CREATING HABITAT FOR THE YELLOW-BILLED CUCKOO (*COCCYZUS AMERICANA*) [1]

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*Abstract: Yellow-billed Cuckoo numbers have decreased alarmingly in recent decades. This is associated with demise of their riparian habitats. Study of habitat along the lower Colorado River and along the South Fork Kern River led to the conclusion that they require dense habitats dominated by cottonwood (*Populus fremontii*) and willow (*Salix *spp.). They nest predominantly in willow and forage primarily in cottonwood trees on insects and tree frogs. On the basis of this information habitat designs were made and revegetation efforts were undertaken to create habitat for this bird species. Factors that decrease planned rapid development of these habitats have included salinity, competition from weeds and damage by local wildlife and, more recently, cattle browsing.*

The Yellow-billed Cuckoo has been declining alarmingly in numbers in recent decades (Laymon 1980, Laymon and Anderson 1988, Laymon and Halterman 1985, 1987, Hunter and others 1987). This decline in numbers is associated with decline in their riparian woodland habitats. Precise data concerning their habitat requirements was determined along the Colorado River from 1976-1983 (Anderson and Ohmart 1984, Rosenberg 1980, Hunter and others 1987) and along the South Fork Kern River from 1985 to present (Laymon and Halterman 1985, 1987). On the basis of data from these studies revegetation projects were designed. Implementation began in 1979 on the Colorado River and in 1986 and 1987 on the Nature Conservancy's Kern River Preserve. The purpose here is to summarize features of cuckoo habitat requirements and to discuss progress in the revegetation effort. We pay particular attention to factors that detract from the objective of creating rather precise habitats as quickly as possible. We also make a prognosis on the likelihood of success in enhancing cuckoo populations on the Kern and Colorado Rivers. Some features detracting from success of a revegetation project are discussed in another paper (Anderson, this symposium). That paper compliments this one, therefore someone seeking a more detailed picture of revegetation problems and methods should will want to consider them collectively.

Methods

Revegetation Schemes

Revegetation schemes were based on cuckoo habitat requirements that have been determined from the work cited above. This work is from the area from the Colorado River westward across much of southern California. The research showed that cuckoos nest and forage in vegetatively dense stands (more than 150 trees per hectare) of cottonwood and willow. Foliage at all levels was greater than in other habitats on the Colorado River. They seem to select willows–often overhanging water–for nesting and cottonwood for foraging. Nests were placed 6-8 meters off the ground in dense foliage. Foraging typically occurred in areas with a greater overall foliage density than where nesting occurs. Average tree height was 10-15 meters.

Revegetation designs should include patches of willows, surrounded by cottonwoods. Planting densities should be high enough that as the community develops final foliage densities will be great enough to satisfy cuckoo needs. Since cuckoo numbers are so low, it is urgent that revegetation methods be used that maximize growth rates. The habitat should be diverse enough to promote foliage development in the understory as well as in the canopy.

Previous work (Anderson and Ohmart 1984) suggested that there would be complete canopy closure in three or four years after planting on the Colorado River where the growing season is over 200 days long. Cuckoos nested on the site beginning the third year after planting. On this site trees were planted at densities of 250 trees per ha. Natural factors, including patches of saline soil, will ensure development of horizontal and vertical foliage diversity.

Site selection must be made carefully (Anderson In press). Not only should it be strategically located so as to enhance the existing habitat, it must have soil and salinity level that will be conducive to rapid growth.

Even if site quality is high several features can reduce success. Among these are (1) inadequate planting stock,

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(2) competition from weeds and (3) browsing on saplings by deer or cattle.

Experimental Design for Propagation of Stock

In learning how to develop appropriate stock we have worked with many variables. Three of the most important include (1) use of rooting hormone to stimulate initiation of roots, (2) determining what constitutes a satisfactory sapling for planting, and (3) determining the potential of pole cuttings planted directly in the field.

