CHAPTER 3

METHODOLOGY

3.1 Introduction

The present study is undertaken to find out waterbirds diversity and its habitat utilization in relation to the presence of aquatic macro-invertebrates, fishes, amphibians and aquatic macrophytes at the Nandur Madhmeshwar Wetland, Nasik, Maharashtra (India).

In Maharashtra, especially at the Nandur Madhmeshwar wetland, the information on diversity of waterbirds and their habitat utilization in relation to food availability is absolutely lacking. The data generated from the present study not only allows to understand the current status, distribution and habitat utilization of waterbirds at this wetland, but also is useful in generating baseline information and developing strategies to conserve this fragile wetland ecosystem. This has been prime reason for undertaking the present work and studying various ecological components at the Nandur Madhmeshwar wetland.

3.2 Study Period, Field Visits, Time and Routes

The present study is carried out from April 2011 to May 2014 for the period of 33 months, covering all seasons in a year and three migratory periods (October to January 2011-12, 2012-13 and 2013-14).

The data collection was carried out twice a day, from 6.30 to 10.00 a.m. and from 4.30 to 6.00 p.m. when the activities of the birds were predominant. The wetland
was walked at slow pace so that the birds observed could be located and identified easily. The routes and direction vary between visits, so that there is no systematic tendency for any particular area visited later or earlier in a day. As most of the data collection activity was carried out in morning and evening, the remaining day time was used for collecting and surveying wetland fauna and habitat data.

As the Nandur Madhmeshwar wetland is surrounded by tall *Typha* vegetation throughout the year, ground level visual techniques cannot be used effectively. So many a times, bird watching towers or agriculture bunds were selected as vantage point for the bird observation. At this time, photography is used to assist the identification of birds.

At each visit, information was gathered on the condition of the wetland (i.e. water level and aquatic vegetation cover), fishing and surrounding agricultural activities. The general levels of disturbances from other human activities were also noted down, as these can also be useful in interpreting results.

### 3.3 Compilation of the Waterbirds Species List

A list describes the diversity of a site and shows the presence or absence of rare species (Bibby *et al.* 1998). As number of species recorded largely depend on the time spent in the field, so the look-see method and other ornithological techniques, such as bird’s call, use of high power spotting scope etc. are used to maximize the variety of species recorded.

**Look-See Method:** The look-see method relies on a prior knowledge of the habitat preference of the birds (Bibby *et al.* 1993). The places where waterbirds are easily
observed within the study area were identified from water depth knowledge as well as from maps and such places were visited twice daily during the survey periods. Excessive walking along the shoreline or searches for waterbirds are avoided, as they are extremely time consuming and may disturb the birds.

The bird species were recorded using direct observations by Nikon 8 x 40 binoculars. Photographs were taken with Cannon SX 30 IS and Nikon D7000 camera (with 150-500 mm zoom lens) to justify the species types, for those species which are difficult to identify in the fields, such as small waders. The birds were identified up to species level with the help of standard books by Ali S. (1996), Grimmett R., Inskipp C. and Inskipp T. (1999), Kumar A., Sati J. P., Tak P. C. and Alfred J. R. B. (2005) and Manakadan R., Daniel J. C. and Bhopale N. (2011).

3.4 Why Birds are not Counted?

As mentioned by Javed and Kaul (2002), once a site is selected or identified as ‘Important Bird Area (IBA)’ site, the next step would be to collect the information on the site and on the birds. As mentioned in table 2.6, the Nandur Madhmeshwar wetland is already identified as an IBA site and is one of the proposed Ramsar sites of Maharashtra state. The Wetland International also announced the Nandur Madhmeshwar wetland as ‘International Important Site’ for the year 2003-07, as 10 bird species complete 1% bio-geographic population criteria (Table 2.5).

The appropriate method for a particular study becomes more obvious, if there is clear purpose. It is always a mistake to rush to the field and start counting birds without prior thoughts. Many bird counts are done at considerable cost of time in
the field, but have turned out to be a just waste of time. Results may fail to meet the aim, if they are not properly understood (Bibby et al. 1993).

Thus considering all above facts, instead of evaluating waterbird population again at this wetland, the present study emphasizes on diversity of waterbird, their habitat utilization and food availability (i.e. aquatic plants, aquatic macro-invertebrates, amphibians and fishes).

3.5 Generation of Habitat Map

Within any site, it is fairly evident that habitat is likely to be an important determinant of the presence and distribution of birds (Bibby et al. 1998). Adequate management of any site obviously depends on understanding the relationship between birds and their habitats.

The first step in understanding the habitat preference of birds in the present study area is to prepare a map showing various habitats used to procure food. The habitat map is generated by the following steps:

1. A base map of the study area was obtained from national cartographic maps i. e. toposheets (46L/4/SW, 46L/4/SE, 47I/1/NE and 47I/1/NW of 1:25,000 scale) prepared by Survey of India.
2. These toposheets were scanned and scanned images are geo-referenced in Arc GIS 9.1 software.
3. The present study area was traced out from the geo-referenced toposheets. The boundaries of the study area and other major features like roads, farmlands, village boundaries and reference points were marked.
4. The provisional habitat map thus prepared, is then checked and refined by ground survey of the study area.

