Biodiversity of the Hyrcanian Forests: A synthesis report

Technical Report · June 2016

DOI: 10.13140/RG.2.2.31436.00649

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FRWO/ UNDP/GEF CASPIAN HYRCANIAN FORESTS PROJECT

BIODIVERSITY OF THE HYRCANIAN FORESTS

A Synthesis Report

June 2016

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Acknowledgements

The report benefitted from the advice and suggestions of Bahram H. Kiabi, Haji Gholi Kami, Mohammad Avatefi Hemmat, Alireza Naderi and Mrs Tajbakhsh. We are grateful to all Caspian Hyrcanian Forest Project (CHFP) staff both in central office as well as provincial coordinators. Senior national consultant, M.Reza Khosravi kindly helped the team with his support.

Citation

To be cited as:
Tohidifar, M., Moser, M., Zehzad, B, and Ghadirian, T. 2016. Biodiversity of the Hyrcanian Forests: A synthesis report. UNDP/GEF/FRWO Caspian Hyrcanian Forest Project. Iran. 41 pp.

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Executive Summary

1. This report presents an overview of the biodiversity of the Hyrcanian Forests in Iran. It has been prepared as an output of the FRWO/UNDP/GEF Caspian Hyrcanian Forests Project.
2. The Hyrcanian Forests comprise a continuous 800+km belt of deciduous forests along the southern shores of the Caspian Sea, on the northern slopes of the Alborz mountains, including 1.85 million hectares in Iran and a further 50,000 hectares of forests in the neighbouring country of Azerbaijan. The Hyrcanian forests survived the quaternary ice ages, providing an important refugium of temperate broad-leaved trees, and date back to at least 25 million years BP.
3. The Caspian region (forest and non-forest habitats) is known for the rich diversity and endemism of its flora, with 3234 species recorded to date, this being 44% of the entire floral species of Iran. At lower altitudes the forests contain a number of relict Arcto-Tertiary thermophilous tree species, and are rich in hardwoods. Nine forest vegetation types have been recognised: Riverine and valley forests; Alluvial and lowland deciduous forests; Submontane and montane deciduous forest; Subalpine deciduous forest (*Quercus macranthera*); Successional and transitional scrubs and woodlands; *Cupressus sempervirens* and *Platycladus* (*Thuja*) *orientalis* woodlands; Juniper woodlands; Ruderal habitats; Cultural landscapes and artificial forests.
4. The Caspian forests support an important assemblage of large mammals including the Endangered Persian leopard, brown bear, wolf, red deer, roe deer. The last Caspian tiger was killed in 1958. The Hyrcanian forests support a rich assemblage of bird species typical of broad-leaved temperate forests, including the near endemic Caspian tit *Parus* (*Poecile*) *hyrcanus*, and an important assemblage of forest specialist species. There are also 31 species of reptiles, nine species of amphibians and 53 species of fish. Invertebrate populations are poorly known.
5. The Hyrcanian forests are recognized as part of the "Caucasus-Anatolian-Hyrcanian Temperate Forests ecoregion, one of the WWF 200 Global Ecoregions, and also encompasses a number of Important Bird Areas as identified by BirdLife International. The continuous forest cover provides a wide range of ecosystem services of great value, including landscape, climate and water regulation, supporting atmospheric quality, timber and non-timber forest products, opportunities for tourism, recreation, health and wellbeing and spiritual experiences.
6. The main threat to the biodiversity of the Hyrcanian Forests arises from habitat loss and fragmentation arising from conversion of forests to agricultural and urban land, private dwellings, dam construction etc. Road construction is a particular threat to the large mammals since it destroys habitat integrity. Large mammals are also threatened by illegal hunting and retaliatory killing by livestock herders (leopards, wolves and bears). Over-grazing by domestic animals inside the forest has a major effect on forest condition. Other threats include unsustainable timber harvest, firewood collection, climate change (pests and diseases, forest fires), and pollution / garbage dumping.
7. Responsibility for the management of the biodiversity of the forests is divided between the Forests, Rangelands and Watershed Organization (flora and non-protected forest areas, including forest reserves), and the Department of Environment (fauna and protected areas). More than 400 thousand hectares are designated as protected areas (including upland steppes) and 17500 ha as forest reserves. Management of the forests has not been adequate to safeguard biodiversity, due to lack of relevant policies, laws (and enforcement), planning, expertise and budgets.

8. Key research priorities are identified, and recommendations are made for conserving biodiversity. In particular, biodiversity conservation needs to be mainstreamed into forest management and sectoral policies, with much greater emphasis on community participation and awareness.

1- INTRODUCTION

1-1 The Caspian Hyrcanian Forests

The Caspian Hyrcanian Forests are a green belt of predominantly temperate deciduous forests stretching over the northern slopes of the Alborz mountain range, along the southern borders of the Caspian Sea. They stretch across three provinces of Iran (Gilan, Mazandaran and Golestan) from Astara in the northwest to the vicinity of Gorgan (Golidaghi) in the northeast of Iran, and also include a small western portion in the country of Azerbaijan. Based on the latest data from the Forests, Rangelands and Watershed Organization (FRWO) the Caspian Hyrcanian Forests are approximately 800 km long and 110 km wide, with a total area of 1.85 million ha. They comprise 15% of the total Iranian forests and 1.1% of the country's area (Sagheb Talebi et al., 2014). The Hyrcanian forests rise from sea level up to an altitude of 2,800 m and encompass a variety of different forest types. The term "Hyrcanian" came from the word "Hyrcan", which means wolf land.

The remarkable Hyrcanian Forests only exist because of the mass of water vapours that evaporate from the Caspian Sea. When these confront the Alborz massif, it acts as a climatic wall, producing dense clouds and discharges of rain or snow; this, in turn, creates a very dense forest on the northern slope of the Alborz mountains, while the southern slopes end in the Kavir desert, one of the driest deserts in the world (Knapp, 2000). Although botanists consider the whole part of the northern Alborz as one region known as the "Hyrcanian vegetation zone", this area includes many non-forested rangelands above the timberline, as well as formerly forested lowland areas that are now almost entirely converted to cultivated lands and human settlements.

1-2 History of the Hyrcanian Forests (vegetation)

The occurrence of many Arcto-Tertiary relict elements, (such as *Zelkova carpinifolia*, *Parrotia persica*, and *Pterocarya fraxinifolia*), has led bio-geographers to the consensus that the Caspian forest has been an important refugium of temperate broad-leaved trees during the Quaternary glaciations – the most recent period of glaciations during Earth's history.

It is supposed that the late Tertiary (more than 2.58 million years ago) climate of the Iranian highlands, particularly in the north and northwest, was more humid favoring the extension of forests elements more pronouncedly than today.

Based on Bobek's studies (1953-1954), a markedly dry period prevailed from ca. 9,000–4,000 BC for the south Caspian area, parallel to the climatic optimum in Europe. Similarly, one researcher concluded from a study on the sedimentary and environmental characteristics of Lake Anzali in northern Iran that a dry, wind-dominated climate prevailed in that region at 10,000-8,000 BP (Kazancı et al, 2004). It was revealed from the study of loess/palaeosol sequences of the Caspian lowlands that during the Pleistocene glaciations, N Iran was an area of increased dust accumulation and loess formation similar to SE Central Europe and Central Asia. In the eastern limits of the Hyrcanian forests, a short pollen diagram from Lake Sulukli located in Golestan National Park indicates the replacement of a steppe with a closed forest ecosystem (dominated by *Quercus* and *Carpinus*) at a recent time (certainly before 450 calendar years BP). This dramatic change might have been caused by both an increasing anthropogenic pressure and the natural recolonization of previously strongly grazed lands and/or a recent dramatic climatic event favoring forest expansion.

Palynological reconstruction of forest history deduced from a pollen profile of peat deposits of a small mire in central parts of the Caspian forests, has shown long-term continuity of forest cover over the

past millennium, with some imprints of climate and man on the vegetation. Furthermore, the formation of the basin, probably as a result of intensified karstification, is an indication of radical hydrological changes during that period. The extent and intensity of early human interference with the forest composition and structure are not fully detected yet. Archaeological finds of wood-cutting for metals melting in the central Caspian forests suggest anthropogenic impacts since at least 1500-2000 BC. The early human presence in the Caspian lowlands has also been palynologically evidenced by the occurrence of *Juglans* pollen since ca. 2,300-2,200 calendar years BP. Increased non-arboreal pollen (NAP) values in the existing pollen diagrams, from the central Caspian forests suggest intensified human impact since the beginning of the nineteenth century. Further to the west, a large-scale deforestation of *Alnus* forest around Amirkelayeh wetland is also evident in a pollen diagram, which indicates that the lowland forest was the subject of stronger human impact (Akhani et al., 2010).

Fig 1. Location of Hyrcanian forest in context of the whole country, in a satellite image - “Thin as an eyebrow, prominent as an eye”.

1-3 Caspian Hyrcanian Forests Project

The FRWO/UNDP/GEF Caspian Hyrcanian Forests Project aims "to put in place a collaborative governance system and know-how for managing a mosaic of land uses in the Caspian Hyrcanian forests that provides habitat integrity and helps maintain landscape level ecosystem functions and resilience". Therefore the project aims to stop and reverse trends of forest degradation, and enhance biodiversity in the Caspian forests through the introduction of ecosystem-based approaches and multipurpose forestry. Field implementation is focusing on 4 pilot landscapes totaling 120,000 ha, with policy and capacity development occurring for the entire area of the forests.

Project implementation started in January 2014, and will end in December 2018, at which point FRWO and other local stakeholders will take responsibility for sustaining the project's achievements.

1-4 Purpose of this report

The aim of this report is: a) to synthesize the current information and data on biodiversity that is available for the Caspian Hyrcanian region; b) To assess the importance of the area and to identify biodiversity hotspots; c) to determine the main threats to biodiversity; d) to identify current conservation activities and gaps; and e) to determine priorities for action.

1-5 Methodology and information sources

The report incorporates the main findings of more detailed reports prepared for mammals, birds and flora. Other information presented here came from a literature review, including books, papers and reports. A number of interviews were also conducted to collect and discuss the proposals for conservation and management of biodiversity.

2- OVERVIEW OF THE MAIN TAXONOMIC GROUPS

2-1 Flora

The Hyrcanian region is known for the rich diversity of its flora. So far, 3234 species belonging to 856 genera and 148 families of vascular plants have been reported from the northern provinces of Iran and Talish in the Republic of Azerbaijan (Akhani et al., 2010), but this total includes many species from non-forested coastal and wetland habitats as well as rangelands and high altitude habitats. In terms of conservation and biodiversity, the occurrence of 44% of the total known species in Iran (3234 out of 7300 species) in only 6% of the Iranian surface area is of great significance. Of these, ca. 280 species are endemic and sub-endemic to the Hyrcanian area and ca. 500 species are endemic to Iran.

