Chapter 2
Methodology

2.1 Introduction

Study of birds may be done with behavioral, ecological, demographical as well as geographical approaches depending upon the purpose and objective of the study. The methodology to be used depends a lot on the objectives. To achieve the already defined objectives the present study required to follow the following steps.

- Preparation of Base maps and other maps.
- Preparation of a master list of birds for the study area as a baseline document.
- Information about topography, geology, soil, vegetation, climate, water bodies etc which impact the bird distribution
- Information and survey about various aspects of birds such as geographical range, population and breeding status, abundance, species richness, migratory movements etc. Such information forms the basis for developing a conservation model.
- Land use study
- Vegetation study
- Human impact assessments

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<td>Past &amp; present location &amp; demographic information about birds</td>
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<td>a)Secondary data collection &lt;br&gt;b)Actual field data collection &amp; Relevant map making techniques</td>
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|   | Distributional patterns of selected bird species | Past & present locational info. about birds | a) Checklist & Inventoring  
b) Mapping  
c) Information from people | a) Secondary data collection  
Actual field data collection  
b) Relevant map making techniques  
c) Interviews |
|---|---|---|---|---|
| 3 | Effect of geographical factors on the distribution | Data/Information about identified geographical factors | a)Secondary information from various sources  
b)Field data collection for filling gaps & updating | a)Secondary data collection  
b)Data collection through Field visits |
|   | Topography  
Weather/ Climate  
Vegetation  
Wetlands | Toposheet study  
Primary data collection  
Primary/Secondary data collection  
Use of maps  
Secondary data collection  
Primary data collection | Preliminary terrain analysis  
IMD data/Preliminary field notes  
Line Transect /Quadrate techniques  
Finding relative location  
Measurement of surface water area  
Info from irrigation dept.  
Field observations. |
| 4 | Impact of anthropogenic activities | Data/Info about identified major Human activities as impacting factor | a) Data/Information from secondary sources  
b) Field data collection | a) Secondary data collection  
b) Data collection through field visits  
c) Impact Matrix |
| 5 | Identify indicator species | a) Presence/absence and population changes of indicator species.  
b) Healthy/unhealthy Environmental changes | a) Past & present records/checklists  
Changes in species composition  
Comparison method  
b-1) Primary data collection | a) Secondary data collection  
a-1) Field study |
2.2 Preparation of Base maps & other maps

Since the present study has a very strong geographical bias, use of maps was an integrated aspect of the study. The base-map was prepared to cover the entire study area. For preparation of the base-map following map sources were used.

- The Bombay sheet of the NATMO (National Atlas & Thematic Mapping Organization)
- Collectorate maps of six districts- Ahmednagar, Thane, Pune, Raigad, Satara, Sangli & Ratnagiri
- SOI topographical maps (one-inch maps of 47 F & 47 G series) for detail study.
- Revenue maps/cadastral maps used for some localities (for Bhimashankar, Matheran, Khandala and Mahabaleshwar)
- Forest maps
- Aerial photographs available for certain selected areas (mostly around Khandala) for knowing previous land use of the area.
- Satellite images for mega as well as micro-level studies. These are available on the available online on the Wikimapia (www.wikimapia.org) and the Google Earth (www.google.com) was also frequently used. These were used for knowing present day/latest land use changes. The Geotools on the Wikimapia were also used for calculating areas or for measuring distances. Many other maps were also prepared which show interrelationship/links between birds & their environment, range maps, migratory routes, threatscape etc.

2.3 Preparation of Master Bird List:

As per the objectives of the study we need to know the changing status of birds and past and present distributions of birds of the study area. We also hope to develop a conservation model for the birds. To achieve these objectives we need some basic information about some species, Whether:

- The species is found in the study area
- Seen in the past, but no recent records
- Was never seen in the past but the species is seen/found presently, may be a new entrant in the region
For such information the main secondary source is the bird checklists of various places/regions. A checklist is an inventory of birds seen/found in an area. There are many shortcomings of checklist. Some of them are:

- It may cover most of the birds found in a given area—almost nearly a complete list or it may cover only a part of the total bird fauna.
- It may cover a small area, may be a bungalow compound or may cover a larger geographical area—a town, taluka, district or a province.
- There may just be one single checklist available for an area or there may be a series of updated checklists available for the same area over a long period of time.
- A checklist may just be a mere casual list of species seen at a place on a particular day, at a particular time or it may be a comprehensive list of birds based on work of many years along with status of each species.
- A checklist may have been prepared by a layman or non-expert and may contain wrong information or wrongly identified species.

