The destruction of riparian vegetation and its impact on the avian wildlife in the Sacramento River Valley, California

Study indicates drastic losses in carrying capacity and diversity of avian wildlife

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Introduction

IN ITS NATURAL, unaltered state, the banks of the Sacramento River supported a dense growth of riparian vegetation. Since the earliest settlement, the development of the river valley has resulted in the continuous reduction of the riparian forests. In recent years the destruction of this habitat has been greatly accelerated by the expansion of agricultural use, by flood control modifications, and particularly by federal riverbank protection projects. It has now been estimated that if the present rates of destruction continue, within 20 years no riparian forests will remain in the valley.

Besides its obvious esthetic value, riparian vegetation is extremely important for wildlife — a rich resource for food, cover, nesting, and rearing young. Although studies to measure the comparative value riparian habitats offer wildlife are few, and most are incomplete, numerous Winter Bird-Population Studies and Breeding Bird Censuses have been taken in riparian woodlands — mostly undisturbed woodlands — and published in *Audubon Field Notes* and *American Birds.* (For an example, see p. 77, this issue). However, in order to provide a clear and cogent *comparison* as to their value to wildlife (especially birds), between altered and unaltered riverbanks, the U.S. Fish & Wildlife Service in autumn, 1974, initiated a study.

The study entailed a year-long census of the avian populations in four habitat types: unaltered riparian, rip-rap habitat (which had been cleared of all vegetation, normally by riverbank stabilization projects), agricultural land associated with or adjacent to unaltered riparian habitat, and agricultural land associated with or adjacent to cleared-bank or rip-rap habitat. By these means, not only might the value of unaltered riparian habitat be demonstrated, but also the benefit of this habitat to adjacent agricultural land might be determined.

Methods

THE STUDY PLOTS were located along the Sacramento River, centered around and within 2 miles of Knights Landing, Sutter County, California (Fig. 1.), at approximately 38°51′N, 121° 42′W. In this area unaltered riparian vegetation still exists in some places, while in others it has been cleared and rip-rap, with its associated vegetation is now maintained. Land in agricultural use extends from the berm across the floodplain in most areas of this region.

Four study areas were selected, two of which were in typical unaltered riparian habitat, and two in typical rip-rap habitat. Within each area two transect plots were selected, one running along the berm, the other perpendicular to the river bank, across agricultural lands. There were thus eight transects in all, or two transects in each of four habitat types. The transect plots averaged 1320 feet long and 100-130 feet wide and 3.22 acres in area. The transects were selected to be identical to each other as nearly as possible, with presence of unaltered or rip-rap vegetation being the only variable.

Unaltered riparian woodland, in the study area, Sacramento River Valley, Calif.

A survey of the vegetation along the transects was conducted by Cay Collette Goude of the University of California at Davis. The vegetation was sampled by the line-intercept method (Gates 1949, Greig-Smith 1957, Phillips 1959, and The U.S. Forest Service 1959). Three line quadrants 6 feet wide were established in each of the unaltered riparian and rip-rap habitats. The quadrants were equally spaced and extended from the top of the levee to the low-water line. The quadrants averaged 75.1 square yards in area. One quadrant 6 feet wide was established along the middle of each agricultural transect. The agricultural quadrants ran the entire length of the transect and averaged 800 square yards in area. Each quadrant was surveyed to determine the vegetative composition, and an additional sampling in the remainder of the transect identified any species which were missed. The coverage and density of each quadrant was estimated using Ocular Estimation (Webb 1942).

The survey of the vegetation in each of the 16 quadrants was taken in late spring 1975. The riparian transects were found to be structured in a three-layered community consisting of an overstory, a midstory, and an understory or ground cover. The coverage density of the overstory (trees) was 52%, of the midstory (shrubs) 73%, and of the understory (grasses and sedges) 30%. The predominant woody vegetation in the overstory was the Fremont Cottonwood, *Populus fremontii*, and the Arroyo Willow, *Salix lasiolepis*. Saplings of these species as well as Box Elder, *Acer negundo*, Oregon Ash, *Fraxinus latifolia*, and various shrubs including Mule Fat, *Baccharis viminca*, were found in the midstory. The understory was composed of mainly Poison Oak, *Rhus diversiloba*, and California Blackberry, *Rubus vitifolius*. In all, 14 species of woody vegetation were found in the unaltered riparian transects.

