



Projection of the impacts of Climate Change on Water Ecosystem and biodiversity

- Projection is based of RICCAR results
- Projection is based on published literature
- It aims at providing trainers with a qualitative and, whenever possible quantitative, examples highlighting the impacts of CC on water ecosystem and biodiversity.
- Trainers would implement similar approach to assess the CC impacts, at national and local levels.





Variations of Temperature

General predicted Ecosystem and Biodiversity Impacts

- Changes in growth, reproduction, and distribution of lake and stream biodiversity
- Temperature increases could influence the quality of surface water in terms of dissolved oxygen, stratification, mixing ratio, self-purification and biological content and growth especially algal bloom, bacterial content and fungal levels.
- Rapid warming, and higher organic inputs affect marine and lake productivity, while combined impacts of wildfire and insect outbreaks decrease water ecosystems productivity
- Accelerated losses of nutrients from terrestrial ecosystems to receiving waters
- For lakes higher temperature are likely to lead to higher primary productivity with more intense algal blooms, stronger and longer periods of summer stratification with greater oxygen depletion in the hypolimnion and increased release of phosphorus from sediments



Variations of Temperature

General predicted Ecosystem and Biodiversity Impacts

- An increasing number of ecosystems, including areas of high biodiversity, are likely to be further disrupted by a temperature rise of 2°C or more above pre-industrial levels
- Introduction of invasive alien species are another threat to biodiversity and native fauna and flora. Alien species are species, sub-species, or lower tax on occurring outside of their natural range and dispersal potential.
- Under warmer seasons, freshwater phytoplankton and zooplankton blooms are also appearing earlier. Other terrestrial animals and plants are moving uphill as their habitats warm. Since the migration rate of many species is insufficient to keep pace with the speed of climate change, they could be pushed towards extinction in the future
- Roughly, 10 per cent of species will face an increasingly high risk of extinction for every 1°C rise in global mean surface temperature (up to an increase of about 5°C).





Variations of Temperature

General predicted Ecosystem and Biodiversity Impacts

-In regions where climatic change may lead to warmer and drier conditions, mountain vegetation could suffer more because of increased evapotranspiration. This is most likely to occur in mountain climates under the influence of continental and Mediterranean regimes. Below 2400 m, the juniper trees are either dead or in very poor condition and regeneration is virtually absent

-Shifts in species ranges are so extensive that by 2100 they may alter biome(broad bio geographical regions defined by climate, vegetation structure and eco physiology) composition of watershed area.





Variations of Temperature

Examples of Hot Spots in Arab region

- Most significant impacts for biodiversity include loss of coastal zones due to sea level rise, sea water temperature rise, droughts and desertification, increased water scarcity and ground water salinity.
- Some projections of climate change impacts suggest reduced rainfall (0-20 percent) coupled with higher temperatures, which would decrease water flows in the Euphrates and Jordan rivers, affecting agriculture in Fertile Crescent lands (Iraq, Syria, Lebanon, Jordan and the Occupied Palestinian Territories).
- The major climate change impacts on wetlands in the region are the decrease of the level of waters and drying of several wetlands which are already under drought stress (e.g. Ammik site in Lebanon, Jabboule site in Syria), the reduction of the fresh waters biodiversity in sites, the elimination of migratory species and the reduction of income of people who are dependent.





Variations of Temperature

Examples of Hot Spots in Arab Region

-*Juniperus excelsa*, subsp, *polycarpos* in open woodland in the central range of the Western Hajar Mountains in Oman. This species is present from 2100 m to the summit at 3000 m. The juniper woodlands of Oman are unique to the Arabian Peninsula. Juniper would be one of the most threaten species if temperature increased up.





Variations of Temperature

Examples of Hot Spots in Arab Region

-IUCN has classified 551 species of invasive species ranging from plankton to red palm weevil, cacti species, water hyacinth and numerous fish . Among these species, 36 percent are classified as aliens.

-Increased temperatures and the associated sea- level rise will result in seawater intrusion into some coastal areas in the Arab region. This will lead to a number of socio-economic impacts in the Nile Delta region in Egypt, and the inundation of some parts of the Bahraini coast. The archipelago of Bahrain has a limited area of about 745 km², and with sea-level rise, it is estimated that an area of 36–70 km², the equivalent of 5–10 per cent of the total area of the Kingdom will be covered with seawater





