

AVIFAUNA AND RIPARIAN VEGETATION IN CARMEL VALLEY, MONTEREY COUNTY, CALIFORNIA¹

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Abstract: Avian abundance and diversity were measured at 5 sites in the riparian zone of the Carmel River, selected to represent different conditions of riparian vegetation, in the spring of 1983. Vegetation varied from lawn (golf course) to mature, undisturbed riparian forest dominated by black cottonwood (Populus trichocarpa). Birds were counted along 700-meter transects on 10 occasions. The abundance and diversity of birds varied directly with the abundance and diversity of the riparian vegetation. A narrow strip of riparian trees tripled the number of species observed at golf courses. Scattered residential development did not effect the number of birds observed in mature riparian forest.

In spring 1983, the avifauna of the Carmel River's riparian zone was surveyed for the Monterey Peninsula Water Management District, for use in the development of the Carmel River Watershed Management Plan.

An extensive riparian woodland, covering much of the 100-year floodplain, was supported by the Carmel River floodplain in its unaltered state. With human development, most of the riparian forest has been reduced to narrow strips along the river bank; in some areas it has been completely eliminated (Kondolf and Curry 1986).

Riparian woodland is of high ecological value to wildlife, relative to other vegetation communities. Snider (1975) states that the riparian community supports the most diverse and abundant animal life of the Carmel River system.

This study examined the avifauna of five sites on the floodplain of the Carmel River. The study sites differed in the abundance of riparian vegetation present, in the breadth and age structure of the vegetation, and in the degree of human disturbance. Comparison of the avifauna at these sites gave quantitative estimates of the importance of these factors for avian abundance and diversity.

Study Sites

Sites were chosen along the Carmel River and its floodplain. The sites were representative of larger portions of the streamside and floodplain, and results of the survey should apply to other portions of the river where similar vegetative conditions exist.

Two sites were at golf courses, one with a narrow strip of riparian woodland bordering the streambank, and one with no significant streamside woodland remaining. These sites were compared to determine how the maintenance of such a woodland strip affects the avifauna. A third site was a large wooded area, studied to examine the importance of breadth of riparian vegetation to avifauna. This thickly forested area stretched from the river over the floodplain, and was essentially free from human presence. Another large forested area, also extending from the river across the floodplain, but with scattered houses present, was compared to determine the impact of human presence on the avifauna when a large area of riparian vegetation is basically left intact. The last site was an area of deforested floodplain, chosen to compare relative values for birds of forested floodplain and cleared grassland environment. Once a cattle ranch, it is now within a regional park.

Vegetation descriptions are from personal observations, supplemented by Beattie and Murphy (1981). A 700-meter transect line was established at each site. Each line sampled an area of some 2.3 hectares in a narrow strip running through the site.

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Site #1: Quail Lodge Golf Course

The Quail Lodge Golf Course site (QL) consists of a golf course bordering the Carmel River with an associated strip of riparian forest on the river bank. This strip, averaging 25 meters in width, consists of mature black cottonwood, arroyo willow (*Salix lasiolepis*), red willow (*Salix laevigata*), California box elder (*Acer negundo*), and sycamore (*Platanus racemosa*) trees. The understory is composed of willow (*Salix* spp.), blackberry (*Rubus* spp), and poison oak (*Toxicodendron diversiloba*). The cottonwoods are mainly of one age class (mature: over 9 meters tall); there are very few juvenile or old and dying trees present. The golf course itself consists of lawns with scattered cottonwoods and exotic species.

A paved path follows the border between the woodland and the golf course, paralleling the river; this path is used regularly by golf carts and pedestrians. The transect was laid along the path, and birds in both environments, forest and lawn, were studied.

Site #2: Carmel Valley Ranch Golf Course

The Carmel Valley Ranch site (CVR) consists of a golf course directly bordering the river. Other than scattered willow there is little streamside vegetation; the lawns meet the riverbanks. The transect was placed along the riverbank, to duplicate as nearly as possible the position of the QL transect. Birds in both the riparian shrubbery and the golf course were studied.

Site #3: Rancho San Carlos

The Rancho San Carlos site (RSC) is a mature riparian woodland area of some 6 hectares, that covers both river banks and floodplain. While vegetation has been drastically reduced in most places along the river, at this site a wide area of forest remained, and probably represented the original appearance of the floodplain.

