CHAPTER 1:

THE ECOLOGY OF FOUR OWL SPECIES WITH PARTICULAR REFERENCE TO THE GRASS OWL (*Tyto capensis* Smith, 1834) BIOLOGY, HABITAT AND PREY SPECIFICATIONS IN THE EAST RAND HIGHVELD, GAUTENG

“Habitats change with time, so that organisms must continually change also in order to adapt”

(Maclean, 1990).
1.1. General Background

A diversity of owls occurs in southern Africa, however this is only 12 of the world’s 135 species. Of these twelve owl species that occur within the subcontinent (Steyn, 1994), four are known to occur in the study area namely the rare African Grass Owl (*Tyto capensis*), Marsh Owl (*Asio capensis*), Barn Owl (*Tyto alba*) and the Spotted Eagle Owl (*Bubo africanus*) of which the Grass Owl is listed as vulnerable in the Red Data Book. The Barn and Grass owls belong to a genus known as *Tyto*, the Cape and Spotted Eagle Owls to *Bubo*, and the Marsh Owls to *Asio*, which only has one representative in southern Africa (Steyn, 1992). Owls are nocturnal birds of prey that are taxonomically unrelated to the diurnal raptors despite similarities in their predatory habits and weaponry (Steyn, 1984). Owls are separated into two fairly distinct families. The first family is Tytonidae, with typical representatives being *T. alba* and *T. capensis*, representing owls of distinct characteristic traits. The most obvious external differences are the general appearance, such as the heart, rather than round shape of the facial disc; the longer skeletal structure and beak; longer legs; longer, more pointed wings and a forked tail. They are evidently considered far removed from true owls of the second family Strigidae, represented by *A. capensis* and *B. africanus*. Steyn (1992) refers to *Tyto* possibly being more closely related to falcons than to owls.
1.2. DISTRIBUTION AND STATUS

Owls are found in virtually every corner of the globe, and the southern African owls are a microcosm of the owls of the world (Tarboton & Erasmus, 1998). The Barn Owl is described as one of the most widespread land birds in the world and occurs in Europe, Africa, Middle East, India, South East Asia, Australia, most of the Americas, as well as many oceanic islands. It is probably one of the most studied species of owl. Some authors (Del Hoyo, Elliott & Sargatal, 1999; Fry, Keith & Urban, 1988) describe as many as 40 or more races of this species occurring throughout the world. However, only one Barn Owl *Tyto alba affinis* (Scopoli, 1769) is recorded throughout sub-Saharan Africa (Wilson, 1988). Although the Barn Owl is very prevalent throughout its African range, the Spotted Eagle Owl is the most widespread and common owl in southern Africa (Kemp, 2001). Both species are, however, found in close association with man.

The distribution of the Grass Owl (*T. capensis*) is poorly understood. It has been proposed that there are two distinct populations: the Eastern Grass Owl of Asia and Australia (*Tyto longimembris*); and the African Grass Owl (*T. capensis*) (Del Hoyo *et al.*, 1999; König, Pizzy & Knight, 1997; Weick & Becking, 1999). Wide dispersals may occur when deteriorating conditions follow exceptionally good breeding seasons and abundance of a variety of terrestrial prey driven by similar fates. These trends of movement, into and out of temporarily favourable wet and dry conditions respectively are reason why
most data given in literature are outdated and distributions as well as status are constantly changing according to environmental cues.

Despite its widespread distribution in West, East and Central Africa, where it is found in a series of isolated and often disjunct populations (Fry et al., 1988) (Figure 1.1), from the Cameroon highlands (3 records), Ethiopia (1 record), Congo, southern Zaire, northern Angola (sparse) and east to south of Uganda and west Kenya then south through west Tanzania and Zambia to west Mozambique found in southern region. No specimens have been recorded from Namibia to date (Irwin, 1982). One specimen apparently also originates from the Caprivi Strip. Many of these populations are ecologically restricted to small areas of suitable habitat distant from other populations. It is usually confined to those elevated plateaux where its habitat is most widely found (Irwin, 1982).

Figure 1.1: Distribution of Tyto capensis across the African continent
It is limited to the eastern third of southern Africa (Harrison, Allan, Underhill, Herremans, Tree, Parker & Brown, 1997) due to its ecological constraints. It is virtually absent from the dry western and southwestern parts of the country (Irwin, 1982; Kemp & Calburn, 1987; Maclean, 1993). Recent bird atlas distribution maps indicate the distribution of this species within South Africa (Figure 1.2). High densities occur in KwaZulu-Natal, where Mendelsohn (1989) considers it to be locally common and up to 22 birds have been recorded in 69 km$^2$, an average home range of one bird per 314 ha. Smaller populations, however, have been recorded in the Eastern Cape, Free State, Mpumalanga, Limpopo Province (Anderson, 1994) and very low densities occur in Gauteng and Swaziland (Harrison et al., 1997). In Swaziland, it is found as a rare breeding resident and a population of only 20 birds was estimated for the country during the five-year bird atlas project (Parker, 1994). Rare sightings by Bateman & Nixon (1997) have been recorded in the Eastern Cape. Most of these sightings were of non-breeding migratory Grass Owls. However, Grass Owls were found to be breeding with a viable resident population in Port Elizabeth during 1996 (Bateman & Nixon, 1997). In the Western Cape, Grass Owls were found confined to small areas and fragmented populations occurred along the south coast in Knysna, George and at De Hoop Nature Reserve (Harrison et al., 1997). This distribution shows a clear preference for highveld and escarpment grasslands. In Lesotho it is poorly studied, although the Grass Owl was once described as common by Winterbottom (1964) it may now be extinct as a breeding species and only occurs as a rare peripheral visitor to this country. Only an estimated population of 1-10 birds has been given by Osborne & Tigar (1990) and was
only recorded once in Lesotho during the most recent atlas project (Harrison et al., 1997).

**Figure 1.2**: Distribution of *Tyto capensis* in southern Africa

An evaluation of the two Red Data Book maps, namely: Brooke (1984) map (Figure 1.3) and Barnes (2000) map (Figure 1.4), data indicate that the range and abundance of Grass Owls in southern Africa have contracted over these 16 years. During 1985 to 2000 the status has changed from indeterminate to vulnerable. Evidence of local population decreases has been indicated (Brooke, 1984; Day, 1989; Steyn, 1982) specifically in big industrialised areas such as Gauteng Province (Davidson & Biggs 1974; Harrison et al., 1997) and where agricultural activities have reduced their favoured long-grass habitat such as in the KwaZulu-Natal midlands and Mpumalanga Province. Furthermore, the remaining populations indicate that the Grass Owls are becoming increasingly fragmented and isolated (Barnes, 2000).
FIGURE 1.3: Brooke (1984) distribution map of the intermediate *Tyto capensis* population within southern Africa.

*Tyto capensis* population within southern Africa.

FIGURE 1.4: Barnes (2000) distribution map of the vulnerable *Tyto capensis* population within southern Africa.
The wetlands of South Africa are important breeding sites for the African Grass Owl as well as the Marsh Owl. Barnes (1998) lists 15 Important Bird Areas (IBA’s), in Barnes (2000), that have been identified as actual breeding habitats and concentration points for the Grass Owl. They are, however, under represented within the protected areas network. None occur in the East Rand Highveld, which is one of the motives of the research within this area.

- Kruger National Park and adjacent areas (IBA SA002)
- Nyl River Floodplain (IBA SA008)
- Steenkampsberg (IBA SA016)
- Amersfoort-Bethal-Carolina district (IBA SA018)
- Chrissie Pans (IBA SA019)
- Proposed Grassland Biosphere Reserve (IBA SA020)
- Ndumo Game Reserve (IBA SA052)
- Kosi Bay (IBA SA053)
- Itala Game Reserve (IBA SA056)
- Mkuze Swamps (IBA SA058)
- Natal Drakensberg Park (IBA SA064)
- Umvoti Vlei (IBA SA069)
- Karkloof Nature Reserve (IBA SA074)
- Umgeni Vlei Nature Reserve (IBA SA075)
- KwaZulu-Natal Mistbelt Grasslands (IBA SA078)

The rationale behind the Grass Owl occurring in the Red Data Book for birds (Barnes, 2000) is as follows. The Grass Owl has a small and declining regional population of less than 5000 mature individuals remaining within
South Africa, Lesotho and Swaziland. Given its narrow habitat specificity, the species is estimated to occupy less than 10% of this total area, giving it a small regional area occupancy of less than 13900 km$^2$. This species has rapidly declined by at least 10% in the last three generations and is likely to decline by 20% in the next three generations, qualifying it as vulnerable.

