1988

Test of wildlife habitat relationships predictions for the riparian corridor of Guadalupe River San Jose, California

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DOI: <https://doi.org/10.31979/etd.r98f-e9cs>
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corridor of Guadalupe River, San Jose, California**

Meyer, Syndie Bachmann, M.A.

San Jose State University, 1989

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Ann Arbor, MI 48106

TEST OF WILDLIFE HABITAT RELATIONSHIPS PREDICTIONS
FOR THE RIPARIAN CORRIDOR OF GUADALUPE RIVER
SAN JOSE, CALIFORNIA.

A Thesis
Presented to
The Faculty of the Department of Biological Sciences
San Jose State University

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts

By
Syndie Bachmann Meyer

August, 1988

APPROVED FOR THE DEPARTMENT OF BIOLOGICAL SCIENCES

A handwritten signature in cursive script, reading "Michael J. Kutilek", written over a horizontal line.

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ACKNOWLEDGMENTS

I am deeply indebted to M.J. Kutilek, H.S. Shellhammer, and L.R. Mewaldt, Professor Emeritus, of San Jose State University, for their guidance and encouragement during all phases of this study. I am especially grateful for their assistance in editing this paper and for their instruction during data analysis. Dr. Mewaldt also spent many hours improving my ornithological skills.

Thanks also to R.R. Duke and the rest of the Wildlife Division at Harvey and Stanley Associates, Inc. for their assistance and support. Mike Rigney and Rob Klinger were especially helpful during the several difficulties that I encountered with the database and analysis of these data.

This study was partially funded by a grant from Harvey and Stanley Associates, Incorporated who also generously supplied computer time.

Materials and other information which assisted this project were supplied by many individuals. Access to the WHR database was supplied by Dave Ziener who also helped solve various additional access problems. Manuscripts were supplied by M.L. Avery and C. Van Riper, and by A.S. England and D.W. Anderson. A draft of the WHR user's guide was provided by D. Airola.

Finally, I would like to thank my family for providing the means to undertake and complete this project. Special thanks are given to Nancy Thurnall, William Meyer, and C.E Roth for their profound contributions. Dan Pappone deserves special commendation for supplying steady nerves, extraordinary wit, and the calm conviction that success was inevitable.

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ABSTRACT

Results of a year-long survey of birds in a section of the Guadalupe River riparian corridor in San Jose, Santa Clara County, California were compared to California Department of Fish and Game's "Wildlife and Fish Habitat Relationships" (WHR) predictions for Valley-Foothill Riparian (VFR) Habitat in Santa Clara County. The list produced by WHR contained 131 species of birds, 83 of which were observed during sampling. An additional 33 observed species were not predicted by WHR. While the 38% error-rate for predictions was not statistically significant, it nevertheless was reduced to 9.5% as a result of modifying the list to correspond with known features of the study area, and by considering the sampling methods used. The initial list provided information about the possible diversity of bird species in a riparian corridor anywhere in Santa Clara County. Modifications were necessary to produce a list which was accurate for this section of the Guadalupe River. Similar modifications will probably be necessary for most other WHR predictions.

INTRODUCTION

California Department of Fish and Game's "Fish and Wildlife Habitat Relationship" (WHR) database contains information about the distribution and habitat requirements of California's 654 vertebrate species. Computer files for each of these were compiled from the available literature and revised through expert reviews. The data may be extracted in several ways: either by a single specification (vis species, habitat, location, or habitat element), or by a compilation of 2 or more of these specifications (Airola 1986, Salwasser and Laudenslayer 1982).

The accuracy of the system as a predictive model has been tested for chaparral and blue-oak woodland in San Benito County (Avery and Van Riper 1986 unpublished), and chamise-redshank and mixed chaparral in Glenn and Tehama Counties (England and Anderson 1985). Data were collected during 2 or more years in these studies, and the study areas were in relatively undisturbed locations. These studies showed between 19% and 25% error between predicted and observed species, and conclude with recommendations to change the status of a number of species in WHR's matrix model.

This paper compares the results of a one-year survey of birds in a disturbed, bottom-lands, riverine system with the WHR predictions for Valley-Foothill Riparian (VFR) habitat in Santa Clara County. I tested the hypothesis of

no difference between WHR predictions and species observed during the survey.

STUDY AREA

The Guadalupe River flows south to north through the bottom lands of Santa Clara Valley from the Guadalupe Creek confluence with Alamitos Creek at the base of Sierra Azul (foothills of the Santa Cruz Mountains) to Alviso Slough (San Francisco Bay) in Alviso. The river is entirely contained within the city limits of the city of San Jose, in Santa Clara County, California. The study area was limited to habitat within and immediately adjacent to the upper 6 miles of river between Interstate Freeway 280 and Blossom Hill Road (Fig.1).

The Guadalupe River drains 420 mi² and is expected to carry 7,500 cubic feet per second (cfs) through the study area in a 1% event, ie., high flood flows produced by a combination of meteorological and hydrological events which have 1% probability of occurring during any storm (U.S. Army Corps of Engineers 1972). The course of the river, its boundaries, floodplains, and surrounding habitat have been altered throughout the history of European man's residence in Santa Clara Valley by the development of land surrounding the river and the implementation of flood-

Figure 1: Location of study area on upper Guadalupe River, San Jose, California.

control measures in and around the river channel (U.S. Army Corps of Engineers 1972, 1976, 1985).

Durrenberger (1976) and Lantis et al. (1977) discussed the diversity of weather, topography and plant communities within the "mild-mediterranean" climate of Santa Clara County. The influences of two mountain ranges (the Peninsula and Hamilton Ranges of the Coast Range complex), two large bodies of water (the Pacific Ocean and San Francisco Bay), and the complex geology of the region alter this climate to the extent that it supports more than six major plant communities. All of these communities, with the exception of grasslands and riparian associations, are dominated by evergreen trees or shrubs.

