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A Study of Avian Habitat Relationships in Claremont Canyon

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STATEMENT ABOUT THE AUTHORS

This study was undertaken by seniors in the Environmental Sciences Group Major in the College of Letters and Sciences at the University of California, Berkeley. The Environmental Sciences major offers three fields of specialization, biological science, physical science, and social science, from which each student selects an area of concentration. In their senior year students in the major participate in a year-long Senior Seminar, investigating an environmental topic of current concern. This project gives the students experience in field work, general research techniques and report writing.

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A Study of Avian Habitat Relationships in Claremont Canyon

David M. Dreher

Introduction

Claremont Canyon is an area of approximately 600 acres located in Berkeley and Oakland between Strawberry Canyon and the Caldecott Tunnel. Property ownership is divided between private owners, the East Bay Regional Park District (EBRPD), and the University of California (UC). The western, lower canyon area is privately owned residential property. The EBRPD land in the eastern, upper canyon south of Claremont Canyon Road is currently designated as the Claremont Canyon Regional Preserve (LaPorte, 1984). UC owns approximately 200 acres of property adjacent to the EBRPD land in the upper canyon and has no current development plans for the area (UCB, 1990).

Open space areas, such as Claremont Canyon, often have the highest degree of wildlife diversity found in urban areas. While the aesthetic benefits of open space are generally understood by the public, the complex wildlife relationships present in these areas are not. This study examines one type of urban wildlife—birds. In order to increase the information available on avian/habitat relationships in urban open space areas and determine varying degrees of bird use between four different habitat types, surveys were conducted to identify the types of birds present and the number of occurrences of each species. The survey results were used to rank the habitats by attractiveness to birds. Habitat types covered in the study include Monterey pine, eucalyptus, coastal scrub, and riparian.

Past Studies

Because of potential housing shortages caused by continued growth in the Bay Area, developers in cities around the Bay are planning to build in areas which are today open space in order to meet future housing needs. As open space areas disappear, protected areas such as parks and reserves become more isolated from each other. Previous research in the area of urban ecology has attempted to assess the impact that development has on the wildlife in these open space areas.

Geis (1974) examined the changes in bird populations resulting from urbanization of partially wooded farmland. Rapid expansion of Columbia, Maryland between 1966 and 1973 afforded Geis the opportunity to compare bird populations before and after urban development occurred. Geis made two general observations on the effects of urbanization on bird populations. First, with increasing urbanization there is a decline in the number of farmland, field, and woodland species and a sharp increase in the number of urban species, including house sparrows, pigeons and starlings. Second, urbanization may actually increase population density and total numbers of birds, but because there are few species adapted to urban settings, species diversity will decline.

Stebbins (1975) analyzed avian habitat relationships in the East Bay Hills. Because Stebbins collected his data in areas protected by the EBRPD, he did not compare sites before and after development as the Geis study did. However, the areas covered in his study are becoming increasingly isolated from one another by urbanization in the surrounding cities of Contra Costa and Alameda counties (see Kopchik, this report).

Stebbins recorded 101 avian species in seven different habitat types. A species' use of a habitat type was classified as either absent, slight use, moderate use, or great use based on the number of sightings. Points were given to each species according to the classification of use: three for great, two for moderate, and one for slight use. The points for all the birds in each habitat were then added together and the totals were compared between the habitats surveyed to determine "attractiveness" of a bird habitat. Three of the habitats surveyed by Stebbins—eucalyptus, Monterey pine, and coastal scrub—are covered in this study. Within these three, coastal scrub was the most "attractive" bird habitat with a score of 143. Eucalyptus, with a score of 133, was next. Monterey pine was the least attractive bird habitat with a score of 45.

Another study of avian species in the East Bay Hills was done in 1985 as part of a resource analysis of the Robert Sibley Volcanic, Huckleberry Botanic, and Claremont Canyon Regional Preserves for the EBRPD (1985). This study indicated whether a species was found in the preserve, but it did not make habitat distinctions like Stebbins. Ninety-six species were observed in the Claremont Canyon Preserve. Fifty percent were classified as "common" or usually encountered. Although not as detailed as the Stebbins study, the EBRPD study depicts the bird composition of areas in Claremont Canyon surveyed for this report.

