# THE EFFECT OF HABITAT PRODUCTIVITY AND STRUCTURE ON BIRD SPATIAL DISTRIBUTION IN AN AIRFIELD LOCATED AT A SEMI-ARID REGION

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## Abstract

Military airfields in semi-arid regions in Israel protect vast areas from intensive grazing and any other interference, thus their primary productivity is higher than the adjacent areas. Accordingly, they attract massive avian populations by increasing: (a) grass biomass and seed quantities for granivorous birds (b) shelter for prey species provided by shrubs, and (c) viewpoints on higher shrubs and trees that are used by raptor birds that use them as hunting perches. Accordingly, bird-aircraft collision risk is significantly high. This study aims to determine the impact of vegetation biomass and other trophic levels, and habitat characteristics on the spatial and temporal distribution of birds in an airfield.

The airfield chosen for the study is at a semi-arid area (260 mm/year) in south Israel. Several study sites were chosen, which differ in their productivity levels. One control site, which is under severe grazing pressure, is studied beyond the airfield fence. In each site we determine plant cover, biomass and seed production, insect biomass and density. Five bird species are investigated: *Alauda arvensis* and *Ciconia ciconia* that cause relatively many collisions with aircraft, *Athene noctua* and *Falco tinnunculus* that are common (although collision numbers are small) and *Bubulcus ibis that* is a large invasive species and thus potentially hazardous. Birds are observed and located by GPS using line transects biweekly.

Initial results indicate that Skylarks select scarce grassland habitats far-off high perches. Kestrels select more dense grasslands with perches. Cattle egrets prefer low shrubs and little owls use open habitats with many low perches.

The major outcome of ecological analysis combined with G.I.S and multi-spectral Ikonos satellite remote sensing data will be used as a basis for a predicting model of temporal and spatial bird abundance and distribution in various scenarios.

**Keywords**: bird-aircraft collision, primary productivity, trophic levels, semi-arid, habitat structure, biomass, community structure, density, GIS, spatial and temporal model.

## Introduction

### Airfields as high productivity ecosystems

Military airfields in semi-arid regions in Israel prevent intensive grazing and other interference in vast areas; thus their primary productivity is higher than in adjacent areas. As a result, the carrying capacity of their habitat is higher, a phenomenon which influences the entire food web (Cody 1985).

Topography, characteristics of soil and climate, especially in desert ecosystems, are major factors that determine the heterogeneity of vegetation distribution and form patchy landscapes (Noy-Meir 1973). Distribution of food resources in patches has a substantial effect on the home range of foraging organisms, and the amount of food in the patch determines the foraging population size (Macdonald 1983).

Population characteristics could be affected by inter-specific and intra-specific interactions, such as predation and competition. These interactions regulate distribution and prevent or enhance the presence of individuals in habitats (Abramsky et al. 1985).

### The effect of vegetation biomass on insects:

Many insect species are herbivorous; therefore, increased vegetation biomass raises insect biomass (Brigitte et al. 1992). However, food abundance may not influence insect density (Marino 1986). For instance, density of ground beetles, from the family *tenebrionidae*, which are omnivorous and detritivorous (feed on dead vegetation material), are regulated by predation pressure, and food abundance does not modify their numbers (Ayal & Merkl 1994).

### The effect of biomass on birds:

Vegetation biomass affects bird density in several ways: increased seed stocks are foraged by more granivorous bird species, as shown in House Sparrows (*Passer domesticus*) and skylarks (*Alauda* arvensis) (Donning & Brown 1982; Donald et al. 2001). Therefore, habitats with more shrub cover on account of grass cover, decreases granivorous density (Brown et al. 1979).

Many studies show a positive correlation between raptors and prey density. The Short-eared owl (*Asio flmmeus*), prefers to forage in tall grassland where its prey is more abundant. Similarly, Sparrowhawks (genus *Accipiter*) prefer grassy habitats where their prey (e.g. squirrels) is abundant (Stewart 1985).

