

**Research Article****A Physiognomic-Ecological Vegetation Mapping of Boujagh National Park, the first Marine-land National Park in Iran****Alireza Naqinezhad**

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**ABSTRACT**

*Vegetation mapping is one of the most important phases of vegetation conservation and also serve as useful guides for identifying a land's potential and its environmental capabilities as presented in the map. Boujagh National Park (BNP) is the first founded land-marine National Park and one of nineteen National Parks in Iran located in Caspian coastline. Part of this area has been declared as a Ramsar site as well and the estuary of Sefidrud, the largest river of Iran, is located in this site. The area is a refuge for many endangered migratory birds such as Siberian Crane. The vegetation types (unites) were studied with physiognomic-ecologic and floristic approach using ILWIS software and all available topographic and aerial maps. Nine vegetation types were recognized in the area based on both field works and satellite mapping. The indicator and accompanying species of each vegetation type are presented. Moreover, the amount of anthropogenic effects on each type are discussed and compared to similar vegetation types occurred in other regions. The preparation of vegetation maps with physiognomic-ecologic point view is highly critical for such a threatened ecosystem in order to evaluate the ecological potential of the area and further decision on its conservation and management.*

**Key words:** Boujagh National Park, vegetation map, Caspian Sea, Iran**INTRODUCTION**

Vegetation mapping is one of the most important phases of vegetation conservation [1]. Maps of actual vegetation show the current distribution of vegetation types in a given area, usually in small areas of particular interest, such as nature reserves [2]. The main goal of traditional vegetation mapping has been the identification of plant communities that are defined as the repetitive combination of species, structural types, growth forms and other terrain attributes [3,4]. Vegetation maps serve as useful guides for identifying a land's potential and its environmental capabilities as presented in the map, thus showing ways for solving many problems which can come up in the course of developing and utilizing a land [5].

Boujagh National Park (BNP) is the first founded land-marine National Park and one of nineteen National Parks in Iran located in Caspian coastline [6]. Part of this area has been declared as a Ramsar site (one of the 22 internationally important wetlands catalogued in Iran) due to its biodiversity and birds refuges [7]. BNP is very important ecosystem complex because of the fact that this area serves as a very valuable resting, nesting and wintering place for a wide variety of waterfowls particularly Siberian Crane, an endangered migratory bird [8]. The complete floristic survey of the area was carried out by Naqinezhad *et al.* [6] followed by some other studies on its fauna [9].

There are few investigations conducted upon vegetation mapping and representing the vegetation structures in Iran particularly with a traditional method of survey. The distribution of vegetation types has been depicted cartographically by Tregubov and Mobayen [10], Mobayen [11], Freitag [12], Frey [13], Kramer [14]; Frey *et al.*, [15], Kunkel [16]; Zohary [17], Leroy *et al.* [18]. Majority of these vegetation maps are based on a physiognomic-ecological separation of large plant formations in the studied areas. Instead, some new vegetation maps are still based on classical phytosociological approaches [e.g. 5, 19, 20]. Due to the ecological and conservational values of the Boujagh National Park, this area was selected for vegetation mapping based on an integrative description of community structure and floristic attributes.

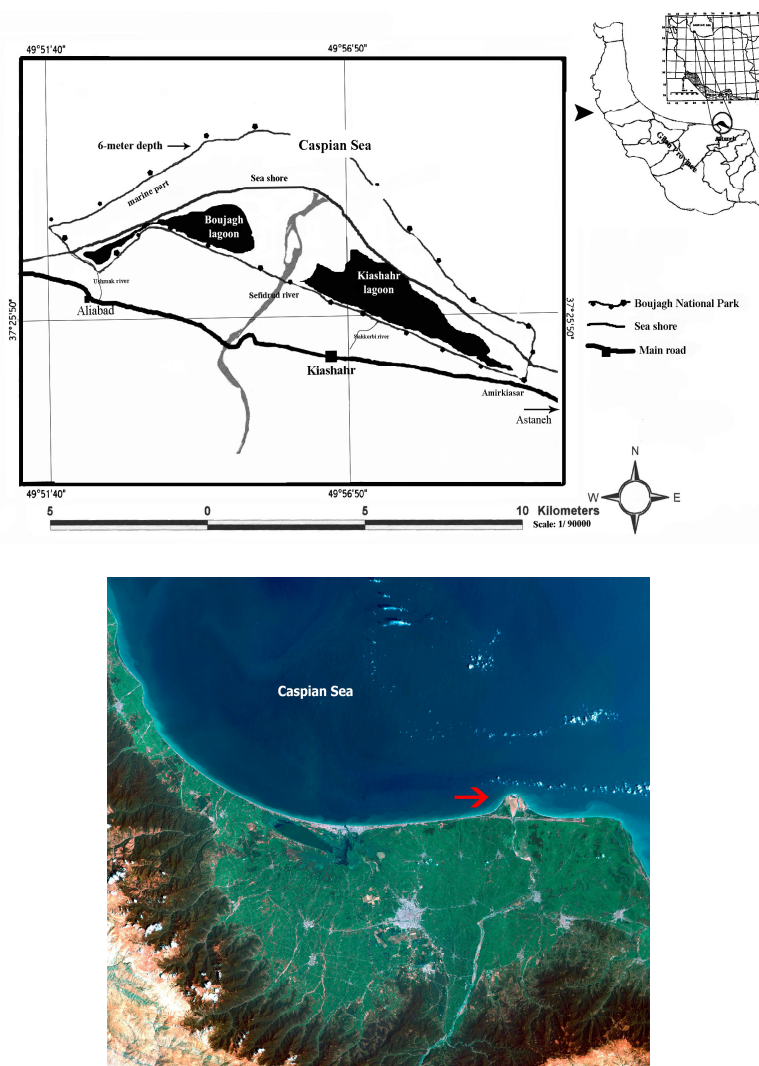
The most important goals of this paper are: (i) to provide a case of vegetation type mapping with physiognomic-ecological approach in the coastal wetland ecosystem using field works and the