Background

Urban open space areas are resources with numerous uses. Extensive trail systems offer recreational opportunity for hikers, joggers, bikers, and horseback riders. Interpretive centers are used for biological field education for all levels of students. Scientific research, such as that done in the University of California Ecological Study Area, is another potential use of these areas. Additionally, it has been suggested that the wildlife in urban areas may be used as an indication of environmental quality (Evenden, 1974).

Because of the abundance of uses, open space areas are normally viewed as having high resource value, and therefore much effort is devoted to their management. The property owned by UC in Claremont Canyon is slightly anomalous in that presently there is no formal management of the area and no plans have been confirmed for its future use (UCB, 1990).

Numerous suggestions covering a wide variety of options have been made for potential uses of the University's Claremont Canyon property. A 1984 report done as part of the Berkeley Campus Space Plan states that due to "limited value for biological studies...and geographic separation from the campus" this area could be used for faculty housing (LaPorte, 1984). The UC College of Natural Resources has expressed a desire to use the area for an experimental forest (McBride, 1979). In 1990, the EBRPD suggested a joint management plan that would "develop a coordinated trail plan and establish goals for resource protection and enhancement" (O'Brien, 1990).

With continuing urbanization of the areas surrounding Claremont Canyon there is a need for the University to make decisions regarding the development or management of this property. The 1991 Oakland Hills fire vividly points to a need for increased attention in the area of fire management in order to increase the safety of Hill Area residents. Action by the University is also necessary to aid EBRPD efforts to formulate future management plans for its property in the Canyon. For example, changes in UC's Claremont Canyon property that reduce the existing habitat would disrupt those species which require the entire wildland area of Claremont Canyon. A reduction would force them to seek out new habitats to suit their needs for large open space areas. Since most habitats are already at carrying capacity, the survival rate of displaced animals is likely to be low (Stebbins, pers. comm., 1991). Such changes must be understood if future management of EBRPD land is to be successful.

Information regarding the biotic resources will be a key component in UC's decision-making process for future use of its Claremont Canyon property. Because the focus of this study is bird habitat relationships, which are only a component of the overall ecosystem, it is not intended to direct the University toward any particular management plan. This report is simply an attempt to add to a foundation of information on which land use decisions may be made.

The Study Area: The area used for this study is located on 51 acres of the UC property in upper Claremont Canyon on a moderately steep south-facing slope (Fig. 1). Within this area, five study sites were chosen on the basis of their characteristic vegetation to represent four major habitat types: Monterey pine, eucalyptus, coastal scrub, and riparian brushland (Fig. 1). The eucalyptus habitat was further divided into "young" and "old" because of significant age differences between sites in the area. A comprehensive examination of the vegetative composition of the study area is given by Winsor (this report).

The Monterey pine site, located along the upper ridge of the canyon, covers approximately four acres and is bordered on the downhill side by coastal scrub. Mature Monterey pine trees (*Pinus radiata*) dominate the overstory of the site while the understory is composed of French broom (*Cytisus monspessulans*) with infrequent occurrences of California bay (*Umbellularia californica*).

