How do insectivorous birds respond to their habitat? : The insects and habitat relationships

Yuan-Hsun Sun
Department of Wildlife Management
Humboldt State University, Arcata, California 95521, USA

Abstract

I examined the insect/habitat relationships in the dune forest northwestern coast, California, in order to gain an insight into the bird/habitat relationships. Twenty buckets were set in representative of 3 habitat types-Willows (Salix spp.), Spruce (Picea sp.), and Lodgepole pine (Pinus contorta). Spruce and Lodgepine stand are more similar in insect fauna. Willow stand is the highest in FSA and FHT, and thus most abundant in insect communities. FAS (<2m) and FHD are significantly correlated with insect communities but for FSD, which explain why FSD is a poor indicator of bird communities.

Key words: Habitat, Insect, FSA, FSD, FHD.

Introduction

It is clear that habitat structures is highly correlated with bird communities (Recher,1969; Jame,1971; Karr and Roth, 1971; Willson, 1974; Roth,1976). Among those habitat indices used to predict bird communities, foliage height diversity (FHD) reflected on bird communities well, however foliage species diversity (FSD) usually shows little relationship with birds species diversity (BSD, MacArthur and MacArthur 1961, Ralph 1985). Because food resources can also play a crucial role in examining the habitat selcection of birds (Gibb and Betts 1963, Brush and Stiles 1986, Blenden et al. 1986). Thus the purpose of my study is to investigate insects (i.e., the major foods of insectivorous birds) and it's habitat associations and consequently is to gain some insights into the mechanisms of bird's response to habitat features.

Materials and Methods

The dune forest, a 90-ha island-like habitat, is located at the northwestern coast, 6 miles west of Arcata. California. Study was conducted at the central portion of the forest, of which canopy is dominated by Lodgepole Pine (Pinus contorta), Spruce (Picea sp.), and Willows (Salix spp.). The Blackberry (Rubus sp.) is frequently seen in the understory at Willows stand, the dominant species of understory is Huckleberry (Gaylussacia sp.) at Logdepole pine stand (Fig.1).

Insects were captured by bucket-trapping method (Southwood 1976). Buckets were hung on trees at breast height (1.3m). Seven were set at Lodgepole pine stand and Willows stand, respectively, and 6 at Spruce stand (Fig. 1). There were in total, 20 Buckets at 3 stands. During early October to early Novmenber buckets were visited weekly, and insects were keyed out by species as possible. In addition, insects were weighed accurately to 0.001 gram after air-dried for 2.5 days.

In measuring habitat features, at each bucket, I centered a 4m-radius plot (0.005-ha) around it where I measured habitat features (Table 1). Of them, foliage surface area (FSA), foliage species diversity (FSD), and foliage height diversity (FHD) were measured and caculated by following the method of MacArthur and MacArthur (1961).

Cluster analysis was employed to examine the similarity among habitat types in term of insect fauna. Multiple regression was utilized to determine the correlation between insect and habitat parameters. MANOVA was used to compare the differences in habitat and insect parameters among habitat types. All statistic results were analyzed usinng BMDP (Dixon 1985) package. The significant level is at 0.05.

Results

The dendrogram, based on the similarity of 14 taxa levels (Table 2), showed that insect communities are more similar within stand than among stands (Fig. 2). Buckets set in Spruce stand seem to have greater similarity in insect taxa, those of the Lodgepole pine the less, and those of the Willow stand the least (Fig. 2). Comparison of these 3 stands shows that Spruce stand is much more similar to the Lodgepole pine stand.

To some extent, most habitat variables are correlated with each other ($p<0.05$), I therefore kicked out some highly correlated variables and then use 5 variables for analysis (Table 3). The 5 variables were generated from MacArthus and MacArthurs' formular (1961) to see how they correlated with insect diversities and abundances (Table 3). Only FSA (<2 m) and FHD are significantly correlated with insect parameters ($p < 0.05$). In other words, habitat variables sbove 2 meter height (i.e., FSA and FSD) had little effect on insect communities collected from the undergrowth, neither did FSD ($< 2m$, $p > 0.05$).