The status of the Marsh Owl is more uncertain elsewhere in the world but south of the Sahara it is considered to be locally common (König, Weick. & Becking, 1999). In north west Africa it is quite scarce. The main threats being similar to those impacting on the Grass Owl (i.e. fire, flood and habitat degradation by overgrazing of cattle and by use of pesticides). It is also susceptible to road traffic (Chapter 3) and entanglement in barbed wire (Irwin & Lorber, 1984). Some nests may also be lost to predators. Little is known about its actual present status, or may in actual fact be incorrect, except for the more or less marked decline in the mixed farmland areas. Furthermore, there is no data on territorial behaviour and habitat selection by both of these grassland species.

Increasing industrial and agricultural development in Gauteng Province are leading to considerable habitat destruction (Brooke, 1984; Barnes, 2000; Davidson & Biggs, 1974; Day, 1989; Steyn, 1982), as seen by the decline of the once abundant populations of Barn Owls, Spotted Eagle Owls, Marsh Owls and in particular, the Grass Owls. Steyn (1984) noted that $T.\ capensis$ inhabits contracting highveld grasslands associated with wetlands. The encroachment of industry and agriculture into this specialised habitat is what is responsible for the decline in the numbers of $T.\ capensis$, and placing it on
the red data list of birds of southern Africa. Other possible sources of habitat destruction are drainage, (Barnes, 2000), too frequent burning, overgrazing and trampling by livestock (MacDonald & Birkenstock, 1980). Another possibility is the accumulation of pesticide residues, depressing their reproductive outputs (Brooke, 1984). This is a potentially important factor specific to the highveld grasslands of Gauteng Province.
1.3. INTRODUCTION TO THE ECOLOGY OF THE FOUR OWL SPECIES

Information concerning the ecology, e.g. habitat preferences and requirements; prey abundance and availability; and breeding of the four species involved in this study: Grass Owl (\textit{T. capensis}), Marsh Owl (\textit{A. capensis}), Barn Owl (\textit{T. a. affinis}) and Spotted Eagle Owl (\textit{B. africanus}) are given in this chapter and will be referred back to in subsequent chapters that specifically concentrate on \textit{T. capensis}.

For most raptors, breeding density is limited by the availability of suitable nesting sites or habitat and food supply (Newton, 1979). These aspects form the foundation of any fundamental studies that are used to understand why a species survives today.

Although owls have been well studied in temperate environments, there is little information of owls occurring in the tropics. Past literature on the general biology of southern African owl species is given in: Owls of the World (Burton, 1973); The Owls of Southern Africa (Kemp & Calburn, 1987); Habitat preferences, population size, food and breeding of six owl species in Springbok Flats, South Africa (Mendelsohn, 1989); Birds of Prey of Southern Africa (Steyn, 1982); A delight of owls: African owls observed (Steyn, 1984); Dwellers in darkness (Steyn, 1992); Hunters of the African night: focus on owls (Steyn, 1994); Owls and Owling in Southern Africa (Tarboton & Erasmus, 1998); Africa’s owls (Tarboton, 2000).
Much has been reported in past literature on the Barn Owl (*T. alba*) and the Eagle Owls (*Bubo* sp.) concerning general observations and various biological aspects. The Barn Owl: Coetzee (1963); Davis (1959); Dean (1973, 1975); Grindley, Siegfried & Vernon (1973); Kirk (1956); Kolbe (1946); Skea (1963); Wilson (1988); Wilson, Wilson & Fry (1988). *Tyto alba affinis* (the African Barn Owl) ecology is analogous to that of other races, found throughout the world (Burton, 1973), making assessment of this species easy. Literature on the Spotted Eagle Owl are given by: Benson (1962); Berry (1971); Carnegie (1961); Grobler (1980); Heathcote & Rowe (1958); Lendrum & Lendrum (1975); Murray (1951); Robbins (1972); Siegfried (1965); Tarboton, (1975) and Welbourne (1973).

Relatively few studies however, have incorporated these aspects concerning the distinctive African Grass Owl, *T. capensis* and Marsh Owl, *A. capensis*. The only literature given on Grass Owls are by: Anderson (1994); Bateman & Nixon (1997); Boddam-Whetham (1969); Crafford, Ferguson & Kemp, (1999); Davidson & Biggs (1974); Dean & Dowsett (1986); Earlé (1978); Erasmus (1988); Horner (1971); Lees & Wood (1978); Lockwood (1978) and for the Marsh Owl: Dean (1969); Hustler (1978) and Smith & Killick-Kendrick (1964). Comparisons between these two African species are given by: Armstrong, (1991), Benson (1981), Craib (1974) and Masterson (1973). Many bird guides also give information concerning identification along with general biology of these owl species (Brown, Urban, & Newman (1982); Fry *et al.* (1988); Harrison *et al.* (1997); Maclean (1993); Newman (1998); Sinclair, Hockey, & Tarboton (1993); Steyn (1982, 1985); Tarboton, Kemp, & Kemp (1987).
This review of the past literature and available data was undertaken to identify important features that can be used to compare typical and suitable conditions in which owls inhabit, to those found within the study area. These comparisons provide indications of the uniformity and variability of different components causing high or low population numbers to occur in different areas. For a deeper understanding of the relationship between the owls and their environment, a number of aspects of the species' ecology and various other aspects have to be clarified. The aim of this study is mainly to elaborate further and to possibly add to the literature on some ecological and biological aspects of these owls within the study area that is perhaps missing or misunderstood. This will most certainly form an important aspect regarding trends in mortality of owls due to vehicle collision (Chapter 3), dispersal patterns and density within an area, with particular importance when looking at the habitat selection, feeding ecology and breeding of these owls (Chapter 2). This information will ultimately be important for the proper planning of conservation strategies of these species.

The relationships between population performance and the relevant environmental factors such as weather condition, food supply, nest site availability, urbanisation, and changes in farmland habitats and land use are assessed. The present study deals with these aspects regarding the four owl species found within the study area. Each of these four owl species however, have their own unique characteristics and certain features that are shared amongst some and will be dealt with in this manner. All four species are known to occur within the study area in abundance, this is evident from the
large numbers of owls being killed in the study area (Chapter 3). Marsh Owls, Barn Owls, Spotted Eagle Owls and Grass Owls can also be found breeding in the same area (pers. obs.). Thus direct comparisons can be made amongst these four species.

1.3.1. General biology

1.3.1.1. Comparative morphology

The Grass Owl looks superficially like the Barn Owl, but its biology is very different from that of its common, productive, catholic and cosmopolitan relative (Kemp & Calburn, 1987). Barn and Grass owls are most easily distinguished by the overall pale, tawny grey colour of the former; in contrast the Grass Owl has a pronounced two-toned appearance that is very dark, brown above and white or buff below (Steyn, 1994).

However, the two species most likely to be confused because of their similar habitats rather than appearance are the Grass and Marsh owls. The distinct two-toned appearance of the former is quite different to the overall buff colouration of the Marsh Owl, which has long wings with pale patches near the wing tips, which are prominent in flight, the ends of the tail projecting beyond its feet. Marsh Owls are medium in size and have a pale facial disc surrounded by a black rim; their dark eyes appear very large in comparison to the other two species described (Day, 1989). The Spotted Eagle Owl is however quite different from these three species and appears grey with large yellow eyes, but some appear in rufous form, so colour of plumage and eyes in this species may not necessarily be a diagnostic feature and it is often
confused with another member of its genus *Bubo*, i.e. the Cape Eagle Owl (*Bubo capensis*). However the Spotted Eagle Owl is finely barred and has relatively smaller feet compared to the Cape Eagle Owl (Steyn, 1992).

*Asio capensis* and *T. capensis* may be frequently confused when flushed from the same area, though their habits are markedly different (Day, 1989) and these assist one to separate them. When flushed from their daytime roosts, the Grass Owl takes to the air reluctantly, legs dangling and soon plummets back into dense cover without even taking note of the intruder. They do not usually vocalise at this point, often giving the field researcher a fright. The Marsh Owl usually flies around the intruder, uttering an alarm call while turning its heads with its legs tucked in for some while to inspect the cause of distress before dropping back into the grass, usually some distance away (Day, 1989; Steyn, 1992).

