THE STATE OF ERITREA
MINISTRY OF LAND, WATER AND ENVIRONMENT
DEPARTMENT OF ENVIRONMENT

THE 5th NATIONAL REPORT
ON THE IMPLEMENTATION OF THE UNCBD

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Convention on Biological Diversity

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ACRONYMS

BIHI: Buri-Irrori; Hawakil Islands
CBD: Convention of Biological Diversity
CCA: Climate Change Adaptation
CCD: Convention to Combat Desertification
CITES: Convention on International Trade in Endangered Species of Wild Fauna & Flora
COP: Conference of Parties
DOE: Department of Environment
ECMIB: Eritrea's Coastal, Marine and Island Biodiversity
EIA: Environmental Impact Assessment
FAO: Food and Agricultural Organization of UN
FWA: Forestry and Wildlife Authority
GEF: Global Environmental Facility
GIS: Geographical Information System
GBH: Girth at Birth Height
IBA: Important Bird Areas
ICAM: Integrated Coastal Area Management
IUCN: International Union for Conservation of Nature & Natural Resources
PPAs: Proposed Protected Areas
PSD: Planning and Statistics Division
MARPOL: The International Convention for the Protection of Pollution from Ships
MCS: Monitoring, Control and Surveillance
MoMR: Ministry of Marine Resources
MOA: Ministry of Agriculture
MRRD: Marine Resources Research Davison
NARI: National Agricultural Research Institution
NBSAP: National Biodiversity Strategy and Action Plan
NEMP-E: National Environmental Management Plan for Eritrea
MSY: Maximun Sustainable Yield
SDB: Semenawi and Debubawi Bahri
SLM: Sustainable Land Management
SOC: State of the Coast
SOE: State of Eritrea
SST: Sea Surface Temperature
TAC: Total Allowable Catch
UNESCO: United Nations Educational, Scientific and Cultural Organizations

EXECUTIVE SUMMARY

This Fifth National Report on Implementation of the United Nations Convention of Biological Diversity (UNCBD) describes and updates the status, trends and threats of biodiversity, and as well as measures undertaken by the Government State of Eritrea in achieving the objectives of the Convention and progresses made towards the Achi targets of 2020 since the submission of the Fourth National Report of 2010. As required by the Convention, the report contains three main parts as discussed below:

i. An update on Biodiversity Status, Trends, Threats and Implications for human well being

Biodiversity is critical to the livelihood of the majority of the Eritrean people. Agriculture (both crop and livestock production), forestry, and fisheries contribute greatly to the daily income of individual families. Life and development in Eritrea are firmly based on natural resources. The National Environmental Management Plan for Eritrea (NEMP-E, 1995) emphasized to ensure that human activities in both terrestrial and coastal areas result in long-lasting benefits. Eritrea's dependence on biodiversity is heavy. Therefore, conserving and sustainable use of natural resources is a major concern. The loss of biodiversity, along with climate change and desertification, were identified as the greatest challenges to sustainable development in Eritrea.

Terrestrial Biodiversity

The designation of the Semenawi and Debubawi Bahri, Buri-Irrori Hawakil Islands as well as Bara-Sole as protected area system in 2013 can be a practical intervention of the Government of the state of Eritrea to ensure conservation of the critical biodiversity resources. The proposed protected areas outstrip both the NBSAP and Aichi Biodiversity Targets in situ-conservation. Hence, more than one million hectare of terrestrial and marine ecosystem has been proposed for protected area establishment and that fund is secured from GEF/UNDP and Government expected to be implemented within 7 years.

There is lack of information and data to generate reliable trends and changes on the status of species diversity. However, there are multiple indicators suggest that there is an overall declining trend for a significant number of species as a result of human made and natural calamities such as climate change, deforestation and over-exploitation of resources.

Habitat transformation, particularly arising from expansion of agricultural area is direct driver of biodiversity decline. Cultivated systems (areas where at least 80% of the landscape falls under croplands, shifting cultivation, or livestock production) that cover three quarters of Eritrean's terrestrial surface. Habitat losses also occur in coastal and marine systems, though the transformation is relatively minimal and less documented.

The forests and woodlands, especially along the riverine areas suffer from deforestation for irrigated horticultural purposes. Excessive collection of firewood and construction materials, over grazing/over browsing, settlements, recurrent droughts, and invasive alien species

(Opuntia ficus indica in the highland forest and *Prosopis juliflora* in the riverine forest and lowland of Eritrea) are generally the major threats to the terrestrial ecosystem.

Marine Biodiversity

The Eritrean waters have not been afforded enough attention from scientists and conservationists. Several elements have shown the importance of the Eritrean coast and islands in terms of globally significant reservoir of biodiversity with unspoiled shores and waters.

Generally the Eritrean coastline and Islands are vegetated with different species of halophytes and few non halophyte plants such as grasses and trees. Some plants that are commonly encountered include mangrove species. Of the seven mangrove species present in the Red Sea area, three species (*Avicennia marina*, *Rhizophora mucronata* and *Ceriops tagal*) exist within the Eritrean Red Sea coast. Two species of mangroves, *Avicennia marina* and *Rizophora mucronata* cover vast area of the muddy coasts, *Avicennia marina* being the most common

Seagrasses are the only group of higher plants (flowering plants) adapted to life submerged under the Sea. Recent findings indicate that out of the 60 existing species worldwide; 12 species exist in the Eritrean Red Sea. Algae is also commonly distributed along the Eritrean Red Sea, representatives from the three main groups known as red, green and brown algae. Seaweeds are relatively dense, band of seaweed during winter months after which it dies down and almost completely disappears in summer due to high temperature. Sedimentation and anchoring are the main threats of seagrasses and algae.

The Red Sea chains a variety of reef types. Typically, fringing reefs are by far the most abundant reef types, lying close to shore and varying greatly in size. Along the main coasts of the southern Eritrean Red Sea hard Corals are less developed. At least 38 existing coral genera and 220 species have been recorded in the Eritrean Red Sea. Many corals are relatively pristine, away from human and economic impact. Now a days there is an increasing threat due to coastal rapid development such as fisheries infrastructure, Fishing operations, aquarium fish collection, tourism, oil pollution, siltation (as a result of land reclamation and road construction), and other coastal developments.

The Eritrean coasts and islands are well known for the large diversity of seabirds and shorebirds. Many species of seabirds and shorebirds exhibit migratory life styles. Over all 30 species are the Palearctic migrant from Europe that appear during winter. The introduction of predatory and grazing mammal species and human interference for decades proved to be the major extinction factor for island breeding birds.

Eritrea is the home to five of the world's seven turtle species, which all of them are threatened with extinction globally, namely Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Olive ridley (*Lepidochelys olivacea*), Loggerhead (*Caretta caretta*) and Leatherback (*Dermochelys coriacea*) turtles. Green and hawksbill turtles are the most abundant and widely distributed along the broad shallow continental shelf of reef

complex, sponge, sea grass and Macroalgae beds; and the other three species are rarely found. The main threats to turtles include incidental catch in trawling, net entanglement, disturbance of nesting and foraging habitats, poaching of eggs and hunting.

There are a number of mammals which occur in the marine waters of Eritrea in which most of them are in the IUCN Red or Endangered list of Species. The status of dugong is inadequate, only one species (*Dugon dugong*) is found in the Eritrean Red Sea. It is widely distributed but less abundant throughout the shallow continental shelf of seagrass and macroalgae beds which are their main food components. A total of 15 cetacean species (7 whales and 8 dolphins) have been recorded from the Red Sea (PERSGA/GEF, 2004). They are relatively mobile and are likely to appear in Eritrean territorial waters at some time of a year.

Agricultural Biodiversity

Eritrea is recognized as a centre of origin and centre of diversity for a number of crops, notably the cereals: sorghum, wheat and barley. There is a rich diversity of crop landraces.

Cereal crops cover about 90 per cent of the total annually cultivated land. Reports indicate that production and land cover of Millet (*Pennisetum typoides and Eleusine caracona)* is declining. Wheat (*Triticum drum*) is the most endangered to genetic erosion due to the past and current introduction of exotic varieties. Oil seed crops are dominated by sesame which stands at 74.5% coverage of total oil crops followed by groundnuts and linseed comprising 15% and 6.7% respectively, which are genetically declining.

In general, agricultural biodiversity is declining as a result of climate change, land use change, and change in cropping pattern, replacement by improved seed, diseases and pests. Loss of these land-races would decrease the stock of genetic material available to plant breeders.

ii. The National Biodiversity Strategies and Action Plans, its Implementation and the Mainstreaming of Biodiversity

Eritrea as a Country Party to the CBD, among other things, has prepared and adopted the National Biodiversity Strategy and Action Plan (NBSAP) in August 2000, as a reference document in order to stick to commitments accepted with the ratification of the CBD. The NBSAP was formulated taking into consideration the country's dependency on the biodiversity resources for socio-economic benefits and future conservation programmes. Consequently, the revised NBSAP is expected to review, set and update national biodiversity targets. The NBSAP is being formulated taking into consideration the country's dependency on biodiversity resources for socio-economic benefits and future conservation programmes. Consequently, the revised NBSAP is expected to review, set and update national biodiversity targets

Since its formulation the country has put in place various measures to implement the Strategy and Action Plans. All relevant sectors are integrating plan of action towards conservation and

sustainable use of the country's biodiversity in the context of NBSAP. Over the past four years, a number of sectoral policies, plans and legislation have been reviewed aiming at environmental challenges in areas of sectoral strategies and action plans including Agriculture, Land, Water and Environment, Energy and Mines, Marine Resources, Forestry and Wildlife, Tourism, Education, Construction and Zonal Administration.

In order to improve and strengthen the forest and wildlife conservation and management, the Government has established a stand-alone authority called Forestry and Wildlife Authority (FWA) in 2012.

In 2010 the Ministry of Land, Water and Environment issued a directive that the Semenawi and Debubawi Bahri remain under permanent enclosure. Furthermore, the Ministry conducted a comprehensive assessment in 2013 to operationalize an integrated Semenawi and Debubawi Bahri-Buri-Irrori- Hawakil and Bara-sole Proposed Protected Area System for conservation and management of biodiversity and mitigation of land degradation. However, these areas are yet to be demarcated and officially gazetted as protected areas.

Despite all the policies and measures that have been instituted by the Government to implement the NBSAP and/or Convention, the following obstacles have been observed to fully implement the NBSAP strategies and action plans:

- Inadequate resources to fully implement obligations of the Convention;
- Inadequate resources to conduct comprehensive country biodiversity study;
- Inadequate mainstreaming of biodiversity issues in sectors and National Government plans and budgets;
- Limited capacity to generate accurate information and data as that are essential requirements for the establishment of protected area system; and
- Low level of awareness on biodiversity at all levels.

iii. Progress towards the 2020 Aichi Biodiversity Targets and contributions to the Millennium Development Goals

Eritrea is in the process of revising and updating the National Biodiversity Strategy and Action Plan (NBSAP, 2000), which is expected to set and realign national biodiversity targets to the Aichi Biodiversity Targets of the Strategic Plan for Biodiversity (2011-2020) and the Millennium Development Goals (MDGs). The national process will revise and update the identified strategies and action plan in the NBSAP towards achieving the various Aichi Biodiversity Targets.

In addressing the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society, the Government of the sate of Eritrea integrated the national and sectoral strategies and plans, which include: Public awareness and advocacy; Poverty

Reduction Strategy and Sustainable Land Management; Promotion of traditional use of forest products; Community tree planting; and Alternative energy sources and efficient improved cooking stoves.

To reduce the direct pressures on biodiversity and promote sustainable use, efforts have been undertaken that include: Mapping and documentation of potential areas for afforestation and for wildlife reserve; Integrated Coastal Area Management (ICAM) Strategy developed; Obsolete chemicals studied and ready for disposal; Waste Water Management and Pollution Control Strategy was developed; and Invasive Alien Species sustainable utilization and Management Programme developed.

To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity, Eritrea has proposed a total land area of 1,009,860 ha (649,266 ha for terrestrial and 360,594 ha for marine protected area; Elephant Management Plan and the Critical endangered African wild ass Management Plan established; Enhancing Ex-situ conservation of cultivated crops and forest genetic resources through human and infrastructure capacity building; and Documenting genetic resources information and studying genetic threats has been established.

To enhance the benefits to all from biodiversity and ecosystem services, Strategy on Degraded Catchments Treatments is being Implemented; Integrated Water Resources Management (IWRM) Action Plan developed; and Sustainable Land Management (SLM) Programme is being implemented.

To enhance the implementation through participatory planning, knowledge management and capacity building, NBSAP is being reviewed and updated; Integrated Traditional knowledge associated with conservation of genetic resources and germplasm is being implemented; National Environmental Days such as Biodiversity Day, National Desertification Day, National Greening Day are being inaugurated; National Environmental Communication Strategy is being finalized; Environmental Station (E-station) installed; and Integrated Water Resources Management and Development Strategies and Plan in place.

1.0 INTRODUCTION

1.1 Background

The United Nations Convention on Biological Diversity (UNCBD) was adopted in May 1992 and Eritrea acceded to it on 21st 1996. The objectives of the Convention are to promote the conservation of biological diversity; sustainable use of its components; and the fair and equitable sharing arising out of the utilization of genetic resources.

Thus far Eritrea has submitted four reports; and this is the Fifth National Report on the Implementation of the United Nations Convention on Biological Diversity (UNCBD): and it has been prepared as an obligation to Article 26 of the Convention, and the relevant decision of its Conference of Parties (COP), particularly decisions X/10, which requires each Party to the Convention to report, through the UNCBD secretariat at every four years or at an interval determined by COP on measures undertaken to implement the Convention and the effectiveness of those measures in meeting the objectives of the Convention. Accordingly, the Eritrean First, Second and Third National Reports were prepared and submitted to the Convention of Biological Diversity (CBD) in December 1997, March 2003 and September 2006 respectively. The Fourth National Report, which focused on assessing the country's progress towards meeting the 2010 biodiversity target was prepared and submitted to the CBD secretariat in April 2010.

This National Report is the Fifth of its kind, which provides an update to the Fourth National Report that was prepared in 2010 and therefore covers a period of four years. The Report contains the status of biodiversity resources of the country, current trends and threats, project/programme initiatives undertaken to conserve and develop the biodiversity resources of the country, achievement and lessons learned in the course of implementing the National Biodiversity Strategies and Action Plans (NBSAP) and Convention in the country. As required by the Convention the report cover three main parts and five appendices namely:

Part 1: An update of Biodiversity Status, Trend and Threats and implication for human well being
Part 2: The National Biodiversity Strategies and Action Plans (NBSAP), its Implementation and the Mainstreaming of Biodiversity
Part 3: Progress towards the 2020 Aichi Biodiversity Targets and contributions to the Millennium Development Goals

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1.2 Description of the Country

Eritrea is located in the Horn of Africa, lies north of the equator between latitudes 12^0 22' and 18^0 02' north and the longitudes 36^0 26' and $43^0$13' east and covers an area of 124,320 km^2. It is situated along the important Red Sea oil and shipping route connecting the Mediterranean Sea with the Indian Ocean. Eritrea shares boundaries with the Sudan on the west, Ethiopia on the south, Djibouti in the southeast and with the Red Sea in the east. There are around 390 islands, the prominent being the Dahlak Archipelago. Administratively, the country is divided into six zobas (administratve region) namely Maekel, Debub, Anseba, Gash-Barka, Northern Red Sea and Southern Red Sea.

The country exhibits a varied topography, rainfall and climate with altitude that ranges from 120 meters below sea level to over 3,000 meters above sea level. The coastal plains zone which is found adjacent to the Red Sea shoreline and extends about 1060 km from the southern tip to the north. The most serious climatic condition of the coastal zone is the shortage of rainfall, either for agricultural, domestic or industrial use. The annual rainfall range is equal to or below 200 mm (NEMP-E, 1995).

When climate, soil types and other parameters are taken into account Eritrea is divided into six agro-ecological zones (Figure 1): (i) the Moist Highlands, (ii) Arid Highlands, (iii) Sub-Humid Highlands, (vi) Moist Lowlands, (v) Arid Lowlands and (vi) the Semi-Desert. Elevation ranges from 100 m (Semi-Desert) to 3000 m (Moist Highlands). Mean annual temperature ranges from 15^0C in the Moist and Arid Highlands to 32 ^{0}C in the Semi-Desert. Annual precipitation varies from less than 200 mm in the Semi-Desert to 1100 mm in the Sub-Humid Zone.

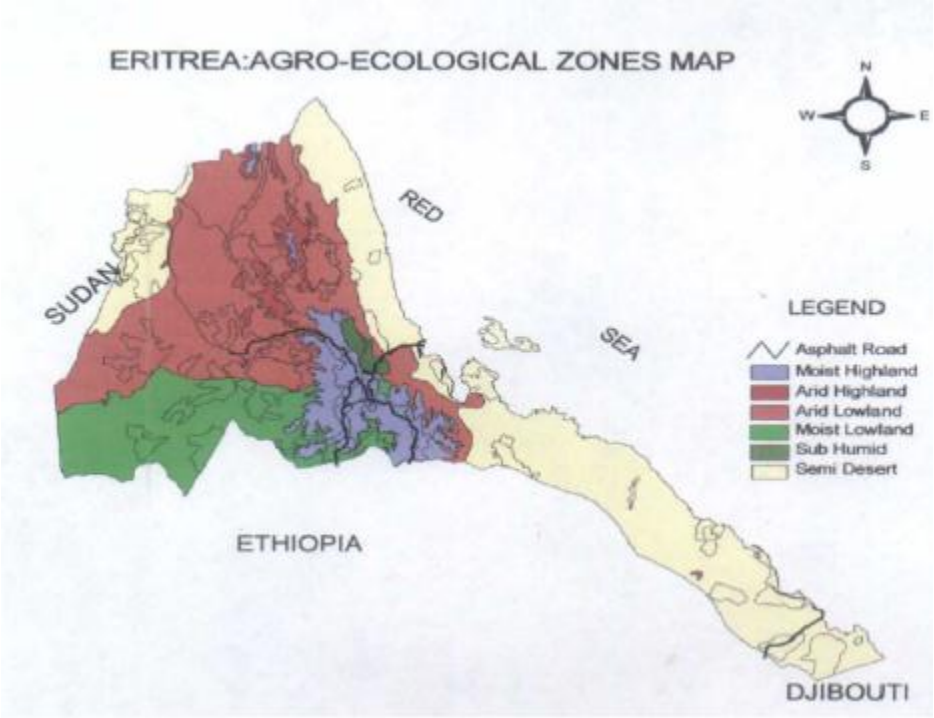


Figure 1: Agro-ecological zone of Eritrea (Source: DoE, 2001).

Owing to the great variation in altitude and climate as well as topography, the vegetation cover of Eritrea shows great differences in terms of species diversity and cover. The vegetation of the coastal plains includes various vegetation formations including swamps along the seasonal rivers and wadis, Acacia woodland, semi-desert Acacia woodlands, bushland and thickets, deserts scrubs and mangrove (Haile *et al*., 1998). In the Central highland the most prevalent plant species are *Juniperus procera* and *Olea africana* mixed with deciduous trees like *Acacia abyssinica, Rhus abyssininca, Carissa edulis, Anogeissus leiocarpus, Terminalia brownii, Mimusops Kummel, Combretum molle,* while the natural vegetation of the lowlands of Eritrea is widespread by Acacia woodland and bushland, grassland and the riverine forest. The dominate tree species in the flat plains are *Acacia tortilis, Acacia mellifera, Acacia asak, Balanites aegyptiaca, Dobera glabra, Capparis decidua,* and *Boscia senegalensis*; on the hillsides the dominant species are: *Acacia mellifera* and *Delonix elata*; and the riverine area is dominated by *Hyphaene thebaica, Ziziphus spina-christ, Salvadora perisica and Tamarix aphylla.*

In Eritrea, about 49% of the country is rangeland, and approximately 75% of the total population depends on livestock and livestock production (NEMP-E, 1995). The major resources in the rangelands include indigenous grasses and browse plants, water points, and shade provided by vegetation. Environmentally friendly management techniques have not been applied in the rangelands. However, in most cases, pastoralists do allow large trees to persist in limited numbers as they provide shade for livestock (NEMP-E, 1995).

Only one century ago, 30% of Eritrea was covered by forest. By 1952, that amount had dwindled to 11%. In 1960, forest cover was estimated to total a mere 5% of the country. Currently, the value is estimated to be as little as 1%, or even less (NEMP-E, 1995; Haile *et al*., 1998; NAP, 2002). This is mainly due to agricultural clearance, war and severe drought in the country.

Eritrea was endowed with a variety of natural resources that have been declining as a result of human made and natural calamities such as drought, deforestation and prolonged war. Historically, the country accommodated a wide range of wildlife species such as African elephant, Hippopotamus, Buffalo, Giraffe, Greater kudu, African wild ass, Nubian ibex, Waterbuck, Lion, Leopard, Cheetah, Colobus monkey and numerous other smaller species (NEMP-E, 1995). At present, a few of these species such as, African wild ass, Nubian ibex, Greater kudu, Waterbuck, Leopard and numerous other avi-fauna species exist in Eritrea, but these populations are small and are considered to be under threat.

The population of Eritrea is about 3.5 million of which 70-80% live in the rural areas and derive their livelihood from agricultural activities (crop and livestock production). The Ministry of Agricultural National Report (2013) estimates the indigenous livestock population in Eritrea at 10.6 million.

PART I: AN UPDATE BIODIVERSITY STATUS, TREND AND THREATS AND IMPLICATION FOR HUMAN WELL BEING

2.1 Overview of Eritrea's Biodiversity Resources

Biodiversity is an all-inclusive term to describe the total variation among living organisms of our planet. In Eritrea, biodiversity or biological diversity is therefore 'Life on Land' and includes marine biodiversity.

As in other parts of the world, life and development in Eritrea are firmly based on natural resources (NEMP-E, 1995). The National Environmental Management Plan for Eritrea (NEMP-E) has been drawn up to ensure that human activities in both terrestrial and coastal areas result in long-lasting benefits.

Eritrea's dependence on agriculture is heavy. Therefore, safeguarding the productivity of the land is a major concern (NEMP-E, 1995). Indeed, Eritrea's pressing environmental problems are directly related to land degradation, deforestation, soil loss and the expansion of desertification, especially in the critical areas where agricultural output is vital (NEMP-E, 1995).

The loss of biodiversity, along with climate change and desertification, were identified as the greatest challenges to sustainable development in Eritrea (NEMP-E, 1995; NAP, 2002; GEF Country Portfolio Evaluation, 2014). The cutting down of trees for firewood, cultivation, for construction…etc are a significant concern because of increased human encroachment upon forest areas, increased resource extraction and further threats to biodiversity. In Eritrea forest resources and vegetation covers are under serious threat i.e. the forest cover and forest quality are declining.

The biodiversity resources of Eritrea is not yet comprehensively studied and documented. However, the recent Biophysical Assessment Report, which was done by the Department of Environment in 2013 with the Global Environmental Facility (GEF) fund to operationaze the Proposed Protected Areas (PPAs) of Semenawi and Debubawi Bahri (SDB); Hawakil Islands (BIHI), and as well as the Bara'soli bay has shown an important indication on the status of the terrestrial and marine habitats in those areas. The assessment has been delineated and assessed a total of 72 vegetation communities sample plots for species diversity and richness. In the SDB, *Terminalia brownie* vegetation community was found to be the most diverse of all the vegetation communities investigated with diversity index (H = 3.2678) and species richness (S = 45). Similarly, the Acacia *laeta* vegetation community /ecosite, which is found in the undulating mountains by the north- east side of the Buri-Peninsula in the coastal area, were found to be the most diverse of the five vegetation communities in the area. Likewise, 20 mammals and 111 bird species in SDB and 16 mammals and 62 birds' species in BIHI have been identified and documented.

Eritrea has records of about 600 bird species. It is also very important, for migratory birds, providing migration route and stop-over location for many species. A total of 14 Important Bird Areas (IBA) have been identified for Eritrea. There are 12 species of global

conservation concern recorded from Eritrea (Redman et al. 2009). A total of 90 reptiles and 19 amphibian species have been recorded for Eritrea. There are two possible endemic reptiles and one possible endemic amphibian. In the absence of a comprehensive national checklist, a number of site-specific checklists are included one list of almost 700 species indicates that considerable plant diversity may persist in human-altered landscapes (4th CBD National Report, 2010).

Although Eritrea is still one of the least ecologically disturbed parts of the Red Sea relative to other enclosed water bodies, it is in increasing jeopardy. There is a growing risk of marine pollution, and environmental degradation from rapidly expanding maritime activities. Coastal habitat is being converted for urban and industrial development. Tourism and recreation usage are growing quickly. That's why proper conservation measures need to be instituted before the coming on of environmental pressures. The areas identified as potential hot spots are the zones of the Buri-Peninsula, Hawakil Archipelago and the bay of Bara'sole. These areas contain some of the world's most important coastal and marine environments, with unique coastal (aquatic/terrestrial) ecosystems and their associated species as important repositories of marine biodiversity on a global scale. There is also a rich cultural heritage that includes large numbers of significant archaeological, historical and sacred sites, which could be conserved as important UNESCO Cultural heritage sites.

The Eritrean Red Sea particularly the southern part is rich in marine plants especially seagrass. A significant coverage of seaweed is also found, relatively less compared to the seagrass. But much abundance is found on the hard substratum of the Northern part of Eritrean Red Sea.

The coastal areas from Ghel'alo to Sahil and the Dahlak Archipelago Islands can be considered as important Bird Area for marine birds especially for the Palearctic migrants. The coastal villages are primary wintering ground and migratory stopover for shorebirds. The coastal areas of Wekerito and Fanus are ideal for roosting and foraging for seabirds. Depending on the commencing season enough information on those breeding birds commencing clutches and fledgling time should be recorded. And the endangered seabird species such as *Socotra cormorant* should be given higher priority.

The offshore areas are important areas of turtle foraging and nesting. However feeding and nesting monitoring sites for sea turtle can be near coastal areas were poaching from fishermen is common. The species diversity for cetaceans is incomplete in particular and nesting area of sea turtle for some islands are not confirmed throughout the field survey, as it was conducted during the season of none-nesting.

As describe in the 4th CBD National Report 2010, Eritrea is recognized as a centre of origin and centre of diversity for a number of crops, notably the cereals: sorghum, wheat and barley. There is a rich diversity of crop land-races still available in Eritrea. A full inventory of the local land-races for all crop types in Eritrea is not yet done.

Habitat transformations, particularly from conversion to agriculture due to anthropogenic pressures are direct drivers of biodiversity decline in Eritrea. Cultivated systems (areas where at least 80% of the landscape is in croplands, shifting cultivation, or livestock production),

and covers three quarter of Eritrean's terrestrial surface. While the expansion of agriculture and its increased productivity is seen as success story of enhanced production and food security of one key ecosystem service, this success has come at high and growing costs in terms of trade-offs with other ecosystem services, both through the direct impact of land cover change and as a result of release of nutrients into rivers and water withdrawals for irrigation and other services. Habitat loss also occurs in coastal and marine systems, though these transformations are relatively minimal and less documented.

2.2 Biodiversity Status, Trends and Threat under different Biome/Ecosystems

The Eritrea Biodiversity Stocktaking Assessment Report (DoE, 1999) and the National Biodiversity Strategy and Action Plan (NBSAP, 2000), have categorized the natural ecosystem of the country into three major types, namely; terrestrial, marine and agricultural. In this National Report, the three core areas were selected in describing the status, trends and threat under different biomes/ecosystems.

2.2.1 Terrestrial Biodiversity

Terrestrial biodiversity are known to provide a range of goods and ecological services while preserving natural and cultural heritage. They are thus essential components in natural and global biodiversity conservation strategies. High rates of loss of wild nature, together with increasing human demands on the environment, make it essential to identify areas that together will conserve the species and habitats they hold, and the ecological services that they provide, as efficiently as possible (CBD, 2004).

In Eritrea, terrestrial biodiversity is the natural biological systems occupying the land area and associated the agricultural biodiversity but, excluding the marine system. There is a good deal of overlap between these systems, especially with regard to extensive rangeland and the coastal plains and islands of the Red Sea (DoE, 2000). In this report, the terrestrial biodiversity is classified under four major biomes/ecosystem types namely: forest ecosystem, woodland ecosystem, bush land/grassland ecosystem, and barren land/ semi desert ecosystem and their current status, trends and threats are described as follow.