Overll insect communities

are significantly different ($p<0.05$) among stands. The Willows stand with highest FSA (<2m) and FHD had the most diverse and abundant insects (Fig. 3), the Spruce stand with second highest values the less, the Lodgepole pine stand with the smallest values the least.

Discussion

The present study shows that FSA (<2m) and particularly FHD are an essential variables in predicting the insect population, while FSD is a poor one. This corresponds when they were used to predict bird communities (MacArthur and MacArthur, 1961; Ralph, 1985). Such suggests that birds also respond to their habitat in the same manner, mostly because their preys (i.e., insects) do so.

Previous works indicated that some birds were characteristic of foraging on certain tree species (Franzreb, 1978; Willson, 1970). My thought coincide with Holmes and Robinson's (1981) suggestion that it may account for the low-predicted nature in FSD, and also they found that insects were more abundant in certain tree species, probably like willows in our study, attracting birds to them.

The reason why the Willow stand has most abundant insect communities probably is because it have the highest FSA (<2m) and FHD (Fig. 3). However, the influence resulted from the coincidence with the time of leaf-dropping of willow trees during study period should not be ignored, because lots of dead leave dropped in the bucket during early-and mid-Octber, and thus might increase the chance of fall into the bucket of stationary insects on the substracts. Thus it should be aware while using bucket-trapping methods.

Acknowledgement

I thank Dr. Robert J. Cooper and Dr. C. J. Ralph for their supply of equitment and study site.

References

Blenden, M.D., M.J. Armbruster, T.S. Baskett, and A.D. Farmer. 1986. Evaluation of model assumptions: the relationship between plant biomass and insect abundance. p11-14. In J. Verner, M.L. Morrison, and C.J. Ralph [eds.], Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. University of Wisconsin Press. Madison.

Brush, T. and E. Stiles. 1986. Using food abundance to predict habitat use of birds. p.57-63. In J. Verner, M.L. Morrison, and C.J. Ralph [eds.], Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. University of Wisconsin Press. Madison.

Frabzreb, K.E. 1976. Tree species used by birds in logged and unlogged mixed coniferous forest. Wilson Bull. 90:221-238.

Gibb, J.A., and M.M. Betts. 1963. Food and food supply of nestling tits (Paridae) in Breckland Pine. Journal of Animal Ecology 32:489-533.

Holmes, R.T. and S.K. Robinson. 1981. Tree species preferences of foraging insectivorous birds in a northern hardwoods forest. Oecologia 48:31-35.

James, F.C. 1971. Ordinations of habitat relationships among breeding birds. Wilson Bull. 83:15-236.

Karr. J.R. and R.R. Roth. 1971. Vegetation structure and avian diversity in several New World areas. Am. Nat. 105:423-435.

MacArthur, R.H. and J.W. MacArthur. 1961. On bird species diversity. Ecology 42:594-598.

Ralph, C.J. 1985. Habitat association patterns of forest and steppe birds of Northern Patagonia, Argentina. Condor 87:471-483.

Recher, H. 1969. Bird species diversity and habitat diversity in Australia and North America. Am. Nat. 103:75-80.

Roth, R.R. 1976. Spatial Heterogeneity and bird species diversity . Ecology 57:773-782.

Southwood, T.R.E. 1978. Ecological methods. with particular reference to the study of insect populations. Methuen & Co., London.

Willson, M.F. 1974. Avian community organization and habitat structure. Ecology 55:1017-1029.