In spite so many shortcomings a checklist is a very useful information tool in bird study. It is especially useful in knowing the past status of a bird or a group of birds. A comprehensive and reliable checklist may be used as baseline data. A reliable, comprehensive checklist for an area is a readymade document and saves our time, energy and efforts for collecting basic information from scratch. If such a list is not available for some places (which is very much possible) then one has to make one’s own list based on field observations.

For the present study area more than 25 checklists are available as secondary data. The author has collection of bird information in the form of diary notes based on his own field observations. This voluminous data collected by the author for more than thirty years (from 1975 onwards till date) is placed in more than 150 plus diaries measuring many thousands of pages. The author developed a master checklist based on the available checklists and his own observations.

2.4 Bird Status:

For developing a conservation model for birds, the first prerequisite is to get information on the population of the listed bird species. One can get to know the population status of birds through
• Published work/checklists
• By physically censusing the birds in field.

There are two kinds of bird status a) Geographical status and b) Population status. The status used in the present study is a simplified one based on Abdulali (1981), Kazmierzak (2000) and Grimett et al. (2011), rather it is a combination of what these three have used.

The geographical status includes following categories:

- BR- Resident breeding
- NBR- Resident Non-breeding
- M- Winter migrant/visitor
- S- Summer visitor
- BR- Breeding migrant
- LM- Local migrant
- PM- Passage migrant
- S- Stray or vagrant or accidental visitor
- I- Introduced
- ?- Uncertain status

The categories under population status are:

- Very common- VC
- Common- C
- Occasional- O
- Uncommon or rare- U
- Stray- S
-Absent- A

2.5 Counting Birds:

Why count birds?

Knowing the approximate or exact number of birds is one of the basic aspects of bird study. Population data are one of the basic requirements of wildlife conservation and management. We require knowing bird population of different species or bird communities as a whole for the following reasons.
- The population size of those birds which are endangered or declining in numbers.
- The number of those birds which are pests/scavengers and whose population is rising.
- For comparing diversity of two different areas (e.g. between a highly disturbed and less disturbed forest habitats.
- For identifying important bird areas meant for conservation.
- For temporal comparison e.g. population size comparison between say 1970 and 2000 data. Such a comparison will decide whether the number of a certain species/bird community has increased, decreased or is stable.
- Routine periodic count for monitoring and managing protected sites or habitats.
- Population density is useful for understanding the ecology, behavior or pest aspect.

2.5.1 Field Techniques for Counting Birds.

There is no single technique that can be used for counting all types of birds. This is mainly because birds differ in terms of their size, behavior traits, habitat preferences etc. (Urfi, 2004). So a census method useful for one species or habitat is ineffective for another. In the ornithological literature, a variety of methods have been described.

Bird census methods are generally divided into two categories viz.
1) Direct and /or Total Count
2) Sampling Count

Direct or total count: Here an attempt is made to count all the animals (individuals) in a given area. This method works best when the area is very small (a few acres) or there is a congregation of birds. (Roosting birds, feeding colony, heronry, rookery etc.) The birds at roosting colonies are generally counted in the evening when most birds return to the roost. A congregation or flock of birds can also be photographed and individual birds can be counted later leisurely from the enlargements. Barring the count at few heronries and roosting colonies the present work did not attempt direct count. In fact it was not required.

Sampling count: It is not possible to count all birds in a given area and is also not required except for some large-sized, endangered, rare birds. Majority birds are
small in size, many of them have secretive habits & a large number of them have dispersed population. For such a situation sampling count is the only method. Generally a small part of the whole area is sampled and the findings are extrapolated for the larger area. Techniques of sampling count: Two techniques are widely used for monitoring birds in the field. These are

A) Line or belt transect

B) Point count.

A) The **Line or Belt Transect** is one of the popular techniques for sampling bird population. This involves recording the number of birds encountered/seen/observed along a definite length or line of habitat. This technique has certain advantages:

- It enables us to cover larger area.
- It is less cumbersome.
- It is very practical.
- It is efficient.
- It is relatively inexpensive.