geographic information system (GIS) techniques; (ii) to compare the results with other wetland areas and (iii) to provide a framework for further conservation studies on rare plant communities in the coastal wetlands.

**MATERIALS AND METHODS**

**Study area**

Boujagh National Park located on the coast of Caspian Sea, 6 km of NW Kiashahr (Astaneh, Gilan Province) and 15 km NE Zibakenar, at 49° 51' 40"– 49° 59' 50" E and 37° 25' 00"–37° 28' 50" N. Total surface, circumference and mean altitude of the Park is 3278.140 ha, 31.409 km and -23 m b.s.l., respectively (Fig. 1).



**Fig. 1.** Map of Boujagh National Park together with aerial photograph of location of the area in the South Caspian coast.

Northern limit of the Park restricted to six-meter depth line of Caspian Sea. Due to Biological and ecological importance of study area, this area (3278.14 ha) including all mentioned parts, reached to the higher level of conservation (National Park) in 2001.

Quaternary deposits are the main geological feature and temperate axeric/humid temperate climate is the main climatic feature in the area [6].

**Data collection and analyses**

Data collection was performed during a continuous survey in the area during years 2004 to 2010. Plant nomenclatures are mainly followed [21].

For preparing the vegetation map, we used GPS data in all parts of BNP. Image projection was World Geodetic System (WGS) 84, and the zone number was 39n. We applied 525 geographically

positioned sampling points to assess the vegetation unites. A total of 248 native plant species were identified in the BNP [6]. Degree and minutes of GPS points were converted to UTM metric unites before analyses in the GIS environment. Then a point map was prepared based on a base-map defined in the software. The field work and satellite images were mutually complementary. Dominant and companion species were recorded in the samples. Vegetation types for each area were recognized according to the occurrence of specific perennial species accompanied by some companion species. These dominant species were used for naming each vegetation type. Species emerging in each season were added to the plant list of each vegetation type during the investigations.

Using data collected in the field and satellite images, the vegetation map was constructed using ILWIS software. We distinguished different vegetation types (as map units on the GIS map) delineated them on the image and produced a final vegetation map. Vegetation map units are defined as areas where vegetation is relatively homogenous.

## RESULTS AND DISCUSSION

Like to other wetland ecosystems in northern Iran, BNP represents a complex of several habitats and small ecosystems with high species diversity [6, 22, 23]. However, for mapping larger areas, the concept of potential natural vegetation (PNV) is often used. PNV is hypothetical vegetation that would exist at certain sites under current site conditions and current climate, provided the vegetation is not disturbed by humans and is allowed to develop into equilibrium with the prevailing site conditions [2]. Therefore, PNV with a physiognomic-ecological assessment were used to apply a vegetation mapping in the area. It was also roughly used in previous large-scaled investigations in different parts of Iran [10, 14, 15]. In the other hand, Boujagh National Park is not completely intact environment, but it is affected by many anthropogenic effects in different plant formations. The occurrence of high proportions of therophytes indicates this claim [6, 24]. BNP includes a complex ecosystem comprising two main parts, marine and land. Land parts include a fresh water coastal wetland, Boujagh wetland in the west, Sefidrud river and its mouth in the center and a relatively large lagoon, Kiashahr in the east. Sefidrud river, one of the most important and second largest river of Iran, passes among the Park, splits it to two eastern and western parts and finally enters the Caspian Sea. Mouth of Sefidrud river comprises an estuary with freshwater or Brackish riverine marshes. A total of 248 species of vascular plants were known from different habitats of BNP [6]. Based on the field observations and physiognomic-ecologic delimitation of vegetation unites, the following vegetation unites (vegetation types) can be differentiated on the map (Fig. 2).