Riparian habitats bound rivers and streams throughout the county, but remnants of deciduous riparian corridors may only be found in the broad flatlands of Santa Clara Valley (Holstein 1984, Stiles 1978). Riparian corridor forests are Arcto-Tertiary relics of deciduous forests which are well represented only east of the Mississippi River (Chabot and Mooney 1985, Holstein 1984, Vankat 1979). The species composition of corridor forests is distinct from eastern deciduous forests and, in Santa Clara County, is dominated by Fremont cottonwood (Populus fremontii) and western sycamore (Platanus racemosa). The understory of shrubby-trees, shrubs, and ground cover often contains box-

elder (Acer negundo), walnut (Juglans spp.), California buckeye (Aesculus californica), valley oak (Quercus lobata), and several types of willow (Salix spp.) (Holland 1986).

The riparian habitat surrounding Guadalupe River has been disturbed during the agricultural, suburban, industrial, and urban activities which have accompanied the development of Santa Clara Valley (U.S. Army Corps of Engineers 1972, 1985). None of the broad forests associated with this type of habitat remain, and the narrow strip of sparse vegetation which still occupies some sections of the corridor has little understory and large proportion of upland species (native or introduced). Among the most common upland species are: Black-locust (Robinia psuedoacacia), California pepper (Shinus molle), elm (Ulmus spp.), English walnut (Juglans regia), eucalypts (Eucalyptus spp.), live oak (Quercus agrifolia), and pine (Pinus spp.) (Harvey and Stanley, Assoc. 1985, 1986, 1987). The dense understory was largely absent in the study area.

METHODS

Surveys were conducted by stratified random sampling using modified fixed-radius point (Hutto et al. 1986) and transect counts (Emlen 1971, 1977). Fifty sample areas were selected which represented the range and proportion of

habitat patch types present within the study area. Habitat patches were defined by WHR size-class and cover-class types for wooded habitats (Salwasser and Laudenslayer 1982). The limits of the corridor were established by property lines (Harvey and Stanley Assoc. 1986) and habitat characteristics, and only birds found within these limits were counted.

Sampling began in January 1986 and continued until January 1987, with repetitions at 14-day intervals throughout the year. Plots were surveyed sequentially using 10-minute samples (Scott 1981). Sampling began each day at dawn and continued until 0930 hours (Robbins 1981). Samples were not taken when the wind speed was greater than 8 mph, or when it was raining (Emlen and De Jong 1981, Richards 1981, Robbins 1981).

Counts using visual and auditory cues began immediately upon entering the sample area. Species, type of cue (sight/sound), number in group, activity, substrate, and indications of vertical and horizontal placement in the vegetation were recorded for each observation. Birds flying over the sample area were not counted, but birds flushed from the site were recorded as were birds flying along the length of the river such as Belted Kingfishers. Care was taken to avoid counting a bird more than once although this method may have resulted in too few birds being counted.

Weather, time of day, plant phenology, and relative water level were also recorded at each plot.

A list of species was generated by the WHR database which combined all size-class and cover-class categories ("highest habitat") of Valley-Foothill Riparian habitat in the Santa Clara County location. This constituted the list of expected species.

RESULTS

There were 131 species expected and 116 observed (Table 1). Only 83 species are represented on both lists (expected and observed: EO). The remaining 33 observed species were not predicted by WHR (observed, not expected: ONE), and 48 of the expected species were never observed (expected, not observed: ENO) within the study area.

The predictive list was 38% in error, and 29% of the observed list were species not predicted. Although McNemar's sign test indicated differences this great had a high probability ($p=0.89$) of being due to chance alone, these error rates seemed high enough that the appropriate next step was to determine whether or not they could be reduced.

Much of the error in predictions made can be corrected by considerations of habitat and the distribution of bird species. Some species may be eliminated from the list if

TABLE 1: List of Species Which Were Predicted by WMR for Valley-Foothill Riparian Habitat, or Which were Observed During Sampling of Gundalope River Riparian Corridor in 1986.

Common	Name	Scientific	Name	Status ^a	Predicted ^b Rel.No. Season	Observed ^c Rel.No. Season	Pref. ^d Habs. Code ^e	
Loon species		<i>Gavia sp.</i>		ONE	-	W	O	3
Pied-billed Grebe		<i>Podilymbus podiceps</i>		ONE	-	PERM	M,O	3
Eared Grebe		<i>Podiceps nigricollis</i>		ONE	-	W	O,M	3
Western Grebe		<i>Aechmophorus occidentalis</i>		ONE	-	W	O	3
Double-crested Cormorant		<i>Phalacrocorax auritus</i>		ONE	-	F,W	O	3
Great Blue Heron		<i>Ardea herodias</i>		O,E	PERM	S,F,W	M	1
Great Egret		<i>Casmerodius albus</i>		O,E	PERM	S,F,W	M,G	1
Snowy Egret		<i>Egretta thula</i>		O,E	PERM	S,F,W	M	1
Cattle Egret		<i>Bubulcus ibis</i>		ENO	F,W	-	M,U	1
Green-backed Heron		<i>Butorides striatus</i>		O,E	PERM	S,F,W	M,R	1
Black-crowned Night Heron		<i>Nycticorax nycticorax</i>		ONE	-	PERM	M	1
Graylag Goose		<i>Anser anser</i>		ONE	-	S,F	U	3
Wood Duck		<i>Aix sponsa</i>		ENO	PERM	-	M,R,O	10
Mallard		<i>Anas platyrhynchos</i>		O,E	PERM	W	N,O	1
Cinnamon Teal		<i>Anas cyanoptera</i>		ENO	PERM	-	N,O	3
Eurasian Wigeon		<i>Anas penelope</i>		ONE	-	W	N,O	4
American Wigeon		<i>Anas americana</i>		ONE	-	W	N,O	3
Scaup species		<i>Aythya sp.</i>		ONE	-	F,W	M,O	3
Common Goldeneye		<i>Bucephala clangula</i>		ONE	-	W	O,M	3
Bufflehead		<i>Bucephala albeola</i>		ONE	-	W	O,M	3
Hooded Merganser		<i>Lophodytes cucullatus</i>		ENO	-	-	M,O	1
Common Merganser		<i>Mergus serrator</i>		ENO	-	-	O,M	3
Ruddy Duck		<i>Oxyura jamaicensis</i>		ENO	F,W,SP	-	M,O	1
Turkey Vulture		<i>Cathartes aura</i>		ONE	-	-	O,M	1
Osprey		<i>Pandion haliaetus</i>		O,E	PERM	F,W	M,O	3
Black-shouldered Kite		<i>Elanus caeruleus</i>		ONE	-	F	A,G,W	1
Bald Eagle		<i>Haliaeetus leucocephalus</i>		O,E	PERM	W	A,O	3
Northern Harrier		<i>Circus cyaneus</i>		ENO	W	W,SP	A,M,G	1
Sharp-shinned Hawk		<i>Accipiter striatus</i>		ENO	PERM	-	A,O	5
Cooper's Hawk		<i>Accipiter cooperii</i>		O,E	PERM	-	A,M,G	5
Red-shouldered Hawk		<i>Buteo lineatus</i>		O,E	PERM	F	W,R,C,A	1
Red-tailed Hawk		<i>Buteo jamaicensis</i>		O,E	PERM	S,W	W,R,C,A	1
Ferruginous Hawk		<i>Buteo regalis</i>		O,E	PERM	F,W,SP	R,W,A	1
Rough-legged Hawk		<i>Buteo lagopus</i>		ENO	PERM	PERM	A,G,W	1
Golden Eagle		<i>Aquila chrysaetos</i>		ENO	W	-	-	4
American Kestrel		<i>Falco sparverius</i>		ENO	PERM	-	A,G	5
Merlin		<i>Falco columbaris</i>		O,E	PERM	PERM	A,G,R,W	5
Peregrine Falcon		<i>Falco peregrinus</i>		O,E	W	F	A,M,W	1
Prairie Falcon		<i>Falco mexicanus</i>		O,E	PERM	F	A,M,O	1
Chukar		<i>Alectoris chukar</i>		ENO	PERM	-	A,G	8
Wild Turkey		<i>Meleagris gallopavo</i>		ENO	PERM	-	-	4
California Quail		<i>Callipepla californica</i>		ENO	PERM	-	-	6,5
Common Gallinule		<i>Gallinula chloropus</i>		O,E	PERM	PERM	C,G,U	1
				ONE	-	S,F	M	3