The woodland canopy consists mainly of mature cottonwoods, although all age classes are present, including dead and dying trees and saplings (under 3 meters). Other trees present include willows, California buckeye (*Aesculus californicus*), and California box elder. The dense, viny understory is composed of poison oak, with wild cucumber (*March fabaci*), wild hemlock (*Conium maculatum*), rose (*Rosa* spp.), and other shrubs.

The transect line paralleled the river and then angled across the interior region, to provide data on both streamside and floodplain conditions.

Site #4: The Narrows, Residential Woodland

The Narrows Residential Woodland site (NRW) consists of a similar mature riparian woodland but with scattered human residential development. Despite the presence of houses, gardens, and footpaths, the forested area has been left fairly intact. Riparian vegetation extends from the streamside well onto the floodplain. The average width of the forested area is 110 meters.

The canopy consists of black cottonwood, arroyo willow, and red willow. All age classes are present. The understory is of willows, blackberry, poison oak, wild hemlock, and other shrubs. Exotic plant species are also numerous, in hedges and gardens.

Site #5: Garland Park

The Garland Park (GP) site lies within the Garland Regional Park, on the floodplain. The site consists of open grassland, covering about 20 hectares. Once used for cattle-grazing, human disturbance is now limited to foot trails regularly used by riders, bikers, and joggers.

The grassland has remnants of a previously existing forest. There are scattered trees (primarily old, dying, or snags), including cottonwood, willow, and sycamore. Scattered coyote bush (*Baccharis* spp.) and other shrubs also occur. The transect was placed in an L-shaped curve through the site.

Methods

At each study site, a transect line of approximately 700 meters was walked at a pace of approximately 0.7 kilometers per hour. The transects were each walked on 10 separate occasions (visits) regardless of weather conditions, between the hours of 06:00 and 15:00 (PST) on weekends from 17 April to 24 May, 1983, by Molly Williams. Each weekend the sites were visited in random order to correct for changes in avian activity during the study hours. The counts were made by walking along each transect line and counting all birds seen within 20 meters of the path, according to the modified Emlen (1977) method. Binoculars (7 x 26, and 8.5 x 44) were used.

The occurrence of certain species such as Great Blue Heron, Common Merganser, Belted Kingfisher, and Mallard seemed to be influenced more by the condition of the river itself than by the surrounding vegetation. We excluded these "aquatic" species and aerial species (those seen only flying over the transects at high elevation) from the count. The remaining species are more closely associated with the particular ecology of each study site and provide a more accurate comparison.

Results

Figure 1 shows the cumulative number of species seen at each site as a function of the number of visits. The plots level off, indicating the survey is complete for the season studied. The data are summarized in Table 1.

A list of species seen at the different sites is given in Table 2. For each site, the total number of sightings of a species is given, followed by the range of sightings during visits. Species that displayed breeding behavior (singing, mating, nesting, or feeding young) are indicated. (The Mallard is discounted as an aquatic species at all sites except QL, where a flock lived on the golf course.)

Discussion

Avian diversity and abundance varied directly with the diversity and abundance of the riparian vegetation. The golf course site with a narrow strip of riparian woodland bordering the river (QL) supported three times as many species, and four times as many birds, as the golf course site with no woodland border (CVR). While 13

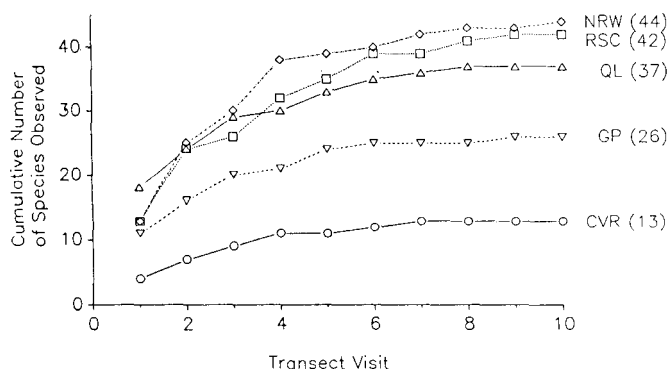


Figure 1— Cumulative species richness.

Table 1 — Summary of Avian Diversity and Abundance.