2.2.1.1 Forest Ecosystem

The forest ecosystem of occupy approximately 2,930 Km^2 or 2,930,000 Ha (FAO, 1997) of the total area of the country and includes the dense and disturbed highland forest, riverine forest, and mangrove forest. For the purpose of this report, however, the mangrove habitat is treated under the marine ecosystem in order to avoid overlaps and its interlinked nature with the aquatic habitat.

Dense and disturbed highland Forest: This forest ecosystem is located in the eastern escarpments of Eritrea encompassing 1001 km^2 (FAO, 1997). There are two types of forest lands, namely disturbed *Juniperus* (coniferous) forest and dense and disturbed mixed forest. Both types of land use and land cover units are found in Semenawi and Debubawi Bahri or

the Green Belt, although small highly disturbed patches of juniper groves are found at Abahane, Kohaito and Soira in the south and Rora Habab in the north (FAO, 1997; DoE, 2013). Abehane, Soira, and Rora Habab juniper forests are extremely disturbed and look unstable. In addition, the upper and lower peripheries of the greenbelt are highly encroached and are under pressure. However some parts of the Green Belt which are managed under permanent enclosures i.e. parts of Mogo, Fagena, Sabur, Filfil, Fishoi and Mirara and Mountaion Bizen are relatively stable. This vegetation type covers 22,600 ha or 17.6% of the total 129, 000 ha Semenawi and Debubawi Bahri Proposed Protected Area. This vegetation type can be further classified as disturbed *Juniperus* (coniferous) forest and dense and disturbed mixed forest.

Disturbed *Juniperus* (coniferous) forest: In this forest ecosystem, the most prevalent coniferous species is *Juniperus procera* and covers about 4,900 ha. Other species, which occur commonly include, *Becium grandiflorum, Meriandra dianthera, Acacia Origena, Carissa spinarum, Cadia purpurea, Aloe camperi, Otostegia fruticosa, Calpurnia aurea,* etc. Two critically endangered endemic species, *Aloe schoellerii* and *A. neosteudneri* are found in the Juniperus forest ecosystem. Both species are reported to have very restricted distribution, *A. schoellerii* being only known from one place, the Kohaito plateau, near Adi Keyih, while *A. neosteudneri* is reported from Mt. Saber, near Geleb (Ghebrehiwet 2012).

Most of the land originally covered *by Juniperus* forest has been extensively harvested mainly for wood fuel and traditional house construction. In areas were the land is suitable for cultivation it is common to see land opened up for crop cultivation. This situation has been even worse for forest land located at proximity to villages and rural settlements. The absence of regenerating and ground cover is related to the disturbance induced from the local community. Hence, the area is less suitable for wildlife. Almost none of the mammalian species found in the locality were occasionally observed except Hamadryas baboon (*Papio hamadryas*). However, the area supports different species of birds (annex III).

Photo 1: Juniperus procera community: Semenawi Bahri(Medhanit area)

Photo 2: Juniperus procera community: Debubawi Bahri (Mt.Bizen)

Dense and disturbed mixed forest: This is composed of two types of forests, the sclerophyllous forest dominated by *Olea europea* subsp *africana* and the deciduous forest dominated by *Terminalia brownii* Other species, which occur commonly in this mixed forest include *Acacia origena, Rhus glutinosa, Carissa edulis, Anogeissus leiocarpus, Combretum molle, Mimusops Kummel,* etc..

The main land use activities prior to the designation of the areas as permanent enclosure were rain-fed subsistent mixed agriculture (crop and livestock production) and forest harvesting for fuel wood and construction. This narrow green belt zone is evergreen almost all year round due to its high and well-distributed bi-modal rain and frequent occurrence of mist. This habitat is the most preferable habitat for wildlife species such as Greater kudu and diverse species of Avian. In Dankur-Mirraa area the abundance of bird species is evident. The area harbours quite a number species of birds including the regional endemic species such as; White checked turaco and Abyssinian oriole.

Photo 3: Olea europaea /subsp. Africana community: Dankur

Photo 4: Terminalia brownii Community: Filfil

Based on visual observation and assessment surveys conducted in the Semienawi and Debubawi Bahri Proposed Protected Area by the Department of Environment (2013) documented in a total of 136 trees and shrubs clustered under 61 families. Out of the total plant species surveyed, 23 are found to be endangered/ rare/ species that require prompt conservation actions (annex III).

Wildlife species status in the forest ecosystem of Semenawi and Debubawi Bahri Proposed Protected Area appear to be stable. Based on the rapid assessment survey and Proposed Protected Area Biophysical Assessment Report (DoE, 2013), there are approximately 20 major mammalian species of 9 different families found in the Green Belt areas of Semenawi and Debubawi Bahri (annex III). Among others, the mammalian species include: *Papio hamadryas*, *Cercopithecus aethiops*, *Felis pardus*, *Potamochoerus percus*, *Phacochoerus aethiopicus*, *Tragelaphus scriptus*, *Tragelaphus strepsiceros*, *Sylvicapra grimmia*, *Oreotragus oreotragus* and *Madoqua saltiana*. Except *Papio hamadryas* (hamadryads baboon), all the rest mammals are considered as highly endangered and thus require due conservation and follow up.

The Riverine forest: The riverine forests are found mainly in the western lowlands, alongside the Gash, Barka and Anseba intermittent rivers, encompassing a total area of 1,865 km2 (FAO, 1997). This habitat supports extensive vegetation with variety species composition and diversity. About 25 woody plant species were reported in the 4th CBD National Report. Although no recent complete floristic inventory has been undertaken in this ecosystem, a recent survey indicates that a total of 167 indigenous plant species and 63 herbs and grasses. The same assessments were also able to document a total of 20 mammals, 136 birds and a number of invertebrate species of which two mammals: Ratel or Honey Badger *(Mellivora*

capensis) and Fennec fox *(Vulpes zerda)* were recorded in the area for the first time (annex III). Wildlife species found in the forest of western lowlands of Eritrea are generally low in terms of diversity and abundance and this especially applies to the large mammals, whereas bird life is better represented (AMRF, 1999).

The riverine forest, in addition to being the usual source of fuel wood, fodder and construction material, some species such as the *Hyphaene thebaica* provide edible nut (*Akat*), alcoholic beverage (*Duma)*, fiber for making sacs and ropes; leaves are used for making different artifacts like baskets, brooms, mats and fans. .

Photo 5: Hyphaene thebaica community: Mogoraib River

Photo 6: Ostrich (*Struthio camelus*): Riverine forest of western lowland

Like the other forests and woodlands of the country, the riverine forest also suffered from deforestation for irrigated horticultural purposes. The need to reduce irrigation costs have induced commercial farmers to clear forests very close to the river banks, triggering a process of river bank erosion, thereby damaging the biological diversity and the environment as a whole. Irrigated agriculture within the riverine forest has been increasing from 1997 to 2009. However, recently the Regional Administration has prepared directives that limit agricultural activities 700 meters away from either side of the river banks. If these directives are put into practice and properly enforced, the destruction of the riverine forest will be reduced. Invasive Alien Species mainly *Prosopis juliflora* is expanding very fast and thus continue to negatively affect the biodiversity of the riverine forest.

Threats to the forest ecosystem area:-

- Excessive collection of firewood and construction wood,
- Forest fire,
- Over grazing/over browsing,
- Expansion of settlements, villages and towns,
- Recurrent droughts,
- Invasive alien species (Opuntia ficus indica in the highland forest and Prosopis *juliflora in the riverine forest*)
- Alien avi-fauna species include Indian miena, House sparrow and Rosemering parakeet.

2.2.1.2 Woodland Ecosystem

Mixed woodlands of *Acacia* and associate species, occurring mainly in the south western lowlands, but also in restricted areas elsewhere in the country (Debresina, Debre-hil , Hamelmalo-Halhal, Monguda), In the lowlands and lower escarpments, *Acacia* woodlands occupy about a quarter of the surface of the country. The total area of the woodlands is estimated at about 14,074 km^2 out of which 7082 km^2 (50%) is found in the western lowland (FAO, 1997).

Photo 7: Acacia tortilis/Ziziphus spina-christi: By the side of ephemeral rivers

Photo 8: Mixed woodlands of *Acacia* and associate species: Western lowlands

According to the Proposed Protected Area Biophysical Assessment Report (2013), at the lower part of the Eastern escarpment and extend to the eastern lowland, the area was found with poor under story and canopy cover and this made the habitat less attracted by mammalian species. During the survey only two species of mammals were observed. These are Klipspringer (*Oreotragus oreotragus*) and Hamadryas baboon (*Papio hamadryas*). Thus wildlife abundance in this particular habitat is very rare.

In the woodlands of the western lowland, there is also a proposed protected area of the Gash-Setit mainly for the conservation the last remaining African elephant (*Loxodonta africana*) populations of Eritrea. These African elephants are probably the most northerly group of the species in the African continent. Their distribution in Eritrea is limited to the Antore, Augaro and Haikota areas extended about 120 km long in the Gash-Barka Zone.

From the point of view of the residents who participate in the protection of the Gash-Setit proposed protected area, although there is a conflict between the farmers and the Elephant due to agricultural expansion, the number of Elephants is increasing in Gash-Barka.

Although no serious surveys have been undertaken so far to know about current status of the Nubian Ibex *(Capra ibex nubiana)*, its presence in the North-Western Region of Eritrea around the Kerkebet area of Zoba Anseba is confirmed through field assessment. The Nubian Ibex is a species of great concern at the global level. Its sustained existence could only be assured by serious conservation efforts. An important survey to know more about this species

is recommended. The species is also believed to exist in Sudan along the northern Eritrean border area, but there is no information as to its current situation.

Threats to the woodland ecosystem area:

- Excessive clearing of woodlands for agriculture especially in the south western part of the country,
- Cutting of live trees for firewood, both for local consumption and to the major urban centres of the country,
- Uncontrolled fir devastates a lot of woodland,
- Excessive pollarding of multipurpose trees, such as Balanites aegyptiaca, Faidherbia albida and for dry season fodder Terminalia brownii, and
- Recurrent drought

2.2.1.3 Bush Land/Grassland Ecosystem

The bush land, grassland and wooded grassland habitats are found in most parts of the western lowland, and in some areas of the eastern coastal plains and foot of the escarpments of Eritrea. The total area of the grassland and wooded grassland is estimated at 25,577 km^2 while that of the bush land is about 53, 824 km^2. These habitats cover 63 % of the total land area of the country (FAO, 1997).

Predominantly, the north-western lowlands grassland/wooded grassland ecosystem consists of *Acacia nubica, Capparis decidua, Balanites aegyptiaca, Boscia senegalensis* and a range of other arid and semi-arid species, whereas the eastern coastal plains are composed of less woody vegetation mainly Acacia species. *Calotropis procera* is usually present where the water table is near the surface. The major land using activity is livestock grazing and browsing, both migratory and sedentary type. There is very little rain fed agricultural cultivation, as rainfall is too low and irregular.

Photo 9: Acacia tortilis community: Buri-peninsula

Photo 10: Soemmering's gazelle: Buri-peninsula

Photo 11: Dorcas gazelle: Buri-peninsula

In the eastern coastal lowlands, the typical shrub and bush land occurrences are found in the top and slopes of volcanic hills and plateaus and characterized by sparsely populated and poorly grown acacia species such as *Acacia mellifera and Acacia laeta* and scattered herbaceous plants.

Although there is no a complete floristic inventory has been undertaken in this ecosystem, the Proposed Protected Areas Biophysical Assessment Report (DoE, 2013) showed that the area is dominated, mostly of weedy species (annex III).

Traditionally grassland in the eastern coast of southern Red Sea zone is interchangeably used with rangeland and it has been defined as land where the current and potential natural vegetation is predominantly grasses (annual or seasonal), grass like plants, forbs, or shrubs. The predominant land use activity are grazing of livestock of pastoral type, particularity Irrori plain is known as the most important habitat and feeding ground for the Critically Endangered African wild ass.

The bush land/grassland ecosystem supports important ecological services for varieties of fauna species. There are about 100 African wild asses (*Equus africanus somaliensis*) live and breed in this area. This may be the viable population of this highly endangered species in Africa (IUCN Red List, 2013). Dorcas gazelle (*Gazella dorcas*) and Soemmerring's gazelle (*Gazella soemmerringi*) also use this area on a seasonal basis congregating in significant numbers on the Irrori and Wengebo plains during the wet season. However, the area is suffering from recurrent drought, grazing pressure, agricultural expansions and salinity problem in some part of the ecosystem.

In general, there are approximately 16 major mammalian species of 8 different families in the Buri Peninsula as indicated in annex III.

Threats to the Bush Land/Grassland Ecosystem:

- Uncontrolled fire devastates a lot of woodland and grasslands,
- Expansion of villages and towns,
- Expansion of agriculture in the Western Lowlands,
- Recurrent droughts,
- Invasive alien species (*Prosopis juliflora*; *Corvus splendens*),
- Illegal hunting of wildlife around Buri and Wengebo proposed protected area, and
- Alien avi-fauna species include Indian crow, Indian miena, House sparrow and Rosemering parakeet

2.2.1.4 Barren Land/Semi desert Ecosystem

The Barren land/Semi desert ecosystem mainly consists of land with exposed rock surface or thin soil and practically with non-vegetation cover and occurs in the eastern coastal plains and in some parts of the north western of Eritrea. The total area is estimated at about 47,301 km^2, (FAO, 1997).

There are few tree species such as *Acacia tortilis* subsp. *raddiana, Acacia ehrenbergiana, Acacia nubica,/orofata Cadaba rotundifolia, Commiphora abyssinica, Tamarix aphylla), Ziziphus spina-christi, Salvadora persica* and *Delonix elata in the* wadis of this ecosystem.

According to the Proposed Protected Area Biophysical Assessment Report (2013), the total land area classified under barren land category is estimated at 108,000 ha or 21% of the total designated terrestrial part of the PA. All dry salt flats found mainly within the Buri-Peninsula, beaches, sandy areas other than beaches, bare exposed rocks and an area of thin soil and all lands with widely spaced and scrubby than that of the shrub and brush category with limited capacity to support life are included in this land use and land unit. The common wildlife species in the Bare/Barren land includes: Hamadryas Baboon, Ruppll's sand fox, Common Jackal, Black-backed Jackal Striped hyena, spotted hyena, Serval, Caracal and Ethiopian Rock Hyrax (annex III).

Photo 12: Acacia millifera community: Semi-arid Ecosystem (Eastern lowland)

Photo 13: The Critically Endangered African wild ass (Equus africanuss) in the semi-arid ecosystem

Threats to the Barren Land/Semi Desert Ecosystem:

- Cutting brushwood to build diversions and bunds for seasonal, spate floods that come from the uplands and to use it for small scale irrigation near some wadis are causing significant degradation to the Acacia trees and other bushy plants;
- Invasion of the invasive alien species mainly Prosopis juliflora along the sides of the wadies;
- Desert locust and pesticide spray (This area is the main breeding ground of the desert locust)
- Excessive grazing and browsing by camels and goats
- Alien avi-fauna species include Indian crow, Indian miena, House sparrow and Rosemering parakeet

2.2.2 Coastal, Marine and Island Biodiversity

The Red Sea represents a complex and unique tropical marine ecosystem, with extraordinary biological diversity and a remarkable high degree of endemism. The Red Sea is one of the most important repositories of marine biodiversity on a global scale and features a range of important coastal habitat. (PERSGA GEF. 2003).

The southern part of the Red Sea and in particular the Eritrean waters have not been afforded enough attention from scientists and conservationists. During the recent past years, several elements have shown the importance of the Eritrean coast and islands in terms of globally significant reservoir of biodiversity with unspoiled shores and waters.

The Ministry of Marine Resources through its core research team has taken the initiative to survey and collect baseline information on the marine wildlife and habitats of the coastal area since independence of Eritrea, 1991. Different international standardized survey methodologies such as rapid ecological assessment, reef check, bird count (census), mega fauna sightings and Stranding, sea turtle nesting, seagrass and mangrove quadrant survey have been employed to collect baseline data.

Surveys were conducted on seagrasses and macroalgae, seabirds, marine mega fauna mainly turtles, mangroves, sea cucumber and coral reefs. Policies and Proclamations were drafted and ratified with the support of the government and stakeholders. The findings have highlighted the importance of Eritrean Red Sea marine resources for the country, region and the rest world with a need some active protection and conservation status in general. The Eritrean Red Sea has also been the place for the discovery of new species of fauna and flora, some of which are presently endemic to Eritrea which could make a strong case for declaring its resources especially the coral reefs as a world heritage site under the UNESCO category (according to Veron at a conference, Asmara, 2007).

The Ministry of Marine Resources, prioritize protection and conservation of the marine environment, has been conducting different on-going awareness campaigns, seminars and trainings to enhance awareness in order to ensure long-term sustainability of its marine resources.

The drafting of the coastal policy that defines the coastal area (Coastal Policy, 2006), setting with 100 meters of setback from a fixed geological feature near the coastal line and the ICAM Proclamations (2008) in the entire coastal area of the Eritrean Red Sea as 'Multiple Use Managed Area' is supposed to favour many of the endangered species such as marine turtle populations. In addition, a core of National Marine Protected Areas (MPAs) networks and species conservation programme has been established (2007) with all technical and legal documents to declare two MPAs for their species and educational purposes. Finally, much remains to be desired and achieved but the challenge is to progressively continue the momentum of the activities by soliciting funds from local and international environmental and conservation organizations.

2.2.2.1 Flora Ecosystem

Mangroves: are a salt-tolerant group of tropical plants that occupy the inter-tidal zones of the sheltered coasts such as estuaries and lagoons. They are variously adapted to survive under unfavourable environmental conditions for growth and reproduction resultant by inundation with salt water, unstable soils due to tidal flow and lack of freshwater.

Of the seven mangrove species present in the Red Sea area, three species (*Avicennia marina*, *Rhizophora mucronata* and *Ceriops tagal*) are present within the Eritrean Red Sea coast. Only two species of mangroves, *Avicennia marina* and *Rizophora mucronata* cover over vast area of the muddy coasts, the first being the most common. *Rhizophora mucronata* have also been identified among mangrove communities in the Dahalk Islands (Hughes and Hughes, 1992), Mersa Mubarek (Hillman, pers comm 1995), Harena Island and small number in the

Buri-Peninsula. Small number of individuals of the species *Ceriops tagal* has been confirmed in Northern Coast such as Marsa Teklay and Museri, an Island of the Dahlak Archipelago (Marine Resources Research Division, 2014 data). Estimation results indicate that the country's mangroves cover about 70 km².

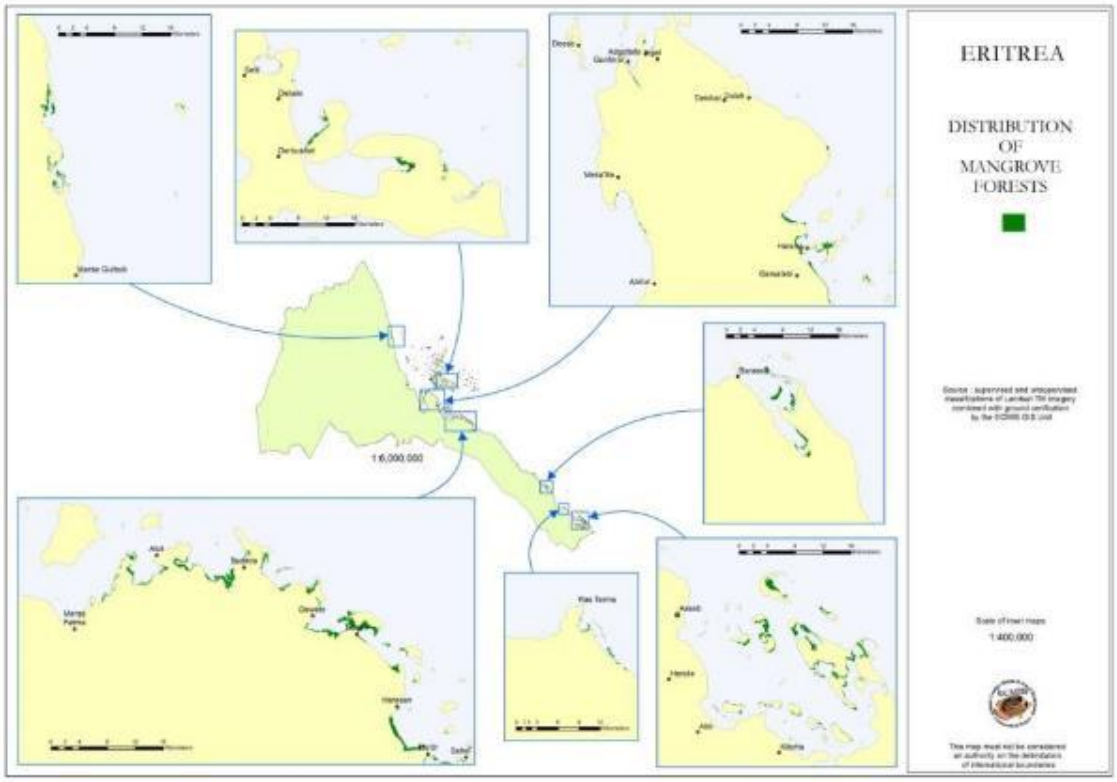


Figure 1: Map of Mangrove Areas at the Eritrean Red Sea Coast (ECMIB-GIS, 2007).

The mangroves act as an important breeding, nesting and wintering sites for migratory birds, both shorebirds and seabirds. The pink-backed pelican (*Pelicanus refescens*), the Western reef heron (*Egretta gularis*) and the Goliath heron (*Ardea goliath*) are among the common mangrove associated birds. Mangroves provide a valuable habitat for other associated species and also provide an important coast defence function, absorbing a large amount of energy from waves.

Rhizophora mucronata

Avicennia marina

(Photo 14: All three taken at Museri Island, 2014)

Ceriops tagal

Status:

The dominant species is *Avicennia marina* with some older trees reach 10m high. The forest seems denser and larger in height with muddy substratum than in the sandy substratum. This indicates that mangroves prefer muddy substratum to sandy substratum. Mangroves often occur on infrequently flooded areas, which are separate from the sea by low dune ridges, such as those found near mersa Mebrok in the north. In Dankalia, mangroves are also found in Asseb bay and in isolated patches. Typically, the mangroves grow as thin or, rarely, thick forests along the shore-line, on near and off-shore islands and Fringing tidal creeks and channels of various size (locally known as khors, sharms or mersas). The area especially the areas between Marsa Fatuma & Sahil are known for their good coverage of mangrove forest as several islands in the southern area. Coasts such as between Ras Hafele of Tio, Saroyta up to Iddi are with no single mangrove tree as they are sandy & highly exposed to wave action.

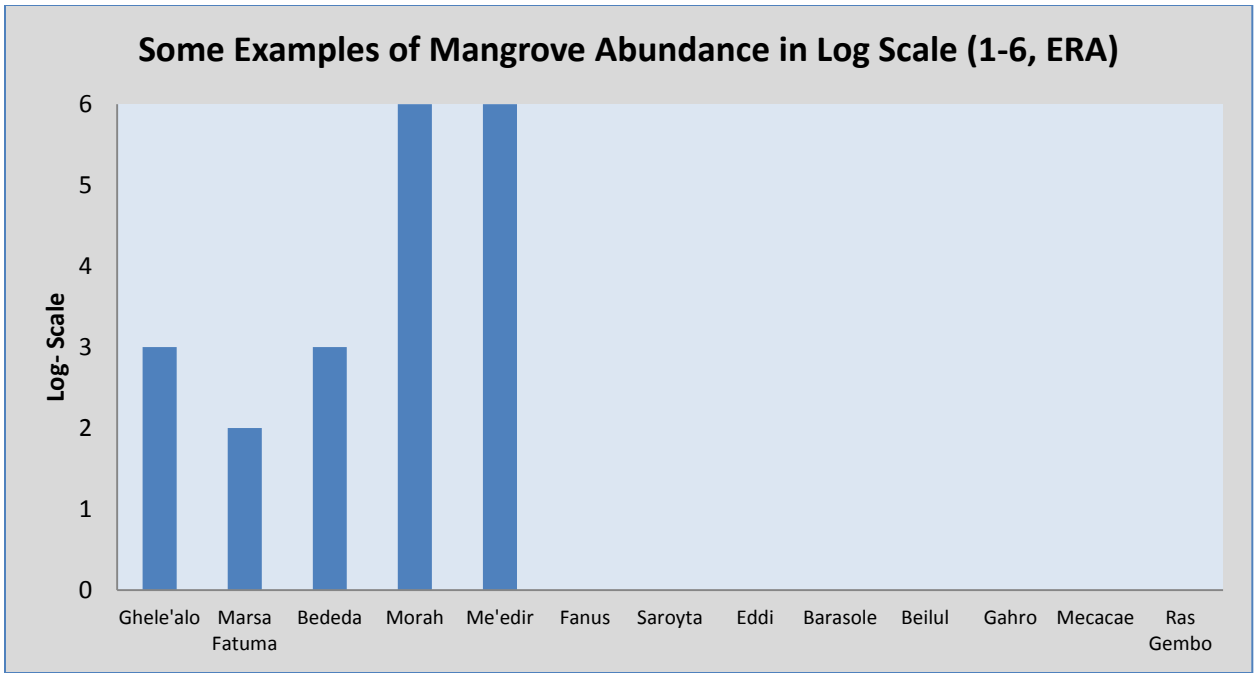


Figure 2: Mangrove distribution and abundance (log-scale, 1-6) at main coastal areas of the surveyed sites (MRRD, 2014)

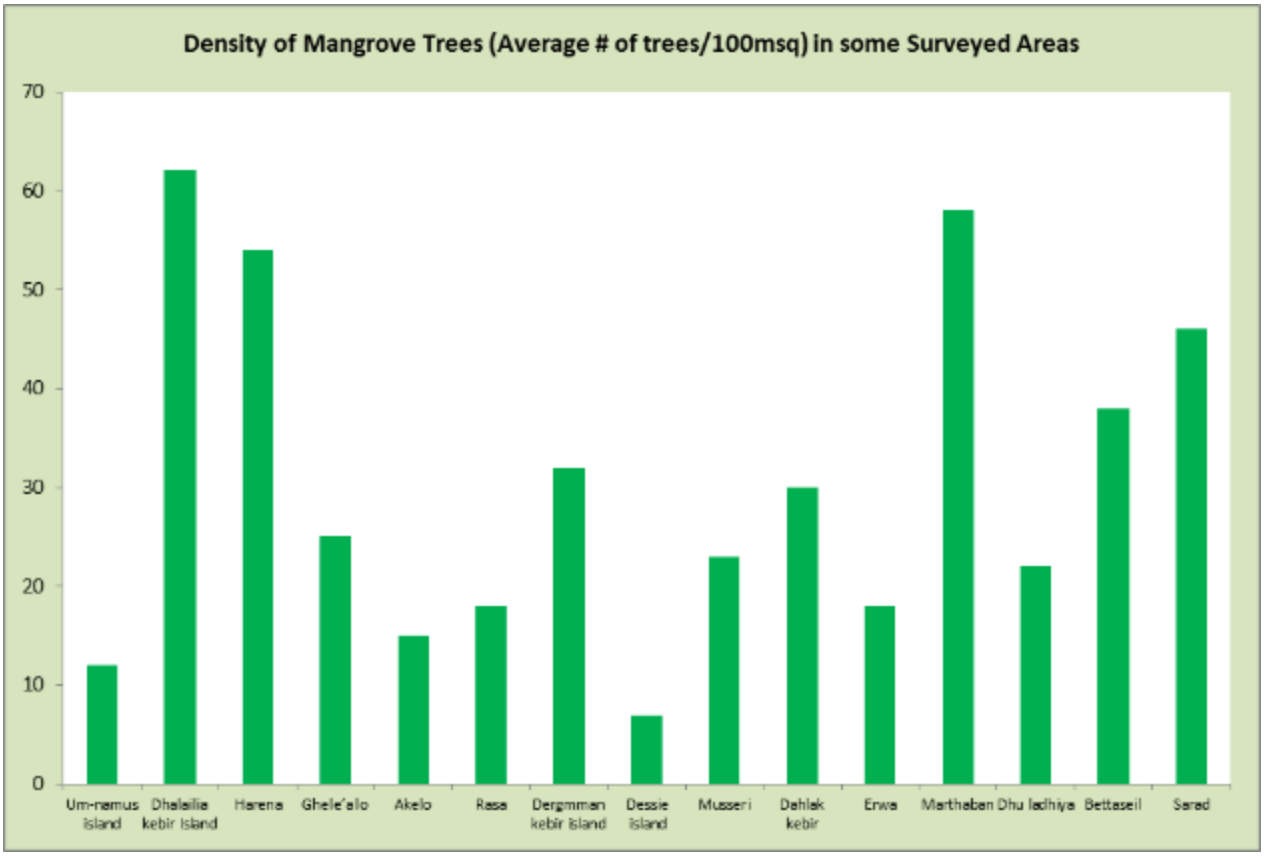


Figure 3: Density of Mangrove Trees at main coastal areas and Surveyed Islands sites (MRRD, 2012)

Although the mangrove stands are typically thin in Eritrean Red Sea, the surveyed mangrove areas so far have a width and length varying from few meters to certain kilometres. The size of the Avicennia plants ranges from stunted bushes, usually growing in the outer fringes of the stand to well-developed trees reaching up to 4-6m in height. The Girth at Birth Height (GBH) of mature well developed trees ranges from 10- 150 cm in some particular localities e.g., Dahlak and Ingel peninsula. The tallest tree measurement was recorded in Dhalalia Kebir Island and it is about 10.8 meter height. In addition to this the largest GBH also recorded in the same island which is about 2.32m in average. High density of mangrove trees and seedling was recorded in Harena and south western Harena and these indicates good mangrove standing on the site.