For the present study more than 200 transects were identified and monitored for the whole study area. While using this technique following standards were followed.

- The length of transect was different in different habitats. It was 200-500 m for urban areas, 800 m for forested habitats and 1000 m for open grass & scrub country.
- In case of fixed width transects the width was taken as 50 m for dense forest habitats and urban localities, 100 m for grass & scrub. A few open width transects (no fixed width limit) were also tried in degraded open forest and scrublands.
- The transects were chosen randomly on maps.
- All transects were conducted in the morning and evening hours.
- Whenever and wherever transects were repeated, same length, width and time was maintained.

While monitoring birds along transects bird calls were also taken into consideration along with actual sightings. In case of unidentified calls, the calls were syllabized/recorded in the field and identified later with the help of a bird call CD (“Ga Vihangano”) published by Ruturang, Pune. This CD covers birds’ calls mostly.
from the Western Ghats of Maharashtra and Goa. In case of identifying difficult calls bird experts were consulted.

Most transects were monitored at least twice, first in winter (when local bird population is augmented due to migratory birds) and secondly in summer when most of the migratory birds have left.

**B) Point Count** is the most popular method for sampling bird population. This technique was frequently used during the present study. More than 600 point counts were conducted. The radii for most point counts differed from 20 m (in forest) to 100 m in open habitats. This technique involves the watcher to stand or sit at one place or spot and count the birds that are seen and heard in the surrounding. In other words a circular area around the watcher is studied. This technique is good in forest, scrublands and urban habitats. The count duration ranged from 5 minutes to 30 minutes depending upon the availability of time. The technique is good for finding relations between birds and habitats. The combination of both techniques gives better results.

**C) Block Count** involves counting a “block” of birds within a flock. A portion of the flock is imagined as a block and birds within that block are counted. A block can be of 10, 20, 50 or 100 birds depending upon the size of the flock. The count within one block is extrapolated for the whole flock. Suppose there are 50 birds counted in one block, imagine how many blocks would be required to cover the whole flock. If it is felt that six such blocks make the whole flock then the flock size would be 300 birds. (50 X 6). This method works well if the flock is homogeneous. It also requires lot of practice of rapid counting because a flock may be moving fast. This method can give estimates only, especially if the flock is very large. If the flock is heterogeneous a 2-person team works well in cooperation. Block count was used in the present study for counting flock birds like mynas, egrets, herons, parakeets, crows, sparrows, ducks, cormorants, rock pigeons and many kinds of waders. For counting birds in flocks a hand tally counter was used.

### 2.6 Method for Knowing Species Richness:

Many techniques for knowing species richness are known. These include
- Encounter Rates technique,
- McKinnon’s Method,
- Mist netting and
Timed Species count

The last method—Timed Species Count, developed by Pomery and Tengecho (1986) was used in the present study for calculating species richness. The method is quite logical and is based on the assumption that in a bird survey, common species are generally detected earlier than rarer forms. Therefore, a time taken to detect a bird becomes a measure of its abundance.

The technique is used like this—

The observer walks through the study area at a slow pace for one hour. This one hour observation period is divided into six 10-minute time periods. All the species seen in the first 10-minute time period are recorded. In the next 10-minute slot of the remaining 50 minutes period, only those species not seen earlier are recorded. The idea is to record a species only once in its appropriate time period. In this way all the six columns are filled, taking care that species seen and recorded once are ignored in subsequent time periods. A minimum ten visits are suggested. It is suggested that during each visit the observer should cover about 1 sq.km. land area. All the species recorded are ranked according their time period. An index of relative abundance then can be calculated on this basis.

2.7 Breeding Status:

The breeding status of most of the birds is already known. But changes in breeding status do take place with changes in environment, e.g., creation of a reservoir. Breeding status does change when some new observations are added. Sometimes past data have some shortcomings or hastily drawn conclusions.