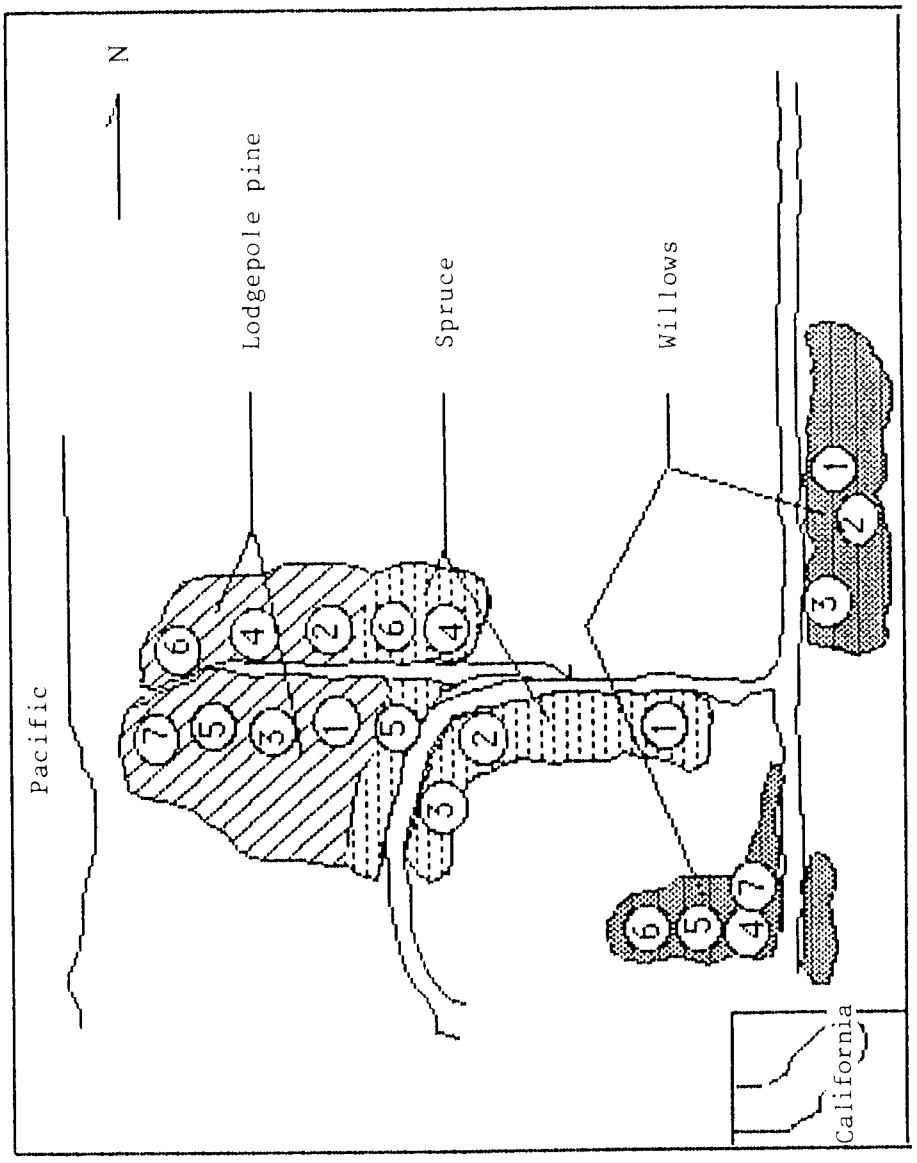

Figure 1. The location of bucket plots in the three habitat types in the central portion of the dune forest, Northwestern California.