1.3.1.2. Morphometrics

Because owls are crepuscular and secretive in their habits, data are lacking on biological aspects of these southern African owl species. Morphometrics are of ecological and taxonomic importance amongst raptors. They can also be used to predict and understand the habitat selection, hunting methods, time budgets and systematic relationships of different species (Brown & Amadon, 1968; Norberg, 1986). Biggs, Kemp, Mendelsohn & Mendelsohn (1979) provide weights for southern African raptors and owls. Few weights of raptors and owls have been published. For many species only a small number of individual measurements are given in guides, however the numbers of
samples used are limited. Live birds or fresh specimens are required for more in depth studies and comparable measurements from different individuals are usually hard to obtain (Mendelsohn, Kemp, Biggs, Biggs & Brown, 1989). Standard linear measurements can however easily be obtained from dried museum skins. Certain assumptions about raptor species represented in collections can thus be resolved even at a later stage.

**1.3.1.3. Sexual dimorphism**

In most vertebrate species, generally the males are larger than the females (Erlinge, 1979; Moors, 1980; Ralls, 1976; Schoener, 1967), however, in Strigiformes (owls) and Falconiformes (most raptors) females are typically larger (Amadon, 1959; Andersson & Norberg, 1981; Earhart & Johnson, 1970; Fry et al., 1988). A multitude of hypotheses have been proposed to explain the possible evolutionary and ecological significance of this reversed sexual dimorphism (RSD) (for a summary see Table 1.1 adapted from Amadon, 1959; Anderson & Norberg, 1981; Earhart & Johnson, 1970; Mueller & Meyer, 1985; Mueller, 1986; Selander, 1966; Storer, 1966). Gerhardt & Gerhardt (1997) state that to date, owl data used for advancing and investigating these hypotheses and related assumptions have stemmed from studies of species occurring in the northern temperate zones including 18 North American Owl species and 13 owl species that breed in Europe giving a total of 24 species. Little information on owl dimorphism outside these areas is available. According to Amadon (1959); Earhart & Johnson (1970); McGillivray (1987); and Mueller (1986), the most applicable measurement used for dimorphism is body weight.
TABLE 1.1: Hypotheses for reversed size dimorphism in predatory birds (adapted from Anderson & Norberg, 1981).

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<thead>
<tr>
<th>A. BEHAVIOURAL RELATIONS WITHIN THE PAIR</th>
<th>AUTHOR</th>
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<tbody>
<tr>
<td>A1. Anti-cannibalism hypothesis: Large females prevent males from cannibalizing the young, which are guarded by the female.</td>
<td>Hagen (1942)</td>
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<td>A2. Male subordination hypothesis: Large females make the male subordinate, which ensures that he will provide food for the family.</td>
<td>Amadon (1959)</td>
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<td>A3. Pair formation hypothesis: Large females run lower risk of becoming intimidated by the male during pair formation.</td>
<td>Cade (1960)</td>
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<tr>
<th>B. FORAGING EFFICIENCY</th>
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<tr>
<td>B1. Food competition hypothesis: Sexual dimorphism reduces food competition between male and female.</td>
<td>Brüll (1937); Hagen (1942); Dementiev et al. (1951); Rand (1952); Storer (1955, 1966); Selander (1966, 1972); Frochot (1967); Earhart &amp; Johnson (1970); White &amp; Cade (1971); Snyder &amp; Wiley (1976); Newton (1979).</td>
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<td>B3. Female supplementary feeding hypothesis: Larger females supplement the male’s foraging from a broader prey size spectrum during the latter part of the breeding period.</td>
<td>Reynolds (1972); Snyder &amp; Wiley (1976).</td>
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<td>B4. Male energy savings hypothesis: Smaller males expend less energy on foraging, and so provide the family with more food.</td>
<td>Reynolds (1972); Mosher &amp; Matray (1974); Balgooyen (1976).</td>
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<th>C. OTHER FUNCTIONS</th>
<th>AUTHORS</th>
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<tr>
<td>C1. Egg size hypothesis: Larger females produce larger eggs.</td>
<td>Reynolds (1972); Selander (1972).</td>
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<tr>
<td>C3. Female nest protection hypothesis: Larger females defend the nest better against predators.</td>
<td>Storer (1966); Reynolds (1972); Snyder &amp; Wiley (1976).</td>
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<td>C4. Male territorial defense hypothesis: Smaller, more agile males are favoured in territorial contests.</td>
<td>Schmidt-Bey (1913); Nelson (1977).</td>
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<tr>
<td>C5. Follicle protection hypothesis: Larger females run a lower risk of damage to the developing eggs when striking prey.</td>
<td>Walter (1979).</td>
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Other lesser measurements included in dimorphism analysis include wing length, tail length, bill length, tarsal length and foot span (Earhart & Johnson, 1970; Gerhardt & Gerhardt, 1997; Marti, 1990; McGillivray, 1987; Mueller, 1986). Indeed, a within-species variation in sexual size dimorphism is poorly known for most birds (Rising, 1987). Sexual dimorphism is thus described for
the species found in this study and to test if the RSD hypothesis hold true for four South African owl species (Chapter 2).

1.3.1.4. Colour morphs

The lack of data on gender is a major limitation of most of the past data recorded, as is it difficult to distinguish differences in sexes in live owl specimens. Some authors (Del Hoyo et al., 1999; Kemp & Calburn, 1987) distinguish gender of *T. alba* and *T. capensis* according to differences in colouration. The female Grass Owl has a darker colour and a distinctly browner facial disc than that of the male (Kemp & Calburn, 1987), but there is some debate to the discrepancy surrounding this statement and thus colourations of different sexes were also noted in the Grass and Barn owls upon examination.

**Grass Owls:**

Irwin (1982) describes an endemic sub-species of Grass Owl in Namibia. He described a very pale specimen of the owl from Damaraland with the underparts white rather than fulvous and to which he applied the name *Tyto capensis damarensis*. It was also said to be of smaller size than the nominate form (type specimen - *Strix Capensis* A. Smith, 1834, Cape Town, South Africa), but other than having unusually small wing measurements, does not differ significantly from the other populations of southern Africa. *Tyto capensis damarensis* recognized by (Irwin, 1982) is regarded as monotypic. The type specimen is a small specimen possibly a male in this somewhat dimorphic species and the spots are generally small and the overall colour is pale. A
collection specimen from Malawi is described as having a pale colouration with smaller spots. It was also noted in the case of the type, that the flight feathers are worn, especially the secondaries albeit feather wear in owls is usually difficult to detect (Irwin, 1982). Some of the reported paleness may therefore be attributed to wear. The facial disc is also white, but as Kemp & Calburn (1987) remark that some birds apparently males, have a white disc compared to the reddish colour in females and young. Examination by Irwin (1982) of seven specimens from the national museum Bulawayo, shows that one bird from Zambia and another from Zimbabwe are whitish rather than buff below. Two further birds sexed as male are more buff below, but not as rich as the three females. The spotting in the two whitish birds also appears to be sparse, particularly on the abdomen.

Fry et al. (1988), describe the male as having a white facial disc with a blackish mark in front of eye, the same size as the eye. The stiff feathers at the rim of the facial disc are yellowish buff, tipped brown. The Grass Owl has olive brown upper parts with small white spots, becoming smaller on the crown area. Under parts being pale fulvous brown or white, with profuse small diamond-shaped dark brown spots, becoming longest on belly, but sparse and minute on the under tail-coverts. The bill is whitish to pale pink, the eyes brown to black, and the feet yellowish. Sexes are alike, however Fry et al. (1988) only mention six male and three female being examined. Similarly only eight specimens were examined in Maclean (1993) for this species.

According to Del Hoyo et al. (1999) the immature Grass Owl’s facial disc is dark or pale fulvous or cinnamon brown, with a white crescent below the bill
extending up the sides of the facial disc. The upper parts are dark brown without white spots and the under parts are deep golden brown with small black spots. Fledglings of both genders are typically darker than adults, until their first moult, when sexual maturity is reached.

Supposedly the pale under parts and darker upper parts of the related *Tyto* sp. are adapted for camouflage, the paler parts complimenting the sky, when seen by prey on the ground while the darker upper parts blend with the terrain. For these reasons it is assumed that because the males do most of the hunting during the breeding period they are typically paler than the females. Females supposedly become paler with age (Del Hoyo *et al.*, 1999).