We prepare cuttings by obtaining pieces of limbs about 38 centimeters long from local genetic stock less than about 15 years old. Cuttings are placed in 4-liter pots filled with equal amounts of sandy soil, peat moss, and perlite or vermiculate. In winter, cuttings are placed in greenhouses constructed from PVC pipe and visquine. To test the effect of rooting hormone we brushed rooting hormone (indolbutyric acid) on the cuttings before placing them into pots. A total of 1312 cottonwood and 560 willow cuttings were treated in this way. As controls an additional 50 cuttings were not treated with hormone. This work was done at The Nature Conservancy's Kern River Preserve, Weldon, California.

Anecdotal evidence suggested that saplings less than about 40 centimeters tall after developing in 4-liter pots for 8-12 weeks do less well after planting than those taller than this. To test this we monitored 125 trees randomly planted on a 10 hectare site on the Kern River Preserve that were 40 centimeters or taller at planting. An additional 152 randomly distributed trees were less than 40 centimeters at planting.

To test pole cuttings we placed 50 unrooted poles about 1 meter long directly into planting holes. On the Kern River sites, that water table is about 1.2 meters from the surface. These trees were randomly distributed and were treated with rooting hormone. Planting was in May 1986. In April, 1987 an additional 30 poles were planted on another site. Growth of these was compared with growth of cuttings.

Experimental Design to Determine Effects of Competition

Competition from trees was evaluated for cottonwood/willow trees planted along the Colorado River in 1979 and along the Rio Grande in 1986. For this work we defined a tree as being in competition if weeds were growing in the irrigation "bowl" in which it was planted. Competitors were either present or absent; no intermediate categories were recognized. Along the Colorado we had a sample of 195 trees with competitors absent and 64 where they were present. Along the Rio Grande we monitored 51 trees where competitors were absent and 16 for which competitors were present. Tillage was identical for both groups and soil and salinity levels were tightly controlled. This work included both cottonwood and willow trees. Since there were no significant differences ($P>0.05$) in variables monitored between the two species, we here combine results for the two species.

Experimental Design for Evaluating Efforts to Overcome Impacts from Browsing

The effects of browsing on sapling cottonwood/willow is discussed by Anderson (1989). In this paper our main objective is to evaluate the effort to reduce damage done by browsing. About 4500 trees planted in 1987 on the Kern River Preserve were browsed by cattle during winter, 1988. Since browsing apparently does serious damage to cottonwood/willow trees (Anderson 1988c) the decision was made to attempt to overcome this damage by irrigating the damaged trees and by providing them with fertilizer for an additional season. For comparison we used 147 two-year old cottonwood that were not browsed. These trees, however, were on another site located about 0.5 kilometer from the site that was browsed, thus comparative data must be viewed with some caution. None of the trees on the browsed site went unscathed. In addition, we monitored 87 cottonwood trees that treated during the second year and 84 trees that received no irrigation or fertilizer after browsing. Both sets of trees were randomly distributed across the site.

In all cases measurements were made weekly. Space precludes presenting all of this data so we present primarily data from the beginning and end of each growing season. Height refers to the distance from the ground to the tip of the tallest upstretched leaf. Growth is the difference in height between time A and time B. For the method of calculating foliage volume, see Anderson (In press).

Results and Discussion

Propagation Methods

Use of Rooting Hormone

After 8-10 weeks 85 percent of 560 willow cuttings treated with indolbutyric acid had developed into plants adequate for 1planting. Among 1312 cottonwood 56 percent had developed satisfactorily. Among 50 untreated trees 40 percent of cottonwood/willow trees (no difference betweens species) developed satisfactorily. These results are statistically significant (X2 5.02, 1 D.F., $P<0.05$), thus indicating that cuttings should be treated with rooting hormone to insure a more even and vigorous development of propagules. The significance of the results becomes apparent when comparing the needs of a project when rooting hormone is used and when it isn't. For example, if 5000 satisfactory cuttings are desired in a ration of 1 willow: 4 cottonwood, 7143 cottonwood and 1177 willow cuttings should be started. Without using hormone 12500 cuttings, 50 percent more, should be started.