2-1-1 Trees

The vegetation is composed mostly of deciduous forests, of which the most dominant species are Oriental beech (*Fagus orientalis*), Chestnut-leaved oak (*Quercus castaneifolia*) and European hornbeam (*Carpinus betulus*). A total of 80 native tree species have been recorded. The Hyrcanian forest at lower altitudes contain a number of relict Arcto-Tertiary thermophilous species, such as ironwood, Caspian honey locust, Siberian elm and false walnut (Akhani et al., 2010). The area is rich in hardwood species, but there are only four genera of native softwood (conifer) trees including yew, Greek juniper, oriental arbor-vitae and Italian cypress. Section 2-1-4 describes the main forest plant communities, giving more detail of the most abundant tree species.

2-1-2 Other vascular plants

Vascular plants (except trees and shrubs) comprise very diverse parts of vegetation in the Hyrcanian forests. Different species are important as edible plants for humans (e.g *Polygonatum orientale*, *Rubus sanctus*, wild garlic) or medicinal usage (eg wild poppy), whilst many plants are consumed as livestock fodder. There is no information about quantity of harvesting or economical values.

2-1-3 Non vascular plants, including fungi.

The Hyrcanian forests provide diverse habitats for a large number of other mesophytic groups such as Bryophytes and Fungi.

Among 437 known bryophytes from Iran, 338 species (77%) are known from the south Caspian provinces of northern Iran. Endemic bryophytes in the Hyrcanian area are very rare. The only true Hyrcanian endemic bryophyte is the pleurocarpous moss *Pseudoleskeella laxiramea*. This epiphytic species and two other Near and Middle Eastern endemics *Leucodon immersus*, *Palamocladium euchloron* occur as widely distributed epiphytes along the Hyrcanian forests (Akhani et al. 2010).

A few studies of the macro fungi in the Hyrcanian forests have revealed a rich community that highlights the significance of region. A study in the Beech forests of Mazandaran province shows no less than a hundred taxa of macrofungi occurring in the area (Borhani et al., 2010). Since the distribution of macrofungi species is concentrated in the northern slopes direction (due to more humidity), it is probable that the western parts of the forests are more rich in macro fungi in comparison to the eastern sections. This is supported by the results of research by Karim et al. (2013) who recorded 35 species in the Shastkalate forest in Golestan.

Although the harvesting of macro fungi by local people is not common due to the co-existence of edible and poisonous mushrooms (Borhani et al, 2010, Asef Shayan pers.comm) and also due to lack of a tradition of consuming wild mushrooms, one researcher pointed out that several species of macrofungi are missing compared with the late 1970s, most probably due to forest degradation (Borhani et al, 2010). Despite this, tens of species occurs as edible mushrooms in region, and the following genera are regularly found in local markets: *Agaricus* spp., *Cantharellus* spp. (Asef Shayan pers. comm.).

2-1-4 Plant communities

Seventeen main vegetation types have been identified in the Caspian region, including: i) sand dune vegetation along the Caspian Sea coasts; ii) C4-dominated grass communities on rocky outcrops; iii) aquatic vegetation on wetlands; iv) riverine and valley forests; v) alluvial and lowland deciduous forests; vi) sub-montane and montane deciduous forests; vii) subalpine deciduous forests (*Quercus macranthera*); viii) successional and transitional scrub and woodlands; ix) *Cupressus sempervirens* and *Platycladus* **(***Thuja*) *orientalis* woodlands; x) juniper woodlands; xi) subalpine and alpine meadows; xii) montane steppe dominated by xerophytic and thorn-cushion species; xiii) rock cliff communities; xiv) halophytic communities; xv) *Artemisia spicigera* steppe and desert like dunes; xvi) ruderal habitats and xvii) cultural landscapes and artificial forests (Akhani et al, 2010). The following nine of these vegetation types specifically refer to the forests:

1-Riverine and valley forests: The hygrophilous trees like *Alnus glutinosa*, *Populus caspica*, *Salix aegyptiaca*, *S. alba*, *Pterocarya fraxinifolia*, *Acer velutinum*, *Diospyros lotus* are the most abundant species in such habitats. In deep valleys, the surrounding steep rocks and high moisture along the rivers provide unique ecosystems with shade tolerant species like *Danae racemosa* and several fern species such as *Athrium filix-femina*, *Dryopteris pallid*, *Polypodium vulgare, Cystopteris fragilis* and *Polystichum aculeatum.*

The riverine vegetation in the Caspian forests is largely degraded by human impact and most importantly by dams. Furthermore, road construction activities have disturbed the establishment and succession processes of this ecosystem.

2-Alluvial and lowland deciduous forests: The alluvial forests of the South Caspian area are almost entirely replaced by cultural landscapes. Only small sites exist in some protected forests such as Khoshke Daran, Kelarabad, Namak-Abrud, Sisangan and Gisumin Gilan and Mazandaran Provinces. The arboreal elements in this vegetation type are comparable with the riverine forests and are composed mainly of *Alnus glutinosa* associated with *Populus caspica*, *Pterocarya fraxinifolia*, *Ulmus minor*, *Cornus australis*, *Alnus subcordata*, *Diospyros lotus*, *Buxus hyrcana* and *Ilex spinigera* (Order Alnetaliasubcordatae). The Hyrcanian endemic *Alnus subcordata* occurs mostly in the montane zone of the hygrophilous communities. The lowland forests occur in altitudes up to 700 m and are dominated by summer green cold-sensitive species. They further include thermophilous trees such as *Parrotia persica* (Fig 2), *Gleditsia caspica*, *Albizia julibrissin* (Fig 3), *Zelkova carpinifolia*, *Acervelutinum*, *Pterocarya fraxinifolia* together with species like *Quercus castaneifolia* and *Carpinus betulus* which penetrate into the upper zone. The occurrence of several evergreen species such as *Hedera pastuchovii*, *Ruscus hyrcanus* and *Buxus hyrcana* (Fig 4), *Danae racemosa*, and *Laurocerasus officinalis* determine the physiognomy of most of these forests.

3-Submontane and montane deciduous forest: Although there is not a clear boundary between lowland and montane forests, we consider the absence of thermophilous species in higher altitudes as a

criterion which can separate the former zone with this vegetation type. A transition zone (i.e. submontane forests) exists in which the density and abundance of thermophilous species declines and more cold-tolerant species prevail. Locally, the amount of rain and clouds increases in the montane zone. In the eastern parts of the Caspian forests, *Quercus castaneifolia* and *Carpinus betulus* dominate large parts of this transition zone at elevations between ca. 700 to 1400 m. The montane forests are located above the transition zone and are characterized by rather dense understorey vegetation. The understorey vegetation is composed of grasses (*Poa nemoralis* and *Festuca drymeia*, ferns (*Drypoteris caucasica*, *Athyrium filix femina*) and *Ilex spinigera* and large number of cold resistance trees such as *Carpinus betulus*, *Sorbus torminalis*, *Ulmus glabra*, *Tilia caucasica*, *Fraxinus excelsior*, *Acer hyrcanicum*. In central and western Caspian forests the montane and submontane zones are mostly dominated by *Fagus orientalis*.

4-Subalpine deciduous forest (*Quercus macranthera*): The uppermost zone of montane forests is replaced by subalpine forest above 1800 m and stretches up to 2500 m and occasionally to 2800 m. The Euxino-Hyrcanian species *Quercus macranthera* occurs along the high altitude forests of Alborz and is associated with *Acer hyrcanicum*, A. *monspessulanum*, *A. campestre*, and *Sorbus torminali*s. The association *Aceri-hyrcani–Quercetum macrantherae* was described from Central Alborz (Djirchal) with three sub-associations. Due to particular topographic and orographic structure, and further intensive tree cutting, grazing and browsing, the subalpine oak forest is fragmented and receives much sunshine. Trees are small and their open intervals are covered by various montane steppe vegetation types of the Irano-Turanian zone, transitional scrubs and meadows of the Euro-Siberian zone.

5-Successional and transitional scrubs and woodlands: The scrub and woodland vegetation in the Caspian forests have three main origins: **a)** *Transitional origin:* towards drier habitats and higher altitudes, the closed forests are usually surrounded by transitional scrubs. The timber-line and shrub-line in Alborz Mountains varies from 2200 to 3000 m. The transitional scrub in this zone mainly consists of *Juniperus communis* subsp. *nana*, *J. sabina*, *Carpinus orientalis*, *Lonicera iberica*, *Ribes melananthum* and *Rhamnus cathartica*. A transitional shrubland dominated by *Paliurus spina-christi*, *Crataegus azarolus* var. *pontica*, *C. pentagyna*, *Acer monspessulanum* subsp. *Turcomanicum* has been established in a zone of reduced rainfall in the east of the south Caspian forests. **b)** *Edaphic origin*: in most parts of the Hyrcanian forest zone, the closed forests are interrupted by steep rocky slopes. The rocky substrate without a distinct or only a thin soil layer favour the establishment of xerophytic shrubs such as *Carpinus orientalis*, *Crataegus.* **c)** *Successional origin*: this type of shrubland can be found in agricultural and previous settlement areas whose vegetation has regenerated after protection. In Golestan National Park, large areas of previously agricultural lands and residential areas are now regenerated by formation of *Paliurus spina-christi*, *Prunus divaricata*, *Rubus sanctus* and *Crataegus pentagyna* scrub.

6-*Cupressus sempervirens* and *Platycladus* (*Thuja*) *orientalis* woodlands: The Cypress open woodlands occur in the rain shadow of deep valleys cutting the Alborz range in Chalus (Hassan Abad, close to Marzanabad), Sefidrud valley near Rudbar and Manjil, and Sourkesh forest near Katool valley (Gorgan). The Mediterranean-type climate of this zone is characterized by vigorous olive (*Olea europaea*) plantations and occurrence of some typical Mediterranean elements such as *Myrtus communis*, *Jasminum fruticans*, *Asteriscus spinosus*, and *Salvia viridis*. In east of Gorgan, near Fazelabad, small stands of natural *Platycladus orientalis* (Fig 5) forest occur in local Mediterranean climatic conditions.

7-Juniper woodlands: *Juniperus excelsa* woodlands are typical of the Irano-Turanian area and occur in the southern slopes of the Alborz Mountains and Khorassan-Kopedagh Mountains in the NE Iran and neighbouring Turkmenistan. Among the sites with juniper as a major component in the eastern part of the Caspian zone are Jahan Nama Protected area, Golestan National Park and, further to the east, Qorkhod Protected Area with very dense *Juniperus excelsa* woodlands. In the road between Galoogah and Damghan (Mazandaran and Semnan provinces), the subalpine forests connect with *Juniperus excelsa* woodlands.

8-Ruderal habitats: The intensive human impact on all types of vegetation has caused colonization of ruderal species all around the south Caspian forests. Ruderal species occur in dried rivers, deforested areas, around cultivated lands, and urbanized and industrialized regions. The climatic peculiarity of the area favours a large number of weedy, introduced, invasive and ruderal species of tropical or temperate origin. The Irano-Turanian flora of the Iranian highlands provides a major source of invaded species which favour open habitats analogous to the drier parts of Iran. During summer time, many C4 weedy and ruderal grasses like *Setaria* spp., *Digitaria* spp. *Paspalum* spp., *Cynodon dactylon*, *Bothriochloa ischaemum*, *Sorghum halepense*, *Imperata cylindrical* occur in gardens, coastal dunes, and around agricultural areas. The overgrazed montane forests and meadows are covered by dense communities of *Stachys byzantina*. Degraded forests and nitrified habitats around forests are covered by *Pteridium aquilinum*, *Artemisia annua*, *Conyza canadensis, Conyzanthus squamatus, Sambucus ebulus, Urtica dioica, Marrubium vulgare, Phytolacca americana*, and *Lythrum salicaria*. The latter mostly occurs around rice fields and road sides where more water is available.