Table 1 (continued)

Common Name	Scientific Name	Status	Predicted Rel.No. Season	Observed Rel.No. Season	Pref. Habs.	Code
American Coot	<i>Fulica americana</i>	ONE	-	C	PERM M,O	3
Killdeer	<i>Charadrius vociferus</i>	ONE	-	C	PERM M,G,U	3
Greater Yellowlegs	<i>Tringa melanoleuca</i>	ONE	-	R	F M	3
Spotted Sandpiper	<i>Actitis macularia</i>	ONE	-	R	F M,R	2
Long-billed Curlew	<i>Numenius americanus</i>	ONE	-	U	F G,M	3
Common Snipe	<i>Gallinago gallinago</i>	ONE	-	R	S M,G	3
Donaparte's Gull	<i>Larus philadelphia</i>	ONE	-	R	SP M,O,U	3
Ring-Billed Gull	<i>Larus delawarensis</i>	ONE	-	C	PERM M,O,U	3
California Gull	<i>Larus californicus</i>	ONE	-	R	S,F M,O,U	3
Herring Gull	<i>Larus argentatus</i>	ONE	-	R	S M,O,U	3
Caspian Tern	<i>Sterna caspia</i>	ONE	-	U	SP,S M,O	3
Forster's Tern	<i>Sterna forsteri</i>	ONE	-	C	PERM U	3
Rock Dove	<i>Columba livia</i>	ONE	-	C	PERM W	1
Band-tailed Pigeon	<i>Columba fasciata</i>	O,E	PERM	R	S G,W,U	1
Mourning Dove	<i>Zenaidura macroura</i>	O,E	PERM	A	PERM U	1
Common Barn Owl	<i>Tyto alba</i>	O,E	PERM	R	SP	1
Screech Owl	<i>Otus kennicottii</i>	ENO	PERM	-	-	5
Great Horned Owl	<i>Bubo virginianus</i>	ENO	PERM	-	-	5
Northern Pygmy-owl	<i>Glaucidium gnoma</i>	ENO	PERM	-	-	5
Burrowing Owl	<i>Athene cunicularia</i>	ENO	-	R	S G,U	3
Long-eared Owl	<i>Asio otus</i>	ENO	PERM	-	-	5
Short-eared Owl	<i>Asio flammeus</i>	ENO	PERM	-	-	5
Northern Saw-whet Owl	<i>Aegolius acadicus</i>	ENO	PERM	-	-	5
Common Poor-will	<i>Phalaenoptilus nuttallii</i>	ENO	PERM	-	-	5
White-throated Swift	<i>Aeronautes saxatalis</i>	O,E	SP,S	U	C,G A,W,G,M	5,6
Black-chinned Hummingbird	<i>Archilochus alexandri</i>	O,E	SP	R	S R,W	1
Anna's Hummingbird	<i>Calypte anna</i>	O,E	PERM	A	PERM C,U,W,R	1
Rufous Hummingbird	<i>Calypte costae</i>	ENO	PERM	-	-	4
Allen's Hummingbird	<i>Selasphorus rufus</i>	ONE	-	R	SP C,W	1
Belted Kingfisher	<i>Selasphorus sasini</i>	O,E	PERM	R	SP C,W,R,U	1
Levins' Woodpecker	<i>Ceryle alcyon</i>	O,E	PERM	A	PERM O,R	1
Acorn Woodpecker	<i>Melanerpes lewis</i>	ENO	PERM	-	-	6,9
Yellow-bellied Sapsucker	<i>Melanerpes formicivorus</i>	ENO	PERM	U	W,SP,S,W,U,G	1
Red-breasted Sapsucker	<i>Sphyrapicus varius</i>	ENO	PERM	-	-	9
Nuttall's Woodpecker	<i>Sphyrapicus ruber</i>	O,E	PERM	R	F,W W,R	1
Downy Woodpecker	<i>Picoides nuttallii</i>	O,E	PERM	U	PERM W,R,G	1
Hairy Woodpecker	<i>Picoides pubescens</i>	O,E	PERM	C	PERM R,W	1
Northern Flicker	<i>Picoides villosus</i>	O,E	PERM	R	S,F W	1
Western Wood-Peece	<i>Colaptes villosus</i>	O,E	PERM	C	F,W W,G,R	1
Black Flycatcher	<i>Contopus auratus</i>	ENO	PERM	R	S W	1
Ash-throated Flycatcher	<i>Empidonax difficilis</i>	O,E	PERM	C	SP,S,F,R,W	1
Cassin's Kingbird	<i>Sayornis nigricans</i>	O,E	PERM	A	PERM R,G,M	1
	<i>Nyctarchus cinerascens</i>	O,E	PERM	R	S C,G,W,R	1
	<i>Tyrannus vociferans</i>	ENO	PERM	-	-	4