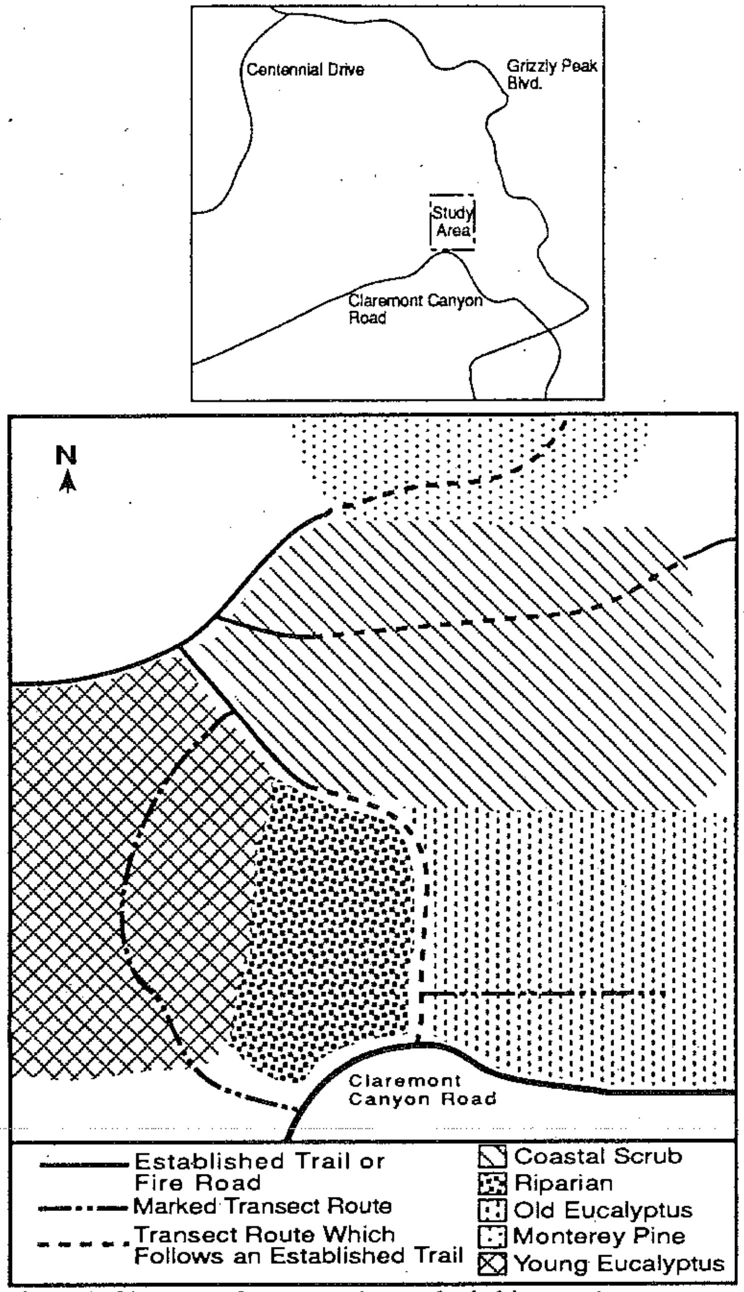

Figure 1. Claremont Canyon study area by habitat type

The coastal scrub site, located midslope below the Monterey pine site, occupies approximately 11 acres. Coyote brush (*Baccharis pilularis*), lupine (*Lupinus* spp.) and California sage brush (*Artemesia californica*) dominate the site and create two-to-five-foot high clumps of brush which cover approximately 80 percent of the area. Other plant species present include sticky monkeyflower (*Mimulus aurantiacus*) and California fuschia (*Zauschneria californica*).

The two eucalyptus sites are located at the bottom of the canyon and are separated from each other by the riparian site. The old eucalyptus site covers approximately seven acres and is characterized by a mixture of mature blue gum and red gum eucalyptus trees (*Eucalyptus globulus* and *E. camaldulensis*). A fairly thick understory composed of poison oak (*Toxicodendron diversiloba*) and immature California bay (*Umbellularia californica*) is present throughout the site. The young eucalyptus site covers 20 acres on a southwest-facing slope. Eucalyptus trees in this site are significantly smaller than those in the old eucalyptus site. A sparse understory of poison oak and small bay tree sprouts is also present.

The riparian habitat, located between the two eucalyptus sites, covers approximately two acres. The area is characterized by a dense seven-foot-high wall of poison oak, coffeeberry (*Rhamnus californica*), and California blackberry bushes (*Rubus vitifolius*). A few willow (*Salix lasiolepis*) and small eucalyptus trees are also present.

While other habitat types, including grassland and oak woodland, are also found in Claremont Canyon, a study including them was complicated by a number of factors. Steepness of slope prevented an adequate survey route through the oak woodland site in the study area. Also, with limited time and my desire to visit each habitat frequently, the number of habitats had to be limited. As a result, habitats such as grassland, which did not represent a significant proportion of the study area, were not included. The habitats chosen for this study represent the dominant habitat types found in the study area which could be adequately surveyed.

Methodology

The Personal Censusing Technique: The personal censusing method, as described in Biological Survey Studies for the East Bay Regional Parks (Stebbins, 1990), aided in the development of satisfactory survey routes and an information gathering system. This method is primarily used for gathering information on the distribution of species encountered during field surveys. The technique assumes the surveyor is experienced in species identification. Since I had no experience in field identification at the beginning of my study I made alterations to allow for this lack of training.