9-Cultural landscapes and artificial forests: The south Caspian area is an important centre for the domestication of cultivated trees and shrubs. The agricultural area of the south Caspian zone plays an important role in the agronomy of Iran. The very rich soils of the alluvial South Caspian lowlands provide extensive agronomic activities including rice, wheat, colza, citrus fruits, kiwi, peach, strawberry and tea cultivations. Olive is a major product of the local Mediterranean bioclimatic zones of the area which is concentrated mostly in Sefid-Rud valley and Gorgan. The history of re- and afforestation activities goes back to 1952. Thereafter, many exotic trees along with a few native species have been planted in the area either for commercial or ornamental purposes. Among them are: *Pinus brutia* subsp. *eldarica*, *Eucalyptus* spp., *Robinia pseudoacacia*, *Cryptomeria japonica*, *Taxodium distichum*, *Cupressus sempervirens*, *Populus deltoids, Ailanthus altissima*, and *Picea abies*.

Fig 2. *Parrotia persica*, relic and endemic species of Hyrcanian region © B.Zehzad

Fig 3. *Albizia julibrissin*, relic species of Hyrcanian region © B.Zehzad

Fig 4. *Buxus hyrcana*, relic and endemic species of Hyrcanian region © M. Soofi

Fig 5. *Platycladus* (*Thuja*) *orientalis* © B.Zehzad

2-2 Fauna

2-2-1 Mammals

Table 1 lists the 58 mammal species recorded from the Hyrcanian Forests. Persian leopard (EN) and the wild goat (VU) are the most threatened mammals included on the IUCN Red List, with a further 6 species included as Near Threatened. In 1958, just 58 years ago, Iran lost its most magnificent carnivore, the Caspian Tiger *Panthera tigris virgata*, when the last known individual was shot at Sharlogh (in the present Golestan N.P). This remarkable animal once lived throughout the Hyrcanian region. However, its lowland forest habitats have been completely destroyed and opened-up for agriculture and urbanization, making any thoughts of re-introduction projects impossible.

Table 1. List of mammal species recorded in the Hyrcanian region.

English name	Scientific name	Status	IUCN category
Southern White-breasted Hedgehog	*Erinaceus concolor*	Common	LC
Long-eared Hedgehog	*Hemiechinus auritus*	Uncommon	LC
Caspian Shrew	*Crocidura caspica*	Unknown	DD
Bicolored Shrew	*Crocidura leucodon*	Common	LC
Lesser White-toothed Shrew	*Crocidura suaveolens*	Common	LC
Mediterranean Water Shrew	*Neomys anomalus*	Unknown	LC
Blind Mole	*Talpa levantis*	Unknown	LC
Caucasian Mole	*Talpa caucasica*	Unknown	LC
Greater Horseshoe Bat	*Rhinolophus ferrumequinum*	Common	LC
Lesser Horseshoe Bat	*Rhinolophus hipposideros*	Common	LC
European Free-tailed Bat	*Tadarida teniotis*	Unknown	LC
Western Barbastelle Bat	*Barbastella barbastellus*	Rare	NT
Northern Bat	*Eptesicus nilssonii*	Rare	LC
Serotine Bat	*Eptesicus serotinus*	Uncommon	LC
Giant Noctule Bat	*Nyctalus lasiopterus*	Rare	NT
Leisler's Noctule Bat	*Nyctalus leisleri*	Common	LC
Noctule Bat	*Nyctalus noctula*	Common	LC
Kuhl's Pipistrelle Bat	*Pipistrellus kuhlii*	Common	LC
Common Pipistrelle Bat	*Pipistrellus pipistrellus*	Common	LC
Soprano Pipistrelle Bat	*Pipistrellus pygmaeus*	Unknown	LC
Bechstein's Myotis Bat	*Myotis bechsteinii*	Rare	NT
Lesser Mouse-eared Myotis Bat	*Myotis blythii*	Common	LC
Geoffroy's Myotis Bat	*Myotis emarginatus*	Uncommon	LC
Whiskered Myotis Bat	*Myotis mystacinus*	Common	LC
Brown Long-eared Bat	*Plecotus auritus*	Rare	LC
Pale bent-winged Bat	*Miniopterus pallidus*	Common	NE
Golden Jackal	*Canis aureus*	Common	LC
Wolf	*Canis lupus*	Uncommon	LC
Common Fox	*Vulpes vulpes*	Common	LC
Jungle Cat	*Felis chaus*	Common	LC
Wild Cat	*Felis silvestris*	Uncommon	LC
Eurasian Lynx	*Lynx lynx*	Rare	LC
Persian Leopard	*Panthera pardus saxicolor*	Rare	EN
European Otter	*Lutra lutra*	Unknown	NT
Stone Marten	*Martes foina*	Common	LC
European Pine Marten	*Martes martes*	Rare	LC
Least Weasel	*Mustela nivalis*	Common	LC
European Badger	*Meles meles*	Rare	LC
Brown Bear	*Ursus arctos*	Rare	LC
Raccoon	*Procyon lotor*	Alien species	LC

Wild Boar	*Sus scrofa*	Common	LC
Red Deer	*Cervus elaphus maral*	Rare	LC
Roe Deer	*Capreolus capreolus*	Rare	LC
Wild Goat	*Capra aegagrus*	Unknown	VU
Noble Calomyscus	*Calomyscus grandis*	Unknown	DD
Eurasian Water Vole	*Arvicola amphibius*	Common	LC
Common Vole	*Microtus arvalis*	Common	LC
Schelkovnikov's Pine Vole	*Microtus schelkovnikovi*	Uncommon	NT
Grey Dwarf Hamster	*Cricetulus migratorius*	Common	LC
Hyrcanian Field Mouse	*Apodemus hyrcanicus*	Endemic to Hyrcanian forests in Iran & Azerbaijan. Common in suitable habitats	NT
House Mouse	*Mus musculus*	Common	LC
Brown Rat	*Rattus norvegicus*	Common	LC
Black Rat	*Rattus rattus*	Common	LC
Fat Dormouse	*Glis glis*	Common	LC
Forest Dormouse	*Dryomys nitedula*	Common	LC
Indian Crested Porcupine	*Hystrix indica*	Common	LC
Coypu	*Myocastor coypus*	Alien species	LC
European Hare	*Lepus europaeus*	Common	LC

Despite the significance of the Caspian forests for mammals, few studies have been undertaken. Lay (1967) in his study of mammals of Iran, had 12 stations in the Hyrcanian region, from which he collected a few species. Misonne (1963) in the book of zoogeography of mammals in Iran identified distributions of 15 species in the Caspian region. Kheleghi Hamidi et al. (2014) surveyed leopards in the Golestan National Park via camera trap and counted 20 individuals. Regarding wildlife-human conflict, a recent study carried out in Golestan national park emphasized the role of livestock diseases in increasing the conflict (Khorozian et al., 2015). As regards small mammals, a study by Ghorbani et al (2010) on rodents of western Golestan recorded 13 species. Javidkar et al. (2005) described the endemic Hyrcanian field mouse from Noor forest. Alinejad (2007) surveyed the habitat suitability of red deer in Shenroud basin, Gilan. Finally two studies were carried out in Kheirud forest covering the ecology of roe deer and European pine marten in this area, as an MSc thesis.

As part of the Caspian Hyrcanian Forests Project, quantitative field surveys were carried out in the forested habitats of four pilot landscapes (comprising 120,000 ha) of Hyrcanian forests in 2014-2015. These revealed that wild boar *Sus scrofa*, Indian crested porcupine *Hystrix indica*, golden jackal *Canis aureus*, and brown bear *Ursus arctos* are present in all areas (Ghadirian & Raeesi, 2015). Distribution of red deer and roe deer, the two most important ungulates of the region, was limited to high elevation areas due to the high hunting pressure in low elevations, except where they were present in protected areas with less human impact (Kiabi et al., 2004). Studies of Ghadirian & Raeesi (2015) showed the presence of three big carnivores in the pilot landscapes as shown in table 2. According to this, the presence of all carnivores differs site to site however the general abundance is medium to low.

Table 2. Abundance of three big carnivores in Caspian Hyrcanian forest, after Ghadirian & Raeesi, 2015

Pilot	Species	Presence in plots	Altitudinal range	Abundance
Ferirud & Zilakirud	Brown Bear	2 (7%)	560-1490	Low
	Wolf	1 (3%)	291-1472	Low
	Leopard	1 (3%)	329-1098	Low

Dohezar & Sehezar	Brown Bear	Not observed	--	Low
	Wolf	1 (3%)	832	Low
	Leopard	2 (10%)	886-1124	Medium
Baliran	Brown Bear	5 (15%)	282-1261	Medium
	Wolf	—	—	—
	Leopard	9 (27%)	344-1371	Medium
Chehelchai	Brown Bear	1 (7%)	1541-1640	Low
	Wolf	1 (7%)	1689	Low
	Leopard	—	—	—

Detailed studies by Ghadirian & Raeesi (2015) showed that all pilot landscapes suffer from conflicts between human and mammals, either carnivores or herbivores or both. There is also a high relationship between livestock disease and predation by carnivores (Khorozyan et al., 2015). Retaliatory killing was the most popular method of mitigation of human-carnivore conflicts in the region. This however, may be intensified by the belief among many herders that the Department of Environment (DoE) has released carnivores such as wolf and leopard in the forests. Human-wildlife conflicts are not confined to carnivores, and herbivores also are victim. The farmers of Chehelchai in Golestan had serious conflicts with wild boar and claimed that half of the products in the farmlands adjacent to the forests were destroyed by wild boar. Conflict between farmers and wild boar was higher in rice farms close to forest (Ghadirian & Raeesi, 2015).

