

A PROPOSED HABITAT MANAGEMENT PLAN FOR YELLOW-BILLED CUCKOOS IN CALIFORNIA¹

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*Abstract: This paper presents data from a 2-year survey of yellow-billed cuckoos (*Coccyzus americanus*) in California and develops a plan from the survey and the conservation biology literature to prevent extirpation in the state. The plan includes recommendations of 23 sub-populations and a total population in California of 625 pairs. Sites for habitat restoration are recommended.*

The yellow-billed cuckoo (*Coccyzus americanus*) is an endangered species in California and is a de-facto endangered species west of the Rocky Mountains (Gaines and Laymon 1984, Laymon and Halterman 1987). The species was once common in the Western states but has been extirpated from much of its previous range including southern British Columbia, Washington, Oregon, Idaho, Utah and Nevada (Laymon and Halterman 1987, Rober-son 1980).

In 1977, a survey for cuckoos throughout California found a population of 122 to 163 pairs, including 35 to 68 pairs in northern and 87 to 95 pairs in southern California (Gaines and Laymon 1984). Further habitat loss along the Colorado River from 1978 to 1985 led to a resurvey in 1986 and 1987. Summary results of that survey are presented in this paper. Based on these results, we redefine suitable habitat for yellow-billed cuckoos. From this new definition and from conservation biology theory we propose a habitat management plan for the yellow-billed cuckoo in California.

Study Area and Methods

The survey was conducted from northern Kern and Inyo counties south in 1986 and from southern Kern and Mono counties north in 1987. We also surveyed the Arizona side of the Colorado River and the lower Bill Williams River in 1986. During the 1977 survey, we conducted surveys at all sites where cuckoos were found regardless of current habitat quality. We also surveyed sites where cuckoos were suspected of nesting since 1977 and at potential habitat that we encountered while in the field. The survey method consisted of playing tape recorded contact calls of the cuckoo 10 times at 1-minute

intervals at points 150 to 200 m apart on transects along and through the habitat.

Results

Predictions of Yellow-billed Cuckoo populations

At each site we predicted the number of pairs of cuckoos that we expected, based on the extent and quality of habitat (table 1). All predictions made away from the Colorado River, including the Bill Williams River, were based on suitable habitat which we defined as a minimum of 10 hectares (ha) of broad-leaved forest at least 100 m wide (Gaines 1974), and at least 1 ha of dense nesting habitat per pair. Along the Colorado River, where no suitable habitat remained, we made predictions based on marginal habitat, which we defined as a minimum of 4 ha of broad-leaved forest at least 50 m wide, and at least 0.5 ha of dense nesting habitat.

In northern California, we found 2230 ha of suitable habitat and predicted a total of 75 pairs of cuckoos in the Sacramento Valley (southern Sacramento County north to northern Tehama County), 10 pairs in the San Joaquin Valley (northern San Joaquin County south to central Kern County) and 3 pairs in other scattered locations (table 1). In southern California we identified 540 ha of suitable habitat and predicted a total of 28 pairs. Along the Colorado River, we identified 370 ha of marginal habitat and predicted that 17 pairs would be found. Along the lower Bill Williams river, we identified 200 ha of suitable habitat and predicted that 25 pairs would be found on the Bill Williams River delta.

The prediction based on 3340 ha of existing suitable and marginal habitat indicated that a total of 125 pairs of cuckoos should breed in California and that an additional 32 pairs should breed in western Arizona. This prediction ignored factors relating to patch isolation.

Survey Results

A total of 19 pairs and an additional 24 unmated males (UMM) were found in northern California, all

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Table 1 - Pairs of Yellow-billed Cuckoos predicted based on existing suitable habitat and the number of cuckoos found during surveys.