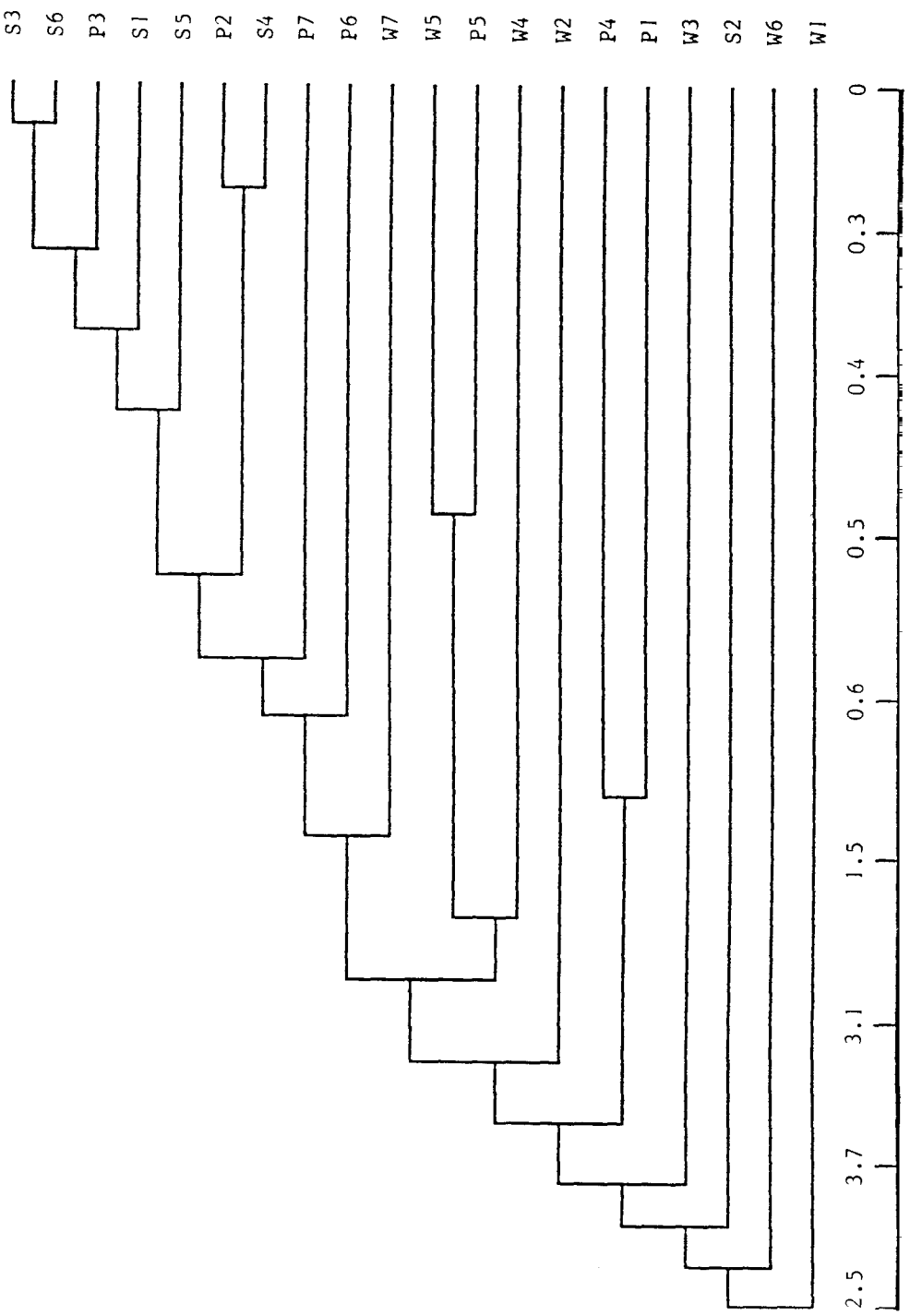

Figure 2. Dendrogram showing similarity of insect fauna among three habitats, w-Willows, s-Spruce, and p-Lodgepole pine.