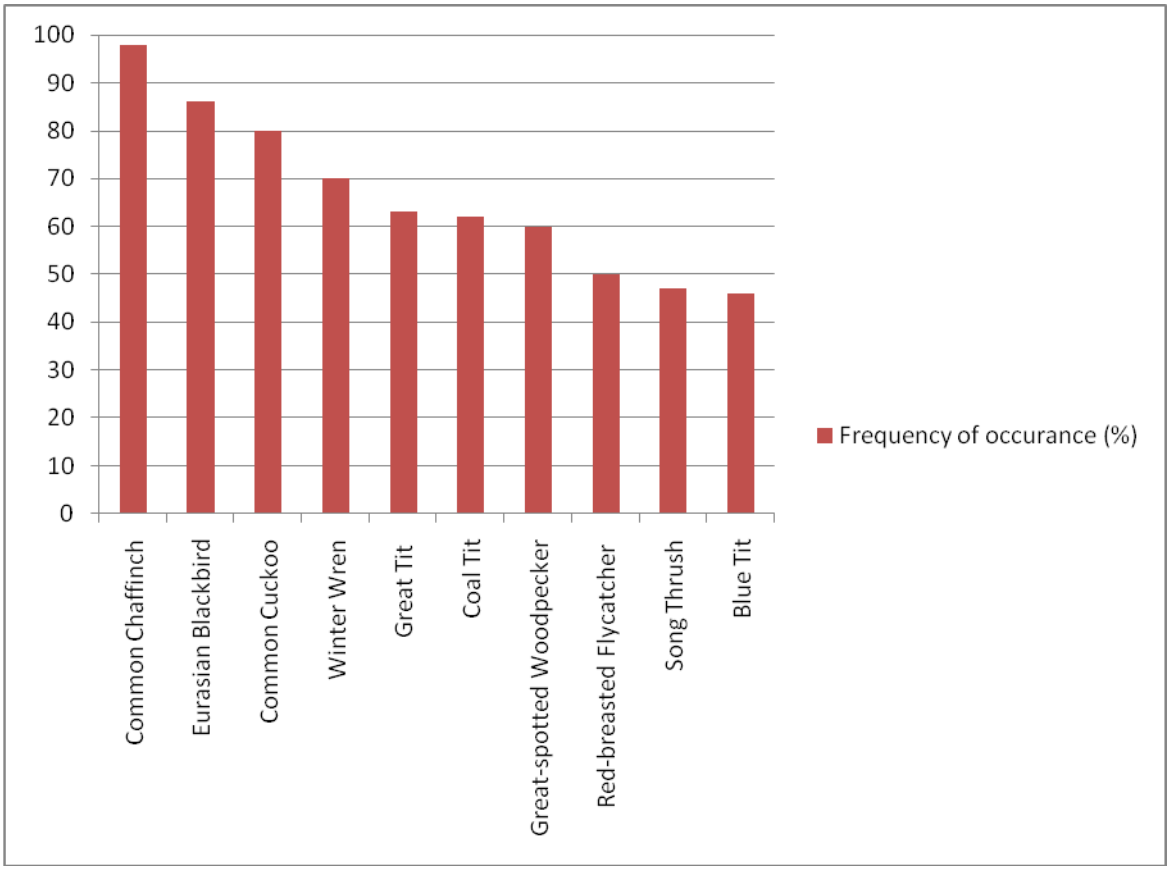
Hunting of mammals generally is against the law unless one has hunting permission. Wild ungulates associated with forest ecosystems (Red deer and Roe deer) are entirely protected; no permission is being issued for hunting purposes. A few, such as Wild boar and Indian porcupine, may be exempt due to damages they cause in agriculture and horticulture, although they are victim even without legal authorization of DOE. In the case of carnivores, the major losses stem from retaliatory killing by herders,and for meso-carnivores by forest-dwellers who keep poultry. The conventional method for hunting is using shotgun and rifle. Lethal traps also are prevalent, and poisoned baits are also used. Although hunting is illegal, many mammals basically ungulates, are killed each year for meat, pleasure or for revenge attributed reasons (Kiabi et al 2004). Furthermore, building forest roads for timber harvesting in line with lack of proper supervision leads to access of untrained people to the middle of the forests causing illegal hunting.

2-2-2 Birds

The avifauna of the Hyrcanian forests have been largely ignored by publications on birds occurring in the extensive wetlands along the Caspian coast. Despite more than 100 existing references including papers, booklets, reports and theses, documents on forest birds are few. Most result from ecological studies by the researchers of University of Tehran in Kheirud forest, an educational forest in Noshahr. A few additional studies have been made in Golestan N.P in the most eastern part of the Caspian forests. The only broad landscape-scale study is an avifaunal investigation of birds in Mazandaran & Golestan provinces (Rezaee, 2012) but the results are limited to a checklist and distributional maps.

In order to fill this gap, a quantitative field investigation of the breeding season avifauna was conducted for the present project in the four pilot landscapes in May 2014. The detailed results of this study have been presented by Tohidifar & Moser, 2015. Figure 6 lists the top 10 species by frequency of occurrence in their studies.

Fig 6. Frequency of occurrence of the ten top species of birds in survey plots in the four pilot landscapes of the Caspian Hyrcanian forest. After Tohidifar & Moser 2015.



The Hyrcanian forests support a rich assemblage (no less than 180 species) of birds typical of broad-leaved temperate forests. Because of the extent of the forests (1.85M hectares) the population size for many of these forest birds is highly significant on a national, regional and global scale. Breeding visitors including European honey buzzard *Pernis apivorus*, lesser spotted eagle *Aquila pomarina*, common chiffchaff *Phylloscopus collybita*, red-breasted flycatcher *Ficedula parva*, Eurasian siskin *Carduelis spinus* and resident species such as common buzzard *Buteo buteo*, peregrine falcon *Falco peregrinus*, black woodpecker *Dryocopus martius* and Eurasian treecreeper *Certhia familiaris* are restricted to the Hyrcanian forest region. Although the Hyrcanian forests lack any endemic bird species, the near-endemic Caspian Tit *Parus* (*Poecile*) *hyrcanus* is limited to the region and parts of the neighbouring country of Azerbaijan. Since the accessibility to upland forests was problematic in the field surveys, no estimation could be presented on the number of breeding pairs of Caspian Tit (Tohidifar & Moser, 2015) even though it occurred in many parts of the upland areas. Five species categorized by IUCN include: Steppe Eagle *Aquila nipalensis* EN, European Turtle Dove *Streptopelia turtur* VU, Eastern Imperial Eagle *Aquila heliaca* VU European Roller *Coracias garrulus* and Semicollared Flycatcher *Ficedula semitorquata* NT.

2-2-3 Reptiles

The herpetofauna of the Hyrcanian region is less diverse in comparison to other vertebrates. The region supports 31 species of reptiles (see Table 3), or nearly 14% of the total of 226 species recorded in Iran (Kamali 2013). This is probably due to the main factors limiting the distribution of reptiles, which are temperature and water. Based on a hypothesis, diversification of lizards is highest in hot and arid environments (Hosseinzadeh et al, 2014). Steiner`s lacerta *Dareviskia steineri* an endemic to the region and country, is confined to the dense forests of Golestan province. The green-bellied Lizard *Dareviskia chlorogaster* and Persian rat snake *Zamenis persica* are near-endemic and restricted to the Hyrcanian forests in Iran & Azerbaijan. Two species are mentioned in IUCN Red List as near threatened species: Meadow Lizard *Dareviskia praticola* and European Pond Turtle *Emys orbicularis.*

Table 3. List of reptiles recorded in the Hyrcanian region.

English name	Scientific name	Status	IUCN category
Slow Worm	*Anguis (fragilis)colchica*	Common in region	LC
Glass Lizard	*Pseudopus apodus*	Common in region	LC
Keeled Rock Gecko	*Cyrtopdion scabrum*	Common in region	LC
Caspian Bent-toed Gecko	*Tenuidactylus caspium*	Common in region	LC
Green-bellied Lizard	*Dareviskia chlorogater*	Endemic to Hyrcanian forests in Iran & Azerbaijan. Common in region	LC
Alborz lizard	*Dareviskia defilippii*	Common in region	LC
Meadow Lizard	*Dareviskia praticola*	Data deficiency	NT
Steiner`s Lacerta	*Dareviskia steineri*	Rare-confined to dense forests of Golestan province	DD
Caspian green Lizard	*Lacerta strigata*	Common in region	LC
Twin-striped Skink	*Ablepharus bivittatus*	Relatively abundant in region	LC
Asian Snake-eyed Skink	*Ablepharus pannonicus*	Common in region	NE
Schneider`s Skink	*Eumeces schneideri*	Common in region	NE
Golden Grass Skink	*Trachylepis aurata*	Common in region	LC
Large Whip Snake	*Dolichophis jugularis*	Relatively abundant in region	LC
Fire Racer Snake	*Dolichophis schmidti*	Relatively abundant in region	LC
Dione`s Snake	*Elaphe dione*	Relatively abundant in region	NE
Four-lined Rat Snake	*Elaphe sauromates*	Relatively abundant in region	NE
Spotted Wipe Snake	*Hemorrhois ravergieri*	Common in region	NE
Derafshi Snake	*Lytorhynchus ridgewayi*	Relatively abundant in region	LC
Grass Snake	*Natriz natrix*	Common in region	LC
Dice Snake	*Natrix tessellata*	Common in region	LC
Spotted Desert Racer	*Platyceps karelini*	Relatively abundant in region	NE
Slender whip snake	*Platyceps najadum*	Common in region	LC
Aesculpian Snake	*Zamenis longissimus*	Relatively abundant in region	LC
Persian Rat Snake	*Zamenis persica*	Endemic to Hyrcanian forests in Iran & Azerbaijan. Relatively abundant in region	DD
Central Asian Cobra	*Naja oxiana*	Relatively abundant in region	DD
Schokari Sand Racer	*Psammophis schokari*	Common in region	NE
Caucasian Pit Viper	*Gloydius halys*	Relatively abundant in region	NE
Levantine Viper	*Macrovipera lebetina*	Relatively abundant in region	NE
European Pond Turtle	*Emys orbicularis*	Common in region	NT
Caspian Turtle	*Mauremys caspica*	Common in region	NE

2-2-4 Amphibians

The amphibian diversity of the Hyrcanian region is rich, reflecting the numerous water bodies such as steams, ponds and wetlands of the Caspian region. Nine out of a total of 22 species known in Iran (40%) occurs in the region of which three of them, namely: cave salamander *Paradactylodon gorganensis*, Persian brook salamander *Paradactylodon persicus* and wood frog *Rana pseudodalmatina* are endemic to the Hyrcanian forests and country and one semi-endemic Talysh toad *Bufo eichwaldi* occurs also in Azerbaijan. Little is known of the ecology and behavior of these four species (Kamali, 2013). Table 4 lists the amphibians of the area. Three species listed by IUCN are: Cave salamander *Paradactylodon gorganensis* (CR) Persian brook salamander *Paradactylodon persicus* (NT) Talysh toad *Bufo eichwaldi* (VU).

Table 4. List of amphibians recorded in the Hyrcanian region.

English name	Scientific name	Status	IUCNcategory
Cave salamander	*Paradactylodon gorganensis*	Endemic	CR
Persian brook salamander	*Paradactylodon persicus*	Endemic	NT
Southern crested Newt	*Triturus karelinii*	Relatively abundant in region.	LC
Talysh toad	*Bufo eichwaldi*	Endemic to the Hyrcanian forests of Azerbaijan & Iran- Common in region	VU
Variable toad	*Pseudepidalea variabilis*	Common in country	DD
Oriental tree frog	*Hyla orientalis*	Common in region	NE
Eastern spadefoot	*Pelobates syriacus*	Rare in region	LC
European marsh frog	*Pelophylax ridibundus*	Common in region	LC
Wood frog	*Rana pseudodalmatina*	Endemic- Common in region	LC

2-2-5 Fishes

The fish fauna of the Caspian region is strongly linked to the Caspian Sea and considered as Caspian drainage basin; thus the species covered here include those living in streams and rivers flowing in the Hyrcanian region plus those that are marine migrants spawning in the rivers. There are 10 riverine fish species belonging to the Cyprinidae which live in only one or two rivers of the South Caspian Basin. The most important water bodies for these species are Sefid Rud and Aras rivers as well as Anzali Lagoon.