Site	QL	CVR	RSC	NRW	GP
Total sightings, all species	494	114	565	569	307
Total species	37	13	42	44	26
Breeding species	14	0	17	19	6

species showed breeding activity at the first site, demonstrating significant utilization of the environment, no breeding behavior was observed in the second site. The importance of riparian vegetation to avian abundance and diversity has been previously demonstrated (e.g. Stauffer and Best, 1980), but it is noteworthy that even a narrow strip of forest supported a dramatic increase in the avifauna. Hurst and others (1980) also found this to be true on the Sacramento River.

With a broader area of woodland there is a further increase in diversity and abundance. At RSC we counted five more species than at QL, and 69 more bird sightings. Three more species were seen breeding. The NRW site also supported more birds than QL, with seven more species, 73 more sightings, and five more breeding species. Similar trends of avian diversity increasing with the width of riparian woodland were observed by Stauffer and Best (1980).

The QL woodland varies from RSC and NRW in age structure as well as forest width. The latter sites have abundant dead limbs and snags, while at QL the trees are younger. This difference mainly affects hole-nesting birds, which may require soft snags for nest sites (Stauffer and Best, 1980). Both the "primary" hole-nesters which excavate holes (the five species of woodpeckers observed) and the "secondary" hole-nesters using previously excavated holes or naturally-occurring cavities (Chestnut-backed Chickadee, Pigmy Nuthatch, House Wren, Bewick's Wren, and Starling, in this study) were more abundant at RSC and NRW than at QL. An exception was the Chestnut-backed Chickadee, which was scarce at NRW for unknown reasons. However, dead limbs and trees do not fully account for these species' presence. At the GP site, where the trees are almost exclusively old and dying, there were four species of primary hole-nesters seen but only one secondary hole-nesting species (the Starling). Perhaps some secondary hole-nesters require denser woodland as well as older and dying trees.

The savannah-like environment of GP supported a poorer avifauna than either the forested areas of RSC and NRW, or the narrow border of QL. At GP, 18 fewer species were seen than at NRW, 16 fewer than at RSC, and 11 fewer than at QL. There were also far fewer bird sightings. This demonstrates the greater value to avian species of riparian vegetation compared to other environments.