5. During ground survey, when wetland is totally dry (i.e. in summer), 285 GPS points were taken at different locations by following the inner margin of the wetland. The various artificial habitats (small islands made by Forest Department) and three natural islands were also mapped using GPS. In monsoon, when wetland is fully flooded, additional 320 GPS points were taken following outer margin of the wetland.

6. The collected GPS points were overlapped on provisional habitat map in Arc GIS 9.1 software and map depicting different habitats is generated.

3.6 Collection and Identification of Aquatic Macro-invertebrates

Diversity is a very useful attribute and valuable indicator of habitat quality (Javed 1996). As the Nandur Madhmeshwar wetland is famous for migratory birds and their huge congregation, the site is likely to be rich in other forms of life too. Hence various aquatic macro-invertebrates such as odonates, aquatic and semiaquatic hemipterans, aquatic coleopterans, mollusca and crustaceans were collected, as they form valuable food source for various waterbirds. The macro-invertebrate collection was carried out throughout the year over three seasons: monsoon (June to September), winter (October to January) and summer (February to May).

The aquatic macro-invertebrates were collected by combination of following different methods:
3.6.1 Direct Search: The easiest way to find many invertebrates is simply looking for them in suitable habitat or microhabitat. Many habitats or microhabitats like under stone, logs, plants base, crevices of wall and rocks, leaf litters were searched. During direct search, care is taken to cause minimum disturbance to these habitats or microhabitats.

Macro-invertebrates living among aquatic vegetations were sampled by placing the plant in shallow white tray and removing invertebrates displaced from it. More active insects, like dragonflies and damselflies were photographed in the early morning, when they are less active.

3.6.2 Use of Pond Net: In this method, net is moved in a figure of eight just above the bottom of water, so that invertebrates like bugs on the substratum are stirred up and caught as they swim away. After taking the net out of water, it is drained and the net content is emptied in white tray. The specimens were picked up by using forceps and placed in Tarsons collection vials.

3.6.3 Other Methods: The collection of macro-invertebrates was also done by hand picking (for e.g. dry molluscs) and D-frame aquatic net from various localities of the wetland.

3.6.4 Collection of Odonates: Individual specimens of odonates were photographed from various angles using Cannon SX 30 IS digital camera. The photographed specimens were then cross checked with standard manuals for final identification. For smaller and active species (especially damselflies), specimens were collected using sweep net and preserved in 70% alcohol.
All collected macro-invertebrates were preserved in the field using formalin solution containing one part of commercial formalin (37 - 40% HCHO) plus nine parts of water in Tarsons collection vials or bottles. The mollusc’s shells were preserved dry in the polyethylene zip bags. All collected macro-invertebrates were properly labeled for all information like localities, time, date etc.

The different macro-invertebrates collected and photographed were identified to the lowest possible level (usually family and genus) with the help of Madhyastha (1998) and Subramanian and Sivaramkrishnan (2007). The photographed dragonflies, damselflies and preserved specimens were identified using standard manuals by Fraser F. C. (1933, 1934 and 1936), Subramanian K. A. (2005), Andrew R. J., Subramanian K. A. and Tiple A. D. (2008) and Subramanian K. A. (2009). The collected molluscs specimens were identified with the help of standard literature by Tonapi G. T. (1980), Subbarao N. V. (1989), Ramkrishana and Dey (2007). The identification is then confirmed from experts of Zoological Survey of India, Western Regional Center, Pune and Zoological Survey of India, Kolkata.

### 3.7 Collection and Identification of Fishes

Fishes were collected with the help of local fishermen at various localities of the wetland, using different types of nets. Morphological features like color, color pattern, color bands or spots were noted immediately after their capture and photographs were taken by Cannon SX 30 IS digital camera. Fishes were preserved in formalin solution containing one part of commercial formalin (37 - 40% HCHO) plus nine parts of water. Large sized specimens were injected with the formalin solution of the same concentration to prevent decay of the visceral organs. The
specimens were identified by using standard keys by Jayaram K. C. (1994, 2010) and Talwar P. K. and Jingaran A. G. (1991). Finally, the specimens identified in the laboratory were also confirmed from the Ichthyologist at Zoological Survey of India, Western Regional Center, Pune.

3.8 Surveying and Identification of Amphibians

Amphibians were surveyed through visual encounter survey method at different localities of the wetland. The frogs and toads killed in road cross and due to other causes were also recorded and photographed. The photographs were taken considering unique and peculiar identification characters of the species to make identification easier. The specimens photographed were identified by using standard keys by Chanda S. K. (2002) and Daniels R. J. R. (2004). The specimens identified were also confirmed from the experts.

3.9 Surveying and Identification of Aquatic Macrophytes

Aquatic macrophytes were surveyed by random opportunistic survey method by visiting different localities of the wetland. The plants were surveyed at different wetland zones such as deep water, shallow water, fringe and nearby moist soil of the wetland. The specimens were observed for their morphological features and identified up to genus and species level with the help of various floras like Flora of Nasik District (Lakshiminarasimhan and Sharma 1991), Flora of Maharashtra State: Dicotyledones vol. - I and II (Singh and Karthikeyan 2000), Flora of Maharashtra State: Monocotyledones (Sharma et al. 1996) and Aquatic and Wetland Plants of India (Cook 1996). The unidentified specimens were
photographed by using Cannon SX 30 IS and Nikkon D7000 digital camera and then identification was confirmed from experts.