Dry Spell

General predicted Ecosystem and Biodiversity Impacts

- Land degradation and desertification will exacerbate habitat loss, including degradation and fragmentation, is the most important cause of biodiversity loss globally.
- Natural habitats in most parts of the world continue to decline in extent and integrity, although there has been significant progress to reduce this trend in some regions and habitats.
- Reducing the rate of habitat loss, and eventually halting it, is essential to protect biodiversity and to maintain the ecosystem services vital to human wellbeing.
- Changes in the reproduction of migratory birds that depend on lakes and streams for their breeding cycle



Dry Spell

Examples of Hot Spots in Arab Region

- Forest area in the West Asian region is less than one per cent of total land cover, the region being a -largely -arid area of sparse vegetation.
- Forest loss in West Asia has increased over the recent decade, with a jump in the deforestation from 2011 to 2012.
- From 2001-2013, cumulative tree cover loss increased from 0.44 per cent to 5.71 per cent compared to forest cover in 2000.
- High rates of forest loss were seen in 2012 (2.14 per cent) and 2007 (0.7 per cent), while 2003 and 2004 had the lowest proportion of deforestation (0.1 per cent each).



Dry Spell

Examples of Hot Spots in Arab Region

- Natural ecosystems especially at risk include the coastal mountain ranges of the Red Sea, the cedar forests of Lebanon and Syria, marshes in Iraq, the mountain ranges in Yemen and Oman and all the major river systems.
- This would include ,as well, the protected area of wadi Al-Ghaf is located south of the West Bank, Palestinian Authority territories along the Taweel Valley near Al-Khalil city, and covers around 1,000 hectares.
- Wadi Al-Ghaf protects many species including a species of bat that resides in the Safa Caves and attracts many visitors. The area is also rich in freshwater and local communities rely on it for agriculture.
- The site hosts a wealth of wildlife including wolf, hyena, deer, porcupine, fox and hedgehog, while the rich vegetation covers and preserves the soil and humidity. There are over 45 kinds of plants and trees in the area, including oak trees, pine trees, maple trees, and sagebrush



Dry Spell

Examples of Hot Spots in Arab Region

- Wadi Wurayah National Park in Fujairah covers an area of 200 km² of the Alhajar Mountain range, which shelters a rich diversity of rare and endangered habitats and species. One of the most striking features of the national park is its freshwater wetland area
- The Wadi Wurayah National Park protects natural and cultural values, and it contributes to the sustainable development of the country. The Park hosts a number of rare and endangered species, such as the Arabian Tahr, *Arabitragus jayakari*, which is listed as Endangered in the IUCN Red List of Threatened Species. Less than 2,000 of these wild goats survive and are all found only in the Hajar Mountains in Oman and Wadi Wurayah in U.A.E.
- The wetlands also shelter the *Garra barreimiae*, which is a regionally endemic fish, listed as Vulnerable by IUCN. In addition, 455 species of insects, ten species of spiders, one species of pseudo-scorpion and one species of woodlice have been recorded.



Variations of Precipitations

General predicted Ecosystem and Biodiversity Impacts

- Decreased flow in rivers and streams, causing a loss of ecosystem services.
- Changes in growth, reproduction, and distribution of lake and stream biodiversity
- Changes in community composition and food web structure caused by increased salinity
- Adverse impacts on submerged aquatic plant caused by changes in underwater light regime resulting from an increase in water turbidity caused by more intense precipitation and suspended sediments loads in summer.
- Changes in the reproduction of migratory birds that depend on lakes and streams for their breeding cycle
- At the regional and local scale, low precipitation conditions could induce forest fires, which change biomass stocks, alter the hydrological cycle with knock-on effects for marine systems such as coral reefs, reduce visibility to near zero, impact plant and animal species functioning and detrimentally impact the health and livelihoods of the human population



Variations of Precipitations

General predicted Ecosystem and Biodiversity Impacts

- The major impacts of human-induced, uncontrolled forest fires on biological diversity and forest ecosystem functioning, and their underlying causes.
- Elimination of migratory species wetland reduction of income of people who are dependent are the major indices of climate change impacts on wetlands in the region
- Apart from the effect on forest vegetation, fire can have a significant impact on forest vertebrates and invertebrates. The direct effect on forest fauna is detrimental.
- Indirect effects of fires are far reaching and longer term and include stress, loss of habitat, territories, shelter and food. Fires can also cause the displacement of territorial birds and mammals.
- The destruction of standing cavity trees as well as dead logs on the ground affects smallest mammal species and cavity-nesting birds



Variations of Precipitations

Examples of Hot Spots in Arab region

-Decrease of the level of waters and drying of several wetlands which are already under drought stress (e.g. Ammik site in Lebanon, Jabboule site in Syria), reduction of the fresh waters biodiversity in sites, elimination of migratory species in the site, reduction of income of people who are dependent are the major indices of climate change impacts on wetlands in the region.