Locality	habitat patches	ha of habitat	# pairs predicted	pairs detected	UMM ¹ detected
NORTHERN CALIFORNIA					
Sacramento River	22	1380	62	18	19
Feather River	3	360	9	1	5
Butte Sink	1	120	4	0	0
Stanislaus River, San Joaquin & Stanislaus Co	5	200	5	0	0
Merced River, Stanislaus & Merced Co	1	20	1	0	0
Kings River, Fresno Co	2	40	1	0	0
Kaweah River, Tulare Co	1	40	2	0	0
Lewis Ck, Tulare Co	1	30	1	0	0
Salinas River, Monterey Co	2	40	2	0	0
Subtotal	38	2230	87	19	24
SOUTHERN CALIFORNIA					
Kern River (X 1985-87)	1	200	10	7	3
Prado Flood Control Basin, Riverside & San Bernadino Co	2	120	6	1-4	0
Santa Clara River, Los Angeles Co	3	40	2	0	0
Mojave River, San Bernadino Co	3	80	4	0	1
Owens Valley, Inyo Co	3	60	3	0	1
Tecopa, Inyo Co	2	40	3	1	0
Subtotal	14	540	28	9-12	5
COLORADO RIVER REGION					
North of Needles, CA	2	80	2	0	0
North of Earp, CA	1	15	1	0	0
North of Blythe, CA	3	50	3	1	1
Picacho Region, CA	2	20	2	0	1
Laguna Dam Region, CA	2	20	2	1	0
Topock Swamp, AZ	2	50	4	2	1
Bill Williams River, AZ	1	280	25	25-30	0
Cibola Region, AZ	3	60	3	2	1
Subtotal	16	575	42	31-36	4
Total California	61	2955	125	30-33	31
Total CA & w AZ	67	3345	157	59-67	33

UMM¹ = unmated male

in the Sacramento Valley. (table 1). In southern California, 9 to 12 pairs and 5 UMM were found. An average of 7 pairs were found at the Kern River from 1985 to 1987 (range = 3 to 10). The Colorado River and the Bill Williams River had a population of 31 to 36 pairs and 4 UMM. The total population of cuckoos in California is estimated at 30 to 33 pairs and 31 UMM. The current estimated population in California and western Arizona is 59 to 67 pairs and 33 UMM.

Magnitude of recent declines

This survey shows a dramatic decline when compared with the 1977 survey (table 2). This decline ranges from

a high of 95 pct along the Colorado River to a low of 46 pct to 72 pct in northern California. Only the small populations of the Prado Flood Control Basin and the Feather River have not declined since 1977. All other populations have declined dramatically (Laymon and Halterman 1987). The total decline in California was 73 pct to 82 pct with the population dropping from 122 to 163 pairs in 1977 to 30 to 33 pairs in 1987.

Discussion

Causes of Recent Declines

Declines found during this survey can be attributed to 4 causes: 1) habitat loss, 2) habitat fragmentation, 3) stochastic extinctions and 4) low colonization rates. Habitat loss is the major problem on the Colorado River. Most cottonwood-willow habitat, the preferred nesting habitat of the yellow-billed cuckoo, was lost due to sustained inundation caused by high river flows from 1983 to 1986 (W.C. Hunter, pers. comm.). Cottonwoods were especially hard hit since they are intolerant of prolonged inundation. The 2 largest patches of cottonwoods remaining are a fairly open, dry 25-ha experimental reforestation plot at Cibola and a 4-ha patch along the All-American Canal 5 km west of Laguna Dam. Some relatively extensive patches of willow-cottonwood forest are still present on the lower Bill Williams River, but approximately 50% of the cottonwoods have also been lost there. Hunter and others (1987) estimates over 4,000 ha of cottonwood-willow habitat were found along the Colorado River in the mid- 1970's. This has been reduced to 200 ha of which most occurs on the lower Bill Williams River.

Table 2 - Decline of Yellow-billed Cuckoos in California and western Arizona from 1977 (Games and Laymon 1984) to 1986-87.

Location	1977 (pairs)	1986-1987 (pairs)	Decline (pct)
Northern California	35-68	19	46-72
Southern California	87-95	11-14	84-88
California	122-163	30-33	73-82
Colorado River	122	6	95
Western Arizona	119	29-34	71-76
California & western Arizona	240-282	59-67	72-79

Prior to the loss in 1983, cuckoos on the Colorado River nested in small patches of cottonwood-willow habitat, sometimes less than 1 ha in extent. In 1981 and 1982 several pairs nested on the 25-ha Cibola revegetation site. They have not been found there, or in most small patches, since 1983. This suggests that these sites were marginal habitat and were not capable of supporting viable populations. The cuckoos in these small, dry sites were probably not reproducing consistently, and the sites were only occupied when cuckoos in suitable habitats were reproducing successfully and provided an overflow. When the suitable habitat was lost in 1983, the marginal habitat was depopulated. Similar patterns of decline have been found for forest interior species in eastern forests as the forests become fragmented (Robbins 1979).