The altered method was as follows. I began by selecting survey routes for each habitat according to three criteria: 1) to ensure adequate coverage of the edges and interiors of a habitat, 2) to provide adequate visibility, and 3) to allow fairly easy access. The routes are indicated in Figure 1. In the Monterey pine and coastal scrub sites fire roads and/or established trails satisfied all criteria and were chosen as survey routes. Because there were no established trails through either eucalyptus site, marked transects were constructed to survey these habitats. A survey route that followed a fire road along the edge of the riparian site was chosen because very dense vegetation in the riparian site prevented setting a transect through the site.

After the routes were established I began surveying the sites. During each survey, ten-minute stops were made at four positions along each route. At each stop I sat quietly looking and listening for birds in the site. When I saw or heard a bird I first judged whether the bird was using the habitat. "Use of a habitat" by a bird is defined for this study as the physical presence of a bird within the boundaries of a habitat as indicated by sight or sound. After determining the presence of a bird I concentrated on it for as long as possible and then recorded the following information on a data collection sheet: date and time of observation, type of species, number of individuals counted, and comments. After each day of surveying I recorded the number of birds observed in each habitat along with date and time of survey, route taken, weather conditions, and comments. This information collection system allowed me to construct a long term record of the number of birds observed, accumulate a list of identified species, and also record any extraneous influences, such as traffic noise, on the survey.

Extraneous influences, such as varying levels of wind or light, strength of a bird's call, and density of vegetation, are always present and limit the success of field collection methods dependent on identification through sight and sound. To minimize their effects bird identification was made only after a number of criteria were met. Calls had to be heard a sufficient number of times to provide a conservative judgment of presence in the site, normally five times. For birds seen above the site, I defined "use" as follows: if a bird was hovering, searching for prey or a roost, then it was counted. If it only passed over the site it was not counted. Defining inter-habitat boundaries was more difficult. Because of fairly distinct vegetation changes, the boundaries of a site could often be seen, easing the determination of presence. When the boundaries of a habitat were not visible from the survey route I was conservative in judging bird presence. Because the effects of extraneous influences cannot be eliminated, the number of birds counted here reflects a conservative estimate of actual bird numbers.

Survey Schedule: Surveying took place during portions of the 1991-92 winter bird season. From late October of 1991 through mid-December 1991 three surveys per week were done. Surveying resumed in late January of 1992 and continued through late February of 1992. During this period surveys were done two times per week. As suggested by Stebbins (Pers. Comm., 1991), the two hours after sunrise and the two hours before sunset were used as survey times. Surveys in each time period were done for all the habitats. While I tried to follow a regular routine, problems caused by inclement weather sometimes forced me to deviate from this schedule.

Data

In total, 30 hours of field surveys, divided equally among the habitats, were conducted for this study. During these surveys 455 birds were counted and 36 species were identified. Table 1 lists the number of species identified, the number of occurrences by habitat of each species, and the

Common Name	Latin Name	MP	CS	OE	YE	R
Allen's hummingbird	*Selasphorus sasin*		1			
American robin	*Turdus migratorius*		5			
Anna's hummingbird	*Calypte anna*	2	4			
band-tailed pigeon	*Columba fasciata*	2				
Bewick's wren	*Thryomanes bewickii*	6		9	1	7
black-capped chickadee	*Parus pubescens*	1	10			
black-shouldered kite	*Elanus caeruleus*		1			
Brewer's blackbird	*Euphagus cyanocephalus*		5		3	
brown towhee	*Pipilo fuscus*		15	3		4
chestnut-backed chickadee	*Parus atricapillus*				2	
common barn owl	*Tyto alba*				1	
Cooper's hawk	*Accipiter cooperii*	2		2		
dark-eyed junco	*Junco hyemalis*		7	6	3	10
downy woodpecker	*Picoides pubescens*				2	
European starling	*Sturnus vulgaris*		2			1
golden-crowned sparrow	*Zonotrichia atricapilla*		8			
great horned owl	*Bubo virginianus*			4		
hermit thrush	*Catharus guttatus*		2			2
Hutton's vireo	*Vireo huttoni*			2	3	4
Lincoln's sparrow	*Melospiza lincolnii*		2			
mourning dove	*Zenaida macroura*				1	
pygmy nuthatch	*Sitta pygmaea*	1				
red tailed hawk	*Buteo jamaicensis*	2	5			
red-breasted nuthatch	*Sitta canadensis*	11				
red-shafted flicker	*Colaptes auratus*	9	7	11	5	5
ruby-crowned kinglet	*Regulus calendula*	3	3		2	
rufous-sided towhee	*Pipilo erythrophthalmus*		7		2	
scrub jay	*Aphelocoma coerulescens*		13		7	7
sharp shinned hawk	*Accipiter striatus*		2			
solitary vireo	*Vireo solitarius*	1				
song sparrow	*Melospiza melodia*		7	8		
Steller's jay	*Cyanocitta stelleri*	7	9	23	9	5
Swainson's hawk	*Buteo swainsoni*				1	
Townsend's warbler	*Dendroica townsendi*	3			1	
turkey vulture	*Cathartes aura*		5		2	
wrentit	*Chamaea fasciata*		17	1	1	4
UNKNOWN		13	16	35	13	27
TOTAL		63	153	104	59	76