The well-grown *Rhizophora macronanta* at Bay of Ingel reached up to 8-12m height and GBH reach approximately 100cm. In surveyed sites the mangrove trees thrive healthy, there is no sign for mass mortalities at mangrove forest; death to the uppermost and outermost branches ('top dying') is common among trees in many severely disturbed mangroves.

Threats:
The major threat to this valuable habitat include are water quality deterioration and land-filling for development and certain changes to coastal processes. Cutting and sever grazing of camels, sheep, goats and donkeys are also recorded.

There are considerable human impacts because of the large settlements. There are many villages in the southern Eritrean Red sea coast where the villagers have large number of herds of camels compared to the other coasts of the Eritrean Red Sea. The mangroves of this region are more affected by camel grazing and also goats and sheep. In some areas grazing by camel is great threat to mangrove trees and is causing some damage like killing of seedlings, pneumatophores and saplings. In addition to the direct grazing of the animals collecting leaves and seeds for animals were observed during some of our surveys.


Photo 15: Leave collection for feeding domestic animals (Berasole, 2007)


Photo 16: Group of Camels grazing on mangrove trees (Hergigo, 2010)

The southern Eritrean Red Sea has many rivers flowing to the sea bringing many nutrients to the sea to mangrove habitat. But currently a serious problem is observed due to the Massawa-Assab road construction. Mangroves are completely blocked by a newly constructed road

from the river which was main source of fresh water input and other important sediments. Due all the cumulative factors most of the mangroves are dry and dead but some of the live trees are also in danger. In addition to this the volume of sea water to mangrove changes and sediment flowing through mangroves results in local erosion (about 50cm) of natural mangrove stands in the areas and high prograding of shorelines and younger pioneer of *Avicenna marina* communities was observed.

Photo 17: Massawa-Assab main road at Ghele'alo area where freshwater input is blocked from entring the sea (2012).

About 0.5 hectare of mangrove trees in the Northern part of the Free Zone, Massawa are completely blocked from getting sea water input due to the new road. Very high salty water was accumulated between the mangrove stand and the new road resulting in low or no tidal sea water input. As a result most of the mangrove trees are dry and dead.

Photo18: Flamingo Park, before road construction around Gergusum (2006)

Photo19: Flamingo Park, after road construction around Gergusum (2011)

Pollution in the mangrove areas is largely confined to domestic solid-wastes, e.g. polythene bags and bottles, plastic and metal cans, which are disposed of in small quantities near population centers of the major coastal towns and villages. This may have serious physical impacts by covering the young seedlings and pneumatophores, blocking tidal channels and causing disturbance to the mangrove-associated fauna.

Pollution resulted from sewage water is not recorded in the coastal areas for the reason that the coastal communities are not using sewage drainage system. Oil pollution or direct chemical and industrial inputs to the mangroves also were not reported during the present surveys since there no major factories are found. However, few oil spills were evident from shipping routes, commercial fishing activities especially in areas of Massawa.

Photo 20: Oil spill from scrapped wreck ship Kutmia-Massawa (2010)

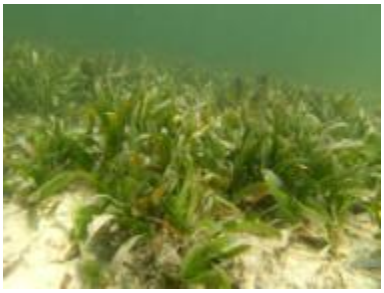
Photo 21: Oil spill affected associated fauna Kutmia-Massawa (2010)

Seagrasses: occur in the shallow coastal areas (0-20m depth). Seagrasses are the only group of higher plants (flowering plants) that have adapted to life submerged under the sea. They inhabit soft bottomed, shallow water areas of temperate, subtropical and tropical seas. Depth around 40m has the potential of supporting extensive communities provided that there is adequate light for photosynthesis (Tickell, 1998). They can form dense beds which provide

food and shelter for many associated species, including dugong, turtles, birds and invertebrates. They also act to stabilize the sediment in which they grow. The sea grass community is one of the most productive of the primary producing marine communities.

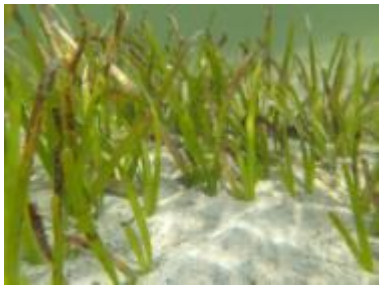
The recent findings indicate that out of the 60 species existing worldwide; the 12 present in the Red Sea are found in the Eritrean waters: dominated by *Thallasia hemprichii* and by *Halodule uninervis* (co-dominance). *Halophila ovalis* and *H. stipulacea* are the underwater marine plant commonly observed at different sites. *Cymodocea rotundata* is the most rarely found species. It was only found in Gele'alo, Bededa and Harasan. A remarkable coverage of *Thalassia hemprichii* is noticed in Allul, Bededa and Harasan. *S. isoetifolium* was observed in Ghel'alo.

Seagrass communities also support sea turtles and the globally endangered dugongs. Significant seagrass beds are found around Barasole, the western side of Mantola Island in the south, Hawakil, Debel Ali, Dergamman Kebir, Baka, Delesen, north side of Harena, west of Adjuz, Norah, Baradu and Dehil islands. Priority areas assessed and a well compartmentalized herbarium of 600 specimens established (2006-2012).

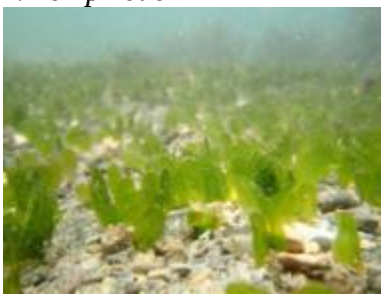


T. hempricae

H. uninervis



C. rutandata



H. ovalis

T. ciliatum

S. isoetifolium

Photo 22: Seagrass communities along the Eritrean Red Sea

Status:

The increasing trend of sea-grass biotope southwards could be attributed to wider continental shelf and greater prevalence of unconsolidated sediments (Sheppard, 1985). The abundance of the sea-grass species has no significant geographic variation except in exposed areas such as Saroyta where they are rare or non-existent. Two species namely *S. isoetifolium* and *T. ciliatum* are exclusively found in the southern Eritrean Red Sea, while *T. hempricae, H. ovalis, H. uninervis, E. acoroides* and *C. rutandata* are common throughout the surveyed sites. *Cymodocea seserulata* (serrated leaves) reported in the Eastern Red Sea coast by Price A.R G. are not encountered during the surveys. Sites around Tio & far to the south, such as

Handa & Wekerito have no or few seagrass population as the result of the high wave dynamism of the open area.

In some sites such as Rasa, Morah, Diwalo and Harasan abundance of seagrass is moderate. Most of the sites with low percentage coverage observed could be due to the topography of the area which reflects vast shallow & exposed Inter-tidal areas (in some places it extended to almost one kilometre towards the sub-tidal). This could be the reason for the low coverage recorded as the transect lies 200m starting from the high tide and never reached the major seagrass bed. Beside to the shallowness, places such as Rasa and Morah, the coast in the upper high tidal area is surrounded by mangrove swamp area, substrates mainly dominated by mud; characterizing high turbidity. These directly influence the growth of sea grass by decreasing the permeability of light penetration which controls photosynthesis.

The distribution pattern of *T. hempricae* was unique in that it showed clear zonation and high abundance ratio. Mollusks (*Strombus tricornis*), sea cucumber (*Holothuria atra*), Green turtle (*Chelonia mydas*) and many adult and juvenile fishes are the most conspicuous species associated with sea grasses.

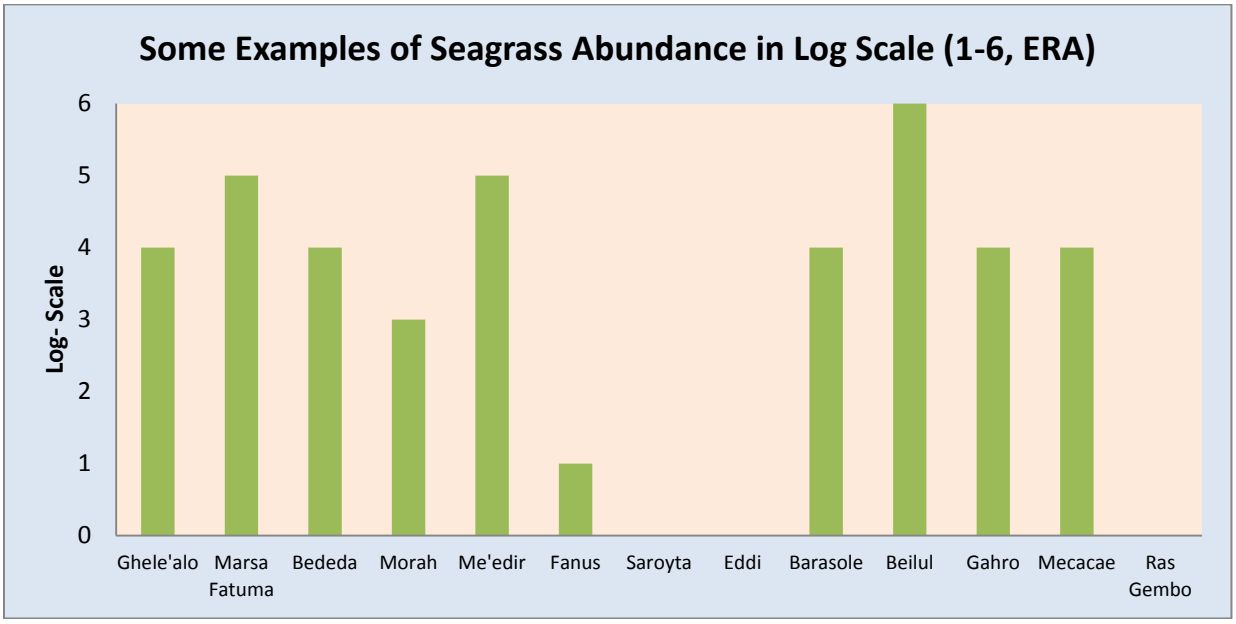


Figure 4: Seagrass distribution and abundance (log-scale, 1-6) at main coastal areas of the surveyed sites (MRRD, 2014)

Threats:
Sedimentation has been the main threat as a result of land reclamation on few coastal sites of Massawa due to land reclamation. Anchoring is also happening by some fishermen and tourist boats at seagrass beds of the frequently visited islands.

Photo 23: Anchor damage on *H. ovalis* bed (Gahro, SERS Region, 2014).

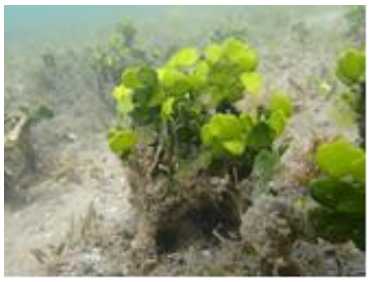
Photo 24: Land Reclamation resulting in Sedimentation (Tiwalet, 2006).

Seaweeds (Macroalgae): Algae is commonly distributed along the Eritrean Red Sea, representatives from the three main groups known as red, green and brown algae. Seaweeds are non-flowering water dwelling plants. They can grow from few centimetres up to several meters long and are attached to hard surface. Unlike Seagrasses, Seaweeds do not have roots to take up water or leaves to make food. The whole surface of Seaweed is involved in the uptake and output of substance (Tickell, 1998). Seaweeds are found in the coastal region between high tide to low tide and in the sub-tidal region up to a depth where 0.01% photosynthetic light is available. Plant pigments, light, exposure, depth, temperature, tides and the shore characteristic combine to create different environment that determine the distribution and variety among seaweed (Dhargalkar and Kavlekar 2004).

According results from the Rapid Assessment surveys conducted during 2012-2014 along the mainland coast Filamentous algae (euntemorpha), sargassum, crustose algae, green algae, Red algae, Brown algae, fleshy algae, Caulerpa, Halimeda, Padina (dominant) are observed. A significant coverage of Seaweed is found. Euntemorpha is observed to have much coverage usually found covering on top of Seagrass beds. Macroalgae such as Cystoseira and Gracillaria are also common. Recently eight genera of Seaweed were confirmed and their distribution also estimated.

Turbinaria ornata

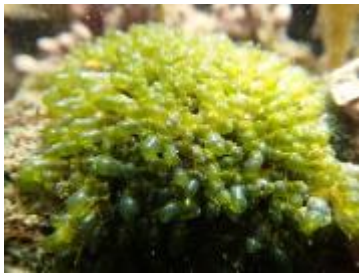
Padina minor



Halimeda macroloba

Dictyota dichotomo

Caulerpa lentillifera



Valonia aegagropila

Photo 25: Seaweeds (Macroalgae) communities

Status:

The cold season (December- February) is the ideal period for macroalgal collection. A number of seaweed taxa reach their highest biomas in this season. Extensive and well-prepared collections are the basis of all studies of marine organisms. The bay of Zula is characteristic of extensive muddy littoral zones, as a result supporting poor macroalgal abundance. On the other hand, the mouth of the bay and the coastal shorelines of Engel have intertidal zones with intermixed patches of sandy and muddy shores, live corals and dead corals overgrown by macroalgae.

Threats:

These species form a relatively dense band of seaweed during the winter months after which it dies down and almost completely disappears in summer due to high temperature. Sedimentation and anchoring are the main threat as to seagrass are especially on coastal development sites.

Halophytes: is a plant that grows in waters of high salinity coming into contact with saline water through its roots found in the coastal area mainly around the seashore. Examples of halophytes are such as Salicornia and salt marshes. Halophytes are considered to be rare plant forms that arose separately in unrelated plant families during the diversification of angiosperms (O'Leary and Glenn, 1994); in this they resemble epiphytes, saprophytes, xerophytes, aquatics, and marsh plants (Kremer and Van Andel, 1995). No comprehensive list of halophyte species exists, due partly to the problem of defining the lower salt-tolerance limit at which a plant should be considered a halophyte. Distinct communities occupy the salt marsh ground and the sand mounds and dunes overlying it (Kassas and Zahran, 1967).

Generally, the Eritrean coastline and Islands are vegetated with different species of halophytes and few non halophyte plants such as grasses and trees. Some plants that are

commonly encountered include glycophytes such as Panicumturgidum, and acacia trees and halophytes such as Zygophylum spp., Salicornia spp., Atriplexspp, Suaeda spp. and other identified species. Common halophyte plants include unknown perennial.

Zygophylum qartarense

Euphorbia cactus

Arthrocnemum macrostachyum

Coastal Grass spp

Limonium axullare

Suaeda furticosa

Photo 26: Different species of halophytes in the Eritrean coastline and Islands

Status:

Halophytes are in good condition. They are available during the whole year as they can survive harsh and hot weather condition. A number of species are found in different main and island coasts. The vegetation varies from open grassland *Panicum turgidum*, low halophytes Zygophylum Spp., Limonium Spp., Salicornia Spp., Atriplex Spp. Suaeda Spp. and to patches of succulent plants like Euphorbia Spp.

The coastal areas of Tio to Saroyta are dominated by the ever common species *Limonium axullare* and coastal grass *spp* in which their extention reached greater than one kilometre upto tens of kilometres from the high tide mark. Islands such as Assarka white are absolutely dominated by *Euphorbia cactus.* They support nesting birds on some remote islands. They are also a resting spot for terrestrial birds which is too hot for them during the daytime. The climate is hot and humid with a daily temperature in the range of 35-40 º C during July and August.

Majority of the islands are uninhabited but very few have resident population (<3000) of fishermen and goat herders (ECMIB Socio-economic Survey, 2007). Goats, camels and cows also kept on some uninhibited islands, namely Shumma, Assaka Black, Assarka White, Baredu and Harat on Dahlak Archipelago; Baka, Hawakil, Harena, El Uelo, Ajuz and Dase on Hawakil bay. As a result grazing might be the main threat for the halophytes.

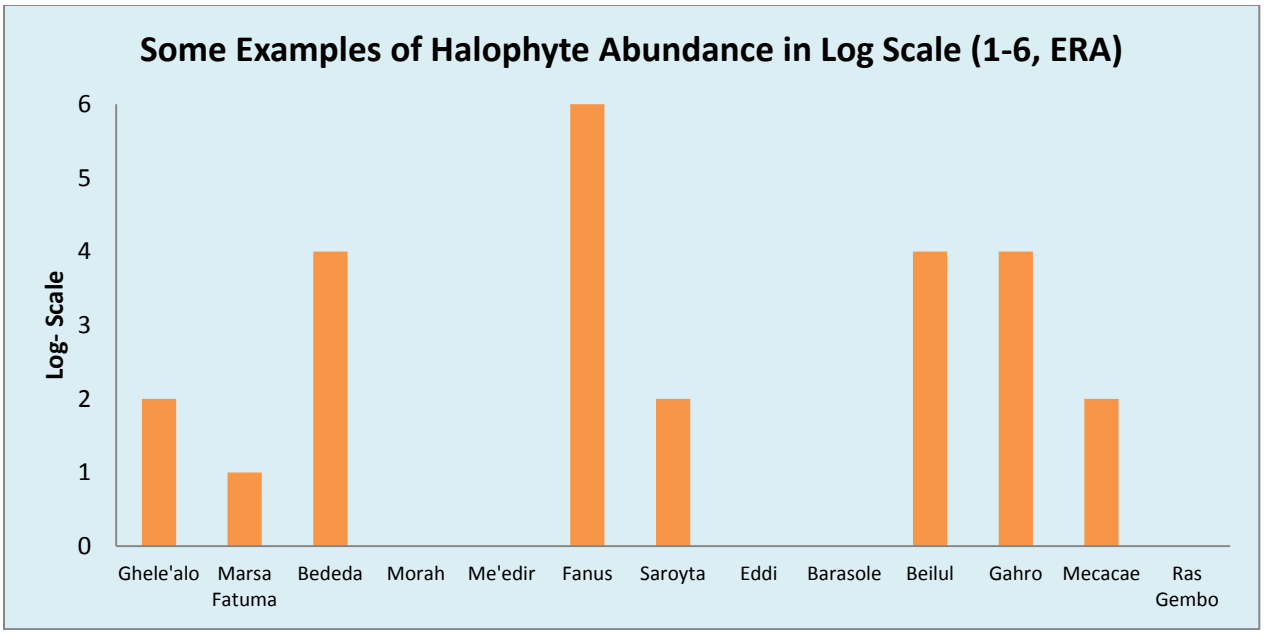


Figure 5: Halophyte distribution and abundance (log-scale, 1-6) at main coastal areas of the surveyed sites (MRRD, 2014)

Threats:
Intensive saltmarsh cutting for shading, cooking, and boiling sea-cucumber is observed around sea cucumber collectors' camp. High garbage solid wastes from cities accumulation like plastic bags, plastic containers, cans and other trashes also cover up the plants avoiding direct sun light.

Other Coastal Plants: the terrestrial sides of the coastal areas are covered with densely populated healthy acacia trees (*tortilis*) (dominant), Riverine Shrubs, 'ankua', Dom Palms (*Hyphaene thebaica*) & mesquite tree (for example Tio). Coastal areas with terrestrial origin such as Ghelealo are found to have the highest cover of Acacia trees.

Microalgae: the southern Red Sea, as the first recipient of Gulf of Eden and Indian Ocean effects, has certain interesting oceanographic and biological nature. It is the host of strong Sea Surface Temperature (SST) i.e. winter monsoon wind, which is the cause of the water movement (stronger in the south) and hence higher turbidity of the water especially during winter. Due to this or other reasons, the southern Red Sea has some biodiversity peculiarities from the northern counterpart. Indian Ocean plankton carried in to the Red Sea by water currents tend to die or migrate in to cooler deeper water as they are transported north. The decline may also be related to productivity differences, since the productivity of the central and northern Red Sea out of the reach of nutrients from the Indian ocean, tends to be less than in the south.

Plankton: occurs throughout the Eritrea Red Sea showing seasonal abundance and distribution. Investigating the spatial and temporal distribution of phytoplankton and zooplankton around the coast is necessary and will be within the main subject area of biodiversity in the future.

There are many factors which influence the distribution and abundance of planktonic organisms, including wind and tidal induced currents, water mass mixing, bottom topography and nutrient availability which will be necessarily accounted for.

2.2.2.2 Fauna Ecosystem

Hard Corals: The Red Sea chains a variety of reef types, arising in part because more than most part of the world, the Red Sea is tectonically active and in many places the reefs are only thin veneers overlying much older substrate. Typically, fringing reefs are by far the most abundant reef types, lying close to shore and varying greatly in size (Al-Sanbouk, 2000).

The southern Red Sea Region is generally termed to be poor in Reefs (McClanahan *et al*., 2000; Zekeria *et. al.*, 2000). This is attributed to a combination of increasing sedimentary conditions, shallowing bathymetry, and higher nutrient levels originating in the Gulf of Aden, favoring algal growth over coral development. Moreover, the continental shelf becomes broader and fringing reefs become irregular, being replaced in many places by sand or mud substrates and mangroves. Where fringing reefs do occur, the gradual sub-surface slope has allowed them to extend considerable distances to Seaward (McClanahan et al., 2000).

Along the main coasts of the southern Eritrean Red Sea unlike the central part, Hard Corals are less developed and neither soft corals are available. Montipora and Porites are the most common. Also among observed corals were crustose coralline algae, Platgyra, Brain coral and Fungii.

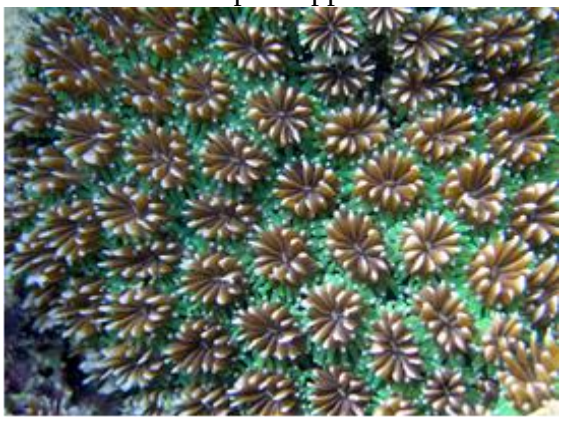
Results of previous and recent surveys realized by Dr. Charlie Veron from Australian, the world leader taxonomist on coral reefs indicate high diversity of coral and fish in many parts of the coast and the islands. At least 38 existing coral genera and 220 species have been recorded such as Acropora, Echinopora, Favia, Favites, Fungia, Galaxea, Goniopora, Montipora, Platygyra, Porites, Stylophora, Tubipora, Xenia and Pocillopora. More than 100 reef sites sampled for substrate cover including three trips with Dr. Veron. Additional 5 coral species identified; with the discovery of five new coral species, all presently endemic to Eritrea and preparations of reference collection of more than 300 specimens. Average % coral cover is estimated to range from 20 – 89 according to findings that have been analyzed and reported for domestic and international use.

"It is this reef that could be least affected by the world climate change after two decades, according to computer modelling and prediction" According to Dr. Veron reasoning out the coral species of Eritrea and of the Red Sea have higher resistance to higher water temperature due to the high temperature of the Sea.

Folacious - Montipora Spp

Table coral - Acropora spp

Soft Coral - Dendronephthya Spp.



Encrusting - Galaxia spp.

Photo 27: A variety of coral reef types in the Red Sea chains

Status:

The corals around in surveyed coastal sites are mostly in patchy forms (Reef Check, 2012-2014). The extension of the reef forms is less developed in southern Eritrean Red Sea. These patchy reefs are dominated mostly by the Porites (massive) and Montipora. The graphical analysis of the collected data showed that the mean cover of live hard coral for all of the reefs surveyed in the islands was 29.9%. The less coverage of live hard coral around the islands to a large extent correlates to the fact that the southern Red Sea region is generally poor in Reefs.

The best coral reef development so far encountered is the Dissie-Madote area where it was estimated the total length of more than 15km. The fact that most of the corals in the Eritrean Red Sea exist in fringing or patchy forms has been confirmed during various field trips such as to Dissie-Madote, Shumaha, Assakeri, Duhul Bahut, some part of Dahlak and Dar Solum Islands.

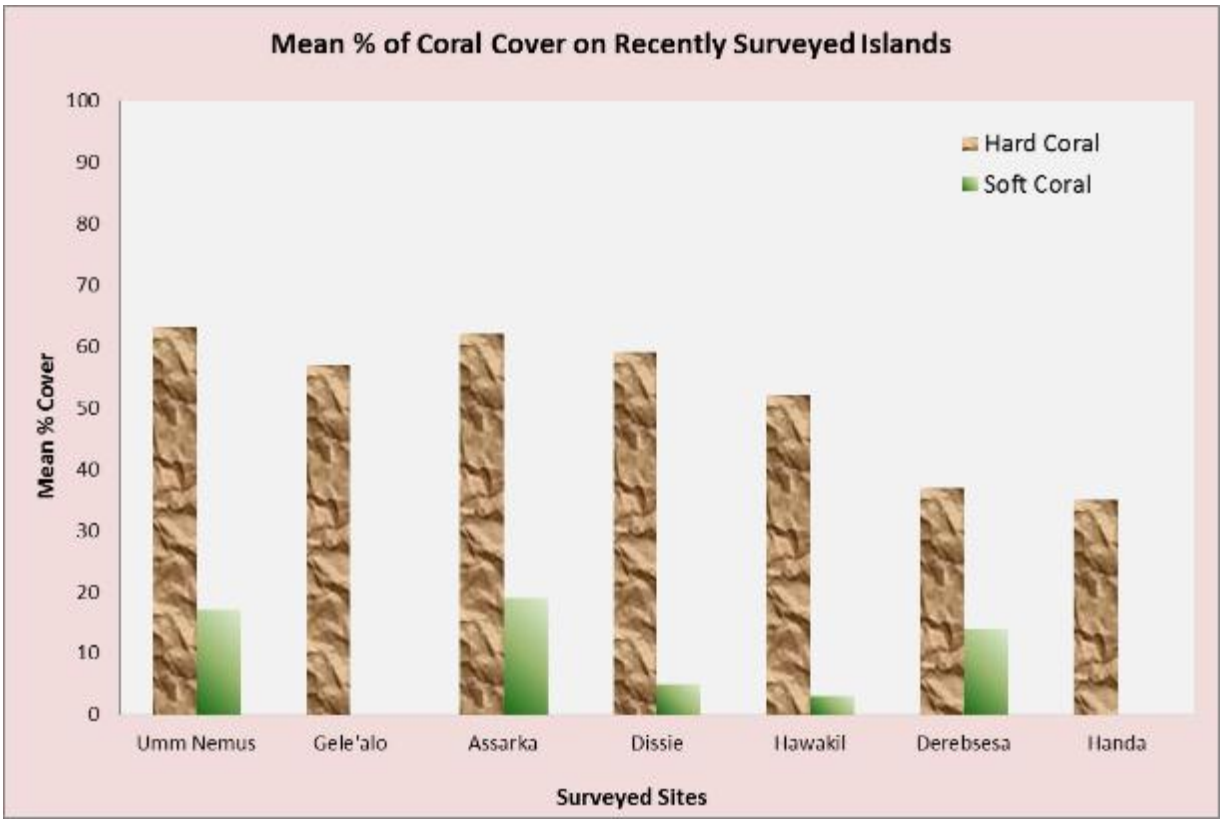


Figure 6: Hard and Soft Coral Cover in Percentage at reefs of some surveyed sites (MRRD, 2012)

Threats:

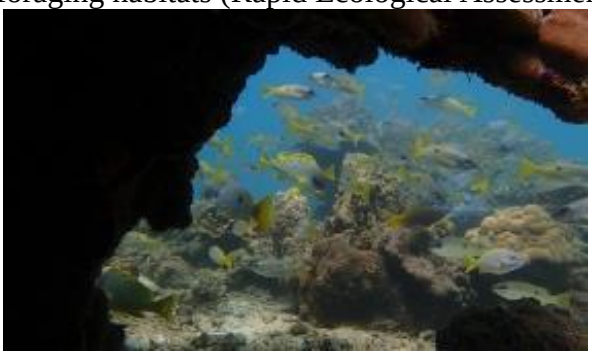
In Eritrean Red Sea, many corals are relatively pristine, away from human and economic impact. But now a days they are increasingly threatened primarily at Massawa by few coastal rapid development such as fisheries infrastructure, Fishing operations (demersal trawling, Sea cucumber fishing), aquarium fish collection, tourism, oil pollution from loading and unloading, siltation - as a result of land reclamation and road construction (e.g. Massawa-Assab, and Massawa cause way expansion etc), and other coastal developments and to some extents increase in coastal population. In addition, there are potential threats from curio collecting of corals and Shells; discharge from oil terminals, sewage and municipal solid waste disposal, cooling effluent from desalinating and power plants and sedimentation of cement dust.