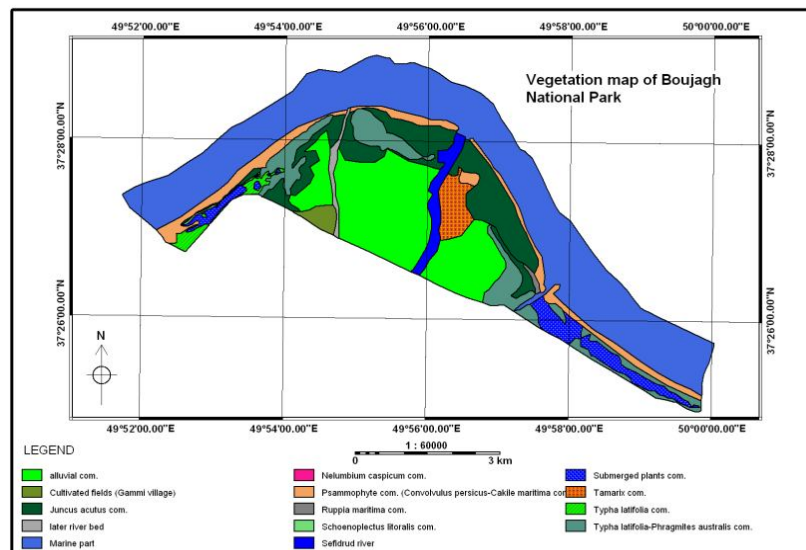


Fig. 2. Vegetation map of Boujagh National Park, N. Iran based on GPS points of location of plant species using ILWIS software

### 1. *Convolvulus persicus-Cakile maritima* vegetation type:

This vegetation type is located in the sand dunes of shore line of Caspian Sea in BNP and is characterized with some obligatory psammophytic plants sparsely distributed on this unite [25].

*Convolvulus persicus* and *Cakile maritima* are two dominant and indicator psammophytes of this vegetation unite. The vegetation type is also characteristic of large sand hills in some parts of southern Caspian shoreline [22, 26]. *Artemisietum tschernievianae*, *Convolvuletum persici*, *Tournefortietum sibiricae* are among some plant associations described in such habitats in Miankaleh Biosphere Reserve [22]. The most important accompanying species frequently found in this unite are: *Agriophyllum squarrosum*, *Tournefortia sibirica*, *Chenopodium ambrosioides*, *Corispermum orientale*, *Daucus littoralis* subsp. *hyrcanus*, *Maresia nana*, *Melilotus polonicus*, *Mulgidium tataricum*.

#### 2. *Juncus acutus* vegetation type:

In Boujagh National Park, there is a large part behind the sand dune vegetation belt with relatively fixed and wet sandy areas possessing higher water table in the soil. This vegetation type reaches to several meters wide (more than 50 m wide) and constitutes well-established microhabitats for many other plants growing under the tall *Juncus* species. Wet soil of this vegetation band is more or less saline or brackish and temporarily flooded in the rainy seasons. This vegetation type can also be observed in other coastal regions across the Caspian seashore and characterized with some plant communities such as *Juncetum acuti*, *Juncetum maritime* [22 in Miankaleh Biosphere Reserve].

Green belt of *Juncus acutus* and *Juncus littoralis* are main constituents of this vegetation type. Species richness of this vegetation type is remarkable including some accompanying species e.g. *Aster tripolium*, *Centaureum pulchellum*, *Cynanchum acutum*, *Hypericum perforatum*, *Juncus maritimus*, *Lotus* spp., *Lythrum hyssopifolia*, *Medicago* spp., *Phylla nodiflora*, *Trifolium* spp.

Some rare and new founded plant records of Iran (e.g. *Eleocharis caduca*, *Isolepis cernua*) were also recorded in the BNP in this vegetation type [6].

Some parts of BNP particularly places with fixed dunes are covered with some shrubby species such as *Punica granatum* and *Paliurus spina-christi*. These species constitute large dense stands in Mazandaran coastal sands [22, 26].