Quite recently, drastic changes in the Caspian Sea ecosystem have occurred. The main one was a rise of some 2 m in the level of the sea from 1977 to the mid 1990s followed by a fall in the most recent decade. This means a decline of fish habitats. Kiabi et al (1999) reports 12 alien fish species that potentially menace the native fish fauna, plus 53 native taxa (see table 5). This makes the Caspian basin an important area for fish. To our knowledge, no fish is endemic to the region. Given that many local people in the region work as fisherman and their income is engaged with fish harvesting, any changes in fish stock heavily influence them.

The threats to the fish fauna of the region are plentiful. Untreated sewage from the cities of Rasht and Anzali heavily pollute the water of the Anzali Lagoon, which is an important spawning ground for many fish species. Sand extraction in rivers such as Haraz and Sefidrud has lead to habitat degradation for many species, especially Acipenseridae (Sturgeon). The construction of dams at Gorganrud, the Aras River and the Tajan River has blocked the migration routes of many fish species. Finally, the extensive extraction of water for irrigation purposes has lead to a drastic decrease of the

water level in many rivers and other water bodies, and thus to a considerable reduction in suitable habitat quantity and quality. This is in particular valid for the rivers Gharasu, Gorganrud, Atrak and Babolrud (Kiabi et al, 1999). Eight species categorized by IUCN include: *Acipenser gueldenstaedti*, *Acipenser nudiventris*, *Acipenser persicus*, *Acipenser stellatus* all are critically endangered (CR), the *Salmo trutta caspius* is endangered (EN) *Barbus capito* and *Cyprinus carpio* vulnerable (VU) and *Caspiomyzon wagneri* is near threatened fish.

Table 5. The distribution of fish species over the main water bodies of the Iranian South Caspian. (Kiabi et al. 1999) Basin. A: Atrak River; B: Gorganrud; C: Gharasu River; D: Tajan River; E: Babolrud;F: Haraz River; G: Sardabrud; H: Aras River; I: Tonekabon River; J: Pol-e-Rud; K: Sefidrud;L: Anzali Lagoon; M: Gorgan Bay-Fishes recorded only in Caspian Sea excluded from this list. Relative abundance: 1= Rare; 2 = medium; 3 = abundant.

Alien species	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**
Crassius auratus	√	√	√	√	√	√	√	√	√	√	√	√	√
Ctenopharyngodon idella		√		√							√	√	
Cyprinus carpio	√	√	√	√	√			√			√	√	√
Gambusia holbrooki	√	√	√	√	√	√	√	√	√	√	√	√	√
Gasterosteus aculeatus		√		√									√
Hemiculture leucisculus												√	
Hypophthalmichthys molitrix		√		√				√			√	√	
Hypophthalmichthys nobilis		√		√				√			√	√	
Liza aurata												√	√
Liza saliens		√	√	√	√	√	√	√		√	√	√	√
Oncorhynchus mykiss		√				√							√
Pseudorasbora parva	√	√	√	√	√	√	√			√	√		

Native species	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**RA**	**IUCN 2015**
Abramis brama												√		1	LC
Acanthalburnus microlepis											√			1	LC
Acipenser gueldenstaedti	√	√	√	√	√	√					√			2	CR
Acipenser nudiventris											√			1	CR
Acipenser persicus		√		√	√	√					√			3	CR
Acipenser stellatus		√	√	√	√	√					√			3	CR
Alburnoides bipunctatus	√	√	√	√	√	√	√	√	√	√	√	√		3	LC
Alburnus alburnus	√	√	√	√	√	√	√	√	√	√	√	√		3	LC
Alburnus filippii								√			√			2	LC
Alosa caspia lenipowitschi												√	√	3	LC
Alosa caspia												√	√	3	LC

persica															
Aspius aspius								√			√			?	LC
Atherina boyeri												√	√	3	LC
Barbus brachycephalus												√		1	VU
Barbus capito	√	√		√	√	√	√	√		√	√	√		2	VU
Barbus lacerta				√	√	√	√	√	√	√	√	√		2	LC
Barbus mursa		√		√	√	√	√	√	√	√	√			2	LC
Benthophilus baeri													√	1?	LC
Benthophilus stellatus													√	2	LC
Blicca bjoerkna	√	√		√	√	√	√		√	√	√			3	LC
Capoeta capoeta gracilis	√	√	√	√	√	√	√	√	√	√	√	√	√	3	NE
Caspiomyzon wagneri		√		√	√	√	√	√	√	√	√	√		2	NT
Chalcalburnus chalcoides	√	√	√	√	√	√	√	√	√	√	√	√	√	3	LC
Chondrostoma cyri								√						1?	LC
Clupeonella engrauliformis												√	√	3	NE
Cobitis taenia		√	√	√	√	√	√	√		√	√	√		3	LC
Cyprinus carpio	√	√	√	√	√	√		√		√	√	√	√	3	VU
Esox lucius				√	√	√					√	√		2	LC
Huso huso		√									√			1	CR
Knipowitschia caucasica													√	2	LC
Leucaspius delineatus												√		1	LC
Leuciscus cephalus	√	√		√	√	√	√	√	√	√	√			2	LC
Nemacheilus bergianus											√			**1**	LC
Nemacheilus malapterurus	√	√	√	√	√	√	√							2	NE
Neogobius fluviatilis pallasi		√		√	√	√	√	√	√	√	√	√	√	3	LC
Neogobius kessleri		√	√	√	√	√				√	√	√	√	3	LC
Neogobius melanostomus		√							√		√		√	1	LC
Pelecus cultratus											√	√		1	LC
Perca luviatilis												√		2	LC
Proterorhinus marmoratus												√		1	LC
Rutilus rutilus caspius	√	√	√					√			√	√		3	LC
Rhodeus sericeus amarus		√		√	√	√	√				√	√		2	LC
Rutilus frisii kutum	√	√	√	√	√	√	√	√	√	√	√	√	√	3	LC
Sabanejewia aurata											√			1	LC
Sabanejewia caspia											√	√		1?	NE
Salmo trutta caspius							√		√				√	1	EN

Salmo trutta fario		√	√	√	√	√	√		√	√	√			2	??
Sander lucioperca		√						√					√	1	LC
Scardinius erythrophthalmus												√		2	LC
Siluris glanis	√	√						√			√	√		2	LC
Syngnathus abaster												√	√	3	LC
Tinca tinca				√	√	√					√	√		3	LC
Vimba vimba persa	√	√	√	√	√	√	√	√	√	√	√	√	√	3	LC

2-2-6 Invertebrates

Although there have only been limited invertebrate studies in Iran, recent references reveal some 20,000-25,000 species for the whole country (Official website of DOE, 2015). For the Hyrcanian region, the results of a 13 day investigation by Austrian biologists in 2001 in the eastern parts of the region is available (including Miankaleh W.R, Golestan N.P and Alagol wetland, in which detailed studies were conducted in the first two sites). Although outside the forest habitats, it showed that from more than 600 species of butterflies/moths (Lepidoptera) which were collected, most were new to the Iranian fauna, and some were new to science. They also recorded 80 species of beetles (Coleoptera), nearly 150 species of bugs (Heteroptera), about 40 different species of spiders (Arachnida) and species of Trichoptera (11) and Neuroptera (16) beside two species of freshwater crabs (Crustacea) (Gutleb & Wieser, 2002). Identification of 900 species of invertebrates in a very short period of time and space undoubtedly reveals the rich invertebrate fauna for the Hyrcanian region.

3- SIGNIFICANCE OF THE CASPIAN FORESTS FOR BIODIVERSITY

3-1 International significance

The Hyrcanian forests contain remnants of the broad-leaved forests that once covered most of the North Temperate Zone 25 - 50 million years ago, in the early Cenozoic Era. When Europe was covered by ice during the Pleistocene epoch, the Hyrcanian Forests remained alive, and at the end of the ice age plant species of the Hyrcanian forests extended their range to Europe. The Hyrcanian forests can therefore be considered as the mother of European forests.

The Caspian Hyrcanian forests are *de facto* an exceptional natural world heritage (Knapp, 2000) and an outstanding source of biodiversity not only for Asia and Europe but for the northern hemisphere (Gutleb & Wieser, 2002). They are also recognized as part of the "Caucasus-Anatolian-Hyrcanian Temperate Forests ecoregion, one of 200 important ecoregions of the globe according to WWF, known as "Caspian Hyrcanian mixed forest". They also encompasses six Important Bird Areas as identified by BirdLife International - most of which are legally covered by protected areas.

Although natural or close-to-natural deciduous forests can be found in many European states, their area is diminutive and a vast proportion of them have been fragmented or converted for agriculture, urban development or plantation forestry. Conditions of forests in eastern Asia are not better, with small areas of natural forests surviving especially in protected areas and adjacent to sacred places. Fortunately, Colchic, Caucasia and Alborz are important remnants of intact forests. Though the area of forests in Colchic and Caucasia are tiny, in northern Iran a relatively large proportion of associated deciduous broad-leaved forests still exist, and from an international and national point of view is exceptionally important for biodiversity, history and human culture.

Hundreds species are endemic to the region and this signifies the importance of conserving the Hyrcanian Forests.

3-2 National Significance

The Hyrcanian forest is considered to be a national treasure because of the diverse values it provides to Iranian and local society. Besides the current economical importance of these forests for providing timber, traditional exploitation of grazing livestock, and harvesting wild fruits and plants, the forest actually is a diverse and significant genetic source for future industrial products. The value of the Hyrcanian forests now and in the future is due to the valuable ecosystem services that the forests provide, in terms of protecting city and village dwellers of the region against floods and droughts, soil erosion and landslides, besides providing fresh water. All of these benefits are dependent on the rich biodiversity of the forests. These values are expected to become even more important in the face of helping adaptation to climate change (Sperber, 2000).

The trees of the Caspian Hyrcanian forests are of enormous economic and intrinsic value. They provide the main landscape component of the forests, play a crucial role in micro-climatic (and probably macro-climatic) regulation, contribute to regulation of floods and droughts, atmospheric quality and to the vital recreation and tourism industries and to health and wellbeing. They also provide or support a number of important non-timber forest products such as honey, silk and nuts. However, the main direct use is for the production of timber. FRWO estimates that a total of 600 thousand m^3 of timber is harvested annually from the forests, with the main uses being for hardboard, chipboard and paper sheet (Avatefi Hemmat pers. comm.). An additional unknown but large volume of timber is also harvested legally and illegally for firewood.

Due to its unique climate, the Caspian forest region enjoys a green ecosystem in an arid and semi-arid country, which plays a major role in tourism and ecotourism development, including domestic demand and recreation. According to the Statistical Centre of Iran (2008a), from a total of 68,973,950 tourist visits who travel to the countryside each year, Rasht (capital of Gilan province) is visited by 2,454,278 people (3.6%) and Sari (capital of Mazandaran province) is visited by 1,254,622 people (1.9%).