Other than these, coral are also threatened by natural causes such as predators like *Acanthaster planci*, crown-of-thorns sea urchin, drupella and disease like the black and white band which are reported in the Red Sea since 1980 (Antonius, 1984). In the expedition conducted by the Coral Team to Dissie, there was an encounter of six Acanthaster planci in the coral reefs of the area. Drupella especially in shallow depth of Shiek Said (Green island) have been observed in hundreds per transect with their effect clearly seen on corals. No encounter of any kind of coral disease in the trips conducted. Despite all these anthropogenic and natural threats, however the general status of Eritrea's corals is in a better condition.

Physical coral damage (breakage) by anchor and foot was present in sites frequently visited by tourists and other few by fishermen. While the effects of previous bleaching events are visible, there are no freshly bleached corals.

Fishes: generally the main land coastal areas and islands are rich in fish abundance with a majority of fry and juvenile fish (Rapid Ecological Assessment, 2012). Among the fish which are identified includes snappers, emperors, groupers, parrotfish, surgeonfish, butterfly fish, angle fish, fusiliers, jacks, rabbit fish, grunts, damselfish, wrasses, goatfish, gobie fish, stingray and other reef fish. Stingrays are found in great number during the high tide especially in inter-tidal areas of the coasts from Sahil to Wekerito, Southern Eritrean Red Sea Region.

It is certain that the coastline provides a valuable habitat for fish, providing food and shelter within and around the several islands & coast that occur along. There are several species of fish occurring in these waters including those associated with the coral reefs, mangrove and seagrass habitats. Sting rays were significantly abundant on the muddy & sandy substratum of the coasts from Sahil to Wekerito indicating these areas could be their important nesting or foraging habitats (Rapid Ecological Assessment, 2012).



Snappers & Sweetlips at Sheik Said Island, 2014.

Carangids at the reefs of Tiwalet, Massawa, 2014.

Fry fish at reefs of Mojeidi Island, Dahlak, 2014.

Parrotfish & Surgeonfishes at Sheik Said Island, 2014.

Photo 28: The main land coastal areas and islands are rich in fish abundance

Status:

From the Reef Check visit on the islands, the corals observed were in good condition due to low human interference (anthropogenic). There was relatively low diversity of fish mostly the aquarium fishes and the reef fishes on these sites.

A difference in the diversity of fish has been observed in the islands visited by the Coral/Fish Team and from the results of the other expeditions. However, the dominant species are recorded to be the black spot snapper (Lutjanidae), Moon tail wrasses (Labridae) and the butterfly fishes (Chaetodontidae) and Angelfishes (Pomacentridae). Though difficult to clearly reason out, big sized fishes like Snappers, Groupers and Parrot fishes are frequently encountered in the outer islands - Dissie, Madote and Duhul Buhut than in the closer sites such as Massawa area.

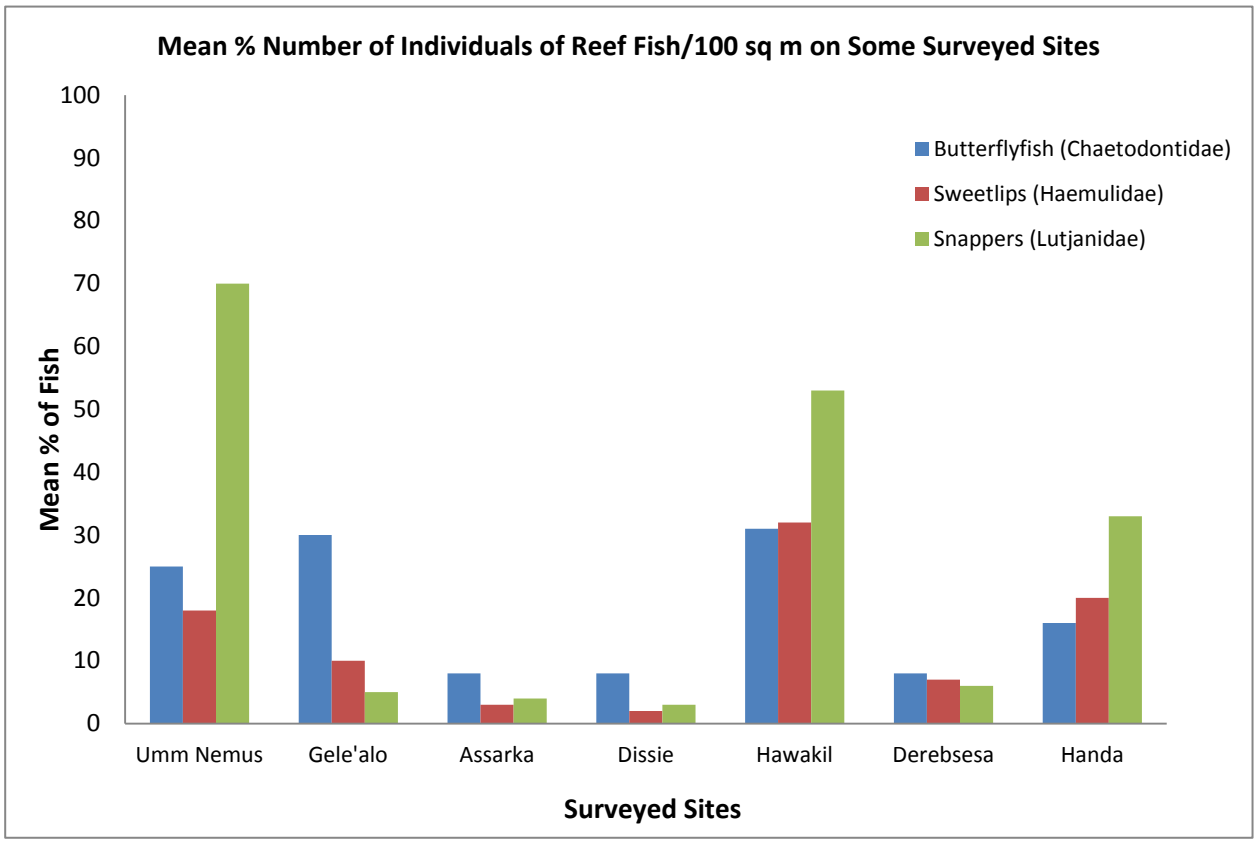


Figure 7: Mean number of three main indicator fish species at reefs of some surveyed sites (MRRD, 2012)

Threats:
Despite the increasing fishing pressure from local as well as foreign fishing, the abundance of indicator fish families and particular fish species was among the highest in the islands.

From data obtained from MCS of the Ministry of Marine Resources, illegal fishing by trawlers and neighbouring countries on reef areas is one of the major threats on our fishery resources which destroy fish habitats. The trawling of shrimp and fish that have been the main component for fishery export have been discarding more than 50% by-catch of undersize and untargeted fishes.

Birds: the Eritrean coasts and islands are well known for the large diversity of seabirds and shorebirds. Many species of seabirds and shorebirds exhibit migratory life styles. Most of them are migrating from the temperate or arctic northern hemisphere before winter in search

of warmer breeding places to the tropics and southern hemisphere. Eritrea being in the subtropical region, it contains a number of habitats that are suitable for migratory and resident bird population.

According to De Marchi and *et.al.* 2006, the Eritrean coastline reveals a number of habitats. These include the exposed mud and sand flat at low tide that provide smaller invertebrates (crustaceans and worms). The sand beach is a source of detritus that are washed by tides and waves from the offshore. The shallow water provides smaller fish and invertebrates. The open sea surface is a source of plankton, small schooling fish and larger fish that feed close to the surface. These habitats attract large congregations of waders and seabirds that migrate from Europe during the cooler winter.

As per earlier and recent ecological surveys of ECMIB Bird Team Unpublished Reports, 2008, 74 species of seabirds and shorebirds have been identified, of which 22 are known to breed on the islands, mainly in summer. While 25 species are true seabirds belonging to different families such as tropic bird, booby, gull, tern and cormorant, the remaining utilize the marine environment partly or completely, including families such as pelican, spoonbill, heron, flamingo, duck, plover and sandpiper. In addition more than 50 species of land birds are identified on the Eritrean islands. Doves, Wagtail, Larks, House crow, Pied Crow (Alba), Grey shrike, Sparrow lark were among the common land birds observed in the land side of the coasts (annex IV).

Based on field studies and data, monitoring sites are identified and 43 sites are proposed for protection for their national, regional and international importance (State of the Coast, 2008 and ECMIB Bird Team Unpublished Report, 2008).

Photo 29: A Socotra cormorant, *Phalacrocorax nigrogulariscormorant* (left), Spoonbill (*Platalea leucorodi),* with breeding plumage nesting on mangrove and Pink-backed pelican, *Pelecanus rufescens* (right) at the Islands of the Southern Eritrean Red Sea 2012.

Photo 30: Red-billed Tropic bird (*Phaethon indicus*), Chick of Osprey (*pandion haliaetus*) and Western reef heron *(Egretta gulari)* at the Islands of the Southern Eritrean Red Sea 2012.

Status:
Thirty Palearctic migrant species from Europe that appear in the cooler winter in Eritrea are recorded. Large flocks of these birds are observed foraging for small invertebrates in exposed mudflat during the low tide and roosting on high tides over the survey area; abundance and diversity of these migratory birds is high (MMR. Report, 2012-2014). From the resident species the Crab Plover, Kentish plover and the Western Reef Heron are the abundant birds recorded in most sites. While From the Palearctic migrants Ruddy turnstone, common sandpiper, common Greenshanks; common Redshank; Bar-tailed godwit and Eurasian curlew are the most common species recorded (ECMIB Bird Team Unpublished Report, 2008).

There are large number of breeding gulls and terns. Some of the important breeding population includes the White-eyed Gull (*Larus leucophthalmus),* Sooty Gull (*Larus hemprichii),* White-cheeked Tern (*Sterna repressa),* Lesser-crested Tern, (*Sterna bengalensis)* and Bridled Tern *Sterna anathetus.* There are also other species that breed in significant number on the Dahlak islands such as Brown Booby *Sula leucogaster*, Pink-backed Pelican *Pelecanus rufescens* and the Crab Plover *Dromas ardeola.* (Coulthard, 2001). The commencement of breeding season is marked by egg lying. Winter breeders initiate clutches from October on wards and summer breeders commence starting from May. In general the entire Eritrean islands may support up to 250,000 breeding birds on summer.

Twenty species of seabirds and shorebirds were found to breed on the Eritrean islands (ECMIB Bird Team Unpublished Report, 2008). Moreover we present also the some data on the terrestrial Sooty Falcon (*Falco concolor),* Abidim`s Stork (*Ciconia abdimi)* and Sacred Ibis (*Threskiornis aethiopicus).* Moreover the Socotra Cormorant *Phalacrocorax nigrogularis* is suspected to breed on some of the Southern islands. These breeding species were found on 186 islands.

Generally, there are three breeding seasons and the commencement of a season is marked by egg lying. Summer breeders refer to those species that appear to commence in late May –July (most Terns). Winter breeders from October onwards until January (like Pelicans, Caspian tern, osprey and others). Spring breeders those that lay between February and late April (spoonbill, sounders tern).

After the breeding season is over, many seabird species disperse from their colony. Migration or dispersal may range from long distance travelers to that circumnavigate the globe, to never leaving the breeding colony vicinity. In winter birds move from polar and temperate to tropical area for wintering. Ultimate reason to this dispersal at particular time may be tied to food availability. Polar and temperate area is very cool in winter season and hence food availability is low so birds migrate to the tropical area to passes cold weather and get food. With arrival of, spring temperature breeding suits and availability of food increases in polar and temperate area, hence birds migrate to north hemisphere (Nelson 1978, Schreiber and Mock, 1998).

Threats:
The introduction of predatory mammal species proved to be a major extinction factor for island breeding birds (Moors and Atkinson, 1984). Some fishermen especially in the southern Eritrean Red Sea introduce cats to eradicate rats from some islands. Fishermen justify the introduction of cats as follows; rats usually spoil fishermen properties or gears, which are kept on the islands. On many of the Eritrean islands, black rats are common and they pose danger to breeding seabirds. (Atkinson 1984).

In addition, the introduction of grazing mammals such as camels and goats has its own effect for island breeding birds. The presence of such mammals can disturb or destroy nests or colony of ground breeding birds. Moreover, camels graze on mangrove leaves; as a result, they have the potential to disturb mangrove-breeding shorebirds such as Pelicans, Heron and Spoonbill.

The major threats for breeding seabirds on the islands come from human interference. For the last decade many investors have involved in the sea cucumber fishing in Eritrea making their camps at the many islands on the Dahlak Archipelago with less or zero respect to the natural environment. The presence of the sea cucumber fishermen on the islands has direct and indirect threats to breeding seabirds such as egg collection of egg for consumption. Terns such as Lesser-crested and Swift Tern are more exposed and preferred for collection.

Habitat destruction result as a result of clearing of halophytes and other vegetation for different purposes such as for firewood, as a protection from wind, as a slide for drying the cooked sea cucumber, as a mattress and others. Also cutting of mangrove for fire and to build a tabernacle is common activity. Such practice has a direct impact for bridled terns, which exclusively depend on vegetation to breed.

Every waste is thrown on the islands and in the sea regardless of its consequence. Packed food canes, plastics, stroke oil canes, rusted metals of different type are known common on many islands. Some islands look like damping sites like Awali Shoura. Islands intensively visited by tourists can disturb breeding seabirds directly. They swim and snorkel on area where the birds feed and chicks stay, they visit breeding colonies for fun and camp and sleep nearby the colonies.

Marine Turtles: the Red Sea area is used as nesting, foraging and migratory corridor of sea turtles. Eritrean is home to five of the world's seven turtle species, which all of them are threatened with extinction globally namely, Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Olive ridley (*Lepidochelys olivacea*), Loggerhead (*Caretta caretta*) and Leatherback (*Dermochelys coriacea*) turtles. Green and hawksbill turtles are the most abundant and widely distributed along the broad shallow continental shelf of reef complex, sponge, sea grass and Macroalgae beds; and the other three species are rarely found. Of the three species known to nest in Eritrea, the Hawksbill and Green turtles are the most common. But in 2005, an Olive Ridley turtle came to nest on the Ras Tarma beach. It was the first nesting record for this species for the whole Red Sea (Pilcher and *et. al*.; 2006,the MMR State of the Coast).

Swimming sea turtle are encountered around several waters of islands or coast mainly hawksbill (both sub-adult and an adult) and green turtle. In addition carapaces (mainly greens) and stranded sea turtles (mainly hawksbills) are frequently recorded in areas relatively near fishing villages (Field Survey, 2014).

Photo 31: Hawksbill turtle nesting, biologist observing and tagging respectively at the Island of Mojeidi, Southwest of Dahlak Archipelago, 2014.

Status:

Since 2007 more than 160 turtles have been tagged with titanium tags with return address to Eritrean Ministry of Fisheries both on their nesting beach and incidentally caught on board of industrial fishing activities. On the other side, tags have been recovered between 1992 and 2006 from nesting females tagged mainly in Oman and few from Eritrea. Nesting season of hawksbill is from December to June and reaches peak during February, March and April.

Threats:

According to surveys conducted by the Sea turtle Team during 2005 to 2012, the main threats to turtles in Eritrea include incidental catch in trawling, net entanglement, disturbance of nesting and foraging habitats, poaching of eggs and hunting. Minor threats are natural such as predation of eggs and hatchlings, erosion of beach and light disorientation of hatchling. Future threats will probably include land-based development and pollution. All these combined with limited awareness, lack of adequate protection and enforcement lead the population of turtles to decrease in the last twenty years.

Turtle's meat, eggs and carapaces have been used for subsistence as a source of food, medicine and ornament. Turtle meat is highly prized by the coastal communities (Afar) and is occasionally sold in the coastal villages.

Photo 32: Carapace and flesh of slaughtered turtles at Bera'sole, 2014

Sea turtles were caught incidentally in the fish and shrimp trawlers. During the fishing season 2013 (January – May) as the booklet of the MMR and the data obtained from the members of research division of different teams indicated more than 60 Sea turtles were caught incidentally by the fish and shrimp trawling vessels. All of the five species of the sea turtles, which had been identified in the Eritrean Red Sea, have been recorded in the incidental catch.

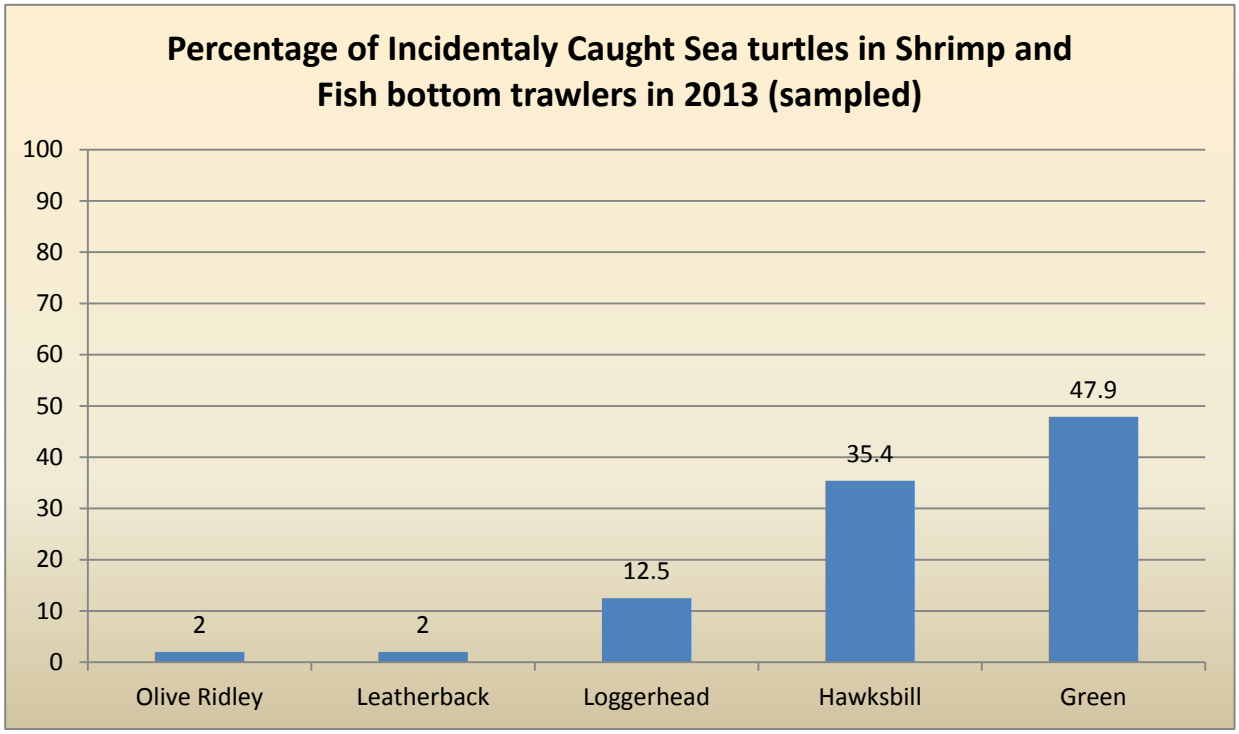


Figure 8: Percentage Incidental Catch of Sea turtles during a recent survey on Industrial shrimp/Fish Bottom Trawlers, 2013.

Sea Snakes: have been told to occur in our areas according to locals and some reports from industrial trawlers by-catch but need to be further surveyed to confirm it.

Marine Mammals/Cetaceans: there are a number of mammals which occur in the marine waters of Eritrea in which most of them are in the IUCN Red or Endangered list of Species. Their distributions have been recorded along most parts of the Eritrean coast & offshore.

Dugong: although the status of dugong is inadequate, only one species (*Dugon dugong*) is found in the Eritrean Red Sea. It is widely distributed but less abundant throughout the shallow continental shelf of seagrass and macroalgae beds which are their main food components. Dugongs are entangled in fishing nets rarely.

Dugongs are rarely caught (3 to 4 each year), usually accidentally in shark nets. When caught, they are eaten by the local community. Dugongs' sites have been identified in several areas where mangroves are found. Eritrea signed the memorandum of understanding regarding dugong.While Dugong '*Arum*' is familiar to the locals (Mengstu and *et al*., 2008).

Dolphins & Whales: Dolphins are most of the time known by their local common name 'Abu Salama' or 'Ohbari'. Knowledge about species identification of whale is very little and whales generally are distinguished by their single local common name '*Ambel Bahir*' (Mengstu and *et al*., 2008).

A total of 15 cetacean species (7 whales and 8 dolphins) have been recorded from the Red Sea (PERSGA/GEF, 2004). Since they are relatively mobile, all are likely to appear in Eritrean territorial waters at some time of a year. Although, the species list for the Eritrean Red Sea is known to be incomplete; about eight species of cetaceans are identified. These include: Bryde's whale/tropical whale (*Balaenoptera edeni*), sperm whale (*Physeter catodon*), short finned pilot whale (*Globicephala macrorhynchus*), false killer whale (*Pseudorca crassidens*), common dolphin (*Delphinuns delphis*), spinner dolphin (*Stenella longirostris*), bottlenose dolphin (*Tursiops truncates*) and Indo-pacific humpbacked dolphin (*Sousa plumbea*). Rhiso's dolphin was also identified once from a stranding at the coastal site near the port town of Assab.

During winter the area is abundant with small fish pelagic (anchovy and sardine) which are the main food items of most whales. The species diversity of whale in the study area is not known. But as they are highly mobile they are all likely to found in the southern part. Bryde's whale is the most commonly seen whale species in Eritrean Red Sea.

There are remains of whale bones (ribs) at different coasts; however there was no observed remained/stranding of a dugong in the surveyed area. Whales are not observed very frequently, the depth of the water being reduced near the shore, but skeleton can also be found.

Invertebrates: There are more than 30 phyla of invertebrates recorded worldwide (Coleman, 1991). The most abundant and well known invertebrates include worms, coelenterates, mollusks, echinoderms, and arthropods. They are important to humans as source food, income, and as ornaments. Shrimp, oysters, abalones, sea cucumbers, and the strombidae family are among the economically important invertebrate species. Invertebrates are also ecologically important in which they act as bio-indicators specially the shellfish which can accumulate different minerals and compounds in their shells and flesh. Invertebrate also serve food for secondary and tertiary consumers, which in turn have great economic value to humans as a source of food and income.

Red sea is thought to be a closed water body, with few or no addition of fresh water or any addition from the neighbouring water bodies resulting in high species biodiversity. There are also species which are endemic to the Red sea due to its unique characteristics.

Status:
Invertebrates such as burrowing crabs (*Uca*) are the most abundant. In addition to that the coastal areas are occupied by different invertebrates such as gastropods (bivalves and cones): strohmbus and top shells. Hermit crab, cowries, clams and other associated fauna are also recorded from different site. Sea cucumber, sponges, sea urchin (*Diadema spp*.) and starfish are less abundant in most sites. Starfish, Pencil urchin, Holuthuria (whitish, thin & long),

Mud Crab & Ghost Grab were also abundant in most sites. Jellyfish are rarely encountered. Sponges (orange and black once), tunicates, Pencil clam, oyster are typical sessile invertebrates observed in several sites. Giant clam are found in several quantity in Ghele'alo and surroundings.

From the results of the reef check recorded data of the indicator invertebrate species (ECMIB Coral & Fish Team, 2008), it is possible to observe that species such as the Pencil urchin, Crown-of-thorns star, and giant clams, Cowries are also present on reefs.

The distribution of macro benthos in relation to sediment characteristics in near shore waters have been quantified in some sites. Sediment characteristics have a great influence in the distribution and abundance of macro-benthic fauna. Molluscs, echinoderms and polychaetes have been confirmed along the sub-littoral zone. The mangrove provides a critical habitat for many marine organisms including gastropods, crustaceans (e.g. hermit crabs, *Ucca* spp., and black colour crabs (unidentified) borrowing in between the pneumatophores. Olive shell and other shells Invertebrates were observed to inhabit the waters of the sandy beaches from Hada to Wekerito were sponges & tunicates are never observed (annex IV).

In 2013, sampling and identification activities of Marine Resources Research Division of the Ministry of Marine Resources on board of industrial shrimp/fish bottom trawlers confirmed the identification of about 38 incidentally caught species of invertebrates that fall in to 29 families and four phyla (Mollusks, Echinoderms crustacean and cnidarians) and six classes. In the identification process the dominantly recorded species were some families of gastropods, crabs, sepia, starfishes, sand dollars, squid, and octopuses (see annex IV).


Sea cucumber


Cowries


Sand Dollar


Ghost Crab


Star Fish


Sponges


Mud/Mangrove Crab


Olive Shell


Sea Worms


Strohmbus


Bivalve/Mussel


Sea Urchin

Photo 33: The various species of Invertebrates found in the Eritrean Red Sea, 2014

Threats:
The high degree of exploitation of molluscs such as strohmbus is mainly observed near coastal villages where the local fishermen (especially women) could have accesses of daily subsistence needs. The high level of log-scale in Alluli & other sites is due to the observed much greater number of smashed discarded molluscs built up through long time of collection period. Pollution has also an adverse effect on ecosystems. Pollution causes stress to the living organisms. The most pollution comes from industrial and domestic wastes around the waters of Massawa.



Photo 34: Top shell unloading at Landing Site, Massawa (2000) and Curio made of bivalve and other shells at a Local Market (2014).

2.2.3 Agricultural Biodiversity

The decisions III/11 of Conference of Parties (COP) to the CBD define agricultural biodiversity as a broad term that includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems, also named agro-ecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem, its structure and processes.

Agricultural biodiversity provides not only food and income but also raw materials for clothing, shelter, medicines, breeding new varieties, and performs other services such as maintenance of soil fertility and biota, and soil and water conservation, all of which are essential to human survival.

Biodiversity and agriculture are strongly interrelated because while biodiversity is critical for agriculture, agriculture can also contribute to conservation and sustainable use of biodiversity. Indeed, sustainable agriculture both promotes and is enhanced by biodiversity. Maintenance of this biodiversity is essential for the sustainable production of food and other agricultural products and the benefits these provide to humanity, including food security, nutrition and livelihoods.

2.2.3.1 Diversity of Individual Crop Species

Eritrea is primary and secondary centre of diversity for several crops such as barley, wheat, pearl millet, okra, sorghum, chickpea, *Eragrostis tef* (*Taff*), sesame, finger millet, grass pea, cowpea, and Niger seed. There is a rich diversity of crop landraces still available in Eritrea. A full inventory of the local land races for all crop types in Eritrea is not yet done.