Extinctions due to stochastic events also have a high probability in small, isolated populations. It is also difficult for colonizers to locate these isolated islands of riparian habitat. The combination of these factors make it unlikely that these sites, capable of supporting 1 to 5 pairs, would be occupied every year. Reduction of cuckoos on the Colorado River also provides fewer potential colonizers for sites to the northwest.

Since 1977, cuckoos are thought to have nested at the following scattered locations: 2 sites in the Owens Valley; the Amargosa River near Tecopa; Mojave River; 2 sites on the Santa Clara River; San Luis Rey River; Prado Flood Control Basin; and the Kern River. In 1986 we found breeding pairs at only 3 of these 9 isolated locations; Tecopa, Prado Flood Control Basin, and the Kern River. Of these, only Prado Flood Control Basin and the Kern River appear to have nesting cuckoos every year.

The Tecopa site, located 265 km NW of the Bill Williams River, has been surveyed yearly since 1977 (Jan Tarble, pers. comm.). This site has suitable habitat for 2-3 pairs but has reached this potential only twice in 10 years, and has been unoccupied during 6 of these years. This illustrates the dangers of extinctions of small populations and shows that the contribution of these isolated sites to the overall population of cuckoos is indeed small.

The Sacramento River still appears to have sufficient habitat to maintain a self-sustaining population of cuckoos. However, the population is now much lower than its potential. There are several possible explanations: 1) the survey was conducted at a population low; 2) the population is dependent upon colonists from the SE; 3) male cuckoos return to the same site to breed each year, while females do not, i.e. the number of pairs varies year to year while the number of males remains relatively constant; and 4) the current definition of suitable habitat is inadequate.

New Definition of Nesting Habitat

Away from the Colorado River, a relationship exists between size of habitat patch and the proportion of patches that are occupied by either pairs or unmated males. Of the 21 sites 20 - 40 ha in extent, only 2 were occupied (9.5%), while of the 17 sites 41 - 80 ha in extent, 10 were occupied (58.8%), and of the 7 sites >80 ha 100% were occupied. This trend towards increased occupancy with increased size is significant ($t=3.63$, $p<0.001$). Along the Colorado River of the 13 sites 20 - 40 ha in extent, 6 were occupied (46.2%), and the only site >80 ha was occupied.

Table 3 — Habitat suitability of yellow-billed cuckoos in California.

Habitat Suitability	Habitat Type	Area (ha)	Width (m)
Optimum	Willow-Cottonwood	>80	>600
Suitable	Willow-Cottonwood	41-80	>200
Marginal	Willow-Cottonwood	20-40	100-200
Marginal	Mesquite	>20	>200
Unsuitable	Willow-Cottonwood	<15	<100
Unsuitable	Mesquite	<20	1/
Unsuitable	Salt Cedar	2/	1/

These findings indicate that a new definition of suitable nesting habitat for yellow-billed cuckoos is needed in California. Riparian habitats in California range from unsuitable to optimal. Additional criteria such as canopy closure may be important. However, until detailed studies of microhabitat use are completed, it is safest to emphasize dominant tree species, total area and area width (table 3). Dominant tree species is important since cuckoos are only known to breed in willow-cottonwood and mesquite habitats in California. Willow-cottonwood habitats are greatly preferred. The mesquite habitats may be occupied only after the willow-cottonwood habitats are saturated.

Total area is derived from the proportion of occupancy of each area class and from literature showing lower nesting success (Chasko and Gates 1982, Gates and Gysel 1978) for open cup nesting birds near edges of large habitat fragments and in smaller habitat fragments. Wilcove (1985) shows that increased nest predation reaches up to 600 m into the forest interior. This indicates that reserves smaller than 100 ha are less valuable than larger reserves (Wilcove and others 1986). The width factor also is derived from the adverse effects of edge. The more circular a preserve is, the less these effects will come into play (Diamond 1975, Temple 1986).