**BARN OWLS:**
The sexes of a Barn Owl are more or less alike, though females have a tendency to be larger and darker on the under parts and facial disk. Females also tend to have larger breast spots than the males (Del Hoyo *et al.*, 1999; Roulin, Dijkstra, Riols & Duncrest, 2001). Members of both sexes can display any phenotype but males are on typically lighter coloured and females more spotted (Roulin, 1999a). Female plumage spottiness according to Roulin, Jungi, Pfister & Dijkstra (2000) signals her offspring’s ability to resist parasites.

Plumage colouration and spottiness varies greatly not only within populations (Roulin, 1999b), but also among 36 worldwide-distributed *T. alba* subspecies and seven *Tyto* species (Taylor, 1994). Geographical distances have produced many local races; the nominate race being the Common or White
Breasted Barn Owl *Tyto alba alba* from Italy (Burton, 1973). Colouration varies from specimens with pure white under parts to those of a deep reddish brown. In general the lighter coloured forms, some almost white above and below, are more common in the Australian, Mediterranean and Middle Eastern regions (Burton, 1973). The races vary in size as well, with the smaller races being found nearer to the equator contrasting with those found to the north and south (Taylor, 1994). There are also, as might be expected, indications of changes in wing size and leg size associated with different hunting habits, but more data are required before these can be fully appreciated. *Tyto alba affinis* (Blyth, 1862), the African Barn Owl is slightly larger than the Dark Breasted Barn Owl (*T. a. guttata*) with the general colouration deeper. The under parts are more ashy and lower parts more intensely rufous. The primaries and tail feathers are more conspicuously banded. Their ecology is similar to its European counterparts *T. a. alba*. Fry *et al.* (1988) describe, *T. a. alba* from North Africa south to South Algeria, Niger and northern Sudan, as somewhat paler than *T. a. affinis*, above and below. *Tyto alba thomensis* (Hartlaub, 1852) is described as being darker than *T. a. affinis*, with a browner facial disc. The under parts are grey with conspicuous small black and white spots and the under parts golden brown. This subspecies has smaller wings, tail and weight (Fry *et al.*, 1988).

The male Marsh Owl is supposedly paler than the female given by Fry *et al.* (1988). *Asio capensis tingitanus* (Loche, 1867) from Morocco and Algeria is darker than the nominate *A. capensis*, with a rufous wash and markings especially on under parts where they contrast with prominent white spotting.
1.3.2. Habitat requirements and preferences

Tarboton & Erasmus (1998), in their book Owls and owling in southern Africa, categorise owls according to where they are likely to be found. Two species, namely *T. alba* and *B. africanus*, are often encountered in urban situations, though they are also found in many other environments, because they are easily adaptable species. *Asio capensis* and *T. capensis* are dealt with together due to their similar but selective choice of habitat. Each of these owl species prefers a particular type of habitat and each is adapted to hunt a particular size and type of prey (Kemp, 2001). In contrast to many of the diurnal raptors, most owl species feed on a wider range of prey and survive in a greater diversity of habitats (Burton, 1973). The related *T. alba* and the *T. capensis* may be confused when considering their similarity in appearance, but regarding habitat requirements these two species are less easily confused than *T. capensis* and *A. capensis*. *Tyto alba* is widely distributed and is often found in almost any habitat provided suitable nesting sites are available together with a sufficient supply of small mammals (De Bruijn, 1994). It inhabits predominantly man-made landscapes in association with structures in the form of old, abandoned or infrequently used buildings, such as farm silos or sheds and old mine workings associated with agricultural surroundings. Nowadays it is found less in natural and semi natural habitats (Kemp & Calburn, 1987).

De Bruijn (1994) reviewed the main habitat requirements for Barn Owls as follows:
1. The presence of old buildings available to owls preferably surrounded by somewhat untidy places with old trees (e.g. farmyard, churchyard, castle park, standard orchard).

2. A relatively open habitat (characteristic of most types of farmland) in combination with the presence of many small landscape elements such as pools, swamps, rows of trees, hedges and small woodlots. Such small landscape elements have to show a scattered pattern over the home range rather than being concentrated in large complexes.

3. The occurrences in relief in landscape (high-low pattern) prove to be a common factor in many traditional Barn Owl home ranges. Relief causes differences in ground water level and soil, and therefore variation in land use and vegetation, bringing about diverse small mammals habitats favoured by hunting Barn Owls.

4. Finally Barn Owls favour patches of more or less open lands, which are not too intensively, tendered by man, such as rough pastures, hayfields, damp grasslands or wetlands, coarse ditches, roadside verges, grassy slopes, young plantations, waste and other marginal land, fringes or hedgerows and edges of woodland.

The Spotted Eagle Owl is very flexible and occurs in habitats that extend throughout the subcontinent. However, the species attains its highest densities in a mosaic of open wood- and grass- land (Kemp, 2001). The Grass and Marsh owls on the other hand are species almost always associated with open rank or moist grasslands, vleys and marshes (Benson, 1981; Fry et al., 1988; Kemp & Calburn, 1987; Lees & Wood, 1978; Steyn, 1982; 1984), often
but not always in close proximity to water, occurring side by side. According to Steyn (1984) dry bushveld is an unsuitable habitat for Grass Owls, however, Kemp & Calburn (1987) found some Grass Owls that have been known to nest in this type of habitat. A possibility being that surplus birds disperse into drier areas where they are temporarily sustained by the abundance of food. Grass Owls seem to be more persistent and selective, covering less ground and settling more frequently (Steyn, 1984). Grass Owls prefer permanent to seasonal vleys and vacate the latter when they dry up.

Both species construct a form amongst grasses on the ground that will either be used for roosting or nesting. Grass Owls tend to use regular roosting sites within their territories, whereas the Marsh Owls are more inclined to move around more using temporary sites (Steyn, 1985; Kemp & Calburn, 1987). Both species will remain in the area throughout the year if suitable patches of grass remain fairly long and unburnt. Before the rainy season in late spring, the cover in most highveld grasslands and vley areas is greatly reduced by veld fires and the birds tend to congregate closer to the wetter areas such as wetlands, marshy areas and small farm dams during times of burning (Steyn, 1985).

Sadly, as a result of the loss of this habitat through habitat degradation such as clearing and drainage of land for agricultural purposes, overgrazing, and too frequent burning, the Grass Owl population has declined, especially in the western parts of the country such as the Cape Province where the type specimen was collected. The Marsh Owl, although still fairly widespread and
relatively common, is also unfavourably influenced by the similar reductions in its habitat (Kemp & Calburn, 1987; Steyn, 1992).

1.3.3. Food and hunting

Although the existing literature on prey of owls is vast, it mostly deals with species composition and abundance as well as weights of prey consumed. Comprehensive ecological association between prey and predator are generally lacking. Because many owls feed on cyclic rodents they face a great fluctuating food supply, which influences every aspect of their ecology, from movements to survival and breeding success. Different species react to a fluctuating food supply in different ways, but all clearly show the role of food supply in limiting numbers and individual performance (Newton, Wyllie & Dale, 1997).

In this study, the food habits of the Grass Owl were studied to: (1) identify prey items in pellets, (2) compare feeding habits to those of different studies, (3) and to compare prey consumption and availability from pellets, gut content and small mammal surveys. The present study is concerned with the species composition of the prey of the four owl species in the study area as evident from examinations of regurgitated owl pellets collected from within the area and stomach contents. Samples thus obtained are biased in favour of crepuscular and nocturnal species since diurnal forms are rarely preyed upon (Coetzee, 1963). Furthermore factors such as differences in the breeding seasons of the different species and the density of cover affecting the relative availability of prey species may influence the results (Coetzee, 1963). A small
mammal study of the area served to identify which general species were present in the area.

All owls like other birds of prey are predators and the size of its prey is generally reflected by the size of the owl. Owls are usually separated from most diurnal raptors by the manner in which their prey is consumed. A hawk or eagle that has caught a small mammal or bird usually plucks off and discards the fur or feathers before tearing up the flesh and swallowing it piece by piece (Tarboton & Erasmus, 1998). By contrast, an owl will swallow its prey whole. However, when feeding chicks, large items are dismembered and are fed to the chicks in individual pieces, as large as possible, until they are old enough to swallow prey intact. Diurnal raptors also possess a crop between their beak and stomach, used as a temporary storage area. Owls on the other hand, lack a crop (Fry et al., 1988) and the food they have just eaten, passes straight into the foregut (they do not posses a true stomach), where the swallowed pieces are digested. The indigestible parts (namely bones, fur, feathers and exoskeletons) are compacted into a pellet, which is regurgitated through the mouth six to 12 hours after the meal (Tarboton & Erasmus, 1998).

