one day the Gaza Strip will be ready to receive tourism, it would be pertinent to adopt strategies now that will facilitate the development of a tourism sector when the opportunity arises. Rehabilitation of the Wadi Gaza system is one of the most pressing needs. As not only does the Wadi Gaza provide a potential recreational resource, the biological importance of this site has the potential to benefit the wider ecology of the Gaza Strip and wide-ranging migratory birds. Although not yet a sovereign state, and so unable to be join the Ramsar Convention for protection of wetlands, The future state of Palestine would be well advised to develop rehabilitation and management strategies based on international conventions, such as Ramsar and the Mediterranean Wetlands initiative (of which the Wadi Gaza already is a part), in order to facilitate accession once statehood has been achieved.

#### 10.2.4.3 Natural Gas, Shipping and the Proposed Gaza Port

There are many environmental considerations to take into account during the construction and operational phases of both the Gaza's seaport and natural gas extraction operations. Numerous international conventions have been drawn up to regulate activities in these sectors, primarily concerning trans-national commitments to prevent incidents of pollution. It is not possible for the future State of Palestine to formally accede any of the conventions, as it is not yet a sovereign state. However, in order to gain greater acceptance in the international community, and to show readiness to actively participate on environmental issues, it would be appropriate for the Palestinian Authority to conduct activities within the guidelines of the conventions, indicating a clear will to accede fully, as soon as the opportunity arises.

### 10.3 Outlook

Prior to disengagement, the Palestinian Ministry of Environment formulated a plan of action to follow when disengagement was implemented. In this plan are lists of required information, concerning both the coastal area, in general, and biological diversity in particular (<http://withdraw.sis.gov.ps/english/EP.html>). In addition, the findings of this report are very much in agreement with the recommendations of the Palestinian Ministry of Environment. Moreover, it is advised that the following needs are addressed as a matter of priority:

1. Provision of information on sources of wastewater pollution into the Wadi Gaza and the Mediterranean Sea, and increase/restore connectivity of the population to waste water treatment facilities.
2. Provision of information on organic and chemical pollution of the Wadi Gaza and Mediterranean Sea, with subsequent identification of sources of contamination.
3. Confirmation of the presence or absence of *Posidonia Oceanica* meadows in the Gaza waters.

4. Stock assessment of targeted marine fish populations (in terms of mean age, size and maturity of captured individuals). So, overall resource sustainability can be assessed, and strategies for efficient sustainable exploitation of this resource can be designed. Fishing methods also need to be investigated, and the number of undersized fish and by-catch should be minimized.

It is also necessary to conduct activities to promote the future sustainability and health of the coastal environment in the Gaza Strip. One of the most critical environmental concerns is the health of the Wadi Gaza ecosystem, and its restoration should be seen as a high priority activity. Not only would a restored Wadi Gaza provide a valuable asset to the Gaza Strip in terms of a tourism resource, but wetlands and associated habitats have a very high value in terms of environmental services. Thus, every activity conducted in the marine environment should be conducted in a manner sensitive to the presence of the valuable habitat type, making every effort to conserve it.

### **Biodiversity:**

The biodiversity is of immeasurable value. It is considered a life-support system that provides a foundation for a healthy functional ecosystem and continued human survival. A more diverse ecosystem gains resilience and is able to withstand environmental stress. And, thus, it is more productive and has higher opportunities to adapt to environmental changes. The many values of the biological diversity indicate the importance why to conserve the biodiversity. So, the continued pressures on the Palestinian indigenous plants and animals, as a result of military occupation and political instability, will inevitably impair the rights of future generations if sustainable utilization measures are not implemented.

As a long-term research endeavour, it is necessary to improve the Palestinian knowledge of how human and natural systems interact. While in the short run, it is needed to develop approaches for monitoring and forecasting human impacts on Palestinian ecosystems. Criteria and indicators for social, economical, and biological components of plant and animal ecosystems are the core of current sustainability initiatives.