Table 1 (continued)

Common Name	Scientific Name	Status	Rel.No.	Predicted Season	Rel.No.	Observed Season	Pref. Habs.	Code
Western Kingbird	<i>Tyrannus verticalis</i>	ENO	H	SP,S	-	-	W,R,G	6
Purple Martin	<i>Progne subis</i>	ENO	H	SP,S	-	-	W	1
Tree Swallow	<i>Iridoprocne bicolor</i>	ENO	H	PERM	-	-	A,M,W	1
Violet-green Swallow	<i>Tachycineta thalassina</i>	O,E	H	SP,S,F	R	S	A,W,G,U	1
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	O,E	H	SP,S	A	SP,S	A,R,G	1
Cliff Swallow	<i>Hirundo pyrrhonota</i>	O,E	H	SP,S	C	S	A,U,G	1
Barn Swallow	<i>Hirundo rustica</i>	O,E	H	SP,S	U	S	A,G,U	1
Scrub Jay	<i>Aphelocoma coerulescens</i>	O,E	M	PERM	C	PERM	C,U,G	1
Yellow-billed Magpie	<i>Pica nuttalli</i>	ENO	H	PERM	-	-	G,U	6
American Crow	<i>Corvus brachyrhynchos</i>	O,E	M	PERM	C	SP,S,F	U,G,A	1
Common Raven	<i>Corvus corax</i>	ENO	M	PERM	-	-	W,G,A	10,5,8
Chestnut-backed Chickadee	<i>Parus rufescens</i>	O,E	L	PERM	C	PERM	W,R,U	1
Plain Titmouse	<i>Parus inornatus</i>	O,E	H	PERM	U	PERM	W,U	1
Bushtit	<i>Psaltiriparus minimus</i>	O,E	H	PERM	A	PERM	C,W,U,R	1
Red-breasted Nuthatch	<i>Sitta canadensis</i>	E	L	F,W	-	-	W	1
White-breasted Nuthatch	<i>Sitta carolinensis</i>	O,E	M	PERM	R	S	W,R	1
Brown Creeper	<i>Certhia americana</i>	O,E	M	F,W	R	W	W	1
Canyon Wren	<i>Catherpes mexicanus</i>	ENO	L	PERM	-	-	G,R	8
Rewick's Wren	<i>Thryomanes bewickii</i>	O,E	H	PERM	C	PERM	C,W	1
House Wren	<i>Troglodytes aedon</i>	O,E	M	PERM	R	W,S	W,R,C	1
American Dipper	<i>Cinclus mexicanus</i>	ENO	M	PERM	-	-	C	7
Golden-crowned Kinglet	<i>Regulus satrapa</i>	O,E	M	F,W	-	-	W,R	1
Ruby-crowned Kinglet	<i>Regulus calendula</i>	ENO	L	SP,S	C	F,W	W,R	1
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	ENO	H	PERM	-	-	W,C	7
Western Bluebird	<i>Sialia mexicana</i>	ENO	L	SP,S	-	-	G,C	6,7
Swainson's Thrush	<i>Catharus ustulatus</i>	O,E	H	PERM	R	SP,S	R,W	1
Hermit Thrush	<i>Catharus guttatus</i>	O,E	H	PERM	R	F,W	W,R	1
American Robin	<i>Turdus migratorius</i>	O,E	H	PERM	A	PERM	U,W,R	1
Varied Thrush	<i>Ixoreus naevius</i>	O,E	H	PERM	R	F	W,R	1
Wrenlit	<i>Chamaea fasciata</i>	ENO	H	PERM	-	-	C	7
Northern Mockingbird	<i>Nimus polyglottos</i>	O,E	H	PERM	A	PERM	U	1
California Thrasher	<i>Toxostoma redivivum</i>	ENO	M	PERM	-	-	C,U	7
Water Pipit	<i>Anthus spinoletta</i>	ONE	-	F,W	U	F,W	G,M	3
Cedar Waxwing	<i>Bombycilla cedrorum</i>	O,E	H	PERM	A	F,W,SP	W,U	1
Phainopepla	<i>Phainopepla nitens</i>	ENO	M	PERM	-	-	W,G	6
Loggerhead Shrike	<i>Lanius ludovicianus</i>	O,E	H	PERM	R	F,W	G	1
European Starling	<i>Sturnus vulgaris</i>	O,E	H	PERM	A	PERM	U,W,G	1
Solitary Vireo	<i>Vireo solitarius</i>	ENO	M	PERM	-	-	W,R	1
Hutton's Vireo	<i>Vireo huttoni</i>	O,E	H	PERM	R	W,SP,S	W	1
Warbling Vireo	<i>Vireo gilvus</i>	O,E	H	PERM	U	SP,S	R,W	1
Orange-crowned Warbler	<i>Vermivora celata</i>	O,E	H	PERM	U	SP,S	C,W,R	1
Yellow Warbler	<i>Dendroica petechia</i>	O,E	M	PERM	C	SP,S,F	R	1
Black-throated Gray Warbler	<i>Dendroica coronata</i>	O,E	H	PERM	A	F,W,SP	W,U,R	1
Townsend's Warbler	<i>Dendroica nigrescens</i>	ENO	M	F,W,SP	-	-	C,W	7
	<i>Dendroica townsendi</i>	ENO	M	F	-	-	W	1