Many species of birds regurgitate pellets of the indigestible remains, but in owls these pellets are often very distinctive. They are also easy to come about and thus provide a wealth of information on the nature of the prey items consumed. Owl pellets are so informative for several reasons. Owls possess comparatively weaker bills than other birds of prey and prey that is not too large are usually swallowed whole, leaving the skeleton and skull of the prey intact. The acidity in an owls gut is also relatively weak, with a pH ranging
between 2.2 and 2.5, compared with diurnal birds of prey, which have a lower pH of between 1.3 and 1.8. This results in only the soft tissues being digested, leaving the bones, fur, feathers and exoskeletons virtually intact (World Owl Trust, 2003). The general size, shape and appearance of pellets are also a diagnostic feature in identifying different species of owls. Owls regurgitate pellets at their own accord, depositing one prior to hunting activities. In most owls hunting bouts usually occur in two sessions, one at dusk and the other at dawn.

1.3.3.1. Pellet analysis

Many studies have been reported on various aspects of owls hunting behaviour and diet. A number of papers on pellet analysis of owls are given: Bateman (1960); Coetzee (1963) gave information on prey of owls for the Kruger National Park; Coetzee (1972); Nel & Nolte (1965) for the Kalahari Gemsbok National Park; Vernon (1972) analysed pellets collected from the Springbok flats at Panfontein, Sandfontein, Clarcot, Mosdene, Warmbaths and Vaalbos farms. Vernon (1980) also studied the prey of six owl species for Zimbabwe. Kemp & Calburn (1987) indicate records of over 20 studies conducted on prey in Barn Owl pellets from almost 100 different localities in southern Africa. Several other authors that have studied pellets of the Barn Owl include: Davis (1958, 1959) analysis of pellets from the Kalahari Gemsbok National Park and the central Transvaal; Dean (1973, 1975) for Warmbaths in the Transvaal and for South West Africa and northern Cape; De Graaff (1960); Grindley, Siegfried & Vernon (1973) for the Cape Province; Skead (1956, 1963), rural roosts and Vernon (1972) for Kruger National Park,
Transvaal, Natal, Cape Province, Kalahari Gemsbok National Park and South West Africa. Data on Grass Owl and Marsh Owl prey are given by: Armstrong (1991); Earlé (1978) for the old Transvaal, Herholdt (1986), Florisbad area; Lockwood (1978); Vernon (1972) for the old Natal and Transvaal areas and Watson (1997) diet of Grass Owls in 61 pellets from Port Elizabeth, in the eastern Cape.

Pellet analysis, despite its known limitations, is a commonly used method in studies of owl ecology (Burton, 1973). Pellets provide a unique opportunity to examine the prey spectrum, but give little information on daily food intake. The formation of pellets depends on size of meal, composition of the food, feeding schedules, availability of food, length of the hunting period, age and individual traits of each species (Burton, 1973). Owl pellets contain the indigestible; solid remains of the prey and is covered by softer fur or feathers, which are also indigestible. The pellet is often encrusted with dried saliva, which presumably assists the owl to regurgitate indigestible portion of the meal (Vernon, 1972).

Although pellets do not represent the actual proportions of the available prey species in their real communities (Del Hoyo et al., 1999), owl pellets may still be a variable source of information on the prey itself and in some instances, have produced new distributional records for mammals (Avery, 1986). Avery, Avery & Roberts (2002) have carried out extensive studies on Barn Owl pellets giving an indication of micro-mammalian distributions in this way. Vernon (1972) states that small mammal systematics, distribution, ecology and palaeontology may be additionally found in such analyses of prey (given in Davis, 1958; 1962; 1965; De Graaff, 1960).
1.3.3.2. Hunting

Two main hunting techniques are recognised, the first is perch hunting, where the owl may sit and scan the ground from a suitable elevated perch until a prey item is located. The other form of hunting is done by wing, where the owl slowly quarters from a low elevation above the ground, probing for potential prey and diving down on the prey when it is exposed (Kemp & Calburn, 1987). Usually the length of the wing is a good indication to the preferred method of hunting and generally shorter wings are used for perch-hunting and longer wings for flight-hunting. Most owls may use both techniques if the opportunity and situation permit. Some species are, however, more specialized feeders, none of which are included in this study, although all owls have a predilection for particular prey, that is available and abundant in their local foraging range.

Barn Owls employ the full spectrum of hunting behaviours known to owls, perch and flight hunting and even while on foot (Del Hoyo et al., 1999; Kemp & Calburn, 1987). African Barn Owls are strictly nocturnal unlike their European counterpart. Many of their kills are made in the first hour or two after sunset. The Barn Owl emerges at dusk to hunt by quartering the ground at a height of between one and three meters and alternate between flap- and glide flight. They may also hover above a particular spot to briefly scan the ground or beat bushes to disturb roosting birds before dropping to the ground to strike prey. Another foraging method is performed from a low perch, such as fence posts (Del Hoyo et al., 1999; Maclean, 1993). Apparently most prey is located by sound alone especially on dark evenings (Crafford et al., 1999; Del Hoyo et al., 1999; Steyn, 1994). Owls also tend to hunt mainly at dusk and dawn as
well as on moonlit nights (Steyn, 1984). Barn Owls often follows regular
hunting beats, in which field boundaries and ditches are favoured flight lines
(De Bruijn, 1994; Fry et al., 1988). Details concerning hunting techniques can
The Barn Owl must cover many miles during a single night as it sweeps
backwards and forwards over the ground, especially when feeding young
(Burton, 1973). When hunting it rarely raises more than a few meters in the
air, except when it has to pass over bushes, walls and hedges.

Grass Owls start hunting earlier in the evenings and finish later in the morning
than Barn Owls (Del Hoyo et al., 1999; Earlé, 1978; Fry et al., 1988; Herholdt,
1986; Vernon, 1972), but also have regular hunting beats and eating ‘stations’
(Fry et al., 1988). It is an elusive and strictly nocturnal species, unless
accidentally flushed from its regular nesting and roosting site (Steyn, 1994).
Grass Owls may also be seen during the day hunting rodents escaping from
veld fires (Del Hoyo et al., 1999; Fry et al., 1988).

Both Marsh and Grass Owls hunt on the wing quartering the open grassland
about one to three meters above the ground. Kemp & Calburn (1987) and
Steyn (1982) indicate four different methods of hunting used by the Marsh
Owl: low-flying, still-hunting, hawking and hovering. Marsh Owls also hunt with
slow steady wing beats, occasionally swerving or hovering before dropping
onto its prey. At night it is likely to be seen perched along fence post or similar
vantage point, keeping watch for potential prey. This habit is seldom observed
in Grass Owls, although they too may hunt from a low fixed perch (Day, 1989;
Fry et al., 1988 and Kemp & Calburn, 1987), but only on rare occasions. The
Marsh Owl is crepuscular and unlike many of the other owls in South Africa, it occasionally emerges two hours before sunset and two hours after sunrise, especially on dull or overcast days, to hunt (Steyn, 1994) and can often be seen foraging along with the African Marsh Harrier (Circus ranivorus). This is the time when the highest proportion of small vertebrates and arthropods are most active which appear to coincide to the breeding season of these owls (Kemp & Calburn, 1987).

Grass Owls do not extend their hunting to short dry grasslands or to croplands nearby (Kemp & Calburn, 1987). This is most probably due to the limited frequency of perches in their preferred open habitat (Kemp & Calburn, 1987). Short rests are taken on perches and on the ground between sessions of hunting, usually at ten minute intervals, though long rests may be taken if the perches are close to their active nests (Kemp & Calburn, 1987). ‘Active nests’ are those that contain eggs, or chicks at any stage of development. Strips of dense grass such as along road verges, boundaries of farm fields and the periphery of vleis provide a good food supply, seldom being grazed or damaged by agricultural practices. However, studies have yet to investigate how the relative availability of perches might affect the hunting behaviour, activity and energy budgets of birds of prey (Mendelsohn & Jaksic, 1989). Other prey is probably snatched in flight, as indicated by bats, birds and winged insects in pellets. Some 90% of strikes are unsuccessful in the Grass Owl. After successful strikes it may remain down on the ground to eviscerate its prey, eat at least the head, and then take the remainder back to a roost or nest (Fry et al., 1988; Kemp & Calburn, 1987). The hunting methods of the
Marsh and Grass Owl differ, the former making shorter flights and settling often in contrast to the former which quarters over the grass with a buoyant flight and pounces on its prey (Steyn, 1994). Only a small proportion of actual hunting attempts by the Marsh Owl result in prey acquisitions; resting between hunting sessions on the ground (Fry et al., 1988). Most attacks seem to be in response to auditory cues and some 80% are unsuccessful or yield only small prey that is swallowed on the spot. This technique ensures that no potential food items are passed up and is reflected in the variety of prey recorded (Kemp & Calburn, 1987). Prey preference and availability, in different areas and different times, are indicated in their diet. They regularly hide prey immediately after capture and return later to feed on these reserves. This enables them to concentrate on prey that might be plentiful but only active for a brief period, for example at dusk (Kemp & Calburn, 1987).