-In changing precipitation, as for change in temperature, the natural ecosystems especially at risk include the coastal mountain ranges of the Red Sea, the cedar forests of Lebanon and Syria, mangroves in the ROPME Sea Area, reed marshes in Iraq, the mountain ranges in Yemen and Oman and all the major river systems .



Variations of Precipitations

Examples of Hot Spots in Arab region

- Reduced rainfall coupled with higher temperatures would decrease water flows in the Euphrates and Jordan rivers by 30 and 80 per cent, respectively, by the end of this century
- For both the Euphrates and the Tigris, it is expected that their discharge would decline at a rate of 30–50 per cent .
- 2-4 Celsius increase in average air temperature between 2000 and 2100 (RICCAR) might reduce runoff to the Al Wahda Dam (Morocco) by 10 per cent.





Variations of Precipitations

Examples of Hot Spots in Arab Region

-The number of Ramsar protected sites in the Arab region is 109 with a total area of 12 410 436 ha, 66 per cent of which are in North African countries (Ramsar 2007); the number of World Heritage Sites totals 65 and covers an area of 1 063 259 (8 per cent) in the Arab region. All these sites will be affected by variations of precipitations and other impacts.



Variations of Precipitations

Examples of Hot Spots in Arab Region

- Mediterranean coastal forests and bushes in Syria, Lebanon, Tunisia, Morocco and Algeria are the most vulnerable to forest fires due to drier conditions. Like other Euro-Mediterranean countries, forest fires have been especially damaging in Lebanon in recent years, representing one of the most important elements that destroy Lebanon's natural resources
- The effects of forest destruction have led to fragmentation and loss of the forest ecosystems, which in turn, has had a devastating impact on the livelihoods of local communities.
- The damages from recent fires were so immense that they reduced the forest cover to 13% in a relatively very short period of time and raised concern at the national and international levels that they could lead to total eradication of forests if radical steps were not taken to solve the problem. To the end of the disastrous forest fires in 2007 which burned more than 2000 ha only in few days.





Extreme Wind

General predicted Ecosystem and Biodiversity Impacts

- Increase in water turbidity due to dust sedimentation
- Change in the nutrients load in fresh water systems with high risk of eutrophication due to fertilization of watersheds
- Destruction of selected terrestrial habitats in watershed
- Changes in the reproduction of migratory birds that depend on lakes and streams for their breeding cycle.
- High wind coupled with drier conditions could induce forest fires that have significant adverse impacts on forests fauna and flora with full destruction of forest habitats



Extreme Wind

Examples of Hot Spots in Arab region

-Merjas Sidi Bou Rhaba and Zerga in Morocco and Garaet El Ichkeul in Tunisia are highly vulnerable because of their value as bird reserves. It supports a high diversity of birds, invertebrates and microphites. Merja Bokka is known locally as a high value site for water birds.

-As for change in precipitation, the Mediterranean coastal forests and bushes in Syria, Lebanon, Tunisia, Morocco and Algeria are the most vulnerable to forest fires due to high winds coupled with drier conditions.





Extreme Wind

Examples of Hot Spots in Arab region

-The Tihamah plain is home to the majority of southwest Arabian endemic bird species. The mountain juniper woodlands are vital habitat for these birds, such as the Yemen linnet (*Carduelis yemenensis*), Yemen thrush (*Turdus menachensis*) and Yemen warbler (*Parisoma buryi*).

-More than 3,000 birds per season pass through Al Hudayah, Gyps fulvus, bearded vulture (*Gypaetus barbatus*), Yemen linnet (*Carduelis yemenensis*), Yemen thrush (*Turdus menachensis*), and African paradise flycatcher (*Terpsiphone viridis*) are all resident in the high escarpments of the Asir Mountains.

-Wadi Turabah in Saudi Arabia is the last place in the Arabian Peninsula where the hammerkop (*Scopus umbretta*) can be found nesting, and the isolated and distinctive endemic race *Pica subsp. asirensis* is present on Shalla ad-Dhana.



Extreme Wind

Examples of Hot Spots in Arab region

- As for change in precipitation, the nine lakes in North Africa (Rhaba, Zerga, Bokka in Morocco, Chitan Ichkeul and Korba in Tunisia and Edkhe, Burullas and Manzela in Egypt) are extremely vulnerable to wind variability due to their value as important bird s habitats.
- According to EU CASSARINA project all nine lakes has undergone substantial ecosystem changes during the last 100 years at an increasing rate over the recent decades. Fresh water availability decreased during the latter part of the 20th century at watersheds .