Cereal Crops: Diversity Status and Trend: Cereal crops cover about 90 per cent of the total annually cultivated land of the country. The most significant cereal crops genetic diversity for food consumptions (both human and animal) are include: S**orghum** (*Sorghum bicolor*), **Barley** (*Hordeum vulgare*), **Wheat** (*Triticum aestivum* and *T. durum*), M**aize** (*Zea mays*), **Taff** (*Eragrostis tef),* **Pearl millet** (*Pennisetum glaucum)* and **Finger millet** (*Eleusine caracona*)

These crops are also the staples that feed the nation. On the average, Sorghum accounts for 46% of total cropped area, compared with just 12 % for Pear millet, 10% for Barley, 6.5% for Taff, 5.3% for Finger millet, 4.7 % for Maize, and 4.5% for Wheat (MoA, 2010).

The most important problems observed were recurrent drought (climate change) and erratic rainfall and consequently instable yield and loss of genetic diversity. Due to these causes some cereal varieties have not been cultivated mainly late maturing varieties.

Sorghum (*Sorghum bicolour:* (L) Moench): data shows that in all zobas the proportion of land covered by Sorghum is steadily increasing but yields were instable and stagnant. As result of recurrent droughts some varieties are disappearing including *Gunseber* (extinct), *Korokora* (in limited area), *Ajebsidu* (extinct), *Brown chimro* (in limited area), *Aklamoya* (extinct), *Arfae gedam* (in limited area), *Feterit* (in limited area), *Anseba* (in limited area), *Kinibiba* (extincting) and *Kibra* (in limited area). Cultivation areas of other varieties such as *Hariray* and *Zengeda* were expanded (Tesfamicael et al, 2013). One improved sorghum variety, *Hamelmalo* is released in 2010 by Hamelmalo Agricultural College in villages around the college. Of the total areas under sorghum cultivation on 10% was under improved varieties. Four wild species of general Sorghum are found in Eritrea (Hedberg and Edwards, 1995).

Photo 35: Sorghum bicolour

Photo 36: Generation of M1 Amal variety by NARI, (MoA, 2013)

Table 1: Present Sorghum diversity trends and status

S.n	*Land-races*	Current status
1	*Gunseber*	extinct
2	*Korokora*	in limited area
3	*Ajebsidu*	extinct
4	*Brown chimro*	in limited area
5	*Aklamoya*	extinct
6	*Arfae gedam*	in limited area
7	*Feterit*	in limited area
8	*Anseba*	in limited area
9	*Kinibiba*	extincting
10	*Kibra*	In limited area
11	*Hariray*	expanded
12	*Zengeda*	expanded

NB: Source Tesfamicael et al 2013

Finger millet *(Eleusine coracana:* (L) Gaertn): predominantly grows in zoba Debub and to some extent in zoba Maekel. But can grow in most part of our country; its preferable choices are heavy clay soil, tolerates water logging, can grow in temperatures ranging between 20-30 ^{o}C and in quite extensive range of altitude (700-2500 m.a.s.l). The genetic erosion risk is rapid due to several attributes. The wild type, *E. multiflora* (A. Rich), *E. indica*, *E. floccifolia* (Forssk), and *E. flagellitera* (Nees), are found in Eritrea.

Pear Millet (*Pennisetum glaucum* (L.) R. Br.)*:* is the second most important cereal crop in Eritrea, grown mainly by small farmers in low lands and mid lands. According the Flora of Ethiopia and Eritrea volume 7 twenty species of the genera *Pennisetum* are found in Eritrea and the species *P. violaceum* is believed proginetor of the cultivated pearl millet. It is predominantly grown in less favourable environments (250-300 mm). The area coverage increased by 2 – 3 folds during last two decades. These increments are due to several reasons including pearl millet preference of farmers to sorghum. Four improved varieties were released by NARI and are under cultivation since 2010. These varieties are P-9401(in 2012, P-9407 (in 2012), White Kona (in 2011) and ICMV 95490 (in 2011). These and previously released improved varieties cover 15% of the total pearl millet cultivation areas.

Photo 37: Pear Millet, Hagaz (MoA, 2013)

Wheat: (*Triticum aestivum* and *T. durum*): The Russian scientist Vavilov (1992) was impressed with the diversity and by the many endemic characters of Eritrean. At present farmers grow more than two species of the genera *Triticum* but the *T. durum* species dominate the farmers' field. There is a worrying situation in the production of the wheat locally called *Manna keih* and *Manna Guandie* are disappearing due to susceptibility of the variety to disease and drought. There are fourteen landrace varieties. Total area under cultivation is stagnant or slightly increased. Three improved bread wheat varieties GOUMRIA17, KATILA11 and QUAFZA32 were released by NARI in 2010. The hectares cover by improve varieties have been increasing in the last years. Estimated improved varieties' seed used is 20%.

There is a worrying situation that the production of the wheat locally called manna keih and manna guandie are decreasing in availability (MoA, zoba Maekel, 2014). The reason for the decline of manna local varieties is mainly because of:-

- Wag infestation which is believed to be a major devastating factor
- Poverty a second treating factor where farmers obliged to consume their farm (wheat) product

Barley (*Hordeum vulgare: (L*): has been grown in Eritrea for at least 5000 years (Harlan, 1969). It grows in the highland mainly as an insurance against drought. Barley is adapted to a wider type of soils and can be grown in almost any soil type in the country. It is one of the crops that tolerates adverse climatic conditions and is early maturing, so farmers can harvest it before the rain ceases and the soil dries. It has wide adaptability and provides fodder for livestock (MoA, 2012). Although most local landraces show relatively low productivity, they have some useful characteristics for breeding including high tillering capacity, tolerance of marginal growing conditions, resistance to barley shoot fly, aphids and frost, vigorous seedling establishment and quick grain filling capacity.

Barley is third in-terms of acreage but the first in the highlands of Eritrea. It is staple crop, row material for brewery and animal feed. Landraces have some superior traits but yield obtained are low compared to improved varieties. Barley improved varieties are *Shishay, Rahwa, Holkor, Beka* and *Proctor were* released by NARI in 2002. The later three are malt varieties used by the local brewery, Asmara Beer Factory. The share of improved varieties' seed for barley is estimated 15%.

Although no systematic study was undertaken but the threats were more likely affecting genetic diversity of barley. No Improved varieties were released in 2010 – 2013. Improved varieties released cover 15% the total area under barley cultivation (*Shishay, Rahwa, Holkor* and *Proctor*).

Maize (*Zea mays*) (L): is the only none native important staple food crop of all filed crops cultivated in Eritrea. It is introduced from other regions but developed unique characters after naturalized, which took several decades. Since most the landrace varieties used for several decades are disappearing it is among the most genetically eroded crops in the country.

Currently, its cultivation is limited in areas with supplementary irrigation such as spate irrigation in eastern lowlands and at highlands in semi commercial farming as offset of vegetables or mixed. Two improved varieties namely *Early local and 04SADVE* were released as outcome of research by NARI in 2010.

Taff (*Eragrostis tef)* (Zucc) Trotter): is an important crop as human food and animal feed. In most areas of the country, local bread called *Injera* is prepared from *Taff.* Identified landraces of *Taff* are *Sergen, Tsaeda taff, Keih taff, Chenger* (*Kuada*) and *Wafey*. Because it has attractive market price mostly farmers sell their product than consuming it. It is common crop in the Central Highlands and south-western midlands of the country. It covers about 7.5% of all cereal crops production. The progeny of *Taff* existing in Eritrea is *E. pilosa* and other 18 wild type of the genera *Eragrostis* are reported in Eritrea (Hedberg and Edwards, 1995). The wild relatives found as weed, wild and these species are good animal feed.

Pulses: A wealth of cultivated and wild legume plant species is available in Eritrea. Pulses cover about 5.3% of all field crops production. Faba beans *(Vicia faba);* check pea (*Cicer arietinum*); field pea (*Pisum sativum*), grass pea (*Lathyras sativum*); cow pea (*Vigna ugunuculata*); fenugreek (*Triganella foenum- graecum)*; linseed (*Linum usitatissium),* lentil (*Lens culinaris*) and common bean (*Phaseolus vulgaris*) are the most common pulses found in Eritrea. Chickpea (*Cicer arietenum*), faba bean (*Vicia faba*), and field pea (*Pisum sativum*) are the three most important crop pulses by area.

Area covered by pulses is steadily decreasing since 2003. This declining trend is more significant in Maekel region. The cultivated area of chick pea, the major pulse food crop sown is decreasing in certain areas due to heavy root rot attack problems. Although not appreciable area is covered by cowpea, eight wild species relatives of cowpea are growing in Eritrea.

2.2.3.2 Oil Crops: Diversity Status and Trend:

Oil crops production cover about 4.8 per cent of the total annually cultivated lands. The most significant oil crops grown in the country are sesame (*Sesamum indicum*); ground nut (*Arachis hypogaea*), and castor (*Ricinus communis*.). Edible oil seed crops are dominated by sesame which stands at 74.5% coverage of land with groundnuts and linseed comprising 15% and 6.7% respectively.

Two – three decades back linseed and Niger seed were cultivated for home use and most of the yield for marketing. Mainly Niger seed importance in market was very high and farmers used to grow it as cash crop. The area planted with these crops significantly declined, primarily due to farmers preferring to grow basic food crops and availability of cheap imported edible oils. Hence, genetic threat is affecting the diversities of these crops. Despite conserving in the national gene bank no efforts were made in promoting production of linseed and Niger seed or reverse the conditions.

There are two wild species of sesame in Eritrea, i.e. *S. alatum* and *S. indicum*. Nine landrace varieties of sesame are available in Western lowlands of Eritrea. Domestic production of

edible oil from sesame is drastically reduced due to several reasons among these is importation of cheap edible oil.

2.2.3.3 Horticultural Crops: Diversity Status and Trend

Many small dams and wells along river beds, streams, flood diversion structures, and hand dug wells have been constructed throughout of the country to support horticultural production.

The climate of Eritrea is favourable for tropical and temperate zone vegetables and fruits. Many temperate vegetables and fruits are introduced and naturalized in the country. The main problems in production of fruits were disease, insects and in some areas water for irrigation. Bulk of temperate fruit seedlings of peach, olive, and apple were imported and distributed to farmers and commercial farms

The most important vegetables considering their origin and genetic threat are indigenous leafy vegetables. Eritrea could be primary or secondary center diversity of these native edible wild and weedy types of leafy vegetables. These leafy vegetables are also important as resilience crops and their status is underutilized. Some among the indigenous vegetables are rapeseed (*Brassica carinata*), grain Amaranths *Amaranthus caudatus*, okra (*Abelmoschus esculentus*), watermelon (*Citrullus lanatus*) and melon (*Cucumis melo*).

Eritrea is a center of origin of Okra. It has been grown by farmers and it also grows as wild in the western and eastern lowlands of Eritrea. The wild relative reported existing in Eritrea is A. *ficulneus*. Eritrea also could be one of primary center of diversity for watermelon. Water melon and melon grow in Eastern and Western Lowlands of Eritrea as cultivated and wild. One wild relative of watermelon is reported in Eritrea. A subspecies of *Cucumis melo* is available as wild.

The Ministry of Agriculture is working hard to ease genetic erosion occurring to many species of fruits/vegetables. In spite of all this, new varieties of fruits and vegetables are getting introduced, still their significant impacts to be studied. In the last four years, a bulk of temperate fruit seedlings of peach, olive, and apple were imported and distributed to farmers and commercial farms.

2.2.3.4 Trees and Shrubs Important for Agriculture

There are several trees and shrubs important for agriculture which include for food, animal feed, medicine, soil fertility reclamation, shelter and field fences. Among the species most are indigenous tree and shrub species. Eritrean farmers manage in a traditional way a variety of wild species including indigenous trees and shrubs and habitats which benefit the sustainability of both agricultural and natural ecosystems. In many parts of Eritrea, the collection of wild-growing natural products is an important part of the overall household economy. For example, *beles*, the fruit of the introduced cactus, *Opuntia ficus-indica* provides food and income for a considerable number of people in the highlands every summer.

The indigenous species status mainly the wild edible fruits are at risks. These species found in very limited areas in few numbers. Out of 49 species, 21 are genetically threatened. The species important for agriculture and status of endangerment is presented in Annex V, Table

5.1. Reason for Decline of Pasture Species and their Habitat:

Rangeland in Eritrea is estimated at 6 million hectares or 49% of the total land mass of the country and approximately 75% of the total population depends on livestock and livestock production (MoA, 2012). About 5% of the total population is pastoralists, with another 25% classified as practicing agro-pastoralism. Almost all farming households own some livestock and many upland farmers move livestock to the lowlands in combined herds for grazing.

The country is also home for many pasture species of leguminous and grasses. More the highlands of Eritrea are a rich source of leguminous and grass forage species. About 120 leguminous species have been reported to occur at elevations between 1500 and 2500 m above sea level (m.a.s.l) (Hedberg and Edwards, 1989). A collection mission undertaken in 2004 resulted in collection of a total of 238 accessions from 53 legume species (Richards et al 2005, Richards et al 2013). The pasture establishment during rainy season was poor and many species of pasture legumes encountered during the 2004 germplasm collecting mission were found to be scarce. The situation is not improving unless otherwise worsening. Cereal straw is an important component of animal feed that supplements grazing. There is shortage of arable as well as grazing land. In the highlands there are special communal grazing areas with seasonal closure called *Hizaati* around the villages.

The pastures in the highlands are infertile and steep, hence fragile under continuous uncontrolled grazing regimes. The grazing area has been shrinking over the years because of over-grazing, extensive cultivation, improper utilization of water resources and deforestation. The removal of forest cover and constant grazing has depleted the resources of the browse layer. The pastures have no opportunity to recover because hungry animals are continuously searching for any edible plant that sprouts. Attempts to allow regeneration by closing land to grazing have shown promising results and are becoming models for recovery. However, generally because of the above mentioned reasons the most palatable species of herbage and browse are decreasing in quantity and leaving space for less palatable species. If the present trend of deterioration persists for much longer, it may not only destroy the palatable species completely but it could also change the land to bare soil and initiate the process of desertification.

2010 **2012**

Photo 38: Rangeland Renovation after on-station initial screening and evaluation trials, some forage lines were found to be promising for rangeland renovation: Site Dubrwa

Western lowland: The intensity of grazing increases in the drier northern part of the lowlands, where the grass becomes relatively scarcer. The extensive and migratory system of animal husbandry allows the rangelands to recover, unlike in the highlands. However, if the present system of uncontrolled grazing continues with a larger animal population, the fate of the rangelands will be similar to that of the highlands. The vegetation of this agro climatic zone presents a picture of great complexity, comprising a wide variety of vegetation types, which may be called semi-arid tropical.

Eastern Lowland: This region is arid, having annual average air temperature that oscillates around 33 ^{0}C, pasture productivity is low and not in good condition in terms of ground cover, as grasslands and browse are limited within a vast desert. Basically, in many places of the arid region, the soils are severely degraded and have lost much of their water-holding capacity; the pastures are subject to sheet and gully erosion.

Erosion has resulted in several areas in a significant shallowing of the topsoil generally, and poor seed set in the heavily grazed areas. This is a significant constraint to productivity in pasturelands, which consist almost entirely of annuals.

2.2.3.5 Livestock Diversity

Livestock are an important part of the Eritrean agricultural sector, through their contribution to diet as meat and dairy products, and also to crop production as drought animals (both oxen and camels); they are thus an important part of Eritrea's total agro biodiversity. In addition, the number and distribution of livestock has considerable impact on terrestrial biodiversity, through grazing pressure on vegetation and also by competition with other wild herbivores (MoA, 2013).

The majority of livestock in Eritrea are indigenous stock which has been selected for the prevailing eco-climatologically conditions, and to a lesser extent for resistance to the major animal diseases present in the country. The actual numbers of introduced stock, the low levels of interbreeding and the poor performance of cross-bred stock indicate that there will be little loss of indigenous livestock breeds.

Ruminants

Cattle: The total population of livestock of the country is estimated at 10.6 million of which cattle constitute 2.2 million (Annex V, Table 5.2).

The number of the species, Barka, mix of Barka and Hameria and Arado are increasing by 1%, based on the predicted/estimated population of the number of recent cattle population is 2.3 million. However, those which are difficult to manage such as the pure breed (Holstein) seems to be decreasing, but when their number is compared to those extensive traditional (Hameria, Barka, and Arado) ones are very small. Therefore, the general trend of cattle population seems increasing. Looking at the number of individual species, the local one (Arado), because of their small size and tolerate the overall hardships (they eat less), their

population seems increasing reasonably. Arado, are widely spread in zoba Anseba and zoba Debub.

Equines and Camels (non-ruminant): Camels and Donkey general trends and status are stable. However, Horses and Mules status and trends are declining. They are genetically eroded. They need particular and intensive care before their total extinction and should be further supported through comprehensive studies.

Sheep/goats: genetically still surviving and improving, and their population (trend) seems increasing (interview response by experts/farmers) and estimated 7.8 million. The main reason for their increment goes for easy to manage (no need for intensive care and more man power) and relatively eat less.

Goats: there are four main breed of goats in Eritrea. The *Afar* is a small goat not fully differentiated from the other breeds, but found only in Denkalia - the southern Red Sea coast. North of Massawa, the *Bahira* breed is more common, whilst in the north of the country the Rora, a large goat with long pendulous ears, is the most common. The fourth variety known as *Barka* or *Shukria* is found in the western lowlands. This breed is used for milk production that yields 1.5 litres per day.

Sheep: The geographical distribution of sheep breeds is similar to that described for goats and cattle. Most of the sheep in Eritrea are mutton type, although they are milked for rural household consumption. There are four main breeds. The *Rashaida* is a fat-ramped breed used by the Rashaida pastoralists who move along the Red Sea coast, especially north of Massawa. The *Hamele* is a large, thin-tailed breed found in the north. The *Shimegana* is a smaller, fat-tailed breed found mostly in the southern highlands along with a few mixed exotic animals, whilst in the western lowlands the main breed is the *Barka.* Recently there is controlled and uncontrolled export of sheep and in some areas of Gash Barka a new breed, *Gerg* is introduced from the Sudan which might affect the diversity of the indigenous breed.

Poultry: it is one of the promising sub-sectors in the economy of the country. To encourage the sub sector the MoA is supporting small scale farmers and investors to engage in poultry farming (MoA, 2012).

There is no significant research conducted to characterize phenotypically, genetically and production aspects of the local breeds. They always keep changing because of the inter mix with exotic breeds.

Bee: there are two wild sub-species of honeybee present in Eritrea, *Apis mellifera mentcosa* and *A. m. yemenitica*. A total of 15,964 traditional and 6,835 modern bee-colonies are found in the country.

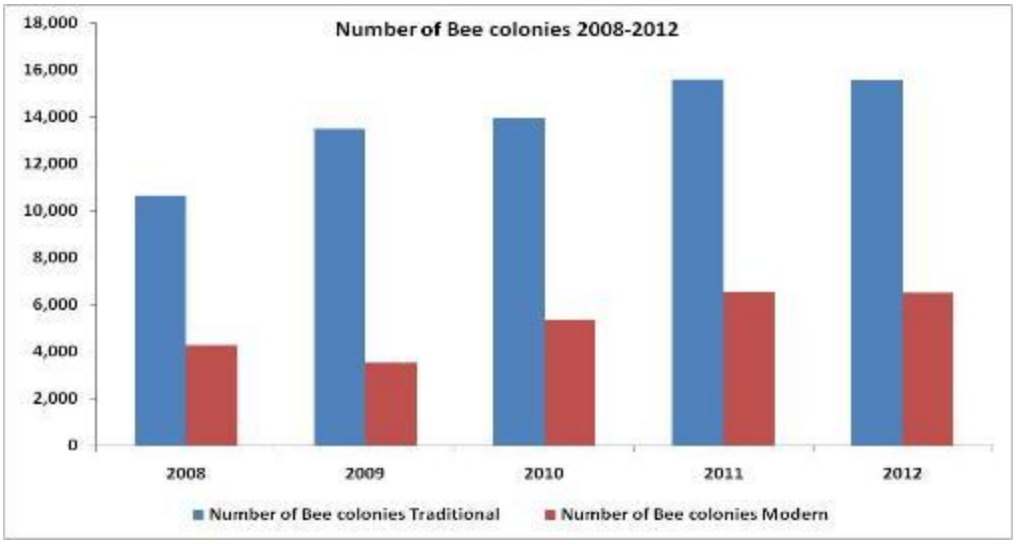


Figure 9: number of bee colonies 2008-2012 (MoA, 2012)

2.2.3.6 Agricultural Biodiversity Threats and its Underlying Causes

Land degradation one of the major threats to Eritrean overall biodiversity, especially to Agricultural biodiversity. This is caused by different interrelated factors. Some of the factors are deforestation, improper land use, urbanization, new settlements, and over exploitation of natural resources.

Agricultural biodiversity is directly under threat from declining soil productivity, drought, change in land use, and change in cropping pattern, replacement by improved seed, diseases and pests. Loss of these land-races would decrease the stock of genetic material available to plant breeders both within and outside Eritrea. This would have international as well as national consequences as Eritrea believed to be one of the origins of several of the world's cultivated crops.

Declining soil productivity: Most of the decline in productivity of agricultural soils of Eritrea is a combined effect of physical loss (soil erosion), lowering of organic matter, degradation of soil physical property, organic matter depletion and reduce moisture availability. Unless this trend is not reversed declining soil productivity will remain a threat to agricultural biodiversity.

Drought: Drought in Eritrea is the most limiting factor of crop production and also a cause of genetic erosion. The statistical data of the annual rainfall registered in the last 50 years shows a great decline in amount and an increase in the variability of rainfall distribution. The recurrent drought of the country encountered during the last 2 – 3 decade and erratic nature of rainfall influence farmers choice on crop varieties. Due to these circumstances, farmers prefer varieties cope with drought or in another wards early maturing crops are only selected and there is a condition of neglecting late maturing or long season varieties. For instance study undertaken on sorghum indicate that early maturing variety, (47%) reported to consider as good variety by the household farmers while 32% express giving reasonable yield during unfavourable condition and 21% adaptability consideration (Tesfamicael et. al, 2013)

Change in Land Use: Though the extent of the threat is limited changes in land use, such as urbanisation around major and smaller towns, road and dam constructions are expanding and occupying agricultural lands. These changes may lead to the loss of locally adapted cultivars if careful attention is not paid to land-use planning and ensuring that farmers who lost land to other development projects are adequately compensated with similar land suited to their cropping patterns.

Disease and Insects: Recently introduced new insects such Woolly white fly (*Aleurothrixus flococosus*) affecting citrus crops, Banana White scale, Tomato leaf miner (*Tuta absoluta)* and Date palm white scale are affecting production severely. Stem rust (*Puccinia graminis*) is a very dangerous disease of wheat and barley in the world. In Eritrea the spread of the disease was from surrounding town of Senafe up to the village of Adi-awsha in 2010, but in 2011 it had spread to Debub administration region up to the village of Tera-emni area. The intensity and severity of the disease differs from low to very high (30-100%). Introduction of Ug99, race of the stem rust was first identified in 2010.

PART II: The National Biodiversity Strategies and Action Plans, its Implementation and the Mainstreaming of Biodiversity

3.1 The National Biodiversity Strategies and Action Plans (NBSAP)

Eritrea as a Country Party to the Convention on Biological Diversity, among other things, has prepared and adopted the National Biodiversity Strategy and Action Plan (NBSAP) in August 2000, as a reference document in order to stick to commitments accepted with the ratification of the CBD. Likewise, the country developed and implemented relevant national strategies, action plans and programmes for the conservation and sustainable utilization of its biological resources; and integration of these into relevant sectoral or cross-sectoral plans, programmes and policies. The NBSAP was formulated taking into consideration the country's dependency on the biodiversity resources for socio-economic benefits and future conservation programmes. Consequently, the revised
NBSAP is expected to review, set and update national biodiversity targets.

The NBSAP aims to merge and integrate biodiversity conservation targets and sustainable use of natural resources within sectorial policies, and as a consequence the implementation of the National Environmental Management Plan for Eritrea (1995).

Since its formulation the country has put in place various measures to implement the Strategy and Action Plans. All relevant sectors are working hard and integrate plan of action towards conservation and sustainable use of the country's biodiversity in the context of NBSAP. The NBSAP has three components namely: Terrestrial biodiversity, Marine biodiversity, and agro-biodiversity. Furthermore, the NBSAP has three major objectives:

- Rehabilitation of degraded terrestrial ecosystems and their components through a combination of natural succession; protected area establishment and management; and sustainable use of terrestrial biodiversity resources,
- The coastal, marine and island biodiversity of Eritrea conserved and human activity managed to promote the sustainable development and optimal use of these resources, and
- Agricultural biodiversity-resources conserved and sustainably utilized for food security, income generation and agriculture, whilst ensuring the socially-fair distribution of benefits arising from the use of national agricultural biodiversity resources.

3.2 Updating the National Biodiversity Strategies and Action Plan (NBSAP)

Eritrea is in the process of revising and updating the National Biodiversity Strategy and Action Plan (NBSAP, 2000), which is expected to set and realign national biodiversity targets to the Aichi Biodiversity Targets of the Strategic Plan for Biodiversity (2011-2020). The national process will revise and update the identified strategies and action plan in the NBSAP towards achieving the various Aichi Biodiversity Targets. In order to help recognize and account the full value of biodiversity across relevant sectors in the country such as agriculture, forestry and wildlife, fisheries, land, water and environment,

energy and mining…etc, the NBSAP updating process will rely on substantial experience and success of the country over the years in integrating environmental issues into national development policies and strategies.

Identification of national biodiversity targets in line with the Aichi Biodiversity Targets of the Strategic Plan for Biodiversity (2011-2020) will be done by active participation of stakeholders through national consultations. The aim is to ensure the proposed national targets that can be easily achieved within the extended timeframe.

3.3 Actions Taken to Implement the NBSAP and Related Outcomes

Since the fourth CBD national report some activities had been undertaken to implement the NBSAP that includes policies, strategies, laws and regulations. The following are some of the achievements made during the period under review:

3.3.1 Institutional Reforms and Arrangements

In order to improve and strengthen the forest and wildlife conservation and management, the Government has established a stand-alone authority, the Forestry and Wildlife Authority (FWA). Established in 2012, the FWA is technically mandated to issue licenses. The new institutional arrangement enables more effective enforcement of policy and legislation on forest and wildlife conservation and management. The FWA is staffed with a group of skilled professionals with knowledge regarding most fundamental aspects of conservation, including science, monitoring, enforcement, and planning. A national guards of approximately FWA 150 forest and wildlife guards work on the field level.

The National Agriculture Research Institute (NARI) at the Ministry of Agriculture was involving long-term conservation of plant genetic resources. A gene bank is established in 1992 to conserve plant genetic resources and the Plant Genetic Resources Unit was responsible for that. Since 2012 A Genetic Resources Division which includes Agricultural Crops, Forest and Farm Animals Genetic Resources units is established in 2012. The main objective of the Agricultural Crops Genetic Resources Unit is collecting plant genetic resources and maintaining through an *Ex-situ*, *In-situ* conservation and making them available for crop improvement and scientific purpose. The seed bank holding is around 5000 accessions of more than one hundred plant species.

3.3.2 Designation of Protected Areas

A number of initiatives and studies were carried out to protect the biodiversity of the country through the establishment of a permanent enclosure area system since independence, and same progress has been achieved to restore the terrestrial and marine ecosystem.

In 2010 Ministry of Land, Water and Environment issued a directive that the Semenawi and Debubawi Bahri remain under permanent enclosure. Nearly 40% of the proposed protected areas (40,000 ha) are now under permanent enclosure. However, these areas are yet to be demarcated and officially gazetted as protected.

Furthermore, the Ministry of Land, Water and Environment in 2013 initiated a comprehensive assessment to operationalize an integrated Semenawi and Debubawi Bahri-Buri-Irrori- Hawakil Protected Area System for conservation of biodiversity and mitigation of land degradation. The project goal is to ensure the integrity of Eritrea's diverse ecosystems in order to secure the viability of the nation's globally significant biodiversity; and its specific objective is to create policy and institutional conditions to operationalize the national protected area system in the country.