Table 1 (continued)

Common Name	Scientific Name	Status	Rel.No. Season	Predicted	Rel.No. Season	Observed	Pref. Habs.	Code
Hermit Warbler	<i>Dendroica occidentalis</i>	ENO	M	SP,F	-	-	W,R	1
MacGillivray's Warbler	<i>Oporornis tolmiei</i>	O,E	H	SP,S	R	SP	W,R	1
Common Yellowthroat	<i>Geothlypis trichas</i>	O,E	M	PERM	U	SP,S,F,M	W,R	1
Wilson's Warbler	<i>Wilsonia pusilla</i>	O,E	H	SP,S	U	SP,S,F,R,W	W,R	1
Yellow-breasted Chat	<i>Icteria virens</i>	ENO	L	SP,S	-	-	R,C	1
Western Tanager	<i>Piranga ludoviciana</i>	ONE	-	-	U	SP	W,R	2
Black-headed Grosbeak	<i>Phaeothicus melanocephalus</i>	O,E	H	SP,S	U	SP,S	W,R	1
Lazuli Bunting	<i>Passerina amoena</i>	O,E	H	SP,S	R	S	C,G	1
Rufous-sided Towhee	<i>Pipilo erythrophthalmus</i>	O,E	H	PERM	R	W,SP,S	C,W,U,R	1
Brown Towhee	<i>Pipilo fuscus</i>	O,E	H	PERM	A	PERM	U,C,R	1
Chipping Sparrow	<i>Spizella passerina</i>	ENO	M	SP,S	-	-	W,G,C	6,7
Lark Sparrow	<i>Chondestes grammacus</i>	ENO	L	PERM	-	-	G,U	6
Savannah Sparrow	<i>Passerculus sandwichensis</i>	ENO	L	F,W,SP	-	-	G,M	6
Fox Sparrow	<i>Passerella iliaca</i>	O,E	M	F,W	R	F	C,W	1
Song Sparrow	<i>Melospiza melodia</i>	O,E	H	PERM	A	PERM	M,R,U	1
Lincoln's Sparrow	<i>Melospiza lincolni</i>	O,E	H	F,W	U	PERM	M,R,C	1
Golden-crowned Sparrow	<i>Zonotrichia atricapilla</i>	O,E	M	F,W	C	F,W,SP	G,U,C	1
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	O,E	H	F,W,SP	A	F,W,SP	G,U,C	1
Dark-eyed Junco	<i>Junco hyemalis</i>	O,E	H	PERM	C	F,W	W,U	1
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	O,E	M	PERM	C	PERM	M,G	1
Western Meadowlark	<i>Sturnella neglecta</i>	O,E	-	-	R	W	G	1
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	O,E	H	PERM	A	PERM	G,U,M	1
Brown-headed Cowbird	<i>Molothrus ater</i>	O,E	H	PERM	C	S	U,G,W	1
Hooded Oriole	<i>Icterus cucullatus</i>	O,E	H	PERM	U	SP,S	W,U	1
Northern Oriole	<i>Icterus galbula</i>	O,E	M	SP,S	C	SP,S	W,U,R	1
Purple Finch	<i>Carpodacus purpureus</i>	O,E	H	PERM	R	SP,S	W,R	1
House Finch	<i>Carpodacus mexicanus</i>	O,E	H	PERM	A	PERM	U,W,G,R,C	1
Pine Siskin	<i>Carduelis pinus</i>	O,E	H	PERM	R	W	W,R,G	1
Lesser Goldfinch	<i>Carduelis psaltria</i>	O,E	H	PERM	A	PERM	C,W,R,G,U	1
Lawrence's Goldfinch	<i>Carduelis lawrencei</i>	ENO	M	SP,S	-	-	G,W,C	6,7
American Goldfinch	<i>Carduelis tristis</i>	O,E	M	SP,S	A	PERM	C,W,G,U,R	1
House Sparrow	<i>Passer domesticus</i>	O,E	-	-	C	SP,S,F	-----	2

a Status: ONE Species which were observed but not expected

ENO Species which were expected but not observed

E,O Species which were observed and expected

b Predicted: Rel. No. (relative numbers) --H Habitat where species should be found in highest numbers

--N Habitat where species should be found in moderate numbers

--L Habitat where species should be found in lowest numbers

Season (predicted seasons of habitat use) --PERM year around

--W winter

--SP spring

--S summer

--F fall

c Observed: Rel. No. (relative numbers observed) --R Rare: seen fewer than 11 times
 --U Uncommon: seen between 11 and 50 times
 --C Common: seen between 51 and 200 times
 --A Abundant: seen more than 201 times

d PREF. HAB.: Seasons (seasons during which this species was counted): (symbols as for predicted seasons)
 HABS.: Habitats used by this species in Santa Clara County (Yutzy et al. 1975)

O Open water
 M Marsh
 G Grassland or savannah
 U Urban or suburban
 W Woodland or forest
 R Riparian
 C Chapparal

e CODE: A Aerial (uses air space above many habitats)
 recommendation and justification for changes in species status

1	No modification			
2	Add to WHR database as an expected species for riparian habitat in Santa Clara County.			
3	Remove from observed. Species primarily urban, domestic, or found in open-water habitats.			
4	Remove from predicted. Species does not occur in Santa Clara County.			
5	" " Species requires territorial area larger than that provided, or species is nocturnal.			
6	" " Species requires grassland or savannah which was not present.			
7	" " Species requires chapparal which was not present.			
8	" " Species requires steep canyons or fast water.			
9	" " WHR map indicates that the species is not found near the study site.			
10	" " (maps not available for raptors, woodpeckers, and ducks). Species requires wooded ponds with large cavity sites.			

the habitat within the study area does not contain specific elements which they require, or when their distribution does not include the location of the study area. Thirty-four of the ENO species require habitat elements which are not present in the study area, or additional non-riparian or non-urban habitat adjacent to the riparian corridor (Table 2). Five other species are not found in the county, and the remainder may have been overlooked or not present during this year of study. The latter idea is supported by the fact that 44 of the observed species were seen 10 or fewer times during the 1045 sample periods.