Stature of Cuttings at Planting

In selecting trees for planting, those that are verdant and healthy looking should be selected. Beyond that cuttings that are 8-10 weeks old and are 40 centimeters or taller are more vigorous growers after planting than those less than this height (Table 1). Saplings less than this height at planting showed 36 percent less foliage volume after one growing season.

Table 1 - Growth (centimeters) over one growing season of cuttings started in 1 gallon pots and unrooted poles planted directly in the field.

Category at planting	Number of trees	Total growth (1SD)	Foliage volume (m^3)	Deviation from controls%
Controls>40 cm	125	143.3(15)	1.01	-
<40 cm	152	119.5(14)	0.65	-35.6
Unrooted poles	29	99.0(22)	0.42	-58.0

This cutoff point was actually discovered by trial and error; by observing growth rates of groups of decreasing size at planting until a size was found below which growth was reduced. The results presented here are the first test of that determination. It has since been repeated with a similar outcome in 1987 (Anderson 1988a).

Failure to use rooting hormone could lead to poor development and subsequent planting of unsatisfactory saplings with disappointing results. Reduced growth and stunting not only slows the development of cuckoo habitat but casts doubt on whether a site planted with poor saplings will ever develop into quality habitat. Growth during the second season indicates that trees less than 40 centimeters at planting lose even more ground relative to controls (Anderson 1988b). The smaller trees at planting showed only 22 percent of the foliage volume of controls. If about 25 percent of the site is planted with saplings less than 40 centimeters tall, it could result in 20 percent less foliage volume at the end of two years than if all sapling would have been 40 centimeters. Other data indicate that saplings over 66 centimeters are less vigorous than those 40-65 centimeters (Anderson 1987).

Pole Plantings

Among 50 pole cuttings planted in May 1987, 37 (74 percent) died by the end of the first season. By the end of the third 38 (76 percent). Mean height was 213 centimeters for those alive after three seasons; controls were 330 centimeters (2 S.E. = 27 cm). Growth of this set of pole plantings was inferior to that of potted cuttings. Planting in May, however, might have been too late in the season for best performance. This experiment was repeated the following year with an additional 30 poles planted in April.

In the second experiment survival was much improved, with only 1 (3 percent) dead by the end of the first growing season. Foliage volume was 58 percent less than for controls (Table 1).

Planting unrooted poles seems undesirable. They are, of course, easier to plant, but obtaining several thousand one meter-long poles could decimate local populations of young trees. Furthermore, if 30-40 percent fail to develop satisfactorily, as with cuttings (see above), an unsatisfactory site could result.

Competition from Weeds

Results indicate that competition from weeds, in our area primarily grasses of a variety of species, salt cedar (*Tamarix chinensis*), and arrowweed (*Tessaria sericea*), can be devastating. Losses after two growing seasons on the Colorado River reached 94 percent for foliage volume relative to control trees. On the Rio Grande losses were 87 percent (Table 2). Saplings encountering a competitive environment apparently rarely recover from the impact. After 10 seasons (Colorado River), 64 percent had died. Among those with no competition 13 percent had died. Weed control seems important.

Table 2 - Effects of competition from weeds for two-year old trees planted on a revegetation site along the Rio Grande near Presidio, Texas and along the lower Colorado River, near Blythe, California. Soil was sandy and salinity low.

River Location	Competitive Environment	Num. of trees	Dead Trees No.	Dead Trees %	Height (m)	2SE	Foliage Volume	(2SE)
Colo. R.	Absent	195	3	1.5	5.8	0.4	36.0	-
Colo. R.	Present	64	16	25.0	2.3	0.6	4.2	-
Rio Grande	Absent	51	0	0.0	3.8	0.2	14.4	0.7
Rio Grande	Present	16	0	0.0	2.0	0.4	1.9	1.8

Assuming that competition will result in foliage volume losses of 80 percent, uncontrolled competition on 25 percent of a site will result in a total loss of 20 percent in foliage volume for that site.