Table 1. Identified species and number of occurrences by habitat.
Key: MP = Monterey Pine Habitat; CS = Coastal Scrub Habitat; R = Riparian;
OE = Old Eucalyptus Habitat; YE = Young Eucalyptus Habitat.

total number of birds observed in each habitat.

Table 2 lists the attractiveness scores for each habitat in order from most attractive to least attractive. The system used to compute attractiveness scores was modeled after the Stebbins study. Attractiveness points were determined by the number times a species was identified: one point for 1-5 occurrences, two points for 6-10 occurrences, three points for 11+ occurrences, and one third of a point for each unknown bird. The sum of these points is the attractiveness score for the habitat. Since almost one fourth of the birds were classified as unknown, I felt they needed to be figured into the attractiveness score. The one third fraction was chosen because many of the birds were likely to be previously identified birds and would have only contributed to a maximum of two points of difference. By assigning each unknown more than a third of a point, I would be overcompensating for their occurrences.

Habitat Type	Attractiveness Score
Coastal Scrub	40.3
Old Eucalyptus	28.6
Young Eucalyptus	23.3
Monterey Pine	22.3
Riparian	22.0

Table 2. Summary of attractiveness calculation.

Note: Calculation of attractiveness scores is provided in Appendix 1 at the end of this report.

Discussion

In this section, the data presented in the tables above are used as the basis for a discussion of avian habitat use in the Claremont Canyon study area. The discussion begins with a comparison of the species found by this study to those found in both the Stebbins (1975) and EBRPD (1985) studies in order to define the group of birds identified and account for the smaller number of identified species in this study. Next, the attractiveness ranking, as presented in Table 2, is examined in the context of ecological factors influencing the area. The section finishes with a short discussion of methodological problems and how they may have altered the results of this study.

A comparison of the list of species in Table 1 to those in the EBRPD (1985) and the Stebbins (1975) studies indicates that the species identified in this study represent a large proportion of the resident species, or those commonly found in Claremont Canyon throughout the year. Seventy-five percent of the species identified in this study were classified as "common" species for Claremont Canyon in the EBRPD study. Of these species, 78 percent were further classified as "residents." Stebbins classified 70 percent of the species identified in this study as "moderate" or "great" users of at least one of the habitats. Three species identified by my study were either classified as rare or were not listed in the other two studies. These species, the black-shouldered kite (*Parus pubescens*), pygmy nuthatch (*Sitta pygmatea*), and Swainson's hawk (*Buteo swainsoni*), were seen very few times and may have been improper identifications. Their contribution to the overall computation of attractiveness and the list of species is small.

Additionally, it is likely that the species not identified by this study which are named in the other two studies are present at some time during the year in the study area.

A comparison of the attractiveness rankings of this study (Table 2) to those of the Stebbins study shows that among habitats surveyed in both studies, namely Monterey pine, eucalyptus, and coastal scrub, there is a close correlation. Both studies found that coastal scrub was the most attractive and Monterey pine was the least attractive habitat. Three environmental factors explain the ordering of attractiveness for the sites surveyed in Claremont Canyon: 1) availability of food, 2) availability of cover for concealment from predators or weather, and 3) amount of solar heating received by the site.

Although the coastal scrub, which received the highest attractiveness rating, had the greatest land area and the greatest visibility, the high attractiveness rating is more likely a combination of food and shelter availability and warmth. The clumped bushes which cover a large percentage of this site provide decent cover and a viable food source during the winter months, since many of the plants do not lose their leaves. The south-facing slope also contributes to the attractiveness of this site: this aspect allows for early morning heating and long sunlight exposure during the day, increasing its attractiveness during the cold winter months.