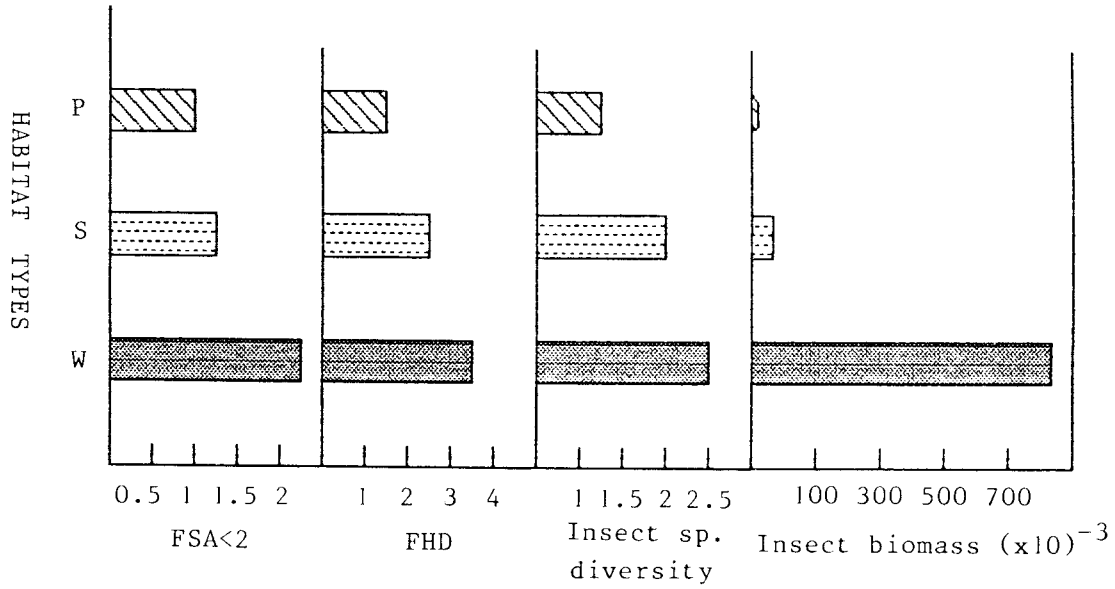

Figure 3. Comparisons of insects and habitat parameters among habitat types.

Table 1. The fourteen habitat variables measured.

Variables (unit)
Tree height (m)
Canopy cover (%)
Green cover (%)
Number of tree dbh 1-8cm/0.005 ha
Number of tree dbh 9-23cm/0.005ha
Number of tree dbh 24-38cm/0.005ha
Number of tree dbh > 39 cm/0.005ha
Foliage surface area (<2m)
Foliage surface area (>2m)
Foliage surface area (total)
Foliage species diversity (<2m)
Foliage species diversity (>2m)
Foliage species diversity (total)
Foliage height diversity

Table 2. Fourteen insect taxa grouped from 77 species were all collected by bucket-trapping method.

T A X A	
1. Ant	9. Tree or Leaf Hopper
2. Bee	10. Lacewing
3. Wasp	11. Beetle
4. Fly	12. Grasshopper
5. Cranfly	13. Earwing
6. Mosquito	14. Moth
7. Bug	
8. Aphid	

Table 3. Correlations of abundances and diversities of insects to vegetation features.

Insect	FSA (<2m)	FSA (>2m)	FHD	FSD (<2m)	FSD (>2m)
Diversity	0.504*	-0.183	0.560**	0.323	-0.020
Biomass	0.584**	-0.280	0.581**	0.340	-0.102

$p <$ * = 0.05, ** = 0.01

食蟲性鳥類如何反應其棲地？：昆蟲和棲地之關係

孫 元 勳

Department of wildlife Management, Humboldt State University, Arcata, California 95521, USA

摘 要

為探討鳥類豐富度和棲地指標（FSA, FSD 和 FHD) 之關聯，吾人研究其主要食物（昆蟲）和上述指標之關係。初步結果顯示同屬針葉林的松和雲杉林的昆蟲相組成較類似。而柳林由於FSA和 FHD 值較大，故昆蟲相較為豐富；由昆蟲和棲地因子之相關性可以說明鳥類反應其棲地正如其食物（昆蟲）亦然。

關鍵詞：Habitat, Insect, FSA, FSD, FHD.