The Spotted Eagle Owl, which is strictly nocturnal, hunts from a perch, (fence post or telephone posts) dropping onto prey, but also catches flying termites with its feet, passing it to its bill whilst in flight (Del Hoyo et al., 1999). It is frequently seen hunting from road fence posts and streetlights (Hume & Broyer, 1991).

Foraging methods and duration of hunting of owls depend on the types of food taken, how much is caught and how much is needed. Nine studies in southern Africa at 38 different sites, revealed vertebrate prey items (n= 14100) of Barn and Grass owls (Vernon 1972), with Myomorpha making up 77-87% of these prey items. Eleven further studies (Herholdt, 1986) indicate that the Multimammate Mouse (*Mastomys natalensis*) is the dominant prey in
11 areas, Vlei Rat (*Otomys irratus*) in three areas, Hairy-footed Gerbil (*Gerbillurus paeba*) in three areas and Large-eared Mouse (*Malacothrix typical*), Striped Mouse (*Rhabdomys pumilio*) and Reddish-grey Musk Shrew (*Crocidura cyanea*) in one area each. Shrews comprise 0-53% (average 8%) and birds 1-19% (average 6%) of prey caught by Barn and Grass owls.

From these studies, the Barn Owl clearly prefers small mammals, particularly small rodents (Steyn, 1992) of the family Muridae (75-97%), but also small birds (up to 95%), shrews (Soricidae), elephant shrews (Macroscelididae), bats (Megachiroptera and Microchiroptera), reptiles, rarely frogs and insects are also included in their catholic menu (Maclean, 1993; Steyn, 1984). The Multimammate Mouse is most frequently eaten during population explosions (Steyn, 1994). The highest consumption of prey occurs in late autumn and winter (Steyn, 1985).

The Grass Owl is less versatile than the Barn Owl in its spectrum of prey because of its more specialized habitat, but both may consume the same prey species (Steyn, 1985). This is because of certain overlaps in foraging grounds in agricultural landscapes specifically. The Grass Owl’s preferred prey consists of mainly the Vlei Rat (*Otomys sp.*) (Kemp & Calburn, 1987; Steyn, 1992), although a wide range of other Muridae and Soricidae, small mammal prey is also eaten.

Birds such as Black Crakes (*Amaurornis flavirostris*), Laughing Doves (*Streptopelia senegalensis*), Levaillant’s Cisticola (*Cisticola tinniens*) and African Snipes (*Gallinago nigripennis*) are also consumed. Other birds and
frogs are rarely caught, despite their availability the owls make no obvious effort to feed on them (Herholdt, 1986; Fry et al., 1988; Steyn, 1984). They have been known to eat various insects such as termites, coprine (dung) beetles and grasshoppers (Fry et al., 1988; Steyn, 1985). Most of its prey may be diurnal, but are taken in the evenings (Fry et al., 1988). Adult Grass Owl females have also been known to eat eggshells from their nests, just after the chicks are born (Lees & Wood, 1978).

The Marsh Owls feed on what is locally available and their diet is usually made up of mainly insects of the major taxa (Coleoptera and Orthoptera) and small rodents (Fry et al., 1988). Remarkably it has been known to kill a bird as large as a Little Grebe (Tachyaptus ruficollis) (Steyn, 1994). This extremely varied diet suggests that Marsh Owls are opportunistic (Del Hoyo et al., 1999). The Spotted Eagle Owl includes a large proportion of arthropods such as insects, spiders, scorpions and the like in its diet and on occasion it also feeds on rodents and birds (Hume & Broyer, 1991).

It is also possible to analyse just how much owls require to raise a brood. In one study of Barn Owls it was estimated that they consumed 35 kg of rodents and shrews while raising five young (Steyn, 1992) with a record of accomplishment of two dozen rodents being delivered to a nest, containing seven chicks, in a quarter of an hour, shortly after sunset (Kemp, 2001; Steyn, 1994). This particular pair produced a total of 32 young in 11 months. This has important implications for the conservation of owls as a natural pest control in agricultural landscapes (Chapter 5).
1.3.4. Breeding

All four species are monogamous and to some extent territorial, especially in the breeding season (Del Hoyo et al., 1999). Barn Owls breed in a variety of sites, often in man-made structures (unused mine shafts, waste dumps, barns, grain storage silos and quarries) and for these reasons take well to artificial nest boxes, at times preferring them over natural sites. They have also been known to breed in natural landscapes such as in caves, on cliffs, and in hollows of trees such as of those in Baobabs and they even sometimes utilise Hamerkop nests (Kemp & Calburn, 1987; Maclean 1993). Breeding may take place at anytime of the year, depending on food supply. In South Africa this may occur in two periods, but mainly between February and May and again, to a lesser extent, between August and October (Steyn, 1985; Wilson, 1988). Breeding adults usually produce five eggs; occasionally a clutch size of up to 12 has been reported (Steyn, 1994). There are two factors making the Barn Owl the most successful of all owls. In a good year a pair may breed twice and individuals may breed at the early age of ten months (World Owl Trust, 2003).

The Grass and Marsh owls, however, are less reliant on human habitation for nesting requirements. They both lay in a trampled depression within a network of tunnels in the grass. Breeding thus depends on the presence of rank grass cover. Marsh Owls tend to prefer to breed in shorter, but dense waist high grass that is relatively wet, but not standing in water (Masterson, 1973). Marsh Owls are the most ephemeral in southern Africa (Kemp & Calburn, 1987). The Grass Owl prefers longer, thicker grass and drier situations. It breeds close to
permanent or seasonal vleys (Tarboton, et al., 1987), but not necessarily directly in association with water (Tarboton & Erasmus, 1998). The young of both species disperse into a system of linked grass tunnels while still downy and this reduces the risk of predation on the entire brood. Adjacent pairs of Grass Owls are likely to be found nesting within 150 m of each other, 300 m was given by Fry et al. (1988), defending a territory around the nest but with their hunting ranges overlapping (Kemp & Calburn, 1987). The peak breeding activity of the Grass Owl is given as February to April for the old Transvaal, which tends to coincide with this areas’ maximum grass cover after the rains in late summer (Del Hoyo et al., 1999; Fry et al., 1988; Steyn, 1982; 1985). Marsh Owls breed from February to September in southern Africa and have occasionally also been known to breed in October, November and December (Steyn, 1985). March, April and May are perhaps the months which both species prefer (Tarboton & Erasmus, 1998). Both species breed opportunistically and may have two broods of large clutches in years of high rainfall and rodent abundance or when early first clutches fail and are replaced (Del Hoyo et al., 1999). In these years the Grass Owl moves into dry savanna, which is typically regarded as a sub-optimal habitat (Kemp & Calburn, 1987). The Grass Owl usually produces a small clutch of between three to five eggs, rarely six, but most frequently four are produced (Burton, 1973; Del Hoyo et al., 1999). The Marsh Owl may lay a clutch size of between two and six eggs, with three being the average clutch size (König et al., 1999).

The Spotted Eagle Owl breeds in a variety of locations, including buildings, abandoned quarries, rocky outcrops, and are often found in suburban
gardens, and are highly adaptable to almost any situation. The Spotted Eagle Owl breeds from July to January, but mainly from August to October and is also known to breed during May and June (Maclean, 1993).