Although, generally speaking, there is a growing awareness in Mandate Palestine of the need to conserve natural resources, the formal institutions for studying, recording, and monitoring plant resources is still incomplete. It is imperative that a biological survey is necessary, in order to monitor changes in the Palestinian ecosystems. However, national and international funding for these activities are crucial. In addition, national guidance is required, in order to ensure the continued monitoring of the Country's natural resources.

Efficient planning for new and sound environmental management requires detailed surveying and mapping of relevant areas. Appropriate development organizations should encourage research in ethno-biology to identify plant and animal species used by local people, living in surrounding forests. The specialized knowledge that local people have accumulated about economically useful plant species and about how the ecosystem functions (including the likely effect of certain human disturbances) can be of great use to the Palestinian society. Such an ethno-biological research would prevent species from being irretrievably lost.

Research and development programs have to cover all aspects relating to the species from collection to utilization or conservation. It is desirable to have a 'need based' approach to research on plants, including screening of plants for biological activity. In the wake of all these developments, the Palestinian policy-makers are being challenged to develop appropriate policies to regulate the use and conservation of resources. At present, the policies prepared, related to this issue, are still missing important info concerning sustainable utilization of biological resources. This is important especially when dealing with issues concerning mis-utilization, including free and uncontrolled gathering, hunting and trading in plant and animal species at national and international levels.

Thus, the future of the Palestinian people on their land is largely dependant on its biodiversity conservation, as well as on the sustainable use of its components. So, the following are some developmental suggestions that should be taken into consideration while planning for better utilization and conservation of the Palestinian biological resources.

## **1. Conservation and Better Management**

### **Protected areas**

The setting up of natural heritage areas, which would be in the form of national, regional and local parks with various protection levels to serve the intended needs.

### **Botanical Gardens**

Establishment of botanical gardens can be necessary to complete the nature conservation network

### **Forests Improvement**

Protection of natural forests and promotion of afforestation are necessary activities to improve forestry sector.

### **Rangelands Improvement**

Improvement of protection and rangeland management and the enforcement of laws concerning this sector.

### **Fauna conservation**

Developing and implementing action plans for the conservation of various species of fauna, foremost among which are raptors, invertebrates, insectivorous bats and amphibians is also important

### **Better Coastal Zone Management**

The fundamental environmental threats on the coastal zone in Gaza should be resolved and beach protection, water quality monitoring, pollution reduction, migratory birds' protection, are all necessary.

### **Genetic Resources**

Genetic preservation, characterization, utilization and commercialization of such resource could be an opportunity to the Palestinians to preserve their plant genetic diversity.

## **2. Legislation and Regulation**

There is a need for a comprehensive review and development of Palestinian policy and legislation pertaining to PGRs utilization and conservation, incorporating standards of accreditation, intellectual property rights, indigenous knowledge, training and research

## **3. Public awareness and Training**

The integration of biodiversity principles in educational programs on all levels; to promoting knowledge and expertise through formal and non-formal education, ongoing research, and increased institutional capabilities, are all necessary.

#### **4. Research**

Strengthen taxonomic and systematic research, ecology, habitats and wildlife population studies, indigenous genetic resources, and popular knowledge assessments. Implementing field measurement and assessment surveys to get a grip on existing biodiversity and the identification of those under threat or are presumed lost or extinct is a first step that should be taken. As a result a Species List and a Red List of threatened species of fauna and flora can be formulated and a computerized information center can be established.

#### **5. Institutional Cooperation**

All governmental and non-governmental organizations working in the field of PGRs must cooperate and take the necessary actions to deal with the PGRs' problems that have occurred and/or exacerbated. It is believed that the most vital action is to conduct decentralized Biodiversity projects in order to fit with prevailing political situation, and to create new job opportunities for the marginalized local communities.

#### **6. International and Regional Co-operation and Co-ordination**

The harmonization of national action with international and regional conventions, activities and plans

#### **7. Income Generation and Community Development**

Enhance income generation activities for the local community such as the plans suggested by BSAPP and Agro-biodiversity strategy including: Rehabilitating damaged ecosystems in order to promote biodiversity conservation as rangeland areas and rainfed agriculture areas; and encouraging the sustainable use of the household food processing such as medicinal plants, and others.