Following the coastal scrub habitat in attractiveness were the two eucalyptus sites. Between the two, the data indicate a distinct preference for the old eucalyptus site. Food availability is one factor contributing to the attractiveness of the old eucalyptus habitat. Compared to the young eucalyptus site, the old eucalyptus had a more leafy canopy and a more developed understory during the winter months. This may have provided the birds with a more substantial food source and also better shelter from wind and rain. Seasonal variations in the amount of food and shelter due to leaf budding and growth during the spring and summer may make these sites more attractive, but only a full-year examination could determine this. The young eucalyptus also receive lower levels of solar heating due to shading in the morning and more indirect exposure in the afternoon. This causes lower temperature levels in the young eucalyptus site which may also decrease its attractiveness.

The two least attractive habitats were the riparian and the Monterey pine. Although these two sites appear to be good bird habitat, features of each site explain the poor attractiveness rating. High wind exposure is the factor most likely contributing to the low numbers of birds observed in the Monterey pine site. Since the site is positioned on top of a ridge, it experiences higher and more constant wind levels than any other site. The increased exposure requires birds to expend more energy to stay warm. A deficiency in the availability of seed type foods, an essential component in the diet of many birds, may also be contributing to its low attractiveness score. Monterey pines represent an uneven food source since they only produce cones every two to three years (McBride, pers. comm., 1992). Often bay and oak trees, which can bolster the food supply, are present in Monterey pine groves (McBride, pers. comm., 1992), but the understory of this site has a relatively low number of these trees.

The riparian site, upon first glance, also appears to be good bird habitat. The dense shrubs provide excellent cover for small birds, and the abundant berry bushes there would appear to supply ample food. Unfortunately, the benefit of cover and food, which would be greatest during the spring and summer months, seems to be outweighed by the poor solar heating of the site during the winter months. Located in the bottom of a steep canyon, this site receives very little direct sunlight and as a result, is colder than the surrounding areas. The fact that about half of the birds seen in this site used it as a temporary stopping point on their way to another habitat further supports a general trend of avoidance.

Generally, the attractiveness rankings presented in Table 2 make sense ecologically, but there are methodological problems that need attention if a more distinct picture of the bird use of these habitats is to be assessed. These problems have all been mentioned previously but they are listed here to emphasize how they may have altered the results of this study. Foremost of the problems is the seasonality of this study. A more accurate picture of avian habitat use in Claremont Canyon can only come from a multi-season survey period. This study only examines the winter season and therefore misses the more bird-abundant spring and summer seasons. During these other seasons, solar heating levels and food availability would increase, bolstering the attractiveness of certain habitats. In particular, the riparian habitat might become more attractive than the Monterey pine and the differences seen in the two eucalyptus sites may be diminished.

The second problem is the limited number of sites and habitats. This study used single sites to sample the avian habitat use patterns present in Claremont Canyon. In order to substantiate the findings of this study for the Claremont region, multiple sites should be surveyed so that each habitat is accurately represented. Further studies also should investigate avian use of other important habitats present in the area, such as grassland and oak woodlands.

A greater variety of survey times would also increase the clarity of the avian use patterns. By limiting the surveys to dawn and dusk in this study, there is the possibility that some habitats were favored. For example, higher temperatures in the coastal scrub area may have attracted more birds to the area in the early morning hours. Including a noon-time survey would help to expose any habitat bias introduced by the limited number of survey times.

Conclusion

This investigation into the avian habitat use patterns present in Claremont Canyon contributes to the knowledge base concerning the relationship between plants and animals in the area. From the data and discussion the following conclusions can be drawn. First, close correlation between this and other previous studies of bird species in the East Bay Hills, along with the seasonality of this study, indicate that the species identified by this study are predominantly winter inhabitants. Additionally, species identified by the two previous studies which were not identified by this study are likely to be found in Claremont Canyon at some time during the year. Second, the ordering of habitats according to attractiveness appears correct in the context of various environmental factors, even though the seasonality of the study may have increased the attractiveness of the coastal scrub and lowered the attractiveness of the riparian and young eucalyptus sites.