The objective of the assessments will be achieved through three outcomes: establishment of necessary protected area policy and institutional frameworks; emplacement of required protected area management capacity and experience; and, emplacement of SLM/SFM capacity required to restore/maintain ecosystem services and support achievement of conservation objectives. The strategy will include providing strategic guidance for the identification of necessary staff, skills gaps analysis, and a training program to address identified gaps. The total resources required for the project is US$ 16,328,000 (of which GEF allocated US$ 5,878,000 and UNDP US$ 3,000,000), and the remaining will be mobilized from Government fund, and will support the establishment and initial equipping of a protected areas administration office to be implemented during project years 3 – 7.

Previous studies in the proposed protected areas have been undertaking jointly by the Ministry of Agriculture and the Food and Agriculture Organization (FAO) of the United Nations since 1997. The Ministry of Marine Resources on its part has also placed the immediate marine surroundings for the Buri-Irrori and Hawakil Islands as one of its priority areas in terms of marine conservation, which was included in the 'Conservation management of Eritrea's Coastal, Marine and Island Biodiversity' project.

3.3.3 National Tree Planting Campaign

As continuation of the effectors in conservation and development of forest and wildlife resources of the country, the Government is addressing environmental degradation through social mobilization in afforestation and soil and water conservation. School students, religious leaders, communities, individual and various institutions are actively participating in this campaign. Religious leaders, students and other community members have been trained and sensitized on the need of tree planting and environment conservation as key strategy to achieve food security.

The achievement of the campaign so far is encouraging. Between 2010 and 2014 alone a total of 7,230 ha of new plantation (more than 18 million seedlings) have been established. Upto date, a total of 39,230 ha of new plantation (more than 98 million seedlings) have been established. In addition, a total of 72,072 ha potential for forest plantation (afforestation) has been identified. Currently, the program is funded from Government treasury. The reforested areas are enclosed against livestock grazing with the aim of enhancing natural regeneration.

3.3.4 Energy Efficient Cooking Stoves *(Adhanet Mogogo)*

Eritrea's Energy policy aims to promote optimum supply and utilization of energy, especially indigenous energy resources, conservation of both traditional and non-traditional sources and

transition from traditional energy sources to modern and clean energy to facilitate socio economic development of the country.

Through research and development efforts by the Ministry of Energy and Mining and other key partners such as the Ministry of Agriculture, an improved version of the *Adhanet Mogogo* has been developed. This new model combines the advantages of the traditional *Mogogo* design with advanced technology that has improved the energy efficiency of the *mogogo* from below 10% to over 50%.

The benefits of the improved *Adhanet Mogogo* include:

- Enhanced energy efficiency that reduces deforestation, greenhouse gas (GHG) emissions, agricultural residues and dung burning;
- Improved economic and environmental benefits by saving the time and effort in wood collection, reducing expenditure on firewood, and creating employment in villages where the mogogo is manufactured and installed;
- More time devoted by women to alternative livelihood activities and by children to learning and extra-curricula activities; and
- Improved health of women and children due to a clean, smoke free cooking area.

Photo 39: Traditional and improved stove (Adhanet Megogo) respectively

3.3.5 Alternative Sources of Energy

The Energy sector has bigger environmental impacts than most other economic sectors. Hence, an alternative energy sources have been promoted in the country including solar, wind and geothermal power to reduce pressure on forest resources.

Solar Energy: the potential for the development of solar energy is great; but the application of solar energy technology has been very limited. Up to the year 2010, around 3,000 units of solar systems, with an aggregate capacity of over 1MW, have been installed in the whole country

Wind Energy: prior to installing large-scale wind farms aimed at exploiting the wind resource potential in the wind-rich sites, a pilot wind energy project has been implemented by the Ministry of Energy and Mines in partnership with Global Environment Facility (GEF) and United Nations Development Program (UNDP). A small wind farm (3 x 200 kW) of 600 kW has been constructed. Since its commissioning at the end of November 2007, the Assab Wind Farm has been performing successfully as expected. Seven different wind-diesel hybrid and wind standalone small turbines with capacities from 3-30 kW have recently been installed mainly in the Southern Red Sea region

Geothermal Energy: the Government of Eritrea intends to develop the geothermal power through the installation of a pilot geothermal power plant at Alid (located in the Danakil Depression part of Eritrea) and the identification of new prospects for additional geothermal plants in the future.

3.3.6 Waste Management

Achievements have been made in waste management in the country. Some of these achievements include the introduction of improved collection method of solid waste and provision of sewerage systems of the urban areas. Some of the older dumping sites of the major towns which were environmentally in severe condition have been relocated in favourable areas. In addition, some industries have been introduced waste water treatment plant and others have introduced used oil management system. Moreover, guidelines on used oil management have been drafted and awareness raising programs on waste management in general have been conducted throughout the country.

3.4 Obstacles to Implementation of the NBSAP

Despite all the policies and measures that have been instituted by the Government to implement the NBSAP and/or Convention, the following obstacles have been observed to fully implement of the NBSAP strategies and action plans:

- Inadequate resources to fully implement obligations of the Convention;
- Inadequate resources to conduct comprehensive country biodiversity study;
- Inadequate mainstreaming of biodiversity issues in sectors and National Government plans and budgets;

- Limited capacity for research and generation of accurate information and data as well as value of biodiversity, which are essential requirements for the establishment of protected area system in the country;
- Low level of awareness of the public and decision makers in the value of biodiversity conservation and developments; and
- Inadequate participation of communities in biodiversity conservation and development.

3.5 Mainstreaming Biodiversity into Relevant Sectoral and Cross-Sectoral Strategies, Plans and Programmes

Considering the seriousness of the issue of biodiversity conservation status and threats, the State of Eritrea is making various efforts to conserve biodiversity by integrating into various national, sectoral and cross-sectoral policies, plans and programmes. Some of the actions taken to mainstreaming the biodiversity issues are summarized in three categories as presented below:

3.5.1 Mainstreaming of Biodiversity in National Strategies and Plans

a) Poverty Reduction Strategy Paper (PRSP)

In 2004 the Government of Eritrea prepared the Poverty Reduction Strategy Paper (PRSP), which represents an initial articulation of the Governments response to the urgent need to reduce the incidence of poverty in Eritrea. The Government gives high priority to proper conservation and use of the environment and as part of its poverty assessment the PPA project took on board environmental issues in order to establish causes of poverty. The main aim had been to help mainstream environmental issues in development planning. However in the sectoral polices and priorities not many of the line Ministries had given emphasis to environmental issues.

b) Sustainable Land Management (SLM)

Eritrea is in the process of integrating the countries conservation resources through sound land use planning. This demands conservation to contribute to national and local land use. In such areas conservation needs to be an important component of rural livelihoods, so as to encourage rural people to actively conserve and manage their conservation resources. The SLM project which is in progress since 2009 in the Central Highlands of the country based on poverty alleviation intimately linked with sound environmental and natural resource management, and in so doing will help Eritrea meet some of its Millennium Development Goals (MDGs) obligations, and actively support the PRSP processes.

3.5.2 Mainstreaming of Biodiversity in Sectors Strategies and Plans

The Government of Eritrea supported development of Sectoral Environmental Strategies and Action Plans as part of mainstreaming of environment and biodiversity into sectoral plans and strategies in selected Ministries. Some of the Ministries which are in the process of integrating environmental issues in their sectoral strategies and action plans includes:

Agriculture, Land, Water and Environment, Energy and Mines, Marine Resources, Forestry and Wildlife Authority, Tourism, Education, Construction and Zonal Administration.

a) Agriculture Sector

The Ministry of Agriculture (MoA) has developed a comprehensive ***Agricultural Development Program (2008-2010)*** through national consultative process. In this program, biodiversity considerations such as: enhancing natural regeneration through establishment of enclosures, afforestation and reforestation, strengthening regulatory activities like plant and animal quarantine etc. are well addresses under the natural resources, regulation and enforcement sections. Furthermore, the MoA has prepared a ***Five-Year (2014-2018) Strategic Plan*** emphasizing the natural resources (soil, water and forests) that must be managed in sustainable manner so that agriculture (Crop and Livestock Development is sustained..

Photo 40: Achievement in biodiversity succession, zoba Debub, enclosure area (MoA, 2012)

The Ministry of Agriculture is playing a vital role in soil and water conservation, and is debating in the Ministerial meetings that land tenure system has to be improved. The ministry has also prepared a guideline on the land use of arable lands, forestlands and grazing lands. In addition starting since 1994, Eritrean students throughout the country have been participating in afforestation and soil-conservation campaigns during their summer vacations, of June-September *(Kremti*), organized jointly by the Ministry of Education (MoE) and the MoA.


Photo 41: Students participation in soil and water conservation activities

The Forestry and Wildlife Conservation and Development Proclamation No 155/2006 in association with the regulations for the issuance forestry permits (Legal Notice 111/2006) and regulations for the issuance of wildlife permits (Legal Notice 112/2006) provides the framework for the conservation and development of forests and wildlife resources of the country.

The proclamation also aims at wildlife protection and conservation to ensure sustainability of wildlife habitats, establishment and maintenance of Protected Areas (PA) and development of a PA network in order to enhance biological diversity of the country.

b) Land Sector

The Land Sector has drafted laws related to land use and efforts are being made to finalize them.

Draft Land Use Policy, (2007): **t**he objective is to promote improved land stewardship by rural and urban land users by better defining and strengthening land and resource tenure rights. It also aims to provide a coordinated, national approach to sustainable land use and planning and to prepare national and local land-use plans to help guide land-use decisions in an environmentally sound, economically sustainable and socially acceptable way.

c) Water Sector

The Water Sector has prepared draft policies and laws that number of Articles relevant to the protection and conservation of land, water resources and the environment.

Water Policy (2010): The draft policy outlines the institutional and regulatory issues, water use, water rights, and water quality. The following objectives of the draft water policy which are relevant to the biodiversity include: Ensures that the ground water resources are adequately protected from deterioration in quality and from over exploitation, Incorporates environmental conservation and protection requirements as integral parts of water resources management, Encourages also that EIA and protection requirements serve as part of the major criteria in all development projects including water resources development projects,

Establishes and adopts water quality standards and proper assessment procedures for the control and preservation of the water resources base, including the control of indiscriminate discharges of untreated effluents into natural watercourses, Promotes appropriate and efficient watershed management practices to maximize groundwater recharge and maintain water quality, Formulates and adopts national standards and criteria for the design, Regulates the treatment of effluents that can affect the surrounding water sources; Ensures that effluents are treated to acceptable levels and standards before discharging them into natural streams, Integrates drainage issues and waste disposal within the domain of water resources management, and Ensures water resources management in the country is progressively integrated.

Eritrean Water Law, Proclamation, No. 162/2010: the objectives are directly related to natural resources management that to promote the rational management and use of the water resources, the provision of clean, safe and sufficient supply of water; and development of water resources without harming the environment.

Action Plan for Integrated Water Resource Management (IWRM) in Eritrea (2009-2016): The aims of the action plan are to enhance the creation of an appropriate enabling environment for water resources management, development and use; to facilitate the creation of institutional frameworks for water resources management and the development and use at national, regional, sub regional and community levels; to improve the knowledgebase on which rational water resources decisions will be made; to improve the water resources assessment capabilities of the water sector through the introduction of appropriate analytical tools and upgrading the institutional and human resources capacity; facilitate the implementation of the framework for water resources management for the future; and to prioritize and classify action plans in terms of short, medium and long term.

d) Environment Sector

The Environment Sector as custodial for Environmental related issues in the country has initiated and prepared different action plans and regulations.

Einvironmnetal Impact Assessment (EIA) of Development Projects and Others
The Department of Environmnet of the Ministry of Land Water and Environment being responsible for the implementationof the national environmental policies and strategies has developed the National Environmental Impact Assessment Procedures and Guidelines in 1999. This document lays out the general principles, approaches and instruments to fulfill the obligations required to maintain a safe and healthy environment and through the application of its procedures determine the potential negative environmental consequences of all development projects. Moreover, the NEAPG is a tool for integrating environmental issues into a planning process. The NEAPG document contains a set of procedures such as the screening and categorizing projects as A,B and C.

Integration of the Three Rio Conventions: The Department of Environmnet has intiated a pilot project for the three Rio conventions (CBD, UNCCD and UNFCCC) and in 2013 a manual was prepared. The main objective of the project was to pilot nationally-driven

integrated processes and approaches to reporting to the three Rio Conventions (CBD, UNCCD and UNFCCC). More specifically, the project aimed to: develop integrated approaches to data collection/analysis and information management of relevance to the three Rio Conventions; increase synergies in the process of reporting to the three conventions without compromising COP decisions in this regard; and contribute to improved overall planning and decision-making processes at the country level related to the implementation of these three conventions.

National Situational Analysis and Needs Assessment (SANA): The Department of Environment of the Ministry of land, Water and Environmnet with the Ministry of Health and other stakeholders has prepared a country report that aimed at the informationa sharing and developing interlinkage between environment and health.The report provides baseline situation of the country interms of risk factors,strategic frameworks,alliance between health and environment,partners currently existing and major needs identified to mitigate the impact resulting from ecosystem disintegration through consolidated alliance of health interlinkage.

The Department of Environment Five Year Action Plan for the Great Green Wall Initiative (2011-2015) Draft: The action plan describes the initiative on The Great Green Wall (GGW) that focuses to combat desertification for countries bordering along the Sahara desert (Senegal, Niger, Nigeria, Burkina Faso, Mali, Mauritania, Chad, Sudan, Eritrea, Ethiopia and Djibouti) aimed to fight for the advancement of the Sahara desertification and its consequences. Eritrea's five year action plan focuses on activities that help in mitigating land degradation, reducing desertification, adapting climate change, increasing agricultural products so as to improve the lively-hood of the people. This action plan includes implementation of sustainable natural resources management (land, water, forest & wildlife) in the country through afforestation, soil and water conservation, establishment and management of enclosures as well as promotion and establishment of nursery sites. The action plan also included the establishment of protected areas such as; Semenawi and Debubawi Bahri (100,000 ha), Buri-Irrori-Hawakil Islands (180,780 ha), Bara'soli (800 ha), including Riverine habitat along Gash and Barka Rivers (195,024 ha), and Nakfa Reserves (16,390 ha).

National Adaptation Programme of Action (2007): The NAPA process in Eritrea was designed to be consistent with on-going national strategies, plans and frameworks. In particular, the NAPA process is closely linked and highly complementary with existing national development plans regarding food security, poverty reduction and sustainable development. Moreover, the NAPA process in Eritrea has been actively seeking to identify ways to mainstream adaptation to climate change into national development processes, by inclusion of climate and vulnerability in sectoral and development policies that are complementary to climate change. Eritrea's NAPA has identified highest priority actions/ projects (102 adaptation projects) that are urgently needed to adapt to climate change. It addresses that each priority project will need strong donor support coupled with effective local project implementation, monitoring and evaluation programmes. Till now, Eritrea prepared the 1st and 2nd National communication to the UNFCCC**.**

National Capacity Needs Self Assessment (NCSA): The Ministry of Land, Water and Environment has prepared a National Capacity Needs Self Assessment (NCSA) through a country driven consultative process in 2007. In this process gaps and priority needs, opportunities for synergistic cross cutting and strategy and action plan for capacity building in the country at various levels have been identified to support the implementation of the global environmental conventions that stressed mainly on the three conventions such as UNCBD, UNCCD and UNFCCC .Accordingly, eight synergetic capacity building intervention areas were identified.

National Biosafety Framework (NBF): Eritrea acceded the Cartagena Protocol on Biosafety under the CBD on March 2005.Under this protocol, a National frame work was prepared in 2007.The NBF includes four sets of guidelines for: 1) Handling requests/ permits for authorization; 2) Risk assessment of genetically modified organisms (GMOs); 3) Public awareness and participation in biotechnology/biosafety; and 4) Protection of confidential business information (CBI).The Biosafety Clearing House(BCH) Mechanism also initiated and two trainings were conducted, i.e. 2008 and 2009 to th relevant stakeholders. The second National Report was submitted in 2012. In the same year, the strategy and Action Plan for the Implementation of the NBF document has been developed.

a) Energy Sector

The Energy Sector Development Plan stresses the use of renewable and alternative energy sources such as wind, solar, geothermal and Liquefied Petroleum Gas (LPG). The use of alternative energy sources such as biogas and improved cooking stoves for domestic uses are also encouraged to minimize the use of charcoal and firewood to protect massive deforestation.

b) Mining Sector

The Mines Department has mainstreamed in its policy Environmental Impact Assessment and rehabilitation of mining areas, which include land reclamation, tree planting in reclaimed areas as well as defined closure measures.

c) Marine Resources Sector

The Marine Resources Sector Policy and Strategy focuses on the promotion of sustainable exploitation and utilization of fish resources and effective protection of the marine and islands environment. Hence, the Ministry has established an environmental impact assessment unit that deals with environmental issues.

Draft National Coastal Policy (2006): the objective is to provide for the sustainable use of the coast for housing, tourism, recreation, ocean access, maritime industry, commercial and other activities in appropriate designated areas. The National Coastal Policy is formulated as a framework designed to direct the elaboration of: (i) the preparation of a Proclamation detailing the National Coastal Area Management and Development Directives including the Institutional Structure necessary for its implementation; (ii) Eritrea's National Integrated

Coastal Area Management Plan; and (iii) the requisite Regulatory framework necessary for the implementation of the Plan: the Coastal Management Proclamation.

The Conservation Management of Eritrea's Coastal, Marine, and Island Biodiversity (ECMIB) project, 2007, which has the potential to provide the framework for the establishment of an integrated coastal zone management system in Eritrea, can be used as a platform to mainstream marine biodiversity.

d) Education Sector

The education sector development programme has integrated biodiversity knowledge in its national education curriculum and learning processes. Biodiversity concept is being taught in various subjects from pre-schools to the Higher Educational Institutions. Integrated Early Childhood Project could help also in mainstreaming the concept of biodiversity through awareness creation of school kids right from their childhood, which can make fundamental shift of thinking of the next generation.

e) Construction Sector

The sector prepared a number of procedures and guidelines, known as Eritrea Environmental and Social Impact Management Guidelines for Road Operations, for undertaking environmental impact assessment for all road development projects.

f) Tourism Sector

The National Tourism Development Plan (2000-2020) calls for sustainable tourism and tourism development through development of tourism policy and strategy and the wider aspect of tourism development plan. The Tourism Development Policy and Strategy for Eritrea has given policy directives to address potential impact on environment including biological diversity of tourism. The Ministry is also promoting environmental protection in its management plan. Within this plan, for the Northern Red Sea Region/Zoba, among the many sites considered include: (i) the proposed protected areas of Buri Peninsula and of the Danakil depression for some infrastructure; and (ii) the inland, the Akwar and Mai-Wooi hot springs are of interest for developing spa health resorts.

g) Zonal Administration plans

Branch office five years agricultural strategic plan (2013-2017): The Ministry of Agriculture has been exerting all possible efforts to restore the environment by developing the capacity of farmers and extension agents. In order to tackle this crucial problem the Ministry of Agriculture has conducted a Rapid Agricultural Production Situation Assessment (RAPSA) which focuses on collecting basic data at Sub-Zoba level. The data which was collected in this assessment was useful for the development of 5 years strategic plan of the sector at local level.

3.5.3 Mainstreaming of Biodiversity in Various Cross-Cutting Sectors

Higher Educational Institutions of the country singles out the following biodiversity conservation related subjects for inclusion in their respective curriculum:

Hamelamlo Agricultural College: Hamelmalo Agricultural College (HAC) which was established in 2005, offers undergrdaute Diploma and Degree programs namely 1)Agricultural Engineering 2) Land Resources and Environment 3) Agricultural Economics 4) Agricultural Extension 5) Crop protection 6) Crop production 7) Horticulture 8) Animal Science and 9) Veterinary Science. Besides, it offers M.Sc degress in applied Osil sciences, plant Protection, Agronomy, horticulture and sustainable animal production.

College of Marine Science and Technology: College of Marine Science and Technology which was established in 2005 and is currently offering four degree and five diploma programs under 4 departments. 1) Department of Applied Marine and Fisheries Science (AMFiS); 2) Department of Aquaculture; 3) Department of Marine Biotechnology; and 4) Department of Marine Engineering (ME). This higher education program has significant contribution on the conservation and sustainable use of biological diversity.

Institute of Science and Technology Mai Nefhi Department of Biology: The department is providing in four biodiversity related courses: 1) Animal zoology and plant ecology; 2) Biodiversity and conservation; 3) Morphology and taxonomy of flowering plants; and 4) invertebrate and vertebrate zoology

The Ministry of National Development coordinates all sectoral development activities in the country. The Ministry of Health and Information also continue to play a key role in creating awareness among the community that conservation of the environment is the responsibility of every citizen.

Despite lack of coordination among sector institutions, the achievement registered in implementing the NBSAP is considerable. Except few thematic areas all have been addressed partly or fully. The following table summarizes the implementation of priority actions for each component.

Table 2: Implementation status of the National Biodiversity Strategy and Action Plan (NBSAP)

Thematic Area	Priority actions	Implementation status (2010 - 2014)
NBSAP Components 1: *Terrestrial Biodiversity*		
Integrated management	-Improve integration of biodiversity into integrated land management, and - Integrated Watershed Management	- Integrated Watershed Management works have been undertaken nationwide as part of the action plans of MoA through involvement of communities, campaigns of students / institutions and as part of SLM activities Funded by Government, communities and IFAD - Conservation Agriculture observation trials have been conducted by the Soil Research Unit at NARI for introducing the technology in the country Funded by Government and European Union
Sustainable use of natural resources	Reduce pressure on plants in natural habitat through promotion of alternative fuels; Increase production of wood-fuel from 'converted habitat'; and Promote the economic benefits to be derived from non-destructive utilization of trees, etc. in natural habitat	-A total of 7,230 ha of new plantation (more than 18 million seedlings) have been planted between the year 2010-2014. Up to now a total of 39,230 ha of new plantation (more than 98 million seedlings) have been planted within the country which funded by the Government. - The use of improved traditional stove is increasing every year up to now 115,497were are installed. Since the last reporting cycle 15,500 traditional stoves are established. - To date, a total of 85 plant species were identified as medicinal plants. Members of families Fabaceae and Lamiaceae are the most used plants. Among the cited traditional medicinal plant species more than half (52 %) of the total were found in natural habitat. About 28 % of the medicinal plants were found to be home garden while 14% species were grouped under natural habitat and home garden and 6% were found in markets -Up to the year 2010, around 3,000 units of solar systems, with an aggregate capacity of over 1MWelectricity, have been installed in the whole country Funding: African Development Fund to support Postgraduate Studies

Thematic Area	Priority actions	Implementation status (2010 - 2014)
Alien Invasive Species	Increase capacity for the control of alien invasive species within Eritrea	-To reduce the expansion of the alien species through sustainable utilization around 10,000 of tones of charcoals making from Prosopis legally permitted by RSD, MoA annually. - Survey was undertaken to investigate and propose appropriate management of *Prosopis chilensis* and *Prosopis juliflora* to negative effects and exploit the potential in-order to reduce pressure to forest biodiversity by the Forest and Wildlife Unit at NARI' - Awareness raising programmes on the sustainable use and control of *Prosopis chilensis* and *Prosopis juliflora* has been conducted at all levels. Funded by Government -Pollination and seed set in *Nicotiana glauca* (Solanaceae) study has been conducted. Funding: African Development Fund to support Postgraduate Studies
Pollution management	Increase protection of biodiversity resources from pollution	-The government is protecting biodiversity resources from pollution through the existing regulatory bodies. However, strong Legal framework is needed to be in place, particularly in importing new species.
In-situ conservation (protected areas)	Formalize the process for establishment of protected areas system appropriate for the current and future Eritrean conditions by establishing a working group of MoA, MoMR, and MLWE (and others) to harmonize policy /legislation on protected areas -	-In 2010 Ministry of Land, Water and Environment issued a directive that the Semanawi and Debubawi Bahri remain under permanent enclosure. Nearly 40% of the proposed protected areas (40,000 ha) are now under permanent enclosure. However, these areas are yet to be demarcated and officially gazetted as protected. -Eritrea has proposed a total land area of 1,009,860 ha (649,266 ha for terrestrial and 360,594 ha for marine protected area) for Integrated Semenawi and Debubawi Bahri-Buri-Irrori- Hawakil Protected Area System for Conservation of Biodiversity and Mitigation of Land Degradation in 2013 and approved by GEF for seven years (

Thematic Area	Priority actions	Implementation status (2010 - 2014)
		2014-2020), Funded by GEF/UNDP and Government -The FWA in collaboration with the Eritrean Mapping and Information Center (EMIC), Office of the President, and MoA Zoba Branches, data and information related to existing enclosures, forest plantations, potential areas for afforestation and for wildlife reserve gathered and documented. A total of 305,232 ha closures (214,133ha –Temporary and 91,099 ha- permanent) and 188,527 ha proposed national park/closure, as well as 28,046 ha Potential for enclosure and 291,711 ha Protected and proposed protected areas (for Wildlife reserve areas and biodiversity conservation) were delineated and mapped. Funded by Government
Ex-situ conservation	Increase biodiversity benefits from *ex-situ* conservation facilities	- Agricultural Crops genetic resources conservation by Genetic Resources Division at NARI increased by 16% through acquisition of new accessions receipt from collection. No significant measures are made on Forest genetic resources maintained at NARI - In the last four years 2010-2013 the number of plant collections deposited in the herbarium of the Department of Biology at Eritrean Institute of Technology was increased from 3000 to 5250.
Taxonomic knowledge	- Increase biodiversity benefits arising from improved taxonomic knowledge	- The Department of Biology (E.I.T.) teaches courses on plant systematics and taxonomy both at undergraduate and post graduate level (Biol 211 Plant systematics, Biol 212 Flowering plants, Biol 511 Principles of plant Taxonomy) - Study conducted to investigates the species composition, density and diversity of woody plants and determine the regeneration status of *Ficus vasta* (*Da'ero*) in Segeneyti and its environs for initiating community-Based Conservation of the species in Segeneyti and its Environs. -The conservation status of the two local endemic species of Aloe in

Thematic Area	Priority actions	Implementation status (2010 - 2014)
		Eritrea i.e. *A.schoeleri* and *A. neosteudneri* are both designated as critically endangered species and need special attention for their conservation. Fund: Dutch Royal Embassy of the Netherlands in Eritrea - As a member of East African net work, Wetland Biodiversity Monitoring Scheme (WBMS), the Department of Biology, UoA was actively participating in water bird census during 2003-2007. This activity is again initiated in 2013 by combining water bird census along with monitoring of important bird areas (IBA) in Eritrea. Fund: International Water bird Census (IWC).
Information acquisition and storage	- Increase biodiversity benefits arising from improved use of biodiversity information	- Tentative check list and data base is prepared from literature i.e. from "Flora of Ethiopia and Eritrea vol 1-8." The checklist contains 2106 of flowering plants. The total checklist of vascular plants (Angiosperms, Gymnosperms and Pteridophytes) is estimated to reach 2150. -E-station installed at DoE in view of sharing information with relevant institution.
Public awareness and education	- Improve the documentation and dissemination of information on the conservation and sustainable use of biodiversity	-Several students' text are designed to increase understanding importance and protection of environment, natural resources and even to some extent at species level - Awareness raising through Radio and Television programs were implemented by the Ministry of Information in collaboration with MoA and FWA about National Greening Day. -136 green clubs with 15,894 numbers of students as members of the green clubs were established since 2000, out of which 90 clubs had been established within the reporting period. -Public gathering was conducted to decision makers, students, arm and general public about conservation biodiversity and sustainable use. - Funded by the Government, UNESCO/GEF

