The Effect of Caspian Sea Water Fluctuations on Miankaleh Habitat Ecological Conditions Using Remote Sensing and Geographic Information System

D. Amozadeh and M.R. Kanani

1Department of GIS, Islamic Azad University, Bandargaz branch, Bandargaz, Iran
2Senior Experts of Mazandran Environment Research Center, Sari 4817511496, Iran

Abstract: This study emphasize on Caspian Sea water changes in Miankaleh wild-life refuge during three previous decades using satellite technology and GIS. Increasing Caspian Sea water level has made many changes in coastal regions specially Miankaleh coasts and bay. In this research, the images of three sensors, MSS (Multi Spectral Scanner), TM (Thematic Mapper) ETM+ (Enhanced Thematic Mapper Plus) of satellite Landsat series, topographic maps with the scale of 1:25000, field data and Erdas imagine, ENVI, ArcGIS were used. Firstly, preprocessing operation was conducted included Radiometric and Geometric corrections and different processing for revealing and making images, and finally, the situation map of Caspian Sea changes was provided in GIS environment. Natural changes in Caspian Sea water have resulted in some gradual ecological reactions in Miankaleh bay natural habitat and wetland, these natural changes that include all environmental factors and components and the habitat of all creatures of this region could be used as a suitable criterion for bioenvironmental studies and habitat succession and predicting future replacement trends. The abovementioned study shows that using satellite technology and GIS is a powerful tool in predicting and effective management of studied ecosystems to preserve all multiple values.

Key words: Satellite images, Geometric corrections, Radiometric corrections, Geographical information system, Miankaleh wild-life refuge

INTRODUCTION

The western part of wetland ecosystem of Miankaleh wild-life refuge where is called by this name because of shallow wetland and Muddy and pond area was sometime like a river basin because of sudden changes in Caspian sea water level increasing and under the effect of Caspian sea hydrodynamic flow system and wind blowing sea sonly. Before 1978 and due to the type of decomposed soil of this surface from tamarix jungle that its length is 15 km and its width is 2-4 km and has consisted the bays western part in the form of dry land. But after 1978, the Caspian Sea water and Gorgan bay progressed completely and formed some part of international wetland of Miankaleh wild-life refuge, but the signs of decomposed branches and trunks of tamarix trees are seen in this area[1-2].

By progressing bay from one side and increasing sedimentary materials transferred through channels and small and big stream to bay in southern part, the region aquatic ecosystem was increased. Marginal plants and beds covered with sedges and saline plants and tamarix shrubs replaced with wetland’s covered with marine floating plants in natural gradual process and the condition was provided for blossoming and living all kinds of marine creatures, mollusca, and herbaceous and zooplanktons and the low depth of this region made it suitable for birds that obtain their food by filter feeding and by gradually entering organic deposits the condition was provided for growing reed bed that caused classic structure of wetland so that only some part of Miankaleh international wetland has coved by considerable aquatic plants that is a suitable place for all kind of birds and is a secure place for wetland depended birds nesting and reproduction[2-3].

In this research, natural condition and situation of Miankaleh wild-life refuge in the past and the rate of changes in it, analyzed by using geometrical information.
system and remote sensing to preserve all ecosystem values and biodiversity by suitable planning and management.

Miankaleh wild-life refuge with 68800 ha area is located in the south eastern farthest end of Caspian Sea and geographical coordinates of 53°24'50" to 54°1'20" eastern longitude and 36°49'24" to 36°56'45" northern latitude and belongs to Behshahr city and Mazandaran province from country division point of view. This region was announced wildlife habitat under protection of environmental organization in 11 Dec. 1973 based on regulation number 54 of high council of that organization published in formal newspaper number 8921 in and after that in 1976 it was introduced to UNESCO man&biosphsper and settled globe biospher reserves Miankaleh refuge with its adjacent wetland’s of 100,000 ha. is one of the most important wetland’s in the world that have international importance in the list of Ramsar convention (Iran 1971) where have high ecological value and global credit in national and regional level for its role as a place for living, reproduction and wintering for many populations of 200 species of native birds and marine migratory birds, resident and summer visitor and the habitat of 40 species of protected birds and have protection classes named vulnerable, scarce and in risk of threat and extinction and deserve suitable planning and effective management for preserving environmental value (Fig. 1).

For conducting this study, three sensors of MSS 1975, Tm 1990 and ETM+ 2002 of satellite, Landsat series and topographic figure maps with the scale of 1:25000 of country mapping organization were used (Table 1).

| 6663 I NE | 6763 IV NW | 6763 IV NE | 6763 I NW | 6763 I NE | 6863 IV NW |
| 6663 I SE | 6763 IV SW | 6763 IV SE | 6763 I SW | 6763 I SE | 6863 IV SW |

MATERIALS AND METHODS

Radiometric Corrections: Sensor corrections include digital number (DN) conversion to Radiance that is actually the internal calibration of sensor. Radiance is the received energy from target to sensor, but because the aim of this study was conducting comparison between bands not their mere measurement and because of the similarity between the behaviour of sensor in changing radiance data to DN, and lacking access to sensor calibration file, this stage was omitted in this study.

Atmospheric corrections are needed because of two reasons. Firstly, for comparing multispectrum images with spectrum library data, that are normally the rate and percent of recorded reflectance and secondly if you want...
RESULTS AND DISCUSSIONS

The comparison of images from sensors MSS, TM and ETM+ satellite Landsat series during 1975, 1990 and 2002 showed that the Vast area of bay surrounding specially in north, south and western part of Miankaleh wild-life refuge have undergone ecosystemic changes due to Caspian sea water progress. Changes extension that are east to west caused increasing wetland level gradually from two halves of east–west longitude and north–south latitude, so that in 1975, the bay's area was 32895 hectares in 1975 that increased to 44565 hectares in 1990, this trend has continued and increased to 49358 hectares in 2002, and after that changes was considerable and now the situation is stable.

As a result of these changes especially in bay's southern side, agricultural ecosystems have changed to wetland ecosystems along with 22 km of northern part of Behshahr and Galoogah. These changes in habitats caused changes in ecologic condition of dependant species that have been limited by reed-beds regressing and tamarix and pomegranate trees sinking located on bays margins and the biodomain of waterfowl migratory birds was developed and the biodomain of many waders was replaced like Sandpipers, Plovers, Dunlins and species like Frankolin, Little Bustard, Lapwing, Stone curlew, and many species were limited that need open area near the wetland so that recently their population were decreased in this region and caused providing a suitable condition for aquatic living and fish eating birds species like Cormorants, Grebes, Fish eating ducks, pelicans[3-5].

Therefore, it is noted find that the area where is consisted of land and seasonly part of wetland and is a place of living aquatic birds and the birds of wetland margin became suitable for other species that show dependency to new ecologic condition because of ecologic changes and this area as an aquatic core zone ecosystem is the most important ecological nich for Flamingo, pelican, Cormorant, duck and Coot, the effective management of region ecosystem and preserving all multiple values are possible when all changes are predictable and manageable in a set of ecosystems, because in an ecosystem, ecologic position is replaced by natural changes but it is not removed completely. By using geographical information system and remote sensing as an effective tool for predicting these replacements during different time duration the possibility of suitable planning and management is provided for preserving all ecosystem values and biodiversity [5-13].
Fig. 2: The map of MSS sensor image of satellite Landsat in 1975

Fig. 3: The map of TM sensor image of satellite Landsat in 1990

Fig. 4: The map of ETM+ sensor image of satellite Landsat in 2002

Fig. 5: The map of water border situation of Miankaleh bay in 1975, 1990 and 2002
REFERENCES