1.3.5. Home range in various landscape types and territoriality in owls

Marsh Owls are nomadic and are considered by Kemp & Calburn (1987) as the most mobile of owls in southern Africa, often occurring in large groups when not breeding. Thirty to 40 birds may be encountered in a couple of hectares during this time with a change towards a more suitable habitat (Del Hoyo et al., 1999; Masterson, 1973; Maclean, 1993; Steyn, 1985; Tarboton & Erasmus, 1998) and it is the only southern African owl known to be gregarious. Even when not occurring in large numbers, several birds may be flushed within a small area, presumably post-breeding family groups (Steyn, 1985). Grass Owls on the other hand are sedentary and resident and are normally observed individually or in pairs (Day, 1989; Kemp & Calburn, 1987). Although also described as secretive and nomadic by Barnes (2000), only fire, drought or overgrazing will force a pair to leave their favoured patch of long grass, to which they return as soon as conditions recover (Hume & Broyer, 1991; Kemp & Calburn, 1987). Del Hoyo et al. (1999) indicated that another possible reason for the scarcity of *T. capensis* is attributed to competition with *A. capensis*, which surpasses the Grass Owl in numbers, occurring in a ratio of 10:1 (Tarboton et al., 1987). Marsh Owls are known to defend a territory of approximately 80 hectares (ha), but territories have been recorded at a little under one square kilometer and two square kilometers, although in areas of dense population and abundant food, nests may be as close as 75 m apart.
(Del Hoyo et al., 1999; König, 1999; Steyn, 1985). The territory size of the Grass Owl is uncertain. Nests have been known to occur at a distance of 300 m apart from one another and it may breed 20-50 m from a Marsh Owl’s nest (Fry et al., 1988; Steyn, 1982). Steyn (1985) found two cases of Grass Owls nesting three meters away from an African Marsh Harrier nest and suggested that Grass Owls seem to be very tolerant of other species. Barn Owls are also sedentary, but move about locally to a certain extent, but for different reasons (Fry et al. 1988; Kemp, 2001) that being in response to fluctuations in food supply. Young of all these species disperse to other areas to locate new territories where food supply and habitat are suitable. Barn Owls show a tendency to hold on to definite breeding sites and foraging areas and can be more aptly described as local (Burton, 1973). For a species like this (in which the adult birds are mainly resident) the term ‘home range’ as defined in Newton (1979) is appropriate, implying the nesting territory (with one or more nest sites) and the hunting grounds of a pair. Large grassland areas, mostly in open complexes, characterise their foraging areas (De Bruijn, 1994). According to Coetzee (1963), a Barn Owl’s hunting range in southern Africa is in similar to that of the Barn Owls in Israel (Bodenheimer, 1949), which vary from five \( km^2 \) to 25 \( km^2 \), depending on the availability of prey. Active nests distances may be as close as 20 m apart and as far as several kilometers apart (Kemp & Calburn, 1987).

In most owl species the female incubates and broods the young while the male supplies the food (Del Hoyo et al., 1999). In Grass and Marsh owls the male is presumed to be roosting not far from the nest during the day (Steyn,
1985). When the Grass Owl female terminates brooding she may assist the male in providing food for the demanding young (Steyn, 1985). Marsh Owl young spend two to three weeks in the nest then leave the nest and are probably fed nearby for another two to three weeks. Nests are often destroyed by winter fires, livestock, flooding and predators such as the Mongoose (Herpestidae), Blacked-backed Jackal (*Canis mesomelas*) and other birds of prey.
1.4. STUDY SITE SELECTION AND DESCRIPTION

The study area was situated in the southeastern parts of Gauteng near the Mpumalanga border (GPS S26º 15’ - E28º 30’ to S26º 27’ - E28º 48’) and comprises roughly an area of 30 by 22 km, with a total area of 660 km\(^2\), extending along the 30 km stretch of the N17 from the Dalpark Toll Plaza to the Devon turnoff.

The beginning of the study area is approximately three km east of the town of Springs on the East Rand of Gauteng Province. The towns of Boksburg, Benoni and Brakpan lie in the northwest while Nigel is located south of the site. The Marievale Bird Sanctuary is situated in the eastern portion of the study area, running perpendicular to the N17 highway. Other reserves include the Grootvaly Wetland Reserve and the Anglo-American’s Private Reserve. Marievale Bird Sanctuary has become an important place for birdwatchers and ornithologists and is recognised on a national and international level as an important bird sanctuary (Haskins, 1998).

The area is almost flat ranging from 1580 m to 1640 m in altitude. From a topographical map of the area, it can be seen that grasslands dominated with sandy loam (15-25%), vertic high clay (>45%) and clay (25-45%) were present in a mosaic form. It is steeply sloping in the southwesterly area, containing some steep slopes (>8%) and grassland with indigenous woodland, flattening out north easterly to grassland. Wetland constituted 5-7% of the area including the Blesbokspruit Ramsar wetland bordering the western section of the study area, which flows into the Suikerbosrand River before
joining the Vaal River. It was recognised as a wetland of international importance in 1986 by the Ramsar Convention and is home to over 250 bird species, both local and migrants, in Springs alone. It is the only such site to occur in Gauteng (Haskins, 1998).

Mixed agricultural activities are carried out in the surrounding areas. The Grassland Biome is the cornerstone of the maize crop, and many grassland types have been converted to this crop. Sorghum, wheat and sunflowers are also farmed on a smaller scale (Bredenkamp & van Rooyen, 1998). The majority of grasslands that were present in the study area were either used for planted teff or for cattle grazing while the remaining land was used for agricultural maize, cosmos, and sunflowers depending on the season (crops being mainly harvested during the winter season). Trees are not a natural feature and occupy only less than 1% of the area. These are mostly in the form of discontinuous rows planted along farmyards and as avenues leading to farmhouses.

Not much of the area was undisturbed, and those sections that were, had previously been exploited. This was indicated by the degradation of plants and soil and the abundance of weeds occurring in these areas. Of a total area of 48 959 km², about 72% of South African grassland, has been transformed and only 0.29% conserved. Grazing is important, but overgrazing converts this grassland to a Karoo type of vegetation (Bredenkamp & van Rooyen, 1998) being unsuitable for nesting grassland owls amongst many other species of grassland birds that rely on such an ecosystem. About 20 km (approximately 1858 ha) in length of the Blesbokspruit wetland is now under protection.
Vulnerable or near threatened species that occur in the area include the Greater Flamingo (*Phoenicopterus ruber*), Lesser Flamingo (*Phoeniconaias minor*), Yellow-billed Stork (*Mycteria ibis*), Secretarybird (*Sagittarius serpentarius*), and the African Marsh Harrier (*Circus ranivorous*) and those species that were listed in Brooke (1984) and that have now been removed from the South African Red Data Book (Barnes, 2000) include the Little Bittern (*Ixobrychus minutus*) and Baillon’s Crake (*Porzana pusilla*), to name a few. Migrant birds from the northern hemisphere use the area to rest and feed before continuing on their annual journey southwards and others remain in the area for several months. These include the Ruff, Little Stint and Curlew Sandpipers. Rare species including the Blacktailed Godwit, Spotted Crake, European Marsh Harrier, Grey Phalarope and Grey Wagtail have been recorded.

Urbanisation is a major additional influence on the loss of natural areas in southern Africa (Bredenkamp & van Rooyen, 1998). Intensive agricultural practices and the effect of urbanisation and industrialisation have had a profound negative influence on the condition and stability of grassland ecosystems. Housing has encroached to within half a kilometer of the N17 in some sections, but small adjoining patches of land have been abandoned by agriculture for some considerable time making suitable areas for breeding of these specialist grassland owls.

The area is furthermore occupied by the country’s industrial and mining center (Mentis & Huntley, 1982). The area incorporates the Grootvlei Mines (Pty) Ltd area. Gold has been exploited from the Witwatersrand reefs in the East Rand
since the turn of the century (from about the 1870’s). Marievale Consolidation Mines Limited situated between Springs and Nigel was one of the first mining companies to exploit gold in the area. Several sewage treatment works are located along the Blesbokspruit and treated sewage is discharged into this wetland. These discharges have contributed to the eutrophic status of the wetland. Continued urban growth in the catchment has necessitated the upgrading of existing, and creation of new, sewage treatment works. The impact of sewage discharges on the Blesbokspruit is likely to increase (unless more efficient treatment technologies are introduced).

1.4.1. Vegetation

The Grassland biome forms one of the major vegetation types within southern Africa. Acocks (1975) defined 31 units within the Grassland biome. This publication remains the most widely used and most useful of all classifications of South African vegetation (Tainton, 1981). South African vegetation is related to changes in climate: temperature and seasonality of rainfall (Acocks, 1975; Van Zinderen Bakker, 1978). The Grassland biome of South Africa is extremely rich in faunal species (McLachlan & Liversidge, 1970). The relationship between bird populations, temperature and rainfall has been discussed by Bowen (1933) and between bird populations and vegetation by Liversidge (1962).