Thematic Area	Priority actions	Implementation status (2010 - 2014)
Legal and institutional structure (capacity-building)	Improve legislative arrangements and coordination for the protection and Sustainable use of terrestrial biodiversity.	-Short-term trainings were provided to strength protection of forest biodiversity and enforce the Forest and Wildlife proclamation - Other short-term trainings provided to staff members of MoA and farmers in areas of Forestry, Wildlife, Sustainable use resources, law enforcement.etc that contribute in conservation and sustainable use of biodiversity Funded by the Government/EU
Institutions (Capacity-Building)	Increase representations of biodiversity issues in relevant sectorial legislation, and increase institutional and technical capacity to promote conservation and sustainable use of terrestrial biodiversity	- In order to improve and strengthen the forest and wildlife conservation and management, the Government has established a stand-alone authority, the Forestry and Wildlife Authority (FWA). Established in 2012, the FWA is technically mandated to issue licenses and otherwise oversee the use of biodiversity resources Funded by GEF/UNDP and Government -The Department of Biology (EIT) is trying to upgrade its herbarium to a national herbarium. This is possible by upgrading the facilities of the herbarium thereby increasing the number of collected plants. - Relevant seed laboratory equipment and materials supplied and installed at Regulatory Services Department Laboratory. Funded by COMESA - The Gene bank (Genetic Resources Division) at NARI acquired new freezers to increase storage capacity of the seed bank. In addition new seed drier and germination cabinet are installed Funded by East Africa Plant Genetic Resources Network
NBSAP Components 2: *Marine Biodiversity*		
Integrated management	-Develop a comprehensive, integrated and participatory management framework for the conservation, management and	- Still in a draft stage (developed) and waiting for approval by relevant government authorities

Thematic Area	Priority actions	Implementation status (2010 - 2014)
	sustainable development of Eritrea's coastal, marine and island biodiversity	- Introduction and application of blocks in fishing ground of industrial trawlers - Use of quota system for all commercial species to be caught yearly. Funded by Government and partners
Sustainable use of natural resources	- Formulate an integrated CMI development and zoning plan	- Introduction and application of blocks in fishing ground of industrial trawlers - Use of quota system for all commercial species to be caught yearly. - Efforts on Stock Assessment being conducted to estimate MSY so as to allocate TAC Funded by Government and partners
Alien invasive species	- Protect the coastal, marine and island environment from alien invasive species	- Ministry of Marine Resources along with Department of Marinetime Transport (Ministry of Land and Water Transport) have been exerting efforts to protect alien invasive species from ballast water to some extent. Funded by Government and partners
Pollution management	- Identify, monitor and control potential sources of pollution within CMI areas	- NEMP on Identification and Monitoring of some Residue from Pollution in the waters of the fishing ground. Some works are done by the maritime transport as their signatory to MARPOL Funded by Government and partners
In-situ conservation (protected areas)	- Develop and implement a participatory program for conservation and management of key CMI areas and for habitats and species of special concern outside of these areas	-360,594 ha for marine protected area for Integrated Bahri-Buri-Irrori-Hawakil Islands and Bara-sole bay Protected Area System for Conservation of marine Biodiversity has been designated. Funded by Government and partners
Ex-situ conservation	Increase biodiversity benefits from *ex-situ* conservation facilities -	No progress

Thematic Area	Priority actions	Implementation status (2010 - 2014)
Taxonomic knowledge	- Increase national capacity for CMI taxonomic data acquisition -	In progress
Information acquisition and storage	- Establish a comprehensive GIS database on CMI biodiversity and related cross-cutting information	-E-station installed at DoE in view of sharing information with relevant institution. Funded by Government and partners
Public awareness and education	- Increase national capacity to undertake CMI biodiversity assessment and monitoring through education and training; and Increase public awareness of CMI biodiversity values	- College of marine science and technology (COMSAT) and Hirgigo fisheries training center have educational program outleting hundreds of students each year. Funded by Government and partners
Legal and institutional structure (capacity-building)	Improve legislative arrangements and coordination for the protection and sustainable use of CMI biodiversity and enhance institutional capacity to implement legislation	- Revision of fisheries proclamation and updating of the guidelines for fishing licences Funded by Government and partners
NBSAP Components 3: *Agro-Biodiversity*		
Integrated management	Inclusion of agricultural biodiversity criteria in the zoning of potential agricultural land	Integrated Watershed Management works have been undertaken nationwide as part of the action plans of MoA through involvement of communities, campaigns of students / institutions and as part of SLM activities Funded by Government, communities and IFAD - Conservation Agriculture observation trials have been conducted by the Soil Research Unit at NARI for introducing the technology in the country Funded by Government and European Union
Sustainable use of natural resources	- Promote the conservation, enhancement, production, utilization and marketing of high value/industrial indigenous crops and livestock for income generation and economic development	-Peach - 235,000 seedling out of which 135,000 by FAO and 100,000 by GoE were distributed to four zobas, namely; Maekel, Debub, NRS, and Anseba. In the last 4 yrs. (2010-2013) TCP: Technical Corporation Program

Thematic Area	Priority actions	Implementation status (2010 - 2014)
	- Produce and distribute to farmers improved varieties of indigenous landrace (crops and livestock) materials. - Improve documentation of the distribution and status of agricultural biodiversity resources - Improvement of rangeland quality through temporary closures, enhancement of perennial grazing cover, increased forage/fodder crops. -Increase honey and wax production by establishing queen (bee) rearing centres and expansion of bee colonies	-Apple - 110,000 seedling out of which 30,000 by FAO and 80,000 by GoE were distributed to four zobas, namely; Maekel, Debub, NRS, and Anseba. In the last 4 yrs. (2010-2013) -Olive oil- 100,000 certified seedlings were imported and distributed by GoE to four zobas, namely; Anseba, Debub, Maekel, and NRS In the last 4 years (2010-2013). -Potatoes – 3,500 quintals of certified seedling out of which 2,130 quintals by IFAD- add-on Project and 1,100 quintals by GoE were imported in the last four years (2010-2013) and distributed to four zobas, namely; Maekel, Debub, Gash Barka, and Anseba. -Different types of certified vegetables seeds (5070kgs) such as lettuce, carrot, okra, onion etc. were imported in the last four years (2010-2013) by National Agricultural Project (NAP) and distributed to zobas -In Gash Barka, 13,000 Ha Protection and restoration of communal rangelands, through temporary closure and natural regeneration are achieved. Project funded by GoE and GEF under IFAD. -In queen bee rearing centres, there are a total of 134 bee-colonies, out of which 60 in mekerka (40 are newly developed), 10 in Merhano, 60 in Mendefera, and 4 in Elabered. Crop development Division, 2013. -A total of 85 plant species were identified as medicinal plants. Members of families Fabaceae and Lamiaceae are the most used plants. Among the cited traditional medicinal plant species more than half (52 %) of the total were found in natural habitat. About 28 % of the medicinal plants were found to be home garden while 14% species were grouped under natural habitat and home garden and 6% were found in markets Funding: African Development Fund to support Postgraduate Studies

Thematic Area	Priority actions	Implementation status (2010 - 2014)
		- The gene bank of NARI distributed 178 accessions of 15 species to users for crop improvement and for scientific research purpose Funded by Government - Nine improved varieties of wheat, sorghum, pearl millet and maize are distributed to farmers by NARI - Participatory barley breeding which conducted through participation of farmers and based on the landraces to improve yield by 20% was conducted Funded by Government and the International Center for Agricultural Research in Dry Areas (ICARDA), International Crop Research in Semi-Arid Desert (ICRISAT) and Association of Agricultural Research In Eastern and Central Africa (ASARECA)
Alien invasive species	- Improve knowledge and control of alien species within agricultural ecosystem	- Awareness raising programmes on the sustainable use and control of *Prosopis chilensis* and *Prosopis juliflora* has been conducted at all levels. - to control pests such as white fly that has affected citrus fruits, an integrated pest management project has been initiated.
Pollution management	- Reduce impact of industrial pollution on agricultural system	-Regulatory Services Department of MoA in collaboration with FAO collected and made ready for transportation the absolute chemical for disposal out of the country around 400 tones.
In-situ conservation	- Increase conservation of agricultural biodiversity within on-farm system	
Ex-situ conservation	- Increase conservation of agricultural biodiversity within ex-situ systems	-Agricultural Crops genetic resources conservation by Genetic Resources Division at NARI increased by 16% through acquisition of new accessions receipt from collection. No significant measures are made on Forest genetic resources maintained at NARI - In the last four years 2010-2013 the number of plant collections

Thematic Area	Priority actions	Implementation status (2010 - 2014)
		deposited in the herbarium of the Department of Biology at Eritrean Institute of Technology was increased from 3000 to 5250.
Taxonomic knowledge	- Increase taxonomic knowledge of biodiversity within agro-ecosystems	In progress
Information acquisition and storage	- Increase use of knowledge about biodiversity within agro-ecosystems	- Survey on Ug99, stem rust (*Puccinia graminis*) by the Protection Unit at NARI and race identifications out of the countries was conducted. The intensity and severity of the disease differs from low to very high (30-100%). - Yellow rust race analysis was continued from 2002 to 2013 and up to now 7 phenotypes of yellow rust were identified by the Plant protection Unit of NARI - Tentative check list and data base is prepared from literature i.e. from "Flora of Ethiopia and Eritrea vol 1-8." The checklist contains 2106 of flowering plants. The total checklist of vascular pants (Angiosperms, Gymnosperms and Pteridophytes) is estimated to reach 2150. - Check list of insects, plant pathologies, weeds and nematodes was prepared by the Regulatory Service of Department of MoA - E-station installed at DoE in view of sharing information with relevant institution.
Public awareness and education	- Increase knowledge of benefits arising from biodiversity within agro-ecosystem	-Flyer with information the importance of plant genetic resources conservation and the gene bank of NARI role and achievements was distributed. Other several flyers for specific plant species management were distributed Funded by the Government
Legal and institutional structure (capacity-building)	- Increase protection of agricultural biodiversity within agro-ecosystem	In progress

PART III: Progress towards the 2020 Aichi Biodiversity Targets and contributions to the Millennium Development Goals

Although implementation of the National Biodiversity Strategy and Action Plan (NBSAP) has some success since its adoption in 2000, its full implementation was hindered mainly by limited human and financial resources. In general, 35% of the priority actions in the NBSAP have been substantially achieved and the remaining 65% have been achieved to a limited extent (Table 2). Some of the notable accomplishment includes the following:

- Review and update of relevant legislation particularly those addressing forestry and wildlife resources.
- Preparation of a number of regulations, guidelines and manuals covering biosafety, solid waste management and hazardous waste management;
- Improving institutional enforcement capacity in Sector Ministries and Forestry and Wildlife Authority (e.g. Forestry and wildlife investigators);
- Designation and upgrading of proposed protected areas
- Preparation of land use policy to promote improved land stewardship by rural and urban land users by better defining and strengthening land and resource tenure rights.
- Preparation of Water Policy and to institutional and regulatory issues, water use, water rights, and water quality related to natural resources management.
- Action Plan for Integrated Water Resource Management (IWRM) in Eritrea aims of the action plan are to enhance the creation of an appropriate enabling environment for water resources management,
- Participate in the Five Year Action Plan that describes the initiative on The Great Green Wall that focuses to combat desertification through the DoE.
- Preparation of National Coastal to provide for the sustainable use of the coast for housing, tourism, recreation, ocean access, maritime industry, commercial and other activities in appropriate designated areas; and
- Public awareness through different pathways such as public gathering and local Medias.

Eritrea has also made an important progress towards the Millennium Development Goals (MDGs) following the Millennium Summit of the United Nations in 2000 significant improvements have been realised in extreme poverty reduction, great achievements in primary education, gender equality and empowerment, significant improvement in child mortality and maternal health and fighting against HIV/AIDS, malaria and other diseases. However, there are a disturbing trends relating to the loss of environmental resources, such as reducing forest cover and declining soil fertility. Rapid settlement growth and agricultural expansions have been the potential environmental pressures and need to be properly managed, especially given the rapid pace at which it is happening. National Targets will be developed during the on-going review and update of NBSAP.

Table 3: present the summary on the implementation of priority actions for the NBSAP towards the Aichi Biodiversity Targets.

Aichi Targets	National actions taken (2010-2014)	Overall Assessment Status
Strategic Goal A: *Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society*		
Target 1: By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.	Public awareness being undertaken by various actors through media, seminars, and workshops related to biodiversity conservation and sustainable use. Advocacy targeting policy makers to address the importance of genetic resources and poverty reduction. A fish and marine resources references library established	
Target 2: By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems	*Poverty Reduction Strategy Paper (PRSP* (2004): proper conservation and use of the environment and as part of its poverty assessment the PPA project took on board environmental issues in order to establish causes of poverty. The main aim had been to help mainstream environmental issues in development planning. The SLM project which is in progress since 2009 in the Central Highlands of the country based on poverty alleviation intimately linked with sound environmental and natural resource management, The MoA has prepared a *Five-Year (2014-2018) Strategic Plan* emphasizing the natural resources (soil, water and forests) that must be managed in sustainable manner so that agriculture (Crop and Livestock Development is sustained. *Action Plan for Integrated Water Resource Management (IWRM) in Eritrea (2009-2016):* The aims of the action plan are to enhance the creation of an appropriate enabling	

	environment for water resources management, development and use; The National Tourism Development Plan (2000-2020): The Tourism Development Policy and Strategy for Eritrea has given policy directives to address potential impact on environment including biological diversity of tourism. Mainstreaming in national policy documents and educational curricula meant genetic resources conservation and sustainable use	
Target 3: By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions	Positive incentive community based afforestation e.g. grasses cut & carry system and harvest of poles as part of revenues to the local communities in the central highland of the country. Promotion of traditional use of forest products. Distribution of improved energy saving stoves subsidized by government and partners. Mangrove development efforts scale-up in partnership with community based mangrove seed and Conocarpus indica plantation initiated in and around Dehil Island.	
Target 4: By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits	Community tree planting for sustainable livelihood use established in 2006 Alternative energy sources (biogas, wind and solar) and efficient improved cooking stoves *(Adhanet Mogogo)* are being promoted in efforts to considerably reduced deforestation since more than 90% of national energy consumption constitute90% biomass energy. Sustainable use of Gum Arabic (from *Acacia senegal*) and resin production (from *Boswellia papyrifera),* Doum Palm	

	leaves for making artefacts by famers association and individuals is promoted.	
Strategic Goal B: *Reduce the direct pressures on biodiversity and promote sustainable use*		
Target 5: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.	Eritrea has proposed a total land area of 1,009,860 ha (649,266 ha for terrestrial and 360,594 ha for marine protected area) for Integrated Semenawi and Debubawi Bahri-Buri-Irrori- Hawakil Protected Area System for Conservation of Biodiversity and Mitigation of Land Degradation in 2013 and approved by GEF for seven years(2014-2020), Funded by GEF/UNDP and government The FWA in collaboration with the Eritrean Mapping and Information Center (EMIC) and MoA Zoba Branches, data and information related to existing enclosures, forest plantations, potential areas for afforestation and for wildlife reserve gathered and documented. A total of 305,232 ha closures (214,133ha –Temporary and 91,099 ha- permanent) and 188,527 ha proposed national park/closure, as well as 28,046 ha Potential for enclosure and 291,711 ha Protected and proposed protected areas (for Wildlife reserve areas and biodiversity conservation) were delineated and mapped In Semenawi & Debubawi Bahri a total of 128, 0000 ha were established as protected area and waiting for approval.	
Target 6: By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of	VHF system to be installed to control illegal fishing. • 30 staff members trained and equipped to enhance MCS. • Fisheries proclamation 1998/2003 updated. • Policies and Strategy for fishery sector under review.	

fisheries on stocks, species and ecosystems are within safe ecological limits.		
Target 7: By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity	Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) is being conducted for agriculture, forestry and coastal developmental projects. Agricultural Land use Master Plan has been developed and is being implemented	
Target 8: By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.	-Implementation of National Land use Master Plan is underway. -Obsolete Chemicals studied and ready for disposal. -Waste Water Management and Pollution Control Strategy was developed in 2013 -Integrated Water Resources Action Plan (IWRM) developed in 2010. -Iintroduction of improved collection method of solid waste and provision of sewerage systems of the urban areas. -Sea water quality and pollution tested in accredited laboratory for any heavy metal contamination each year.	
Target 9: By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.	-Invasive alien species sustainable utilization and Management Programme is developed (2008) -Migratory pests and desert locust control was developed in 2005and implementation is underway.	
Target 10: By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning	-National Climate Change Strategy was developed in 2005 -Integrated Costal Area Management (ICAM) Strategies and setback developed.	
Strategic Goal C: *Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity*		
Target 11: By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems	-Eritrea has proposed a total land area of 1,009,860 ha (649,266 ha for terrestrial and 360,594 ha for marine protected area) and delineated by 2013 with GEF/UNDP funds.	

of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes.		
Target 12: By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained	-Elephant Management Plan (2010-2014) -African wild ass Management Plan (2015). -Sea Turtle management and action plan for conservation developed. -Tagging of Sea Turtle on nesting beaches and on board of industrial trawlers (when incidentally caught).	
Target 13: By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.	-Enhancing *Ex-situ* conservation of cultivated crops and forest genetic resources through human and infrastructure capacity building -Documenting genetic resources information and studying genetic treaties - Indigenous wild tree fruits domestication and making available in local markets	
Strategic Goal D: *Enhance the benefits to all from biodiversity and ecosystem services.*		
Target 14: By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.	-Strategy on Degraded Catchments Treatments (2006) is being Implemented -Water Proclamation (2010) and Integrated Water Resources management (IWRM) Action Plan -The State of the Coast, 2006 -The Eritrean Coastal Marine and Islands Biodiversity (ECMIB) project (2004-06) is being implemented -Integrated Costal Area Management (ICAM) is developed	
Target 15: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.	-National Climate Change Strategy is in place to address adaptation and mitigation to climate change impacts (NAPA, 2007). -National Action Plan to Combat Desertification (2002) is in place. -Sustainable Land Management (SLM) Programme is being implemented in several parts of the country (e.g. Maekel, Debub & Gash-Barka regions) since 2009. -40 hectares of coastal are ready to be planted with	

	mangrove in both southern and northern Eritrean Red Sea.	
Target 16: By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.	-The National Focal Point and Competent Authority for the Nagoya Protocol have been designated in 2010. - Preparatory work has been started to document all relevant information pertaining policies, legislations for genetic resource use -Comprehensive inventory of genetic resources as well as acquisition of traditional knowledge is being undertaken	
Strategic Goal E: *Enhance implementation through participatory planning, knowledge management and capacity building*		
Target 17: By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.	-The drafting of the reviewed and updated NBSAP is in progress	
Target 18: By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.	-Integrated traditional knowledge associated with conservation of genetic resources and germplasm is being implemented -Efforts been done to consider the traditional knowledge and practices and are being promoted and recognized in fishing ground management and sustainable use of marine resources such as Snail nail collection.	
Target 19: By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied	-Annual National Biodiversity Days are being implemented -National Environmental Communication Strategy is being finalized -National Desertification Day (June 17) is being implemented. -Environmental Station (E-station) is developed since 2012. -National Greening Day (May 15) is being implemented since 2006. -Integrated Water Resources Management and Development Strategies and Plan in place -Summer Students Campaigns is being conducted since	

	1994 -Research finding and marine biodiversity references to be publicized in2014 and shared with relevant institutions -College of Marine Sciences and Technology curriculum developed with consultation of MoMR.	
Target 20: By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan 2011-2020 from all sources and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization should increase substantially from the current levels; This target will be subject to changes contingent to resources needs assessments to be developed and reported by Parties.	-IFS (Integrated Financial System) for Sustainable Land Management (SLM) are planned.	

Key levels of the achievments

Fully Achieved

Substatially Achieved

Achieved to a Limited Extend

Not Achieved

LESSONS LEARNED

In realizing the lessons learnt, it was evident that dynamics vary at global, regional, country and even at individual levels and were looked according at their political, economic, social and environmental perspectives that required a coherent and integrated approach. In the process of implementing CBD obligations, the country has learnt a number of lessons. Some of these lessons include:

- Effective implementation of the convention needs commitment and cooperation among ministries, and between central and local institutions.
- Integration, resource mobilization, networking, programme/project preparation and proper implementation are the drivers of biodiversity conservation and use.
- A single institution only can't follow up the implementation of the Biodiversity Conservation and sustainable use. There is no enough monitoring and reporting mechanism in place to measure the progress made in achieving targets of the planned priority activities in the NBSAP.
- Mainstreaming the biological diversity issues to the national development frameworks and sector policies and program through a continuous consultation and provision of sensitization and awareness activities is critical for effective implementation of the convention in the country.
- Inadequate communication and platform between and among key ministries and stakeholders on biodiversity-related information resulted delayed on timely reporting of the CBD National Report. Inadequate reliable data and information limits the understanding on status and trends of biodiversity of the country
- The report should reflect national status of biodiversity thus enough time and resources need to be allocated on time.
- Promotion of alternative livelihood activities including alternative source of energy can greatly enhance protection of biodiversity and ecosystem processes by reducing harvesting on natural forest.
- CBDobjectives can only be achieved through a balanced and harmonious collaboration of partners and stakeholders at all levels and hence play in facilitating the removal of the structural, institutional, technical and financial weaknesses to attain collective and sustainable development.
- There is huge fertile area in which one can build capacity at local and grass-root levels for users or community-led planning, implementation and monitoring functions.

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Annex I: Information concerning the reporting party and preparation of the fifth National report

A1. REPORTING PARTY

Contracting Party	The State of Eritrea
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Name of the reporting Institution	Department of Environment, Ministry of Land, Water & Environment
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Signature of the officer responsible for submitting the national report	
Date of submission	August, 2014

A2. THE FIFTH NATIONAL REPORT PREPARATION PROCESS

The Fifth National Report on the Implementation of the Convention on Biological Diversity was initiated with the preparation of situational analysis and rapid field assessment made in collaboration with all concerned stakeholders. Relevant ministries assigned their expertise with the formation of the National Technical Committees under the auspices of the Department of Environment, Ministry of Land, Water and Environment. The process was coordinated by the Department of Environment assisted by a senior consultant and involved key partners in a participatory manner at all levels.

The MoLWE/DoE is working closely with Government and concerned stakeholders in meeting the national and international biodiversity objectives. This CBD 5th report is also seen as one of its regular achievements. The preparation process was developed through multi-stakeholder participatory approach representing key Government Ministries and Zonal administrations. A series of formal and informal meetings and workshops were held to look for views of all stakeholders. Practical and participatory systems that enable the process to do their work effectively were put in place. In preparing this report a number of activities ranging from gap analysis, programming, logistical arrangements, monitoring, review and the overall biodiversity aims and targets were discussed.

A number of workshops were organized so that stakeholders can provide inputs on key issues related to their areas of competence while taking into consideration Guidelines for Preparation of the Fifth National Report. These workshops served not only as a platform for consultation and validation, but also offered an opportunity for sensitization of broader partners to ultimately obtain the required feedbacks and reach to an updated NBSAP.

As listed in the reference of this 5^{th} CBD report, the partners were equipped with sufficient hard and soft copies to enable them acquire basic information and prepare the final report as required.

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SN	Name	Institution/Position	Email
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Annex III: List of Tables for Terrestrial Biodiversity

Table 3.1: A list of endangered/rare plant species found in Semienawi and Debubawi Bahri based on number of species, family name and growth form.

S.N	Family name	Species name	Growth form
1	Moraceae	*Ficus sycomorus*	Tree
2	Moraceae	*Ficus vasta*	Tree
3	Anacardiaceae	*Lannea fruticosa*	Tree
4	Papilionaceae	*Lonchocarpus bussei*	Tree
5	Capparidaceae	*Maerua angolensis*	Shrub/Tree
6	Capparidaceae	*Maerua crassifolia*	Shrub/Tree
7	Capparidaceae	*Maerua oblongifolia*	Shrub
8	Myrsinaceae	*Maesa lanceolata*	Shrub/Tree
9	Sapotaceae	*Mimusop kummel*	Tree
10	Sapotaceae	*Mimusops schimperi*	Tree
11	Loganiaceae	*Nuxia congesta*	Shrub/Tree
12	Flacourtiaceae	*Oncoba spinosa*	Shrub/Tree
13	Anacardiaceae	*Ozoroa insignis*	Shrub/Tree
14	Rubiaceae	*Plectronia bogosensia*	Shrub
15	Rubiaceae	*Psydrax schimperiana*	Shrub/Tree
16	Anacardiaceae	*Rhus abyssinica*	Shrub/Tree
17	Anacardiaceae	*Rhus natalensis*	Shrub/Tree
18	Anacardiaceae	*Rhus retinorrhoea*	Shrub/Tree
19	Anacardiaceae	*Rhus vulgaris*	Shrub/Tree
20	Polygalaceae	*Securidaca longepedunculata*	Tree
21	Myrtaceae	*Syzygium guineense*	Tree
22	Caesalpinioideae	*Tamarindus indica*	Tree
23	Olacaceae	*Ximenia americana*	Shrub/Tree

Source: Proposed Protected Area Biophysical Assessment Report (DoE, 2013)

Table 3.2: Number of the major wild woody plant species found in the dense and disturbed forest of Semenawi and Debubawi Bahri

Family	Number of Species	Family	Number of Species
Anacardiaceae	6	Myricaceae	1
Apocynaceae	2	Myrsinaceae	1
Araliaceae	1	Myrtaceae	1
Asclepiadacea	1	Olacaceae	1
Balanitaceae	1	Oleaceae	2
Barbeyaceae	1	Pacifloraceae	1
Bignoniaceae	2	Arecaeae	1
Bombacaceae	2	Fabaceae	4
Boraginaceae	6	Phytolaccaceae	1
Burseraceae	1	Polygalaceae	1
Cactaceae	2	Polygonaceae	2
Caesalpinioideae	3	Ranunculaceae	1
Capparidaceae	10	Rhamnaceae	6
Caesalpinaceae	3	Rubiaceae	2
Cobretaceae	1	Rosaceae	2
Combretaceae	6	Rutaceae	1
Asteraceae	1	Solanaceae	3
Cupressaceae	1	Salvadoraceae	2
Ebenaceae	3	Santalaceae	1
Euphorbiaceae	8	Sapindaceae	2
Flacourtiaceae	2	Sapotaceae	2
Lamiaceae	3	Sterculiaceae	3
Loganiaceae	3	Tamaricaceae	1
Malvaceae	1	Tiliaceae	5
Meliaceae	1	Ulmaceae	1
Melianthaceae	1	Apiaceae	2
Mimosaceae	11	Verbenaceae	2
Moraceae	2		
TOTAL		**55**	**137**

Source: Bein *et al*, 2006; and Proposed Protected Area Biophysical Assessment Report (DoE, 2013).

Table 3.3: Mammalian species found in the dense and disturbed forest of Semienawi and Debubawi Bahri

Family	**Species Scientific Name**	**Common Name**
Cercopithecidae	*Papio hamadryas*	Hamadryas Baboon
Cercopithecidae	*Cercopithecus aethiops*	Grivet Monkey
Canidae	*Canis aureus*	Common Jackal
Canidae	*Canis mesomelas*	Black-backed Jackal
Herpestidae	*Herpestes ichneumon*	Egyptian Mongoose
Hyaenidae	*Hyaena hyaena*	Striped Hyena
Hyaenidae	*Crocuta crocuta*	Spotted Hyena
Viverridae	*Genetta genetta*	Common Genet
Viverridae	*Genetta abyssinica*	Ethiopian Genet
Felidae	*Felis serval*	Serval cat
Felidae	*Felis caracal*	Caracal
Felidae	*Felis pardus*	Leopard
Procaviidae	*Procavia capensis*	Ethiopian Rock Hyrax
Suidae	*Potamochoerus percus*	Bush Pig
Suidae	*Phacochoerus aethiopicus*	Warthog
Bovidae	*Tragelaphus scriptus*	Bushbuck
Bovidae	*Tragelaphus strepsiceros*	Greater Kudu
Bovidae	*Sylvicapra grimmia*	Common Duiker
Bovidae	*Oreotragus oreotragus*	Klipspringer
Bovidae	*Madoqua saltiana*	Salt Dikdik

Source: Bein *et al*, 2006; and Proposed Protected Area Biophysical Assessment Report (DoE, 2013).