3-3 Ecosystem services valuation

A number of ecosystem services provided by the Hyrcanian forests have already mentioned. Based on recent findings and in terms of timber production, the monetary value of each hectare of these forest is estimated 5,420,000 IRR (180.6 US$) on average (30110 IRR=1 USD). However the price value of water yield per hectare is calculated 222,300,000 IRR (7382 US$). This number is almost 41 times higher than the value of timber production. Although currently there are few payments for those receiving these ecosystem services, the Caspian Hyrcanian forest project aims to incorporate these numbers in to the basic planning system of forest management (Panahi, 2016)

4- THREATS TO BIODIVERSITY

Despite the great national and international importance of the Hyrcanian forests, the area faces many threats affecting both forest cover and forest condition, and therefore biodiversity. Since 1950, the area of the Hyrcanian forests has decreased very significantly from 2,750,000 ha (Saeii, 1950) to 1,850,000 ha, that is a loss of 32.7 percent (= one third of the forest).

Table 6 summarises the main threats, and the trend of those threats compared with 20 years before, and the affected taxonomic group.

Table 6. Summary of the main threats to biodiversity in the Hyrcanian forests. Each threat, scored from zero (NA) to three (high) based on subjective impact on different taxonomic threats. The written terms (low, medium etc) indicate to rate that each taxonomic group can potentially be affected by the various threats and face alteration in their population or distribution or both. Note that mentioned impacts are relative and they have been compared with each other.

Main threats/affected taxonomic group	Trend of threat	Flora	Mammals	Birds	Reptiles	Amphibians	Fishes	Invertebrate	Average score
Connectivity loss and fragmentation due to road building or other developments	↗	High	High	High	Medium	Medium	Low	High	2.4
Harvesting dead trees for firewood	↘	Low	Medium	Medium	Low	Low	NA	High	1.4
Illegal hunting and direct killing	→	NA	High	Medium	Medium	Low	NA	NA	1.1
Water pollution	↗	High	Medium	Medium	Medium	High	High	High	2.6
Garbage dumping or dropping	↗	Low	Medium	Low	Low	Medium	Low	Low	1.3
Land encroachment and diverting forest to orchards, cultivated land or villa	→	High	High	High	High	High	Medium	High	2.8
Overgrazing by livestock	→	High	High	Medium	Medium	Medium	NA	Medium	2.0
Collecting medicinal, industrial or edible herbs	↗	Medium	Low	Low	Low	NA	Low	Low	1.0
Unsustainable harvesting timber	↘	Medium	Medium	Medium	Medium	Medium	Medium	Medium	2.0
Extensive usage of biocides (pesticide, herbicide, fungicide, etc)	↗	Low	Low	Low	High	High	High	High	2.0
Dam construction and diversion of water for irrigation etc	↗	High	Medium	Low	Low	Low	High	Low	1.7
Over-fishing	↗	NA	Low	NA	NA	NA	High	NA	0.5
Exploitation of sand and silt from river bed	↗	NA	Low	NA	Medium	High	High	Medium	1.6
Alien species	↗	Medium	Low	Low	Low	Low	Medium	Low	1.3
Pests and diseases	↗	High	Low	NA	NA	NA	Medium	NA	0.8

Main threats/affected taxonomic group	Trend of threat	Flora	Mammals	Birds	Reptiles	Amphibians	Fishes	Invertebrate	Average score
Human disturbance (e.g. tourism)	↗	Low	Medium	Low	Low	Low	Low	Low	1.0
Forest fires	↗	High	High	Medium	Low	Low	NA	Low	1.6

If we classify the above threats into habitat loss, habitat degradation and harvesting; the weight of habitat degradation has highest number (12.6) followed by habitat loss (8.5) and harvesting (6). However, all the seven taxonomic groups are vulnerable to 'Land encroachment and diverting forest to orchards, cultivated land or villa' more than other threats (2.8/3) followed by 'water pollution' (2.6/3) and 'connectivity loss and fragmentation due to road building or other developments' (2.4/3). The lowest rank (.5/3) is assigned to 'overfishing' which has the lowest impact on other taxa. The following section discusses some of the specific threats to different taxa.

4-1 Flora

The most significant threats to the flora of the region includes: connectivity loss and fragmentation of habitat due to road building or other developments, land encroachment and converting forest to orchards, cultivated land or villas, overgrazing by livestock, pests and diseases and forest fires, afforestation by alien species, water pollution and dam construction and diversion of water for irrigation etc.. Beside the chief threat from forest conversion, menace severe threat to flora arises from the large numbers of cattle and sheep which graze freely over much of the Hyrcanian forests, denuding the forest floor and preventing re-growth, particularly of trees (Firouz, 2005). This threat is reversible by reduction of grazing pressure and better grazing management. Currently, vegetation composition has been modified since plants which are resistant to grazing or browsing will dominate. Many originally tree-forms species including *Carpinus orientalis*, *C. betulus* and *Quercus macranthera* are now widely seen in the form of scrub (Mehrabian & Madjnounian, 2015). Further threats, particularly to tree species and forest condition arise from forest fires and tree diseases, both of which are increasing in frequency. Climate is changing in the Hyrcanian region, and the average annual temperature has increased by one degree Celsius and precipitation declined by 125 mm over the last three decades (National plan for forest conservation of Iran, 2015).

Regarding diseases, the fungi are responsible for 96 percent of diseases in forest ecosystems, while insects plus viruses comprise the remaining four percent (Marvi Mohajer, 2011). In the case of insect pests in the Hyrcanian forest, the general species are leaf-eating caterpillars from the family Geometridae, as well as Tortricidae (Akbary, 2004). A number of insects including oak leaf-eater moth (an introduced species) or diseases such as Dutch elm disease have foreign origin (probably China), imported to the country in 1958 (Mehrabian, 2014). The latter, is responsible for the destruction of one million individual trees of both Mountain elm (*Ulmus glabra*) and English elm (*U. minor*) in the country since the 1970s. The commercial value of these elm trees was estimated to be nearly four percent of the total industrial woods of Iran, and now is only estimated to be less than one percent (Rahnama & Araghi, 2009).

In recent years Boxwood blight caused by *Calonectria pseudonaviculata* (Syn: *Cylindrocladium buxicola*) has been established in hyrcanian forest and the considerable damage has been recorded . (Rezaee et al, 2012).

Fire is also a very determining element in quality and quantity of Hyrcanian forests. Although fire in broad-leaved forest is not as dangerous as in coniferous woodlands (Adeli & Yakhkeshi, 1975), due to increase of dry-periods in northern forests, the vulnerability of such forests is increasing.

Water pollution and dam construction also impact the flora, although no official statistic is available regarding the amount of damage by these factors.

4-2 Mammals

Road construction and forest fragmentation, whether for timber harvesting or rural or urban development, are a particular threat to large mammal populations. The roads disconnect the forest integrity, and provide access to the heart of the forest for illegal hunters and cause road-kill mortality. It seems that the chief threat to mammals in the Caspian forests is habitat loss and degradation plus illegal hunting of large herbivores and also Brown bear. Drastic declines of wild ungulates lead to a dramatic drop in number of prey for leopard and grey wolf that enhance predation of domestic livestock which eventually leads to an increase in the frequency of human-carnivore conflicts which often results in retaliatory killing. The details of such mortality has been elaborated in section 3-2-1.

4-3 Birds

Birds as vital elements of Hyrcanian forests are suffering similar threats to the Mammals. The foremost threatening factors stem from habitat loss or degradation. Satellite images reveal numerous small or large patches and isolated islands of forest habitat throughout the Caspian forests.

Tohidifar & Moser (2015) suggest that intact high forest including large amounts of older trees and dead wood are important to woodpeckers and other forest specialist bird species. In line with this, many studies have highlighted the vital roles of forest cavity-nesting bird (CNB) communities as indicators for monitoring forest quality. Implementing forest management to benefit cavity-nesting birds will ensure that the ecological needs of these species are met, and may also provide better habitat for other dependent species. (Bani Assadi et al., 2015).
The near-endemic Caspian Tit living in highland forests is extensively dependant on standing dead trees (snags) for nesting (Loskot, 2014). This is widely collected by local herders as fuel wood. However, other forest species are widely distributed across areas with different forest cover and condition. The management implications within this working forest are that significant areas of high-forest should be set-aside from direct timber exploitation (but still used to deliver other ecosystem services), while sustainable use (forestry, grazing, NTFPs etc) of the remainder of the forest is likely to be compatible with bird conservation.

4-4 Reptiles

Two threatening factors stand as the main hazard for reptiles; these are land encroachment as well as use of pesticides. However, illegal hunting and direct killing also pose another menace. Although reptiles are not used for food nor hunted for skins, they have suffered a great decline due not only to habitat destruction but specifically because of direct killing stemming from an inbred human fear of reptiles. The case for snakes is worse, since the dread of snakes in particular, leads many people to kill

them on sight. This slaughter in line with high levels of biocides in orchards, crops and streams has severely depleted reptile populations in many regions (Firouz, 2005).

4-5 Amphibians

The vast number of frogs once seen in the marshes, ponds and streams, as well as gardens in towns and cities are no more. They are rarely seen nowadays and neither are toads or salamanders. Water pollution, land encroachment and converting forest into artificial landscapes, extensive usage of biocides and exploitation of sand and silt from river beds or even any combination of these, comprise the most important hazards for amphibians in the region. Owing to their physiological dependence on water, these creatures are more vulnerable to environmental degradation than other classes of animals. In Iran, as elsewhere, the alteration, destruction and pollution of wetlands and comparable despoliation of other bodies of water (rivers, lakes and sea-shores) have all resulted in the rapid decline and extinction of many populations of amphibians (Firouz, 2005).

4-6 Fishes

Many of Caspian species such as *Salmotrutta caspius*, *Rutilus frisii* kutum and the *Acipenseridae* (sturgeon) family are anadromous, spawning in their natal waters. The problems facing these fish increase yearly, including water pollution (also eutrophication), the diversion of water for irrigation and the construction of dams and traps that prevent the majority of populations from reaching their customary spawning grounds (Firouz, 2005). The loss of spawning grounds is the major cause of decline in the population size of *Caspiomyzon wagneri* in Iranian water bodies (Kiabi et al, 1999).

The successful ones still face a degraded aquatic ecosystem. Pollution (via extensive use of biocides) and over-fishing have also led to a great decrease in the commercial fish catches. For instance, all *Acipenser* species plus *Barbus capito* suffer from overfishing and degradation of spawning grounds (Kiabi et al., 1999). In addition to above threats, alien and introduced species whether coming from a different drainage basin or different country, pose a menace through import of parasites or diseases to which the native species are much more vulnerable. They may also be a serious food competitor or predator, whether on the mature indigenous fishes or on their eggs and their young (Firouz, 2005). Although there have been important publications concerning the poor status of fishes in Caspian basin, there have been no successful conservation measures for the rivers as yet. Harvesting sand and silt from the river-bed and other hazards exist and unfortunately surged dramatically in recent years.