The influence of agricultural practices on grassland microclimate has been extensively examined within South Africa. Savage (1980) and Savage & Vermeulen (1983) have, however, reported on the effects of fire on grassland
microclimate, while Van den Berg, Roberts & Vorster (1976) investigated the influence of different grazing practices on moisture infiltration. As with grazing, burning trials have been undertaken widely and over long periods of time in South Africa. Nonetheless, precise data on the influence of fire on grassland production is disappointingly scarce. Fires and grazing effects are important as they may yield change in flora and fauna species composition within particular ecosystems.

Composition and production of grasslands may change rapidly when they are subjected to stress conditions. As an example, the yield of a tall grassveld community in KwaZulu-Natal has been found to decline to 30% of its original after six years of grazing at twice the recommended grazing capacity and dramatic changes in composition have been shown to occur in less than this period (Tainton, 1981).

Recent degradation of vegetation of southern Africa is widely ascribed to three factors: bad grazing practices, the incorrect use of fire and the clearing of woody plants (Acocks, 1975). Pentz (1945) and Scott (1951) attributed changes largely to bad land use practices resulting from amongst other things an optimistic assessment of the suitability of land for intensive agricultural use. However, it has been the over-use of grassland through overstocking which has been largely blamed for the larger scale retrogression of grasslands.

Grasslands are subject to periodic fires, now largely controlled by man. Grassland birds are adapted to the drastic changes made by fire and some of them capitalise on such conditions, (i.e. flushing out of prey). Most grassland
birds tend to prefer to hunt over bare grass areas burnt less than a year previously. But fires can also have detrimental effects such as destruction of nests. Fire is a serious potential hazard within the East Rand Highveld. Accidental or deliberate fires frequently burn uncontrollably in the vast dry reedbeds. This poses a significant threat to birds utilising these areas.

The role of fire in influencing the nature of South Africa grassland vegetation remains controversial. There is no doubt that it has for long been a major factor in shaping the structure and composition of this vegetation (Hall, 1984) and recent changes in the vegetation may be ascribed either to present day under-use or over-use of fire or to incorrect management procedures adopted during the recovery period of burnt vegetation (Story, 1952; Tainton, 1981; Tainton & Mentis 1984). The exclusion of browsing animals from the veld, which is subject to scrub invasion during the recovery period following a burn is believed to encourage the change from grassland to bushveld (Trollope, 1982).

The vegetation of the Springs/Devon area is little known floristically and ecologically. The natural plant communities are broadly described by Acocks (1975) as Highveld Grassland. The area is situated in Moist Cool Highveld Grassland (Acocks veld type no.48- *Cymbopogon-Themeda* Veld). This grassland is widespread, covering the central-eastern part of the highveld in the Free State, as well as the southern and eastern parts of Gauteng (Bredenkamp & Van Rooyen, 1998). These natural grassland communities are, however, limited due to the urbanisation and surrounding land use practices i.e. predominantly mining and agriculture within the study area.
Neither land use nor conservation objectives can be attained without a thorough knowledge of the ecology of a particular area.

This grassland veld type merges with the Bankenveld and is a sparse, tufted sourveld. The aquatic habitat associated with wetlands in the area, consists mostly of *Phragmites australis* and *Typha latifolia*, which cover 90% of the water surface and is surrounded by inundated sedges and hydrophilous grassland (marshy areas) forming a small component as a narrow band on the outer edge of the wetlands, which exist mainly during the summer rainfall period. These wetlands cover an area approximately 85% of the Marievale Bird Sanctuary. The remaining 15% of this sanctuary is grassland, which is broadly classified as Bankenveld. This type of reed habitat is not directly used by owls but may be utilised, as a refuge during raging highveld veld fires (Haskins, 1998).

### 1.4.2. Climate

An examination of climatological data from surrounding weather stations may suggest probable weather influences on the habitat, food availability, breeding and mortalities of these owls through precipitation and temperature changes. It was thus important to obtain daily and monthly weather data from the South African Weather Bureau, of the study area, recorded at the same time each day.

The area experiences the typical climate of the Gauteng Highveld, that being one of summer rainfall (October to April) and winter drought (May to September). The mean annual rainfall is 670 mm, recorded over a period of
31 years ranging from 600-700 mm. However, rainfall is known to vary considerably from year to year in most areas. Rainfall records indicated that 2002 was drier than 2003 within the study area. Very high rainfall typical in October through to March can cause local flooding of vley areas. Surface water remained for long periods following precipitation. Hailstorms are not uncommon during summer. Snow falls on rare occasions. Temperatures fluctuate greatly, both seasonally and daily, varying from -10°C in winter to 35°C in summer with an average of 17°C. Frost occurs from April through to October. During the coldest months of June and July, ice can occur on shallow open water.
1.5. PROJECT MOTIVATION

The East Rand Highveld area is one of the few areas where Grass Owls are present in fairly substantial numbers. This is evident from the large numbers found killed by motor vehicles along the 30 km stretch of road from Springs to Devon. In the Highveld of South Africa, farming practices have modified the habitat considerably and certain species such as the Grass Owl along with many other species of birds, such as the Blue Crane, have shown marked declines in populations in recent years due to some of these practices (Maclean, 1990).

This gave rise to this study, and the grounds to raise the following two questions:

“What are the reasons for the high Grass Owl population densities in this area, and could this contribute towards information on the ecology of this grassland owl and towards the conservation of this species as a whole?”

and secondly,

“What is the reason for the high Grass Owl mortality incidents in the area, which threatens their continued abundance?”

To answer these questions, all known data pertaining to these four owl species were gathered, analysed, re-evaluated and practically applied to the owls in the study area and are given in two baseline chapters, namely Chapter
CHAPTER 1.5: PROJECT MOTIVATION

2 (Ecology of the four owl species) and Chapter 3 (Mortality of the four owl species due to vehicle collisions).

This study provides the first assessment of the Grass Owl in this particular area and its relative importance. Due to their large territories and nocturnal habits studying this owl is difficult and prior to this research little was known about this secretive species.

Data is presented on a preliminary study of the current status of the Grass Owl in the East Rand Highveld together with habitat selection and prey preferences within this particular area. It was also attempted to try to establish more information on the territorial behaviour of such a secretive species of bird. The study explains the requirements of habitat for the nesting of the Grass Owl within this area.

Determining other impacts of the various types of threats to populations of owls, initiating and co-ordinating relevant research projects, and directing educational and awareness programmes to regions that have similar problems, will form part of future research. Thus a baseline study was first needed to gather information that would form a framework for future studies to build upon and thus the reason for this study.

1.5.1. Aims & objectives of the project

This study aims to:

- Determine, thereby possibly reducing, the impacts that affect the status of the *T. capensis* population specifically within the study area.
CHAPTER 1.5: PROJECT MOTIVATION

- Determine the ecological status of its habitat and the success rate of the breeding in this particular area can then possibly be applied to develop a representative model to be used in other similar case studies, ultimately promoting the long-term survival of these owls in southern Africa.

Through these initiatives at a national level, involving research, monitoring and awareness or education, by combining the data into a possible management plan for the conservation of these owl species can be achieved successfully. The project also aims to review the existing knowledge of South Africa’s owls and use this information to assess the current status of Grass Owls in this area and efforts to conserve them.

Specific objectives were to determine:

- The cause of high concentrations of mortalities found on roads.
- The level and seasonal occurrence of road mortality in owls and its impact on owl populations.
- If particular features of roads and their associated habitats predispose to high levels of mortality.
- Whether measures could be taken to help mitigate mortality and advise how they might be implemented.

Some key findings and recommendations are given in Chapters 4 and 5

1.5.2. Working hypotheses

1. High abundance
The favourable habitat of the study area is conducive to high population density of Grass Owls.

2. High mortality
The high incidence of mortalities on the road in the study area is due to the concomitant high owl population densities. Agricultural practices in the area lead to the spillage of grain on the road during transportation. Potential prey species possibly feeding on this spilt grain makes them very vulnerable to possible predation from the grass owls. This process leaves the owls vulnerable to vehicle collisions.
1.6. REFERENCES


*Herbage Abstracts, 50*: 589-603.