Table 3.4: Major mammalian species found in the riverine forest of western lowlands

No.	**Family**	**Scientific Name**	**Common Name**
1	Orycteropodidae	*Orycteropus afer*	Aardvark
2	Lepordae	*Lepus habessinicus*	Abyssinian Hare
3	Felidae	*Felis silvestris lybica*	African wildcat
4	Canidae	*Canis mesomelas*	Black backed Jackal
5	Muridae	*Gerbilluscus nigricaudus*	Black-tailed Gerbil
6	Hystricidae	*Hystrix cristata*	Crested Porcupine
7	Bovidae	*Gazella dorcas*	Dorcas Gazelle
8	Suidae	*Phacochoerus africanus* ssp. *aeliani*	Eritrean Warthog
9	Canidae	*Fennecus zerda*	Fennec Fox
10	Canidae	*Canis aureus*	Golden Jackal
11	Erinaceidae	*Hemiechinus auritus*	Long-eared Hedgehog
12	Papiinae	*Papio cynocephalus*	Olive Baboon
13	Canidae	*Vulpes pallid*	Pale Sand Fox
14	Mellivorinae	*Mellivora capensis*	Ratal, or Honey Badger
15	Bovidae	*Madoqua saltiana*	Salt's Dik-dik
16	Felidae	*Felis (Leptailurus) serval*	Serval Cat
17	Bovidae	*Gazella soemmerringi*	Soemmerring's Gazelle
18	Hyaenidae	*Crocuta crocuta*	Spotted Hyaena
19	Sciuridae	*Euxerus erythropus*	Striped Ground Squirrel
20	Herpestinae	*Ichneumia albicauda*	White-tailed Mongoose

Source: 4th CBD National Report (2010), & Bisha Mining Ecological Assessments, 2013

Table 3.5: Number of the major wild woody plant species found in the woodlands of the western escarpments and western lowlands:

Family	Number of Species	Family	Number of Species
Anacardiaceae	2	Tamaricaceae	1
Asclepiadacea	1	Tiliaceae	2
Balanitaceae	1	Verbenaceae	1
Bignoniaceae	1	Sapindaceae	1
Bombacaceae	1	Celastraceae	1
Boraginaceae	1	Fabaceae	16
Burseraceae	2	Solanaceae	1
Caesalpinaceae	3	Lamiaceae	1
Capparidaceae	6	Cucurbitaceae (all are herbs)	1
Combretaceae	3	Lythraceae	1
Ebenaceae	1	Acanthaceae	1
Hernandiaceae	1	Malvaceae	3
Meliaceae	1	Zygophyllaceae	1
Mimosaceae	12	Acanthaceae	1
Arecaceae	1	Euphorbiaceae	2
Papilionoideae??	2	Vitaceae	1
Rhamnaceae	2	Olacaceae	1
Salvadoraceae	2		
TOTAL		**35**	**79**

Source: 4th CBD National Report (2010), & Bisha Mining Ecological Assessments, 2013

Table 3.6: Major mammalian species found in the woodland ecosystem

Family	**Scientific Name**	**Common Name**
Orycteropodidae	*Orycteropus afer*	Aardvark
Elephantidae	*Loxodonta Africana*	African Elephant
Lepordae	*Lepus habessinicus*	Abyssinian Hare
Felidae	*Felis silvestris lybica*	African wildcat
Canidae	*Canis mesomelas*	Black backed Jackal
Muridae	*Gerbilluscus nigricaudus*	Black-tailed Gerbil
Felidae	*Felis caracal*	Caracal
Hystricidae	*Hystrix cristata*	Crested Porcupine
Bovidae	*Gazella dorcas*	Dorcas Gazelle
Suidae	*Phacochoerus africanus* ssp. *aeliani*	Eritrean Warthog
Procaviidae	*Procavia capensis*	Ethiopian Rock Hyrax
Canidae	*Fennecus zerda*	Fennec Fox
Canidae	*Canis aureus*	Golden Jackal
Bovidae	*Tragelaphus strepsiceros*	Greater Kudu
Cercopithecidae	*Cercopithecus aethiops*	Grivet Monkey
Felidae	*Felis pardus*	Leopard
Erinaceidae	*Hemiechinus auritus*	Long-eared Hedgehog
Papiinae	*Papio cynocephalus*	Olive Baboon
Canidae	*Vulpes pallid*	Pale Sand Fox
Mellivorinae	*Mellivora capensis*	Ratal, or Honey Badger
Bovidae	*Madoqua saltiana*	Salt's Dik-dik
Felidae	*Felis (Leptailurus) serval*	Serval Cat
Bovidae	*Gazella soemmerringi*	Soemmerring's Gazelle
Hyaenidae	*Crocuta crocuta*	Spotted Hyaena
Hyaenidae	*Hyaena hyaena*	Striped Hyena
Sciuridae	*Euxerus erythropus*	Striped Ground Squirrel
Herpestinae	*Ichneumia albicauda*	White-tailed Mongoose

Source: 4th CBD National Report (2010), & Bisha Mining Ecological Assessments, 2013

Table 3.7: The major woody plant species found in the Buri-Peninsula Proposed Protected Area

Family	**Number of Species**	**Family**	**Number of Species**
Asclepiadacea	1	Chenopodiaceae	1
Balanitaceae	1	Mimosoideae	6
Boraginaceae	1	Palmae	1
Burseraceae	1	Rhamnaceae	1
Caesalpinioideae	1	Verbenaceae	2
Capparidaceae	2		
Total		11	18

Source: Proposed Protected Areas Biophysical Assessment Report (DoE, 2013)

Table 3.8: Mammalian species found in Buri-Irrori and Hawakil Islands Proposed Protected Area

Family	Scientific Name	Common Name
Bovidae	*Madoqua saltiana*	Salt Dikdik
Bovidae	*Nanger soemmerringi*	Soemmerring's gazelle
Bovidae	*Gazella dorcas*	Dorcas gazelle
Canidae	*Vulpes pallida*	Ruppll's sand fox
Canidae	*Canis aureus*	Common Jackal
Canidae	*Canis mesomelas*	Black-backed Jackal
Cercopithecidae	*Papio hamadryas*	Hamadryas Baboon
Equidae	*Equus aficanus*	African Wild ass
Felidae	*Felis serval*	Serval
Felidae	*Felis caracal*	Caracal
Felidae	*Felis sylvestris*	African wild cat
Hyaenidae	*Hyaena hyaena*	Striped hyena
Hyaenidae	*Crocuta crocuta*	Spotted hyena
Procaviidae	*Procavia capensis*	Ethiopian Rock Hyrax
Suidae	*Phacochoerus aethiopicus*	Warthog
Lepordae	*Lepus fagani*	Abyssinian hare

Source: Proposed Protected Areas Biophysical Assessment Report (DoE, 2013)

Table 3.9: Plant species (woody and none woody) found in the semi-desert area of the northern part of the coastal plains

Family	Number of Species	Family	Number of Species
Acanthaceae	1	Malvaceae	2
Aizoaceae	1	Mimosaceae	4
Amaranthaceae	2	Orobanchaceae	1
Asclepiadaceae	2	Papilionaceae	6
Asparagaceae	1	Plumbaginaceae	1
balanitaceae	1	Rhamnaceae	1
Boraginaceae	4	Rhizophoraceae	2
Burseraceae	1	Rubiaceae	1
Caesalpiniaceae	2	Salvadoraceae	2
Capparidaceae	4	Solanaceae	2
Chenopodiaceae	6	Tamaricaceae	1
Compositae	1	Verbenaceae	1
Cruciferae	1	Vitaceae	1
Euphorbiaceae	4	Zygophyllaceae	3
Cyperaceae	3	Typhaceae	1
Gramineae	23	-	-
Total		31	86

Source: Proposed Protected Areas Biophysical Assessment Report (DoE, 2013)

Annex IV: List of Tables for Coastal, Marine and Island Biodiversity

Table 4.1**:** The marine birds recorded in this survey with the movement status and their account along the Red Sea. ECMIB Bird Team Unpublished Report, 2008)

Sr.no.	COMMON NAME	SCIENTIFIC NAME	ACCOUNT	Movement status
1.	Red-billed Tropicbird	*Phaethon athereus*	Frequent	Resident
2.	Lesser frigate bird	*Fregata ariel*	Vagrant	Migrant
3.	Brown Booby	*Sula leucogaster*	Common	Resident
4.	Masked booby	*Sula dactylatra*	Rare	Resident
5.	Pink Backed Pelican	*Pelecanus rufescens*	Common	Resident
6.	Greater White Pelican	*Pelecanus onocrotalus*	Rare	Resident
7.	White-breasted Cormorant	*Phalacrocorax lucidus*	Vagrant	Migrant
8.	Socotra cormorant	*Phalacrocorax nigrogularis*	Frequent	Migrant
9.	Lesser Black-backed gull	*Larus fuscu*s	Common	Migrant
10.	Sooty gull	*Larus hemprichii*	Abundant	Resident
11.	White-eyed gull	*Larus leucophthalmus*	Common	Resident
12.	Black-headed gull	*Larus ridibndus*	Frequent	Migrant
13.	Slender-billed gull	*Larus genei*	Frequent	Migrant
14.	Richardson's Skua	*Stercorarius parasiticus*	Vagrant	Migrant
15.	Lesser-Crested Tern	*Sterna bengalensis*	Abundant	Resident
16.	Greater Crested Tern	*Sterna bergii*	Common	Resident
17.	Caspian Tern	*Sterna caspia*	Frequent	Resident
18.	Gull-billed Tern	*Sterna nilotica*	Frequent	Resident
19.	Common Tern	*Sterna hirundu*	Abundant	Migrant
20.	White-Cheeked Tern	*Sterna repressa*	Abundant	Resident
21.	Bridled Tern	*Sterna anaethetus*	Abundant	Resident
22.	Little Tern	*Sterna albifrons*	Frequent	Resident
23.	Saunders` Tern	*Sterna saundersi*	common	Resident
24.	White-winged Tern	*Chlidonias leucopterus*	Frequent	Resident
25.	Brown Noddy	*Anous stolidus*	Frequent	Resident
26.	African Skimmer	*Rynchops flavirostris*	Rare	Migrant
27.	Osprey	*Pandion haliaetus*	Common	Resident
28.	Sooty Falcon	*Falco concolor*	Common	Resident
29.	Eurasian spoonbill	*Platalea leucorodi*	Common	Resident
30.	African spoonbill	*platalea alba*	Rare	Resident
31.	Sacred Ibis	*Threskiornis aethiopicus*	Common	Resident
32.	Western-reef Heron	*Egretta gularis*	Common	Resident
33.	Little Egret	*Egretta garze*tta	Frequent	Resident
34.	Goliath Heron	*Ardea goliath*	Frequent	Resident
35.	Purple Heron	*Ardea purpurea*	Frequent	Resident
36.	Grey Heron	*Ardea cinerea*	Frequent	Resident
37.	Black-headed Heron	*Ardea melanocep*hala	Uncommon	Resident
38.	Squaco Heron	*Ardoela ralloides*	Frequent	Resident
39.	Red Sea Green-backed Heron	*Butorides striatus*	Common	Resident
40.	Abdim`s Stork	*Ciconia abdimii*	Frequent	Migrant
41.	Greater Flamingos	*Phoenicopterus ruber roseus*	Common	Migrant
42.	Lesser Flamingos	*Phoenicopterus minor*	Uncommon	Migrant

43.	Egyptian Goose	*Alopochen aegyptiaca*	Uncommon	Migrant
44.	Northern Shoveller	*Anas clypeata*	Frequent	Migrant
45.	Blue-winged Teal	*Anas discors*	Rare, perhaps first record	Migrant
46.	Crab-plover	*Dromas ardeola*	Abundant	Resident
47.	Eurasian oystercatcher	*Haematopus ostralegus*	Frequent	Migrant
48.	Pied Avocet	*Recurvirostra avosetta*	Frequent	Migrant
49.	Black-winged Stilt	*Himantopus himantopus*	Frequent	Migrant
50.	Kittlitz`s Plover	*Charadrius pecuarius*	Frequent	Migrant
51.	White-fronted Plover	*Charadrius marginatus*	Frequent	Migrant
52.	Common Ringed Plover	*Charadrius hiaticula*	Common	Migrant
53.	Little Ringed Plover	*Charadrius dubius*	Frequent	Migrant
54.	Kentish Plover	*Charadrius alexandrinus*	Common	Resident
55.	Mongolian Sandplover	*Charadrius mongolus*	Frequent	Migrant
56.	Greater Sandplover	*Charadrius leschenaultii*	Common	Migrant
57.	Caspian Plover	*Charadrius asiaticus*	Frequent	Migrant
58.	Grey Plover	*Pluvialis squatarola*	Common	Migrant
59.	Common Sandpiper	*Actis hypoleucos*	Common	Migrant
60.	Terek Sandpiper	*Xenus cinereus*	Frequent	Migrant
61.	Common Greenshank	*Tringa nebularia*	Common	Migrant
62.	Marsh Sandpiper	*Tringa stagnatilis*	Frequent	Migrant
63.	Spotted Redshank	*Tringa erythropus*	Uncommon	Migrant
64.	Common Redshank	*Tringa tetanus*	Common	Migrant
65.	Broad-billed Sandpiper	*Limicola falcinellus*	Frequent	Migrant
66.	Little Stint	*Calidris minuta*	Frequent	Migrant
67.	Sandreling	*Calidris alba*	Frequent	Migrant
68.	Curlew Sandpiper	*Calidris ferrugniea*	Common	Migrant
69.	Dunlin	*Calidris alpina*	Abundant	Migrant
70.	Ruddy Turnstone	*Arenaria interpres*	Abundant	Migrant
71.	Black-tailed Godwit	*Limosa limosa*	Frequent	Migrant
72.	Bar-tailed Godwit	*Limosa napponica*	Common	Migrant
73.	Whimbrel	*Numenius phaeopus*	Frequent	Migrant
74.	Eurasian Curlew	*Numenius arquata*	Common	Migrant

Table 4.2: Common and local (Afar) names and IUCN Category of Sea turtles in Eritrea (ECMIB Sea turtle Unpub. Report, 2008)

Common name	***Scientific***	***Local (Afar) name***	***IUCN Category***
Green	*Chelonia mydas*	Bisa'e/ Tuhu	Endangered
Hawksbill	*Eretmochelys imbricata*	Lida'e	Critically endangered
Olive Ridley	*Lepidochelys olivacea*	Zahlefa	Endangered
Loggerhead	*Caretta caretta*	Girfa / Sugur	Endangered
Leatherback	*Dermochelys coriacea*	Nea'ma	Critically endangered

Table 4.3: Muddy/Mangrove areas Invertebrate species found around Massawa coast (Marine Resources Research Division baseline survey for EIA, 2013)

Class	**Family**	**Genus**	**Species**	**Common name**
Bivalvia	Arcidae	Barbatia		
Bivalvia	Spondylidae	Spondylus	gloriandus	
Echinoidae	Diadematidae	Echinothrix	diadema	Diadema
fan worms				
Gasgtropoda	Olividoae	Oliva	bulbobsa	Olives
Gastropoda	Melongenidae	volema	pyrum	
Gastropoda	Nassaridae	Nassarius		
Gastropoda	Strombidae	Strombus	tricornis	
Gastropoda	Trochidae	tectus	dentatus	
Gastropoda	Muricidae	Chicoreus	ramosus	
Gastropods	Potamididae	Terebralia	Palustris	Horn shells
Gastropods	Nassaridae	Nassarius	Castus	
Gastropods	Planaxidae	Planaxis	Sulcatus	
Gastropods	Muricidae	morula	granulata	
Gastropods	Nassaridae	Nassarius	Castus	
Holothuroidea	Synaptidea	Synapta	maculata	spotted sea cucumber
Malacostraca	Ocypodidae	Uca Sp.		Fiddler crab
Malacostraca	hermit crab			
Malacostraca	Portunidae	scylla	serrata	mangrove crab
Malacostraca	Portunidae	Portunas	pelagicus	
Malacostraca	Portunidae	scylla	serrata	
Malacostraca	Ocypodidae	Uca Sp.		Fiddler crab
Malacostraca				lobster juvenile
Malacostraca	Ocypodidae	Ocypod Sp.		ghost crab
Malacostraca				burrowing crabs
				Marine worms
Scyphozoa	Cassiopeidae	Cassiopeia	andromeda	upside down jelly
				Sponges
				sea ants
				Holes

Table 4.4: Sandy shore invertebrate species around Massawa coast (Marine Resources Research Division baseline survey for EIA, 2013)

Class	Family	Genus	Species	Common name
Asteroidea				cushion star fish
Bivalvia	Pteriidae	pinctada	radiata	
Bivalvia				juvenile bivalve
Bivalvia	Tridacnidae	tridacna Sp		giant clam
Bivalvia	Modiolinae	Modiolus Sp.		
Bivalvia	Pinnoidea(F^2)	Atrina	vexillum	
Bivalvia	Spondylidae	Spondylus	gloriandus	
Bivalvia	Malleidae	Malvufundus	normalis	
Echinoidae			sand dollar	
Echinoidae	Diadematidae	Echinothrix	diadema	Diadema
Echinoidea				sand dollar with long crak
Gastropoda	Muricidae	Morula	granulata	
Gastropoda	Muricidae	Chicoreus	ramosus	
Gastropoda	Melongenidae	volema	pyrum	
Gastropoda	Terebridae	Terebra Sp.		
Gastropoda	Strombidae	Strombus	tricornis	
Gastropoda	Strombidae	Strombus	luhuanus	
Gastropoda	Strombidae	Strombus	gibberulus	
Gastropoda	Conidae	Conus Sp.		
Gastropoda	Planaxidae	Planaxis	Sulcatus	
Gastropods	Olividae	oliva	bulbosa	
Gastropods	Cypraeidae	Cypraea	staphylaea	Cowries
Gastropods	Trochidae	Tectus	Dentatus	
Gastropods	Strombidae	Strombus	fasciatus	
Gastropods	Strombidae	Strombus Sp.		
Gastropods	Fasciolariidae	Pleuroploca	trapezium	
Holothuroidea	Synaptidea	Synapta	maculata	spotted sea cuccumber
Malacostraca			hermit crab	
Malacostraca	Portunidae	scylla	serrata	
Malacostraca	Portunidae	Portunas	pelagicus	
Malacostraca	Ocypodidae	Ocypod Sp.		ghost crab
Malacostraca	small burrowing crab			
Malacostraca	Ocypodidae	Uca sp.		Fiddler crab
Malacostraca				lobster juvenile
Malacostraca	Ligiidae	ligia	exotica	exotic shore slater
Ophiuroidea				brittle star
Polyplacophora	Chitonidae	Acanthopleura	vaillantii	
Scyphozoa	Cassiopeidae	Cassiopeia	andromeda	upside down jelly

Table 4.5: Rocky shore area invertebrate species around Massawa coast ((MRRD, 2013)

Class	Family	Genus	Species	Common name
Bivalvia	Modiolinae	Modiolus Sp.		
Bivalvia	Arcidae	Barbatia		
Echinoidae	Diadematidae	Echinothrix	diadema	Diadema
Echinoidea	Echinometridae	Echinometra	mathaei	Mathae's sea urchin
Gastropoda	Potamididae	Potamides	conicus	
Gastropoda	Muricidae	Morula	granulata	
Gastropods	Melongenidae	Volema	pyrum	
Gastropods	Neritidae	nerita	textilis	
Gastropods	Potamididae	Potamides	Conicus	
Gastropods	Nassaridae	Nassarius	Castus	
Gastropods	Strombidae	Strombus	tricornis	
Gastropods	Cypraeidae	Cypraea	arabica	
Gastropods	Conidae	conus Sp.		
Gastropods	Trochidae	Tectus	Dentatus	
Gastropods	Neritidae	nerita	deblis	
Gastropods	Cypraeidae	Cypraea	turdus winckworthi	Cowries
Gastropods	Buccinidae	Engina	mendicaria	
Gastropods	Buccinidae	Engina	mendicaria	
Malacostraca	Portunidae	scylla	serrata	mangrove crab
Malacostraca				hermit crab
Malacostraca				lobster juvenile
Malacostraca				mangrove crab
Malacostraca	Ligiidae	ligia	exotica	exotic shore slater
Malacostraca				white&black dots crab(mang. Crab)
Malacostraca			black mangrove crab	
Malacostraca				red mud crab
Ophiuroidea	Ophiotrihidae	ophiothrix	spiculata	spiculate b.star
Polyplacophora	Chitonidae	Acanthopleura	vaillantii	
				tube worms
				tube worms
				holes
Holothuroidea	holothuriidae	Holuthuria	atra	
Holothuroidea	holothuriidae	Holuthuria	scabra	

Table 4.6: Abundance of identified species of invertebrates incidentally caught by bottom trawlers from their family to genus and for some to their species level

GASTROPODS	**GENUS**	**GENUS-SPECIES**
FAMILY		
NATICIDAE	*Natica*	*Natica onca*
MURICIDAE	*Murex*	
MURICIDAE	*Murex*	*Murex cf. tribulus*
MURICIDAE	*Vokesimurerex*	*Vokesimurerex elenensis*
STROMBIDAE	*Tibia*	*Tibia curta*
STROMBIDAE	*Strombus*	*Strombus gibberulus*
STROMBIDAE	*Tibia*	*Tibi insulaechorab*
XENOPHORIDAE	*Xenophora (stellaria)*	*Xenophora (stellaria) salaris*
NASSARIDAE	*Nassarius*	*Nassarius sp.*
CARDITIDAE	*Laevicardium(fulvia)*	*papygraceum*
FICIDAE	*Ficus*	*Ficus Subintermedia*
CASSIDAE	*Semicassis*	*Semicassis fauratis*
CONIDAE	*Conus*	*Conus incriptus*
TONNIDAE	*Malea*	
BIVALVES		
ARCIDAE	*Arca*	*Arca ventricosa*
VENERIDAE	*Tapes*	*Tapes sulcurius*
CEPHALOPODS		
SEPIIDAE	*sepia*	*Sepia pharaonis*
LIGONIDAE	*Loligo*	*Loligo duvauseli*
OMMASTREPHIDAE		
OCTOPODIDAE		
SEPIIDAE	*Sepia*	*Sepia sp.*
OCTOPODIDAE	*Octopus*	*octopus sp.*
ECHINODERMS		
LAGANIDAE	*Lagunum*	*Lagunum depressum*
HOLOTHURIIDAE	*Bahadschia*	
HOLOTHURIIDAE	*Halothuria*	*Halothuria scabra*
ASTROPECTINIDAE	*Astropecten*	
Starfish unidentified	*arms with blue lines*	
SAND DOLLAR	*GREEN COLOR*	
CNIDERIANS (JELLY		
ULMARIDAE	*Aurelia*	*Aurelia aurita*
CRUSTACEANS		
PORTUNIDAE	*portunus*	*Portunus pelagicus*
DROMIIDAE	*Dromia*	*Dromia dehani*
PENAEIDAE	*Penaeus*	*Penaeus indicus*
PENAEIDAE	*Metapenaeus*	*Metapenaeus monoceros*
HARPOSQUILLIDAE	*Harpiosquilla*	*Harpiosquilla harpax*
SCYLLARIDAE	*Thenus*	*Thenus orientalis*
PANULIRuDAE	*Panulirus*	*Panulirus versicolor*

Annex V: List of Tables for Agro-biodiversity

Table 5.1: Trees and shrubs important for agriculture

S/N	Species	Common Name	status	Uses
1.	*Acacia albida*	*Apple ring acacia*	*vulnerable*	*Live fence, soil fertility amelioration*
2.	*Acacia nilotica*	*Egyptian mimosa*	*Very vulnerable*	*Live fence, tanning*
3.	*Acacia polyacantha*	*Falcon's clow*	*Gomero*	*Dysentery,gastric ulcer (bark)*
4.	*Acacia Senegal*	*Gum Arabic tree*		*Live fence, wind break, gum Arabic, soil ameloration*
5.	*Adansonia digitata*	*Baobab*	*Critically endangered*	*Providing shelter, food and fibers*
6.	*Agave sisilana*	*Sisal*		*Bee forage, live fence, fibber*
7.	*Albizziaanthelmintica*	*Worm cur albizia*		*used as anthelmintic (Bark powder)*
8.	*Aloe vera*	*Aloe*		*Sprain (root)*
9.	*Balanitesaegyptiaca*	*Desert date*	*vulnerable*	*Food, treatment of malaria (leaves)*
10.	*Boscia senegalensis*	*Boscia*		*Food, medicine (Cough, head pustules (leaves)*
11.	*Bosciaangustifolia*	*Boscia*	*Endangered*	*Swellings (bark)*
12.	*Buddleia polystachya*	*Buddleia*		*Antihelmentica (leaves & florescence)*
13.	*Cadaba farinose*	*Cadaba*		*Food (young shoots),Medicine (leaves, roots, ash*
14.	*Cajanuscajan*	*Pegeon pea*		*Soil fertility amelioration, food*
15.	*Calotropisprocera*	*Dead Sea fruit*		*Warts, swellings, inflammatory wounds (Milky exudates)*
16.	*Caralluma ango*	*Caralluma*		*Stems are eaten row*
17.	*Carica papaya*	*papaya*		*Its fruit as a Food, medicines*
18.	*Casuarinacunninghamiana*	*beefwood*		*Wind-break, soil fertility amelioration*
19.	*Colutea abyssinica*		*Critically endangered*	
20.	*Cordiaafricana*	*mukomari*	*vulnerable*	*Food(fruit)medicine (bark, roots) fodder leaves bee forage (flower)*
21.	*Crolotariagrhamiana*	*Lion's claw*		*Soil fertility amelioration*
22.	*Desmanthusfruiticosus*	*Desmanthus*		*Soil fertility amelioration, fodder*
23.	*Diospyrosmespiliformis*	*Africal ebony*	*Critically endangered*	*Food (fruit) carvings (timber), medicine*
24.	*Dovialiscaffra*	*Kei apple*		*Live fence, food, bee forage*
25.	*Eucalyptus globules*	*Fever tree*		*Cough (leaves)*
26.	*Flueggiavirosa*	*Flueggia*	*Critically endangered*	*Sprain, rabbis (roots, young twigs)*
27.	*Gliricidiasepium*	*Gliricidia*		*Fodder, soil fertility amelioration,*
28.	*Grewia flavescens*	*Grewia*		*Stomach disorders (roots)*
29.	*Hyphaen ethebaica*	*doum palm*	*vulnerable*	*Food, fiber,*
30.	*Lawsonia inermis*	*henna*	*vulnerable*	*Lawsone "Dye", perfume,*

S/N	Species	Common Name	status	Uses
				fodder,
31.	*Leucaenaleucocephala*	*Leucaena*		*Fodder, soil fertility amelioration*
32.	*Meriandra bengalensis*	*Meriandra*		*Boiled leaves used to treat cold & stomach ache*
33.	*Mimusops kummel*	*Schimper's bullet tree*	*Critically endangered*	*Food (fruit), smoke bath (wood)*
34.	*Moringaoleifera*	*Cabbage tree*		*Food,*
35.	*Opuntiaficus-indica*	*Prickly pear*		*Food (fruit) bee forage (flower) fodder (young stem)*
36.	*Osidiumguajava*	*Guava*		*Food*
37.	*Ostegiaintegrifolia*	*Ostegia*	*vulnerable*	*Insecticide (whole part)*
38.	*Oxytenanthera abyssinica*	*Lowland bamboo*	*Critically endangered*	*Fodder, walking stick, fence*
39.	*Sclerocaryabirrea*	*Sclerocarya*	*Critically endangered*	*Food , drink (fruit) fodder , bee forage (leaves, fruit)*
40.	*Senna alexandriana*	*Alexandrian senna*	*Critically endangered*	*Stomach purgative*
41.	*Sesbaniasesban*	*Sesbania*	*Critically endangered*	*Fodder, soil fertility amelioration*
42.	*Syzygiumguineense*	*Guinea syzygium*	*Critically endangered*	*Food , carvings*
43.	*Tamarindusindica*	*Indian date*	*Critically endangered*	*Food (fruit pulp), fodder (leaves) medicine (bark, leaves, fruit, root)*
44.	*Tephrosiavogolii*	*Tephrosi*		*Fodder, soil fertility amelioration*
45.	*Terminalia brownii*	*Brown'smyrobalan*		*Cure jaundice & other liver mal functioning (bark) dye clothes*
46.	*Tithonia diversifolia*	*Tithonia*		*Soil fertility improvement*
47.	*Vangueriamadagascariensis*	*vangueria*	*Critically endangered*	*Food (fruit) support for grapes (branches)*
48.	*XimeniaAmericana*	*Hog plum*	*Critically endangered*	*Food, farm tools, Anti-vomit,leech, corneal opacity*
49.	*Ziziphusspina-christi*	*Ziziphus*		*Food (fruit) fodder (leaves, fruit) live fence, medicine*

Table 5.2: Estimated Cattles population, nationwide (MoA, 2013).

Livestock type	Livestock Population	
	2011	2012
Cattle extensive –Traditional	2,215,562	2,237,718
Cattle intensive -Pure & cross breeds	16,506	17,735
Cattle Intensive – Local	13,482	14,582
TOTAL	2,245,637	2,270,035