Accumulation of information pertaining to the past and present biotic composition of Claremont Canyon is essential for future land use planning decisions regarding the area. Studies which further expand the understanding of the biotic composition and also create an historical record of the evolution of the area need to be continued. Since these studies require time and money, a cost effective research program should be formulated by the University. Encouraging faculty to develop studies and use undergraduate and graduate students as staff is one way to initiate such studies. Besides offering the students an opportunity to gain useful field study experience, it also increases the University's information base on the area.

Success of faculty-led study projects depends on two factors. First, the study periods should be year-long or multiple year. Incorporating ongoing projects into classes could establish a long-term, regular record of events. Expanding the survey sites to other areas of Claremont Canyon in order to achieve a greater variety of habitats is also needed. As stated earlier, this study is an attempt to add to the foundation of information on which the decision-making processes regarding the future uses of Claremont Canyon may be made. Because of the high resource value of this open space area, it is apparent that the research must continue if future management is to be successful.

References

East Bay Regional Park District (EBRPD), 1985. *Robert Sibley Volcanic, Huckleberry Botanic, and Claremont Canyon Regional Preserves: a Resource Analysis.* Prepared by R.H. Alley and Abey Landscape Architects and Larry Seeman Associates, Inc., Natural Resource Management, Adopted by Resolution No. 1985-6-184, Oakland, CA, 81pp.

Evenden, F. G., 1974. Wildlife as an indicator of a quality environment. In *Wildlife in an Urbanizing Environment*; J. Noyes and D. Progulske, eds., Cooperative Extension Service, Amherst, Mass., University of Massachusetts, pp. 19-21.

Geis, A. D., 1974. Effects of urbanization and types of urban development on bird populations. In *Wildlife in an Urbanizing Environment*; J. Noyes and D. Progulske, eds., Cooperative Extension Service, Amherst, Mass., University of Massachusetts, pp. 97-105.

LaPorte, T., 1984. *Hill Area Task Force Report.* Prepared for the University of California, Berkeley, as part of the Berkeley Campus Space Plan, 71pp.

McBride, Joe, 1979. *Management Plan for Strawberry and Claremont Canyons;* Report prepared by the Committee on Conservation and Environmental Quality for the University of California, Berkeley, 35pp.

McBride, Joe, Professor, Department of Forestry and Resource Management, University of California, Berkeley. Personal communication, 1992.

O'Brien, P., 1990. Unpublished letter to UC Chancellor Heyman from Mr. O'Brien, General Manager at East Bay Regional Parks District. Obtained from Dale Sanders, Campus Planning Office, University of California, Berkeley, 2 pp.

Sanders, Dale, Senior Planner, UC Berkeley Campus Planning Office, Berkeley, CA. Personal communications, 1991.

Stebbins, Robert, 1975. Use of habitats in the East Bay Regional Parks by free-living vertebrate animals. In *Vegetation Management Principles and Policies for the East Bay Regional Parks District*, East Bay Regional Park District, Oakland, CA, 14pp.

Stebbins, Robert, 1990. *Biological Survey Studies for the East Bay Regional Parks;* Museum of Vertebrate Zoology, University of California, Berkeley, 50pp.

Stebbins, Robert, Professor, Museum of Vertebrate Zoology, University of California, Berkeley. Personal communication, 1991.

University of California, Berkeley, (UCB) Planning Office, 1990. *Long Range Development Plan University of California, Berkeley;* UC Berkeley, January, 1990.

Habitat type:	11 or more Occurrences	6 to 10 Occurrences	1 to 5 Occurrences	Unknown	Attractiveness Score
Coastal Scrub	3 species@3 points per species	7 species @ 2 points per species	6 species @ 1 point per species	16 birds at .33 points per bird	40.3
Old Eucalyptus	2 birds @ 3points per bird	3 birds @ 2 points per bird	5 birds @ 1 point per bird	35 birds at .33 points per bird	28.6
Young Eucalyptus	0 birds @ 3 points per bird	2 birds @ 2 points per bird	15 birds @ 1 point per bird	13 birds at .33 points per bird	23.3
Monterey Pine	1 bird @ 3 points per bird	3 birds @ 2 points per bird	9 birds @ 1 point per bird	13 birds at .33 points per bird	22.3
Riparian	0 birds @3 points per bird	3 birds @ 2 points per bird	7 birds @ 1 point per bird	27 birds at .33 points per bird	22

Appendix 1. Computation of attractiveness scores