Efforts to Overcome Impacts of Browsing

At the end of one growing season browsed trees showed a reduction in foliage volume of about 26 percent (Table 3). Anderson (1988c) provided data indicating that second year losses increased to 46 percent. We hoped that by irrigating for another season and by applying fertilizer we could help browsed trees recover from the impact. By mid-August of the second growing season trees that were treated had 19 percent less foliage volume than expected of same-aged trees that had not been browsed. From previous work we predicted a 46 percent loss at this age in browsed trees, the observed loss was 35 percent. This could be due to slightly higher salinity conditions on the site with the trees serving as controls. Importantly, extensive loss was predicted and extensive loss was observed, even if precision was somewhat off.

Table 3- Impact of browsing by cattle on cottonwood trees on the Kern River Preserve over a two year period. S.D. = one standard deviation. Treated trees were provided with irrigation and fertilizer during the second year.

		Average						
Year	Category	N	Height (m)	S.D.	Growth (m)	S.D.	Foliage vol. (m^3)	S.D.
1	Not Browsed	147	1.4	.29	1.12	.29	.80	.50
1	Browsed	46	1.3	.26	1.06	.28	.59	.32
2	Not Browsed	141	2.6	.69	2.06	1.13	6.25	.73
2	Browsed							
	treated	87	2.4	.73	1.91	.76	5.05	3.73
	untreated	84	2.2	.60	1.73	1.10	3.93	2.90

The treated trees had 54 percent greater foliage volume than untreated trees, suggesting that our treatment during the second season had a significant beneficial effect. There remains some doubt, however, since cottonwood and willow trees treated for a second season on a site on the Colorado River showed similar improvement, but the treatment seemed to only postpone detrimental impacts until the third and subsequent years (Anderson and Ohmart 1982). Possibly browsed trees will yet falter. It may be premature to say that any sapling damaged in some way (browsing, competition, salinity effects) during the initial year of growth is likely to never recover, but as data accumulate this possibility looms more likely.

If browsing, whether by wild or domesticated animals, occurs on 25 percent of the site and average loss in foliage volume of browsed trees is 40 percent, there would be an overall loss of 10 percent on the site. Browsing by deer at this intensity is not unusual in our area. Incursion by domestic stock, as shown above, can cause damage far beyond this level.

Cuckoo Response to Revegetation

On the Colorado River, where growth of cottonwood and willow trees averaged three meters per year, cuckoos foraged on the site in the second year (1980). One pair nested on the site in 1981 and three pairs nested in 1982 and 1983. Thus it is possible to quickly develop habitat that cuckoos will accept. Unfortunately, annual growth on Kern River sites, because of a shorter growing season, is less-about 2 meters. Cuckoos neither foraged nor nested on a Kern River site during the third growing season. On that site foliage volume approached a level suggesting the cuckoo use might not be far off. But subtleties not apparent by mere measurement of foliage volume (e.g. branch configuration) may require yet further development. The point is that cuckoo habitat cannot be created overnight. The species' populations are low and their need for more habitat is urgent, but, in truth more habitat will not be forthcoming quickly. That cuckoos used the revegetation site on the Colorado River so soon after implementation provides stimulus to proceed with revegetation projects, but this undertaking should be done with the utmost care.

In this paper we indicate the vulnerability of revegetation projects to losses from inappropriate action at the propagation stage or as a result of planting low quality saplings. Thereafter competition from weeds can lead to additional losses. Even light browsing by deer detracts further from the probability of achieving the desired outcome. Anderson (1988) has shown that inappropriate tillage will add to these losses as can inadequately monitored irrigation. In desert riparian areas salinity levels must be carefully considered. No matter how careful site selection is there is likely to be some places on the site where salinity level will exceed levels at which cottonwood/willow trees will be maximally productive. Careless site selection can be disastrous to the project. Small, seemingly insignificant losses tolerated in one phase can quickly become disasters if similar disregard is multiplied across the nine factors mentioned above. In addition other factors affect vigor (soil type, use of fertilizers, factor interactions) that have not been discussed but that are nonetheless real. Serious effort to create habitat for cuckoos must take these realities into consideration.

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