The portion of the error attributable to ONE species was reduced by eliminating species observed only in the percolation ponds adjacent to the Guadalupe River (Table 3). While wooded ponds are part of VFR habitat, the ponds immediately adjacent to Guadalupe River, have barren, gravelly banks. Furthermore, the water used to fill these ponds originates from sources other than the Guadalupe River. Nineteen ONE species were seen only on the ponds, and 6 others were only seen in the bare areas surrounding them. Of the remaining 8, 4 should be added to the list of expected species.

The list of observed and expected species which includes only species expected in habitats similar to the study area, and includes only those portions of the study

Table 2: Species Expected but not Observed, and Probable Reasons for their Absence from the Count or from Guadalupe River Corridor during 1986.

<i>Common Name</i>	<i>CODE^a</i>	<i>MODIFIED STATUS</i>
Cattle Egret	5	Eliminate from list
Wood Duck	8	Eliminate from list
Eurasian Wigeon	2	Eliminate from list
Hooded Merganser	8	Eliminate from list
Common Merganser	8	Eliminate from list
Bald Eagle	4,5	Eliminate from list
Northern Harrier	5	Eliminate from list
Ferruginous Hawk	1,2,4,5	Eliminate from list
Rough-legged Hawk	4,5	Eliminate from list
Golden Eagle	4,5,	Eliminate from list
Prairie Falcon	2,4,7	Eliminate from list
Chukar	10,2	Eliminate from list
Turkey	2,5	Eliminate from list
Western Screech Owl	3,9	Eliminate from list
Great Horned Owl	3,9	Keep
Northern Pygmy Owl	3,9	Eliminate from list
Long-eared Owl	3,9	Eliminate from list
Short-eared Owl	3,9	Eliminate from list
Northern Saw-whet Owl	3,9	Eliminate from list
Common Poorwill	3,5	Eliminate from list
Costa's Hummingbird	2	Eliminate from list
Lewis Woodpecker	2,5	Eliminate from list
Yellow-bellied Sapsucker	2	Eliminate from list
Western Woodpewee	9	Keep
Cassin Kingbird	1	Eliminate from list
Western Kingbird	5	Eliminate from list
Purple Martin	2,5	Eliminate from list
Tree Swallow	9	Keep
Yellow-billed Magpie	2,5	Eliminate from list
Common Raven	4,7	Eliminate from list
Red-breasted Nuthatch	9	Keep
Canyon Wren	7	Eliminate from list
American Dipper	7	Eliminate from list
Golden-crowned Kinglet	9,11	Keep
Blue-grey Gnatcatcher	6	Eliminate from list
Western Bluebird	5	Eliminate from list
Wrentit	6	Eliminate from list
California Thrasher	2,6	Eliminate from list
Phainopepla	5	Eliminate from list
Solitary Vireo	11	Keep
Black-throated Gray Warbler	12,9	Eliminate from list
Townsend Warbler	11,9	Keep

Table 2 (continued)

Common Name	CODE ^a	MODIFIED STATUS
Hermit Warbler	11,9	Keep
Yellow-breasted Chat	12	Keep
Chipping Sparrow	6,9	Eliminate from list
Lark Sparrow	5,9	Eliminate from list
Savannah Sparrow	5,9	Eliminate from list
Lawrence Goldfinch	5	Eliminate from list

a CODE:

- 1 Not found in county (Santa Clara County species list)
- 2 Not found in study area (WHR species maps)
- 3 Nocturnal
- 4 Habitat area not large enough to support territory
- 5 Grassland/savannah not adjacent to riparian habitat
- 6 Chaparral " " " " "
- 7 River not in steep canyon nor on steep slope
- 8 No wooded ponds nor large nest cavities over water
- 9 species easily missed or mistaken
- 10 No rocky slopes adjacent to river
- 11 No coniferous or mixed coniferous/hardwood forests
- 12 Insufficient scrub or dense thickets

Table 3: List of Species Observed Using Guadalupe River Corridor During 1986, but Which Were not Predicted by WHR.

<i>Common Name</i>	<i>CODES^a</i>	<i>MODIFIED STATUS</i>
Loon species	1	Eliminate from observed
Pied-billed Grebe	1	Eliminate from observed
Eared Grebe	1	Eliminate from observed
Western Grebe	1	Eliminate from observed
Double-crested Cormorant	1	Eliminate from observed
Black-crowned Night Heron	0	Add to predictions
Greylag Goose	3	Eliminate from observed
Cinnamon Teal	1	Eliminate from observed
American Wigeon	1	Eliminate from observed
Scaup species	1	Eliminate from observed
Common Goldeneye	1	Eliminate from observed
Bufflehead	1	Eliminate from observed
Ruddy Duck	1	Eliminate from observed
Osprey	1	Eliminate from observed
Common Moorhen	4	Add to predictions
American Coot	1	Eliminate from observed
Killdeer	2	Add to predictions
Greater Yellowlegs	2	Eliminate from observed
Spotted Sandpiper	0	Add to predictions
Long-billed Cerlew	2	Eliminate from observed
Common Snipe	2	Eliminate from observed
Bonaparte Gull	1,2	Eliminate from observed
Ring-billed Gull	1,2	Eliminate from observed
California Gull	1,2	Eliminate from observed
Herring Gull	1,2	Eliminate from observed
Caspian Tern	1,2	Eliminate from observed
Forster Tern	1,2	Eliminate from observed
Rock Dove	0,3	Add to predictions
Burrowing Owl	2	Add to predictions
Rufous Hummingbird	5	Add to predictions
Water Pipit	2	Eliminate from observed
Western Tanager	0	Add to predictions
Western Meadowlark	2	Eliminate from observed
House Sparrow	0,3	Add to predictions

a CODE:

1 Requires open water

2 Requires bare soil or grass

3 Urban species

4 Emergent vegetation required

5 Accidental

0 Add to WHR database for VFR habitat in SC County

area which are within the banks of the river, has a higher proportion of concurrence than the unmodified list (Table 4). The 6 ONE species and 10 ENO species represent 6.5% of the observed, and 10.4% of the expected species, respectively.