There are some established international criteria (Campbell & Lack referred in Urfi, 2004) to decide whether a bird species or a group of bird breeds in a given area or not. The same criteria were followed in the present study to decide the breeding status of some lesser known species.
Table 2.2: Criteria for knowing Breeding status of Birds

<table>
<thead>
<tr>
<th>Standard observations</th>
<th>Remark on Breeding status</th>
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<tr>
<td>Species observed during breeding season</td>
<td>Possibly breeding</td>
</tr>
<tr>
<td>Species observed during breeding season in possible nesting habitat</td>
<td>Possibly breeding</td>
</tr>
<tr>
<td>Singing males/calls heard during breeding season</td>
<td>Possibly breeding</td>
</tr>
<tr>
<td>Pair observed in breeding season in suitable habitat</td>
<td>Probably breeding</td>
</tr>
<tr>
<td>Display &amp; courtship observed</td>
<td>Probably breeding</td>
</tr>
<tr>
<td>Observed birds building nest/excavating holes</td>
<td>Probably breeding</td>
</tr>
<tr>
<td>Used nest / eggshells found</td>
<td>Confirmed breeding</td>
</tr>
<tr>
<td>Fledglings / chicks found</td>
<td>Confirmed breeding</td>
</tr>
<tr>
<td>Occupied nest found</td>
<td>Confirmed breeding</td>
</tr>
<tr>
<td>Adult carrying food observed</td>
<td>Confirmed breeding</td>
</tr>
<tr>
<td>Nest containing eggs found</td>
<td>Confirmed breeding</td>
</tr>
<tr>
<td>Nest with chicks found</td>
<td>Confirmed breeding</td>
</tr>
</tbody>
</table>

2.8 Seasonal Movements:

About one third bird species from the study area are migratory. Though migratory movement was not a major objective of the study, distributional studies always require knowing the emigrational movements. Most of the winter migrants arrive in August-September and leave in March. In other words they spend six to seven months in their winter quarters.

For every winter or summer migratory bird the arrival and departure dates, especially the first arrival dates and the last departure dates were noted down. In many cases previous dates/time of arrival & departure are available. Any changes in these dates were noted down because such changes are closely associated with changes in climate or sudden weather changes in the neighboring regions.

Weekly or fortnightly records of some bird species (Pond heron, Black drongo, Roller etc.) at selected sites were also maintained for one year. In case of daily movement of some birds, their roosting sites were identified first. The birds were counted in the evening when they fly towards the roost in flocks. The direction/s of their daily outward flight was identified and the final destination of their daily migration was also identified by following them on motorbike.
2.9 Mapping Birds

Mapping birds has been an important aspect of the present study. Especially putting spot sightings on the map was an arduous task, because of the voluminous data about it. In most cases it was done manually, but in certain cases where the GPS locations were noted in the field and the coordinates read, the GPS records were uploaded on the Google Earth site to get the actual locations on maps.

Maps have been used to know

- Changes in distributional ranges of a species or group of related species
- Seasonal changes in distributional ranges of a species or group of related species
- Seasonal movements of some species
- Identifying threats to some species and their habitats.
- For comparing past range with present range of distribution.
- Daily migration routes

2.10 Geographical Factors:

A number of geographical factors influence the bird fauna of the area. These are: Topography, Climate, Vegetation, Wetland, Land use

Topography:

The study of topography includes:

i) General terrain aspect (hilly/plain/plateau/rocky)

ii) Slope aspect, especially steep slopes and cliff aspect was noted down. The horizontal and vertical extent of cliffs was noted down because many birds (Longbilled vulture, Laggar falcon, Kestrel nest on cliffs whereas many others are associated with it.) General geological aspects such as laterite plateaus and soil aspects such as color were also noted down for association of some birds with them.

Altitude was considered since it was found that it influences the bird diversity to a certain extent.

Climate:

Information about temperature and rainfall distributions, dominant wind direction was derived from the secondary data available with the IMD and many web sites on weather and climate. Local weather conditions were noted down in the field at the time and place of observations.
Vegetation Study:

Vegetation is one of the basic elements of any system that influences the ecology, distribution and movement of birds. Any positive or negative change in vegetation is definite to affect the fauna in general and the bird fauna in particular. Following aspects of the vegetation were noted down—type/s, overall composition, height and layers, canopy cover, overall thickness, anthropogenic impact.