Using this new definition of yellow-billed Cuckoo habitat, the previously defined suitable habitat is divided into 3 categories. At present in California, away from the Colorado River, there are 2768 ha of riparian habitat that could be used by cuckoos, of this 26 pct is marginal, 36 pct is suitable and 38 pct is optimal. Along the Colorado River, including the Bill Williams River there are 572 ha of habitat of which 51 pct is marginal and 49 pct is optimal.

Management Plan

A management plan for yellow-billed cuckoos in California requires more than habitat preservation. All existing habitat should be preserved regardless of present habitat quality; however this probably will not insure the survival of the species in the state. In addition,

much habitat restoration is needed before recovery of the cuckoo is complete, but how much and where? Any number that is derived is a result of a trade off between number of patches, patch size and patch isolation as pointed out by Shaffer (1985).

Using simulation modeling, it has been demonstrated that populations of <10 pairs are very unstable and always become extinct in a short period of time (Richterdyn and Goel 1972; Roth 1974). In addition Shaffer (1981) theorized that with more realistic models this minimum number would increase. A minimum of 25 pairs in a subpopulation with interchange to other subpopulations should be reasonably safe from extinction by stochastic events. This should be a minimum goal for any major subpopulation. This goal has been adopted by The Nature Conservancy for their habitat management plan for the yellow-billed cuckoo on the Kern River Preserve. At present, no subpopulations >25 pairs exist in California. The Bill Williams River in Arizona population meets this criteria.

The number of subpopulations needed is the second issue. Using simulation models, Roth (1974), shows that variance of mean subpopulation size decreases as the number of subpopulations increases. The Sacramento River subpopulation is close to 25 pairs if it is assumed that the entire river is considered 1 subpopulation. A subpopulation should be defined as the cuckoos breeding in a discrete area with relatively contiguous habitat. A 3 km break between the habitat patches might be sufficient to delineate a subpopulation and an 8 km break surely would be sufficient. Using an 8 km break, the Sacramento River from Red Bluff to Colusa now encompasses 6 subpopulations. The population goal for this area would be a minimum of 150 pairs of cuckoos (25 pairs X 6 subpopulations). This would require a total of 3000 ha of suitable or optimal habitat and would require restoration of 1830 ha (table 4).

Since the Sacramento Valley population is isolated, additional subpopulations will be needed to connect this population to the ones to the south and east. We recommend the establishment of one subpopulation on the Feather River, and five in the San Joaquin Valley. In addition, we recommend the establishment of three subpopulations in southern California (table 4). The establishment of seven new subpopulations is needed on the Colorado River. This is especially critical since the populations further north may be dependent on this area for immigrants. A minimum of 23 subpopulations of at least 25 pairs each would provide habitat for a minimum of 625 pairs. This number, while only a fraction (i.e. <5%) of the original population of cuckoos in California, should: 1) provide protection from extinction by stochastic events, 2) provide sufficient genetic diversity (Soule and Simberloff 1986), 3) cover much of the cuckoo's original range and habitats in

Table 4 – Minimum management goals for subpopulations pairs and reforestation of suitable habitat for yellow-billed cuckoos in California and western Arizona.

Locality	Subpopulations	Pairs	Current Suitable (ha)	Reforestation Suitable (ha)
Northern California				
Sacramento River	6	150	1170	1830
Feather River	1	25	120	380
Stanislaus River	1	25	120	300
Cosumnes River	1	25	0	500
Merced River	1	25	0	500
Kings River	1	25	0	500
Mendota Pool	1	25	0	500
Sub Total	12	300	1410	4510
Southern California				
Kern River	1	25	200	300
Prado Dam	1	25	120	370
Mojave River	1	25	40	450
Owens River	1	25	0	500
Sub Total	4	100	360	1620
Colorado River				
Needles-Parker	4	100	330	1750
Parker-Blythe	2	50	0	1000
Blythe-Yuma	3	75	0	1500
Sub Total	9	225	330	4250
Total	25	625	2100	10,380

California, and 4) provide sufficient colonists to occupy small, outlying sites. In order to accomplish this goal a total of 10,380ha of suitable or optimal habitat must be restored. While this is no small undertaking, it will certainly require less expertise, engineering and money than did the channelization and flood control projects that aided in the destruction of the once vast riparian forests of California.

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