#### 3. *Trifolium repens*-*Centaurea iberica* vegetation type:

This vegetation type is mainly located on a rather large area of alluvial flat habitat along the Sefidrud river. This habitat covers permanently alluvial plain parts along the bank of Sefidrud river. This vegetation unite is mainly affected by seasonal flooding and characterized with grassland vegetations adapted to habitat changes. The most important indicator species of this vegetation type are *Trifolium repens* and *Centaurea iberica*. Other accompanying species of this vegetation unite are: *Centella asiatica*, *Euphorbia helioscopia*, *Fimbristylis bisumbellata*, *Juncus acutus*, *Juncus maritimus*, *Myosotis palustris*, *Portulaca oleracea*, *Trifolium* spp., *Verbena officinalis*, *Hydrocotyle vulgare*, *Ranunculus muricatus*, *Rorripa islandica*, *Schoenus nigricans*.

*Centella asiatica*, a vulnerable species in the Red data book of Iran [27] distributes only in BNP (*Trifolium repens*-*Centaurea iberica* vegetation type) and Anzali wetland [6, 28].

#### 4. *Tamarix ramosissima* vegetation type:

Part of the latter vegetation type (*Trifolium repens*-*Centaurea iberica* vegetation type) is covered by *Tamarix ramosissima* in the eastern parts of Sefidrud river. The accompanying species are similar to latter vegetation unite. *Tamarix ramosissima* is one of the characteristic species of wet salty soils along the Caspian Sea particularly in the eastern coasts where the pure stands of *Tamarix* are found along some coastal lagoons e.g. Gomishan [29].

#### 5. *Ruppia maritima* vegetation type:

This vegetation unite covers the eastern parts of Sefidrud river between sand dunes and *Juncus acutus* vegetation type. These places are largely affected by seasonal flooding of Caspian Sea and covered by brackish to salty water with a carpet-like vegetation of *Ruppia maritima* as a dominant submerged plant. This plant is considered as a halophytic plant in a variety of ponds and salty wetlands in Iran [30]. *Spergularia marina* and *Salicornia europea* are some other halophytic plants growing around these salty wetlands and also characteristic of some halophytic plant communities in other coastal ecosystems [22].

#### 6. *Typha latifolia*-*Phragmites australis* vegetation type:

This vegetation type covers most parts of marginal areas of two main lagoons of BNP, Kiashahr and Boujagh and constitutes wide marshlands around the lagoons. *Typha latifolia* and *Phragmites australis* are two important species of this vegetation type. Some other helophytic plants

accompanying this vegetation unite are *Berula angustifolia*, *Cladium mariscus*, *Galium elongatum*, *Hydrocotyle ranunculoides*, *Iris pseudacorus*, *Solanum dulcamara* and *Typha* spp.

Parts of marginal areas of Boujagh lagoon are covered by *Typha latifolia* as a mono-dominant species (Fig. 2).

7. *Schoenoplectus litoralis* vegetation type:

Like to latter vegetation type, *Schoenoplectus litoralis* vegetation type constitutes a thin strip of northern coast of Boujagh lagoon. *Schoenoplectus litoralis* is a pure mono-dominant species here. This species is also characteristic of coastal wetlands of other parts of Caspian Seacoast [e.g. 31].

8. *Nelumbium caspicum* vegetation type

There is a small patch of *Nelumbium caspicum* in the northern parts of Boujagh lagoon. The rare occurrence of this vegetation type is due to its adaption to grow in freshwater ecosystems [see 19, 32]. Boujagh wetland is temporary affected by seasonal flooding of Caspian seaways [6].

9. *Ceratophyllum demersum*-*Myriophyllum spicatum* vegetation type:

Open water areas of two lagoons in BNP are characterized with this vegetation type. *Ceratophyllum demersum* and *Myriophyllum spicatum* are indicator species of this unite. In some parts of the lagoons particularly in young places, *Chara* sp. is a dominant species. Some of the most important accompanying floating and submerged species in this vegetation type are *Lemna* spp., *Najas* spp., *Nymphoides peltatum*, *Utricularia australis*. Detailed survey on phytosociological delimitation of this vegetation unite resulted in description of some specific plant communities in some wetland ecosystems in north of Iran [19, 22, 32].

### Vegetation mapping and its importance in conservation

Vegetation mapping is considered critically important particularly for restoring ecosystems with high risk of destructions and sensitivity. Moreover, these maps can also be used for assessment of dynamics of plant communities within the context of ecological successions. Boujagh National Park is affected by anthropogenic pressure, livestock grazing and fishing by local people. Some parts of the area are affected by agricultural activity as well. These activities have led to major changes in habitats and ecosystems and have threatened wildlife.

The preparation of vegetation maps with physiognomic-ecologic point view is highly critical for such a threatened ecosystem in order to evaluate the ecological potential of the area and further decision on its conservation and management. These ecosystems represent landscapes that can be restored and managed for uses such as ecotourism and recreation. It can be suggested that further phytosociological assessment on the recognized vegetation types and their relationships with environmental factors will reveal more detailed information of distribution of plant communities in this important National Park.

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## Alireza Naqinezhad

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