Wetlands:

Wetlands play a very important role in the distribution of bird fauna in general and aquatic birds in particular of any area. The density of rivers & streams, reservoirs & canals, lakes & ponds, their perennial & non perennial nature, ecological stages (young/mature etc.) of reservoirs decide the diversity and abundance of many bird species. The following aspects of wetlands were noted down:

- Type of wetland
- Area and shape
- Seasonal changes in water level
- Vegetation
- Level of ecological maturity
- Nature of shore/banks/channel/floor characteristics
- Bird fauna— Diversity, number, seasonal changes, nesting & breeding activities,
- Overview of fish and amphibian diversity

Human Activities

Land-Use Study:

Rapidly changing land use is the most crucial factor for ecology and fauna of the area in general and for the birds in particular. As the two prime growth centers viz. Mumbai and Pune lie on either side of the study area, land use changes due to and because of urban and industrial expansion is a vital area of study. To know the changes in land use/landscape, old maps of the study area were procured from various sources. These included past topographical maps of SOI, aerial photographs of some part around Khandala, urban land use maps (in case of Pune city) and land use maps published by NATMO. Old maps were used as base reference maps in the field while conducting survey for present land use.
2.11 Information from People:

A mountain of wildlife information is available with local people—the peasants, farmers, grazers, hunters, poachers, trappers, wood cutters and tribals. Such a person is known as KI – Knowledgeable Individual. Information was also collected from urban-based forest officials, wildlife experts, bird watchers, ornithologists and researchers.

Conversations and discussions with KIs provided information about

- Presence of a species/past reporting or sightings.
- Changes in geographical/population status of birds
- Breeding records/information
- Possible reasons of increase or decrease in population.
- Past/previous land use

2.12 Impact Assessment:

A number of anthropogenic factors have been influencing the environment in general and the bird fauna in particular in the study area. For assessing the impact of these factors on the birds the Impact matrix method was used (Nalavade, 2003). Twelve major drivers impacting the ecosystems in general and bird fauna in particular were identified. Most of the drivers are responsible for

i) Reduction in habitat size
ii) Reduction in habitat quality
iii) Creation of a new habitat
iv) Reduction or increase in bird population size

The identified drivers for the study area are:

- Urbanization (including new hill towns)
- Industrialization
- Population growth
- Transportation and traffic
- Dams, reservoirs and multipurpose projects
- Mining & Quarrying
- Recreational activities and tourism
- Agricultural activities (including livestock culture)
- Loss and degradation of habitats
- Raab practice & forest/bush fires
- MFP collection
- Hunting, poaching & collection
- Domestic cats and dogs menace.
- Pollution
- Mining and quarrying activities

The bird fauna of the study area was categorized into five categories based on habitats.
These are:
- Urban birds.
- Forest & woodland birds
- Farmland birds
- Aquatic & wetland birds
- Scrub & grassland birds

The drivers were arranged against the birds on a matrix to identify the level of impact of drivers on concerned bird groups. The details of this technique are discussed in Chapter 9.

2.13 Equipments Used:

The following equipments were used for the field data gathering.

**Binocular**- Two different binoculars were used for watching birds. The 8 X 40 Task Optic for general use and 7 X 21 Olympus for use in urban habitats.

**Hand Tally Counter**- This instrument was used for counting birds especially when they were moving in flocks etc. This counter is 4-digit and counts up to 9999.

**Compass**- For finding and fixing directions a hand-held liquid filled orienteering compass with a circular moving disc was used.

**Pedometer**- For fixing short distances in paces a Casio digital pedometer (Model PDM-10 B) was used.

**Thermometer**- A digital hand-held battery operated non-branded thermometer was used for knowing temperatures in the field.

**Camera**- For field photography two cameras were used. Initially a Ricoh SLR with 52 mm normal and Tamron 70-300 zoom lense was used. In the later period a Canon SX 30 IS was used for overall and close-up photography.

**GPS** – On few occasions a GPS instrument (Garmin e-Trex H hand held receiver) was used.
2.14 Books and Field Guides:

For identification of birds in the field following illustrated guide-books were used

- Birds of the Indian Subcontinent-Richard Grimmett, Carol Inskipp and tim Inskipp (2011)

For further references following books were consulted-

- Popular Handbook of Indian Birds- Hugh Whistler (1986 reprint)

PLATE 2.1: White-throated fantail: A woodland bird, also seen in gardens