Different trends in patterns of use are revealed when seasonal residency and relative numbers for observed species are compared to the same characteristics for expected species. In the expected species, the permanent residents outnumber the seasonal residents by more than 2:1, but more species were observed as residents during the breeding season than were permanent or winter residents. Species expected to have their highest numbers present in VFR habitat accounted for over 58% of those species in the WHR list, but fewer than 11 individuals were counted for 37% of the observed species. Only 19 species had more than 200 individuals counted during the more than 174 hours of observation.

DISCUSSION AND CONCLUSIONS

The expected and observed lists were not statistically different from one another, although there was 38% error in the species predicted. This is a greater error-rate than is normally acceptable for this type of model when it is used as a basis for management decisions. Accuracy of 70%

TABLE 4: Modified List of Species Limited to Those Species Which are Most Likely to be Found in the Guadalupe River Corridor, Based on Data Collected in 1986.

<i>Common Name</i>	<i>Status^a</i>	<i>Code^b</i>
Great Blue Heron	O,E	1
Great Egret	O,E	1
Snowy Egret	O,E	1
Green-backed Heron	O,E	1
Black-crowned Night Heron	ONE	1
Mallard	O,E	1
Turkey Vulture	O,E	1
Black-shouldered Kite	O,E	1
Sharp-shinned Hawk	O,E	1
Cooper's Hawk	O,E	1
Red-shouldered Hawk	O,E	1
Red-tailed Hawk	O,E	1
American Kestrel	O,E	1
Merlin	O,E	1
Peregrine Falcon	O,E	1
California Quail	O,E	1
Common Gallinule	ONE	3
Killdeer	ONE	3
Spotted Sandpiper	O,E	2
Rock Dove	O,E	1
Band-tailed Pigeon	O,E	1
Mourning Dove	O,E	1
Common Barn Owl	O,E	1
Great Horned Owl	ENO	5
Burrowing Owl	ONE	3
White-throated Swift	O,E	1
Black-chinned Hummingbird	O,E	1
Anna's Hummingbird	O,E	1
Rufous Hummingbird	ONE	1
Allen's Hummingbird	O,E	1
Belted Kingfisher	O,E	1
Acorn Woodpecker	O,E	1
Red-breasted Sapsucker	O,E	1
Nuttall's Woodpecker	O,E	1
Downy Woodpecker	O,E	1
Hairy Woodpecker	O,E	1
Northern Flicker	O,E	1
Western Wood-Pewee	ENO	1
Western Flycatcher	O,E	1
Black Phoebe	O,E	1
Ash-throated Flycatcher	O,E	1
Tree Swallow	ENO	1
Violet-green Swallow	O,E	1
Northern Rough-winged Swallow	O,E	1

Table 4 (continued)

<i>Common Name</i>	<i>Status^a</i>	<i>Code^b</i>
Cliff Swallow	O,E	1
Barn Swallow	O,E	1
Scrub Jay	O,E	1
American Crow	O,E	1
Chestnut-backed Chickadee	O,E	1
Plain Titmouse	O,E	1
Bushtit	O,E	1
Red-breasted Nuthatch	ENO	1
White-breasted Nuthatch	O,E	1
Brown Creeper	O,E	1
Bewick's Wren	O,E	1
House Wren	O,E	1
Golden-crowned Kinglet	ENO	1
Ruby-crowned Kinglet	O,E	1
Swainson's Thrush	O,E	1
Hermit Thrush	O,E	1
American Robin	O,E	1
Varied Thrush	O,E	1
Northern Mockingbird	O,E	1
Cedar Waxwing	O,E	1
Loggerhead Shrike	O,E	1
European Starling	O,E	1
Solitary Vireo	ENO	1
Hutton's Vireo	O,E	1
Warbling Vireo	O,E	1
Orange-crowned Warbler	O,E	1
Yellow Warbler	O,E	1
Yellow-rumped Warbler	O,E	1
Townsend's Warbler	ENO	1
Hermit Warbler	ENO	1
MacGillivray's Warbler	O,E	1
Common Yellowthroat	O,E	1
Wilson's Warbler	O,E	1
Yellow-breasted Chat	ENO	1
Western Tanager	O,E	2
Black-headed Grosbeak	O,E	1
Lazuli Bunting	O,E	1
Rufous-sided Towhee	O,E	1
Brown Towhee	O,E	1
Fox Sparrow	O,E	1
Song Sparrow	O,E	1
Lincoln's Sparrow	O,E	1
Golden-crowned Sparrow	O,E	1
White-crowned Sparrow	O,E	1
Dark-eyed Junco	O,E	1
Red-winged Blackbird	O,E	1
Western Meadowlark	ONE	1
Brewer's Blackbird	O,E	1
Brown-headed Cowbird	O,E	1

Table 4 (continued)

Common Name	Status ^a	Code ^b
Hooded Oriole	O,E	1
Northern Oriole	O,E	1
Purple Finch	O,E	1
House Finch	O,E	1
Pine Siskin	O,E	1
Lesser Goldfinch	O,E	1
American Goldfinch	O,E	1
House Sparrow	O,E	2

a Status:

ONE Species which were observed but not expected

ENO Species which were expected but not observed

E,O Species which were observed and expected

b CODE: recommendation and justification for changes in species status

1 No modification

2 Add to WHR database as an expected species for riparian habitat in Santa Clara County.

3 Remove from observed. Species primarily urban, domestic, or found in open-water habitats.

Remove from predicted.

4 Species does not occur in Santa Clara County.

5 Species requires territorial area larger than that provided, or species is nocturnal.

6 Species requires grassland or savannah which was not present.

7 Species requires chaparral which was not present.

8 Species requires steep canyons or fast water.

9 WHR map indicates that the species is not found near the study site (maps not available for raptors, woodpeckers, and ducks).