4-7 Invertebrates

Similar to other taxa, habitat loss affects greatly this group. Since general knowledge on the status of Lepidoptera (particularly butterfly species) is more significant, here, examples focus on this taxon.
Forest destruction and road building (which already affected the population of *Polymattus vandarbani*) follows by replacement of one human-preferred plant instead of a community of herbs generally affects insects. Planting wheat or rice paddies in a converted land can easily delete the host plant of a butterfly which is the case for *Anathocharis carolinae* and *Melanargia evartianae* both endemic to Hyrcanian forests of Iran (Mazandaran & Golestan provinces), as well as *Lasiommata adrastoides* , *Hipparchia turcmenica* (Naderi, 2012). The other serious threats to invertebrates of the Hyrcanian forests include usage of agricultural pesticides that also kill many other benign invertebrates. This particularly has shown increasingly severing impacts on beneficial insects as well as endemic butterflies (e.g. *Ochlodes hyrcana*) or other general butterflies (e.g. *Vanessa atalanta*) especially in areas adjacent to agricultural fields or orchards (Nazari, 2003). The second threat is

harvesting dead trees, which host specific invertebrate fauna. Truly named as wildlife trees, dead trees provide valuable living habitat for many species chiefly invertebrates and over-exploitation for timber or fuel wood can affect them badly. Water pollution is also hazardous element for invertebrates, many of which reproduce in aquatic habitats. Many species are also affected by overgrazing including some butterflies: *Polymattus klasusschuriani* endemic to Hyrcanian forests of Iran (Mazandaran province) *Polymattus valiabadi , Melanargia teneates,* both endemic to Hyrcanian forests of Iran & Azerbaijan *Phengaris alcon*, *Polyommatus aegagrus* (Endemic of Iran) and *Coenonympha arcania* (Naderi, 2012).

4-8 Climate change and Hyrcanian forest

Climate change impacts on forests vary greatly due to stand age, soil trait and composition of plants; however degraded forests are less resilient and more prone to be influenced by climate change (Khosravi & Tohidifar, 2015).
During the last half century, the climate of the Caspian forest became warmer. Research (Jafari, 2007) showed that during the last 49 years in Rasht station mean annual temperature increased by about 1.28 °C and even its minimum temperature shows 2.45 °C increases. Increase in mean annual temperature in Baboulsar station in last 54 years is about 1.44 °C and its minimum temperature shows 1.80 °C increases. Decrease of annual precipitation in Anzali station during last 54 years of records is about 409.4 mm and amount of decrease of precipitation for the period of last 53 years in Gorgan station is about 55.6 mm. In study zones especially in Gilan and Gorgan areas temperatures show more than one degree increases and main species of vegetation cover moved upward about 100 meters.

Due to the strong relationship of temperature regime and vegetation distribution, it is predicted that distribution of plant communities will be affected (Jafari, 2007). Severe impacts of global warming in temperate forests can lead to an outbreak of new diseases and pests (Khosravi & Tohidifar, 2015). Many scientists attribute Box (*Buxus hyrcana*) dieback disease in Hyrcanian forests to climate change. The extensive consequences of such changes on forests can also affect humans, causing devastating floods (heavy rainfall in a degraded forest) or droughts or exposing the forest to dryness and fires. Local people and biodiversity are both victims of such incidents. Both the vegetation composition of the Hyrcanian forests and the fauna will be threatened, although some species (e.g. pioneers) would benefit from such conditions (Jafari, 2007). Different impacts of climate change must clearly be elaborated for decision-makers for further determinations to alleviate the impacts.

5- AN OVERVIEW OF BIODIVERSITY CONSERVATION AND MANAGEMENT IN THE CASPIAN FORESTS

5-1 The main laws and policies for biodiversity conservation

According to national laws, the protection, rehabilitation, development and harvesting of forests, rangelands and bush lands have been assigned to FRWO. The Department of Environment (DOE) has responsibility to identify and protect areas with unique ecological features, important ecosystems, high-valued plants and animals including rare and threatened species as well as their habitats (environmental protection laws and regulations of Iran, 2005).

Furthermore, the draft of the sixth five-year development plan of Iran (2016-2021) emphasises conservation, rehabilitation and sustainable harvesting from natural resources and biodiversity with participatory approach of NGOs as well as development of regional and international collaborations for removal of trans-boundary environmental problems.

5-2 Current status of protected areas and forest reserves

Based on the duties upon DOE, four areas including national parks, national/natural monuments, wildlife refuges and protected areas have been proposed and selected in the country since 1974. At the time being, nearly 30 protected areas (Table 7, Figure 2) are designated in the Caspian forests, including all four DOE categories (National park, wildlife refuge, protected area and national natural monument). These are not just forest habitats, but also include surrounding mountain steppe, upland scrubland and even lowland semi-arid zones, bringing a total of no less than 500,000ha of the northern aspect of the Alborz including the Caspian Hyrcanian forests under DOE control. It can be estimated that approximately 80% (= 400,000 ha) of this is forest habitat (ie approximately 22% of the Hyrcanian forests). Moreover, DOE also identified and proposed many areas as no-hunting zones which in essence means hunting is the only banned activity. Other conservational aspects include; international wetlands, biosphere reserves and geo-parks in which despite their mention in the environmental literature, have no place in national rules and regulations.

In addition, FRWO also controls two categories including natural forest parks and nature parks, which comprise approximately 48,500 ha in the region. Of this area, nearly 70% (34,000 ha) has a forest management plan. Indeed, almost half of the Hyrcanian forest area is covered by operational forest management plans, overseen by FRWO and in all areas with active forestry plan, a few parcels are selected as preserved patches especially those with unique forest stands or rocky and high slope terrains (but these do not necessarily address biodiversity conservation requirements) (Tohidifar 2016). FRWO also bans cutting a number of trees namely; Box (*Buxus hyrcanus*), Italian cypress (*Cupressus sempervirens*), English Yew (*Taxus baccata*), Oriental arbor vitae (*Platycladus orientalis*), Common birch (*Betula pendula*), *Acer velutinum* and etc.

FRWO also is responsible for forest reserves; habitats of rare, endangered, threatened species or other native species of plant that in comparison with other flora, have a superior genetically value. 40 forest reserves (Table 8, Fig 2) with an area of approximately 17,000 ha are located in the Hyrcanian forests.
Table7. List of protected areas governed by Department of Environment (DOE) in HF region

Number	Name & category of area	Province	Area (ha)
1	Abshare Shirgah PA (Waterfall)	Mazandaran	3639
2	Alborz-e-Markazi PA (Central Alborz)	Mazandaran-Tehran	398820

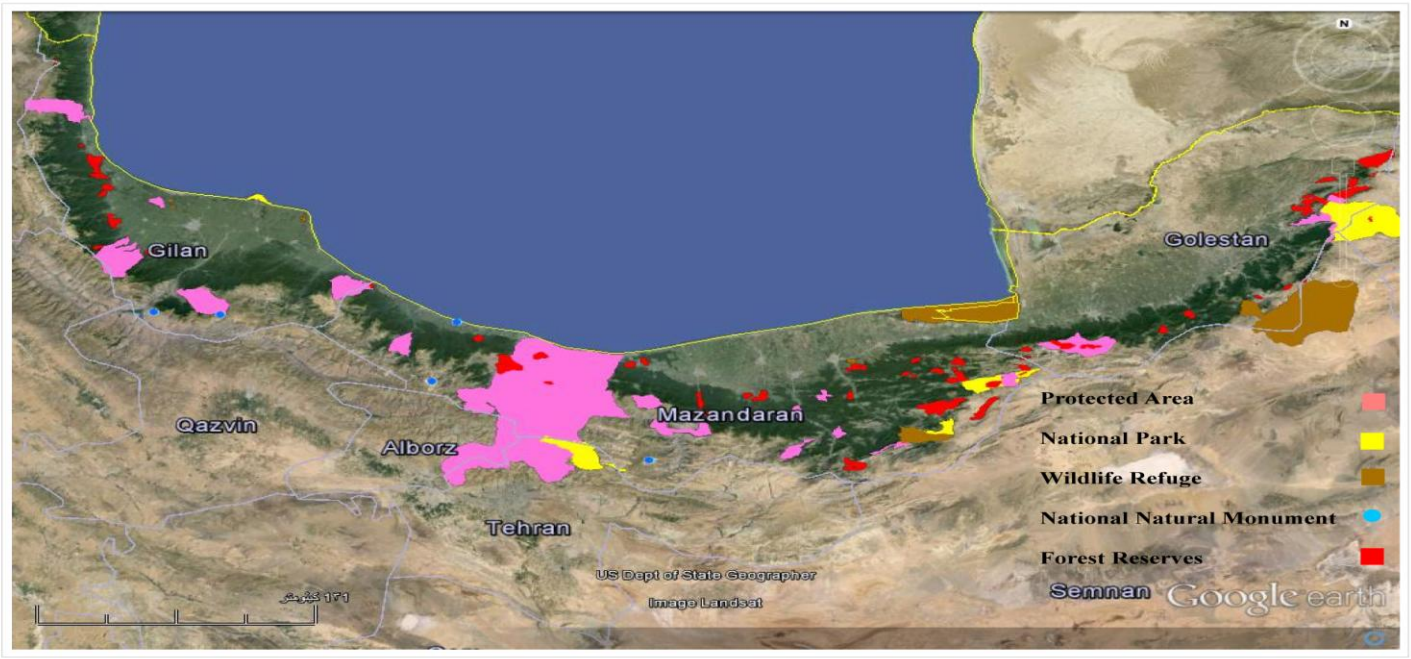
3	Balas Kuh PA	Mazandaran	11211
4	Bola PA	Mazandaran	3907
5	Chaharbagh PR	Mazandaran	19482
6	Dasht-e-Naz WR	Mazandaran	56
7	Dodangeh WR	Mazandaran	16868
8	Esas PR	Mazandaran	2997
9	Fakjoor Damkesh Spring NM	Gilan	0.05
10	Gashte Roodkhan and SiahMazgi PA	Gilan	39514
11	Golestan NP	Golestan, N Khorassan	87402
12	Haraz PR	Mazandaran	15481
13	Harzvil Cypress (Cupressus sempervirens) NM	Gilan	0.6
14	Hezar Jarib PA	Mazandaran	6195
15	Jahan Nama PR	Golestan	30511
16	Khoshkeh Daran NM	Mazandaran	254
17	Kiasar NP	Mazandaran	9027
18	Khiboos and Anjilsi PA	Mazandaran	3471
19	Lilium ledebourii NM	Gilan	1
20	Lisar PA	Gilan-Ardabil	31142
21	Lavandville WR	Gilan	1074
22	Loveh PA	Golestan	3589
23	Paband NP	Mazandaran	24445
24	Sarvelat and Javaherdasht PR	Gilan	21254
25	Semaskandeh WR	Mazandaran	1041
26	Shesh Rudbar PA	Mazandaran	7922
27	Siahrud Rudebar	Gilan	28289
28	Vaz PA	Mazandaran	9646
29	Zav PA	Golestan	14323
	Total		791563