Table 2 - Species Occurrence and Relative Abundance at Five Sites

Species	QL		CVR		RSC		HRH		GP	
	T	R	T	R	T	R	T	R	T	R
Acorn Woodpecker	0		0		20*	0-5	5	0-2	52*	0-8
Allen's Hummingbird	1	0-1	0		10	0-3	4	0-1	2	0-1
American Crow	0		0		4	0-2	0		31	0-5
American Goldfinch	0		0		0		0		3	0-3
Anna's Hummingbird	3	0-1	4	0-1	16	0-3	8	0-2	16	0-4
Ash-throated Flycatcher	0		0		0		0		3	0-1
Barn Swallow	21	0-5	5	0-5	0		18	0-5	15	0-3
Bewick's Wren	4*	0-1	0		16*	0-4	12*	0-3	0	
Black Phoebe	5	0-2	0		5	0-2	17*	0-4	0	
Black-headed Grosbeak	21*	1-4	0		14*	0-3	9*	0-2	0	
Black-Shouldered Kite	0		0		0		0		16*	1-2
Brewer's Blackbird	36	1-9	15	0-4	3	0-2	5	0-2	0	
Brown Towhee	13	0-1	0		24	0-4	10	0-3	1	0-1
California Quail	29*	1-5	0		48*	2-9	52*	0-14	13	0-5
Chestnut-backed Chickadee	68*	3-9	0		77*	4-12	28*		0	
Cliff swallow	37*	0-10	10	0-10	0		46*	0-8	2	0-2
Common Bushtit	41*	1-6	0		31*	0-9	49*	2-9	1	0-1
Common Flicker	0		0		12*	0-2	6*	0-2	10*	0-2
Cooper's Hawk	0		0		1	0-1	1	0-1	0	
Dark-eyed Junco	4	0-2	0		0		0		0	
Downey Woodpecker	4	0-1	0		12	0-3	15	0-3	0	
English Sparrow	2	0-1	3	0-1	0		3	0-2	0	
Hairy Woodpecker	0		0		3	0-1	3	0-1	3	0-1
House Finch	0		0		1	0-1	29*	1-5	0	
House Wren	2	0-1	0		5	0-2	12*	0-2	0	
Hutton's Vireo	11	0-2	1	0-1	5	0-2	5	0-1	0	
Kestral	2	0-1	0		4	0-1	5	0-2	9	0-1
Killdeer	0		20	0-6	0		1	0-1	0	
Lesser Goldfinch	2	0-1	0		4	0-2	14	0-4	1	0-1
Mallard	17*	0-6	Aq		Aq		Aq		Aq	
Mourning Dove	12	0-2	0		16*	0-4	12*	0-3	2	0-1
Nuttall's Woodpecker	1	0-1	0		4	0-2	5	0-2	1	0-1
Olive-sided Flycatcher	0		0		1	0-1	0		1	0-1
Orange-crowned Warbler	0		0		3*	0-1	1	0-1	0	
Pygmy Nuthatch	0		0		4	0-2	5	0-2	0	
Red-shouldered Hawk	0		0		0		11*	0-2	0	
Red-winged Blackbird	0		2	0-1	0		1	0-1	1	0-1
Robin	28	1-5	12	1-2	13	0-3	16	0-3	0	
Ruby-crowned Kinglet	2	0-1	0		2	0-1	0		0	
Rufous Hummingbird	0		0		1	0-1	0		0	
Rufous-sided Towhee	2	0-1	0		12*	0-2	11*	0-2	0	
Scrub Jay	12	0-4	2	0-1	18	0-4	13	0-2	17*	0-4
Song Sparrow	29*	1-5	2	0-1	51*	3-8	31*	1-5	23*	0-5
Starling	12*	0-3	6	0-2	36*	0-8	14*	0-5	51*	2-10
Steller's Jay	4	0-2	0		4	0-2	5	0-1	0	
Swainson's Thrush	5*	0-2	0		5*	0-2	9	0-2	0	
Tree Swallow	0		0		0		0		4	0-4
Turkey Vulture	0		0		0		0		21	0-4
Violet-green Swallow	0		32	0-12	6	0-6	4	0-3	8	0-3
Warbling Vireo	35*	1-5	0		31*	0-6	27*	1-5	0	
Western Flycatcher	6	0-2	0		8	0-2	7'	0-2	0	
Western Tanager	4	0-4	0		0		0		0	
Western Wood Pewee	5*	0-1	0		7*	0-2	9*	0-2	0	
Wilson's Warbler	4*	0-2	0		12*	0-3	21*	0-5	0	
Wrentit	4	0-1	0		9	0-2	6	0-2	0	
Yellow Warbler	6*	0-2	0		7*	0-2	4*	0-2	0	

T = Total sightings

R = Range of sightings from visit to visit

* Species exhibiting nesting behavior

When the undisturbed RSC and the human disturbed NRW sites were compared to determine the effects of human habitation where the woodland is left intact, we found both sites to be rich in bird abundance and species diversity. Two more species were observed at the inhabited NRW than in the undisturbed forest of RSC, and two more species were seen breeding at NRW. However, due to the residential nature of the NRW site, we had to assume the birds there were more accustomed to human presence. They were probably less secretive, and consequently more detectable. They might also have been more willing to exhibit breeding behavior in the presence of an observer than the wilder birds at RSC were. Such variation in detectability may also exist when comparing RSC to the other sites, all of which had more human exposure than RSC. Unfortunately we were unable to measure this "shyness factor." Shyness and detectability also vary between species, making absolute bird densities very difficult to determine. In this study only relative densities were examined, so this issue was ignored. RSC may well have "hidden" more species that are particularly intolerant to human presence.

Nevertheless, the NRW site figures indicate that human presence is generally tolerable to riparian avifauna, so long as the riparian forest (with all age-classes present) is allowed to remain.

This study did not measure the seasonal variations in species richness caused by migrating and overwintering species. Some birds sighted were transients, such as the Western Tanagers sighted at QL, but the relative value to migrants of different vegetative conditions can only be determined by carrying out a year-long survey. Such a study was conducted in the Sacramento Valley (Hurst and others, 1980), and mature riparian forest was found to support 90 species annually, while rip-rap streambank supported only 25 species.

In conclusion, this study supports previous work that has shown riparian vegetation to be a vitally important environment for native birds. Unless river management includes the maintenance of at least narrow strips of riparian woodland, the abundance and diversity of the native avifauna will be severely at risk.

Acknowledgments

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