Insect density will regulate bird density as well. Bird density in an Arizona oak forest decreased by 50% as a result of impoverishment of insects (Cody 1985).

### Structure of habitat and foraging:

The link between biomass and bird density is more complicated when prevention of predation risks are involved (Cody 1985). In open habitats such as grassland, predation risk increases with the distance from shrubs (Weins 1992). Foraging will not take place in most abundant habitats but in areas where both food resources and shelter are available (Weins 1992).

Habitat structure influences foraging efficiency. In grassland habitats it was shown that grass height affected foraging raptors' flight speed and the number of halts during food searching (Brownsmith 1977). The Snowy Owl (*Nyctea scandiaca*) that detects its prey from perches, prefers short grassland, although food density in this habitat is relatively low. Stewart (1985) suggested that in such a habitat, the Snowy Owl’s ability to detect prey is significantly improved.

### Study aims:

The present study aims to determine the impact of vegetation biomass and other trophic levels and habitat characteristics on the spatial and temporal distribution of birds in an airfield.

The specific research questions are:

1. What is the spatial and temporal distribution of major bird species which cause bird-aircraft collisions in the area of an airfield?
2. How does each productive level affects bird distribution, individual number and diversity of major bird species in an airfield?

3. How does distinctive perching and roosting sites affect the composition and structure of bird community in an airfield?
Six bird species were chosen for this study: Little Owl *(Athene noctua)*; White Stork *(Ciconia Ciconia)*; European Kestrel *(Falco tinnunculus)*; Cattle Egret *(Bubulcus ibis);* Skylark *(Alauda arvensis*) and Chukar (*Alectoris chukar*). The reasons for choosing these species for the study are: recorded collisions with aircraft (Sky lark, Kestrel, White Stork and Chukar), high potential risk because of high observed densities (Little Owl) or extending specie's habitat (Cattle Egret).

**Study area:**
The study is conducted at an airfield in a semi-arid area (mean annual rainfall of 200 mm) near Beer-Sheba in south Israel – an area with relatively low ecological productivity but high biodiversity.
5 areas are investigated in the airfield, representing different a-biotic characteristics (e.g. topography and soil), and different vegetation biomass. Each area is divided into two habitats differing in vegetation cover (a total of 10 plots).

**Methodology:**
1. Plant biomass (vegetative and seeds) will be measured at each plot of the study area in spring and autumn (before Skylark arrival). Insect species composition, abundance and biomass will be analyzed using capture-recapture technique.
2. Bird spatial and temporal distribution and species abundance will be examined bimonthly using Line Transect method and Point Counts in the vicinity of specific places (in order to follow detailed behavioural activity).
3. Insect species composition, abundance and biomass will be analyzed: capture-recapture technique for ground arthropods once a month and sweeping with butterfly nets for flying insects will be conducted in the summer.
4. General Linear Model (GLM) analysis will be performed to determine the significance of variance between different study areas. Linear regression analysis will be used to correlate plant and insect biomass. In addition, a correlation between granivorous bird distribution and plant (mainly seed) biomass, and between insectivorous bird distribution and insect biomass will be performed.
5. The relationship between bird perches spatial distribution bird and insect abundance will also be examined.

**Initial results:**
Paired t-test analysis indicates that Skylarks selectively forage in scarce grassland habitats (P=0.0014) far-off high perches. Kestrels selectively use more dense grasslands with perches for foraging (P=0.002). However, Little owls do not show a significant preference to high or low productivity habitats (P=0.247) but prefer habitats with many low perches (P=???). The only two observations on Cattle Egrets (not statistically analyzed) indicate their preference for low shrub habitat.
There is very little data analyzed so far; therefore, the results section is extremely poor. Accordingly, I will add more "simple" results describing the fact that since the beginning of the study, during 8 days and 40 hours of observations, 5 species of the project's concern were observed (as others are not presented during the former seasons). In addition, I will provide some raw data concerning the presence of species near airstrips (e.g. Kestrels and Little Owls) explaining their important significance for flight safety.

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