Table 8. List of forest reserves in the Hyrcanian region governed by FRWO

Number	**Name**	**Location**	**Province**	**Area(ha)**	**Important plant species**
1	Sarvenoush sorkesh	Aliabad	Golestan	195	*Platycladus orientalis*
2	Peste Qazanqyeh	Kalaleh	Golestan	785	*Pistacia spp*
3	Zarbin Ramian	Ramian	Golestan	520	*Cupressus sempervirens*
4	Zarbin Zarin Gol	Aliabad	Golestan	115	*Cupressus sempervirens*
5	Shemshad Cheshme bolbol	Bandar-Gaz	Golestan	420	*Buxus hyrcana*
6	Sorkhdar Afratakhte	Aliabad	Golestan	200	*Taxus baccata*
7	Zarbin Hasina	Galikesh	Golestan	50	*Cupressus sempervirens*
8	Anab kalaleh	Kalaleh	Golestan	20	*Ziziphus sp*
9	Daghdaghan Bagho	Bandar-Gaz	Golestan	30	*Celtis caucasia*
10	Azad deland	Ramian	Golestan	200	*Zelkova carpinifolia*
11	Rash qezlagh	Gorgan	Golestan	200	*Fagus orientalis*
12	Sorkhdar pon	Aliabad	Golestan	200	*Taxus baccata*
13	Ors Jahan nama	Kordkoy	Golestan	300	*Juniperus spp*
14	Fandogh poshte Heyran	Talesh	Gilan	150	*Corylus avellana*
15	Kabod mehr	Talesh	Gilan	75	*Corylus avellana*
16	Dr.Dorostkar	Rezvanshahr	Gilan	200	*Buxus hyrcana*
17	Safa Gashteh	Fouman	Gilan	50	*Corylus avellana*
18	Qale roudkhan	Fouman	Gilan	80	*Taxus baccata*
19	Halimeh Jan	Roudbar	Gilan	10	*Populus caspica*
20	Amarlou	Roudbar	Gilan	1250	*Juniperus spp*
21	Katbe kellas	Roudbar	Gilan	1000	*Juniperus spp*
22	Sidan	Roudbar	Gilan	185	*Cupressus sempervirens*
23	Ashker sar	Roudsar	Gilan	500	*Juniperus spp*
24	Safrabasteh	Astaneh asharfieh	Gilan	199	*Populus caspica*
25	Sefid pelet Nour	Nour	Mazandaran	550	*Populus caspica*

26	Shemshad MirzaKochak Khan	Amol	Mazandaran	250	*Buxus hyrcana*
27	Noghle ben Siah bisheh	siah bisheh	Mazandaran	221	*Juniperus spp*
28	Ahnah sar	Marijon	Mazandaran	70	*Juniperus spp*
29	Ziar	Amol	Mazandaran	50	*Juniperus spp*
30	Khibous	Savad kouh	Mazandaran	604	*Buxus hyrcana*
31	Gazoo	Savad kouh	Mazandaran	300	*Taxus baccata*
32	Sangedeh	Sangedeh	Mazandaran	100	*Buxus hyrcana*
33	Yaneh Sar Galogah	not known	Mazandaran	50	*Taxus baccata*
34	Zarbin hasan abad	Marzan Abad	Mazandaran	7400	*Sorbus boisseriei & Betula pendula*
35	Shemshad Toskatak	Noushahr	Mazandaran	104	*Juniperus spp*
36	Chista Abasabad	Abbas abad	Mazandaran	82	*Cupressus sempervirens*
37	Keisi	Noushahr	Mazandaran	12	*Buxus hyrcana*
38	Tous	Siah bisheh	Mazandaran	128	*Buxus hyrcana*
	Total			16855	

Fig 7. Provincial boundaries, protected areas and forest reserves in the Hyrcanian forests.



5-3 Conservation planning and management, monitoring and law enforcement

Generally, natural forest parks and nature parks are the main venue for recreational purposes in both regional and national level and since the utilization is beyond the capacity, they are prone to degradation or destruction. In terms of conservation, actions in forest reserves as the main important parts, have been limited to physical protection (fence & barbed-wire enclosures). Regarding the DOE with very few exceptions, management plans and guidelines either do not exist for these protected areas, or are not implemented effectively.

As a matter of fact, neither protected areas nor forest reserves are efficiently guaranteeing the long-term conservation of these set-asides. The problem stems from the fact that any proper management needs planning and scheduling procedures which is either completely absent or, if it exists, is never put into practice. The problem also derives from the management plans which are rarely feasible enough for implementation, and do not engage the required stakeholders. The quality of gathered data

is actually very weak since not enough field visits are undertaken in areas, and socio-economic studies chiefly depend on governmental statistics with less technical interviews and almost no questions ever asked regarding the willingness of local people for helping and prompting conservation near their homeland. This is why we witness numerous 'paper protected areas' which are *de facto* suffering from different problems and the quality of ecosystems has a gloomy future, despite the fact that laws and regulations seems adequate to ensure conservation of natural ecosystems; furthermore, the enforcement of law is fragile.

The key problem as described above originates from mismanagement and the scarcity of trained staff both in rangers as well as at expert level. In a broad view, lack of strategy for nature conservation in bodies of both DOE and FRWO in Iran is leading ecosystem instability.

5-4 Special Areas for Biodiversity

As mentioned before, nearly 30 protected areas have been designated by DOE in the Alborz Mountains and south Caspian area (Table 5) and nearly 40 forest reserves by FRWO (Table 6). However, due to lack of management or mis-management, they have not succeeded in adequately protecting the biodiversity of the Hyrcanian forest, given that most threats are increasing. Therefore, improving the effectiveness of the management of these protected areas, and increasing their area through the addition of new sites is crucial to guarantee conservation of this very important natural heritage of SW Asia. However, protected areas alone will never be adequate for safeguarding biodiversity throughout the Hyrcanian forests, for which a broader landscape-scale approach to conservation is required.

The term SABs (Sabz="green in farsi") (Special Areas for Biodiversity) has emerged from the set-aside concept addressed in the project document of the Caspian Hyrcanian forest project. The project by the end of 2018, should officially introduce a minimum 100,000 ha of such areas that are extremely significant for biodiversity conservation and should be representative of the high value forests of the region with a rich flora and fauna. Meanwhile, the project should develop a SABs guideline to address the general outlines for management of the site. At the time being, the proposal for nominating appropriate candidate SABs is under development and will be finalized by the end of 2016.

6- GAPS IN INFORMATION / PRIORITIES FOR RESEARCH

To our knowledge, no thorough study has been conducted in order to address different ecological relationships of flora and different faunal groups within the forest ecosystem. The few recent quantitative biodiversity surveys (Tohidifar & Moser, 2015 & Ghadirian & Raeesi, 2015) are just preliminary researches and there is a need to systematically study the occurrences of different taxa in a landscape with regard to forest condition or cover. The results of such studies are urgently needed to guide forest management. Finally, knowledge on many endemic or threatened species, especially in terms of fauna, is very limited and biological and ecological studies should be done to understand their requirements in more detail.

The following sections provide a preliminary list of priority topics for research, which should be pursued by universities and research institutes:

Ecology of species

- Study on the effect of harvesting timber on wildlife
- Study on ecology of forest specialist birds regarding their habitat preferences
- Study and identification of invertebrates living in dead trees
- Population estimation of large mammals in Hyrcanian forest
- Habitat preference of large ungulates in untouched forests
- Impacts of removal of large ungulates on forest quality in untouched areas
- Phytosociology studies in different flora types of Hyrcanian forests and preparing forest communities map for these forests.
- A thorough study on the small and meso mammals of the Caspian region
- Preliminary research on the effects of an apex predator like leopard on population control of mesopredators like wolf in Hyrcanian forests

Forest conservation and protection

- Study on trend of forest cover in Hyrcanian region
- Investigation on beliefs of local people regarding carnivorous mammals
- Estimation of the amount of illegal hunting along Caspian forests
- Study of quality of forests in protected areas in comparison with managed forests
- Detecting reasons of livestock disease and impacts of mortality on economy of local people

Climate change

- Study of vulnerable ecosystems toward impacts of global warming with proposing adaptation methods
- Study of vulnerable species of wildlife against climate change across Caspian forests

7- RECOMMENDED BIODIVERSITY CONSERVATION MEASURES

Given that the mentioned threats are proximate, the root causes of such threats originate from many socio-economical, political and also cultural issues of which a number are listed below: Weak supervision and enforcement of natural resources management and biodiversity regulations or laws, lack of awareness of forest ecosystems and function among policy-makers, increased demand for fish, timber, etc, sectoral attitudes for land management, disregard of environmental/biodiversity issues in economic developments plans (Avatefi hemmat, pers.comm).

The conservation and management of the Caspian forests for its biodiversity and other values is a complex issue and there is no one solution. Integrated and holistic management that incorporates both ecological and socio-economical aspects is required. Simultaneous and integrated implementation of conservation and sustainable use requires a twofold solution:

* Comprehensive conservation of untouched (protected) forests.
* Sustainable utilization and exploitation of non-protected forests should be fulfilled according to principles of the CBD ecosystem approach and sustainable forest management, in which biodiversity conservation is mainstreamed and public participation has high priority.

Nearly 100,000 ha of the Caspian forests are still pristine (Sperber, 2000), reflecting 25-50 million years of natural evolution. These most critical areas of the forests have to be strictly protected against exploitation or road building activities. The global values of these areas of forests far outweigh the revenues that could be derived from timber extraction (Knapp, 2000).

The following specific recommendations are made to improve biodiversity conservation in the Hyrcanian forests:

1- The establishment of 100,000 ha of Special Areas for Biodiversity as described above, with appropriate management measures including community conserved areas.

2- Mainstreaming of biodiversity conservation into the responsibilities of all agencies that are affecting the forests, through integrated management plans, as well as appropriate sectoral guidelines.

3- Since human-wildlife conflicts are present in many areas of region, Ghadirian & Raeesi suggested two types of mitigation methods: human-focused and animal-focused. Human-focused methods include education and awareness of herders and farmers, training guard dogs, removing and burning carcasses of livestock and insuring livestock; animal-focused methods include carnivore-proof fencing (e.g. electric fences) and habitat management for increasing the population size of wild prey. This should ideally be put into practice as a group work by DOE, FRWO and active NGOs.

4- Management planning for the Hyrcanian forests should consider setting aside areas of high quality (older trees with plenty of dead wood habitat) as undisturbed forest for forest specialist birds as well as other wildlife species. The results suggest that sustainable forest management across the remainder of the forests is likely to be compatible with bird conservation objectives. Engagement of universities with FRWO is highly recommended here for ensuring right and correct conduct.

5- Encroachment and increasing of cultivated fields and orchards should have a definite limit to guarantee remaining of adequate habitat for wildlife. The declining trend of large herbivores impel them into secondary habitats that would reduce quality of habitat for different sorts of living, including mating and even feeding (Kiabi, pers comm.). Connectivity of habitats must be considered as first and foremost priority even more important than population increase. For this, writing and ratification of a nature conservation strategy for the Hyrcanian forest is an inevitable solution. A participatory task force including DOE, FRWO, universities and active NGOs should be established to prepare a legal draft for approval by the high council of environment to officially send into related sectors.

6- Regarding public awareness and training of stakeholders, priorities should be developed by NGOs with close collaboration with DOE and FRWO and the training material published as leaflets, posters or brochures, to be widely distributed via provincial DOE/FRWO offices in the region. Simultaneously, all authorities including NGOs should inform and educate the public and to attempt to create a conservation consciousness.

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