10 Species requires wooded ponds with large cavity sites.

to 75% is normally considered to be acceptable (Marcot et al. 1984, and Rice et al. 1984). Raphael and Marcot (1986) state that "A model is considered useful if at least some of the model predictions are empirically correct." The utility of any model, including this one, is determined by how readily errors are discovered and by how easily they can be corrected.

The species list produced by WHR provides a generally sound base from which to begin the process of predicting species that will use the riparian habitat. However, there are several species for which the database should be modified. There were four species listed by WHR which are not in the species list for Santa Clara County (Yutzy et al. 1975): the Eurasian Wigeon, Ferruginous Hawk, Chukar, and Cassin's Kingbird. These species should be removed from the database records for this county. Furthermore, there were two observed species (Spotted Sandpiper, Western Tanager) which are commonly seen in riparian areas in the county, but which were not listed in WHR predictions. These two species should be added to WHR for this county: the tanager as a migrant, and the sandpiper as a breeding bird.

Two urban species, Rock Doves and House Sparrows, should be added to the list of expected species. These species thrive in residential and industrial development

which is prevalent along the river courses throughout the county. They were found throughout the study area and are likely to occur in other riparian zones adjacent to urban and suburban areas.

The adjustments listed above require minimal knowledge of the study site and change the accuracy of the predictions only slightly. Additional modifications, achieved by the elimination of unlikely species and addition of probable species, require a more intimate knowledge of specific elements of the habitat and how individual bird species use these elements. The presence or absence of specific elements, variation in adjacent habitats, and the biases of the sampling methods were used to justify the modifications discussed below.

After inspecting the study area it was apparent that many species would not be found during the sampling (Table 2). Species which require large territories (raptors), savannah, chaparral, or grassland habitats (many raptors and passerines), steep canyons (Prairie Falcon, Canyon Wren, American Dipper), or large cavity nest sites overlooking slow water (Wood Duck, mergansers), would be very unlikely on the study site. These species, therefore, were removed from the list of expected species (Table 5).

Burrowing Owl, Killdeer, and Western Meadowlark should be added to the list of expected species. These species

Table 5: Summary of How Predicted Species are Expected to Use the Habitat Compared With How Observed Species Have Been Seen to Use Guadalupe River Riparian Corridor During 1986.

<i>Variable</i>	<i>O,E</i>	<i>ENO</i>	<i>ONE</i>	<i>Total</i>
Expected species	83	48	--	131
Observed species	83	--	33	116
Number of species	83	48	33	164
WHR PREDICTIONS				
Habitat use High	52	21	--	73
" " Medium	18	17	--	35
" " Low	2	6	--	8
Permanent Residents	49	27	--	76
Breeding "	21	9	--	30
Winter "	12	10	--	22
Migrants	0	1	--	1
OBSERVED SPECIES				
>201 Count/species	19	--	0	19
51--200 " "	18	--	7	25
11--50 " "	16	--	8	24
< 11 " "	29	--	15	44
Permanent Residents	28	--	5	33
" Breeding	33	--	10	43
" Winter	22	--	14	36
Migrants	3	--	1	4
Species having Riparian Habitat as first or second preference	15	10	2	27
Species Which do Not Prefer Riparian Habitat	39	40	32	111

occurred in small areas of gravel and sparse grass adjacent to the river. These were areas where vegetation had not yet recovered or was just beginning to recover after construction activities. Interruptions in the corridor are necessary elements for these species, and are likely to be found in riparian areas elsewhere in Santa Clara County.

Species observed on the percolation ponds adjacent to the Guadalupe River were open water species, not those expected to occupy riparian ponds. Species observed only in this area were removed from the ONE list, because the ponds could not be considered riparian due to the absence of riparian vegetation.

I did not expect to observe owls during the sample periods because of their nocturnal habits. Barn Owls and Great Horned Owls are large enough to be seen occasionally while roosting, and they are also species which use some urban and suburban habitats. For these reasons, all owl species except Barn and Great Horned were eliminated from the list of expected species.

By implementing these changes the error between predictions and observations was reduced by two-thirds to 11%. ONE species make up only 6% of the remaining list. The remaining ENO species may be attributed to bird community variability between years, species detectability, skill of the observer, or the fact that the species may not

occur there. ONE species may be expected when transient species move through the corridor, or when particular habitat elements that are not riparian are located near riparian habitats.

As a general conclusion to this research, it appears that field verification of WHR predictions will have varying success depending upon the size of the area and the length of the study. Larger areas tend to house more species than smaller ones of the same type (Carlquist 1974), and longer studies involving more field hours, more seasons, or more years, will increase the possibility that rare species are observed. Increased effort will also improve the chances of counting species which are difficult to detect.

Seasonal timing also affects the success of field verification. If samples are taken during a single season, or for less than the full compliment of seasons, species which are predicted to use the habitat during the remaining seasons are much less likely to be observed. Birds which are quite conspicuous during the breeding season are often difficult to locate during migration or while they occupy their winter habitat. Conversely, birds which gather in large flocks during the fall and winter are much more visible than during other seasons.

The value of the WHR database appears to be not in its

precision, but in its versatility. It provides an extensive list of species, most of which will probably occur in the particular habitat or geographic location under study. Special geologic, and geographic characteristics of the study area, the quality of vegetation, and the specific qualities of the surrounding habitats may require some modification of the list beyond the resolution of the database as was the case here. In this study, a modified list was produced by taking into account the particular character of the Guadalupe River corridor and its adjacent habitats.

Future use of WHR predictions for VFR habitat in Santa Clara County, and probably for most habitats in California, will require adjustments to the list to reflect the unique qualities of each area. Most adjustments may be made after reviewing the predictions and inspecting the site for those particular habitat elements which would be required by the predicted species. If certain characteristics are absent from the site or the adjacent areas, species associated with those characteristics can not be expected to occur with any regularity. If these species are of special interest, specific studies may be necessary to determine their status.

I conclude that WHR predictions are generally useful and appropriate. The database produced a list which

included nearly all avian species which were likely to inhabit the study area. Beyond this it is the responsibility of the researcher or agency to modify the list to reflect the level of accuracy appropriate to the project at hand.

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