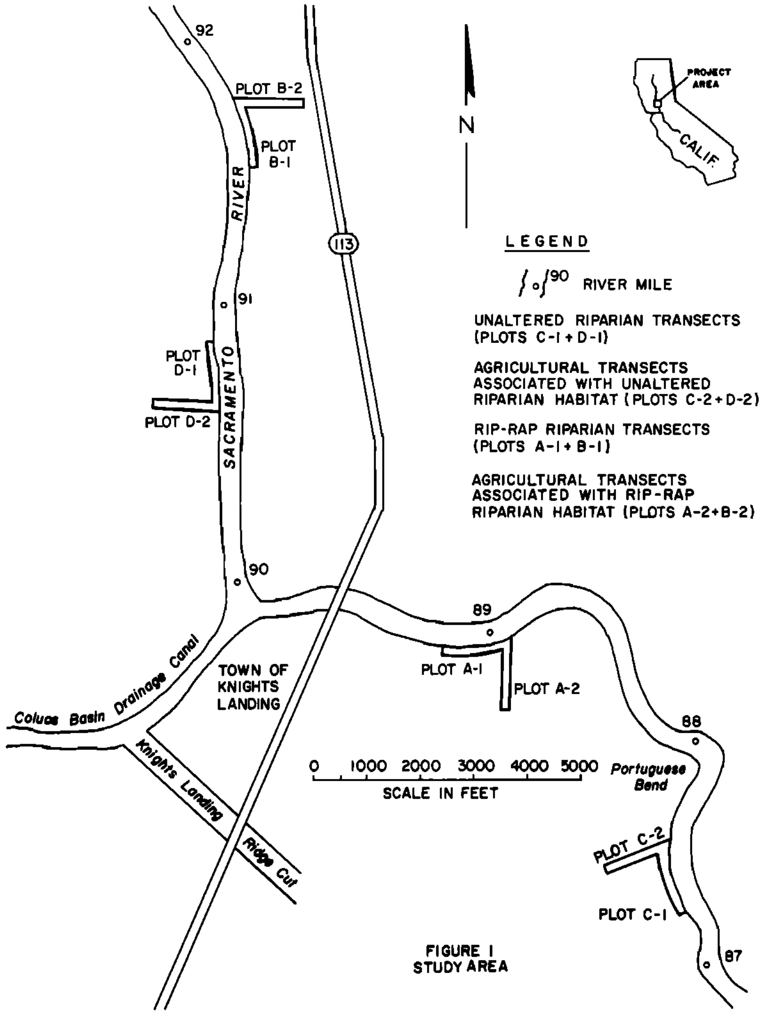
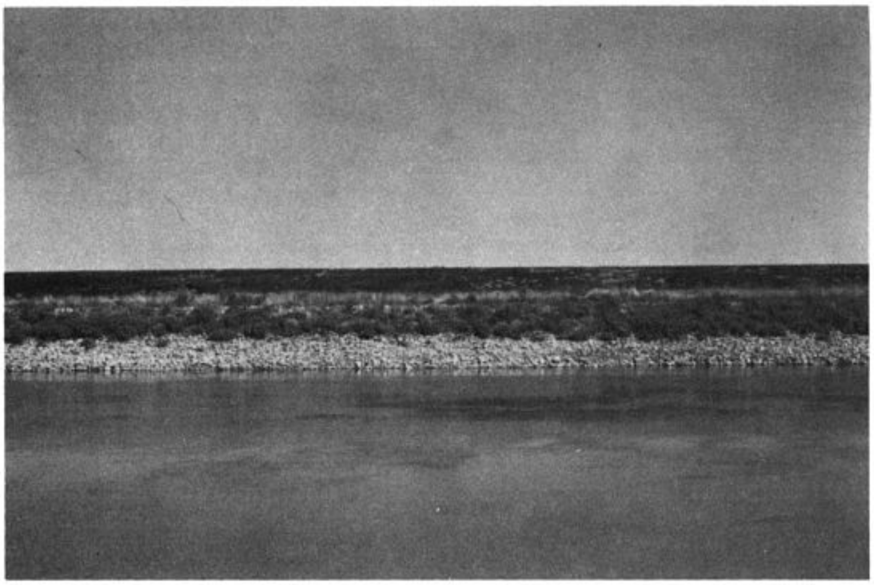


FIGURE 1
STUDY AREA

The rip-rap transects contained no woody vegetation, being either bare ground or ground cover with a coverage density of 30%. The predominant herbaceous plants included species of grasses, legumes, and thistles. The agricultural transects supported mainly crops of rice, *Oryza sativa*, wheat, *Triticum*, sp., alfalfa, *Medicago sativa*, and tomato, *Lycopersicum esculentum;* the coverage density being 72-74%.

A census of the birds observed in each transect was made every two weeks, regardless of weather conditions, from September 6, 1974 through August 22, 1975. The counts were conducted by Merlin Hehnke of the U.S. Fish & Wildlife Service and Eric Hurst of the University of California at Davis. All counts were made between 0600 and 1200 hours; the order in which the counts were made was reversed alternately to correct for changes in avian activity throughout the study hours. The counts were made by walking along each tran-transect line and counting all the birds seen according to the sample-plot method of Pettingill (1970), using 8 x 50 power binoculars.


Cleared rip-rap riparian landscape, also in the study area.

Rip-rap on one bank, unaltered opposite. *Photos/Eric Hurst.*

Results

BETWEEN SEPT. 6, 1974 and Aug. 22, 1975, 26 counts of each transect were taken. The year's data were tabulated employing standard statistical procedures (Cox, 1972). The results from the two transects of similar habitat types were combined to compute the following figures.

In carrying capacity, the unaltered riparian (hereafter, UR) transects supported an average of 24 birds/acre/day, and the rip-rap transects (hereafter, RR) supported an average of 3.5 bird/acre/day. These figures indicate a loss in carrying capacity of 93% in the rip-rap areas. For the agricultural transects associated with unaltered riparian habitat (hereafter, UR-A), 34.5 birds/acre/day were observed, and for the agricultural transects associated with rip-rap habitat (hereafter, RR-A) 1.6 birds/acre/day were observed, for a loss in carrying capacity of 95% for the RR-A. Putting it another way, the projected bird-year use (birds/acre/365 days) was 8800 for the UR transects, and 620 for the RR transects, for a loss for the latter of 93%. The projected bird year use for the UR-A transects was 12,600, and for the RR-A transects was 580, for the carrying capacity loss for the latter of 95.4%.

For avian species richness the UR transects supported an average of 3.5 species/acre/day, while the RR transects

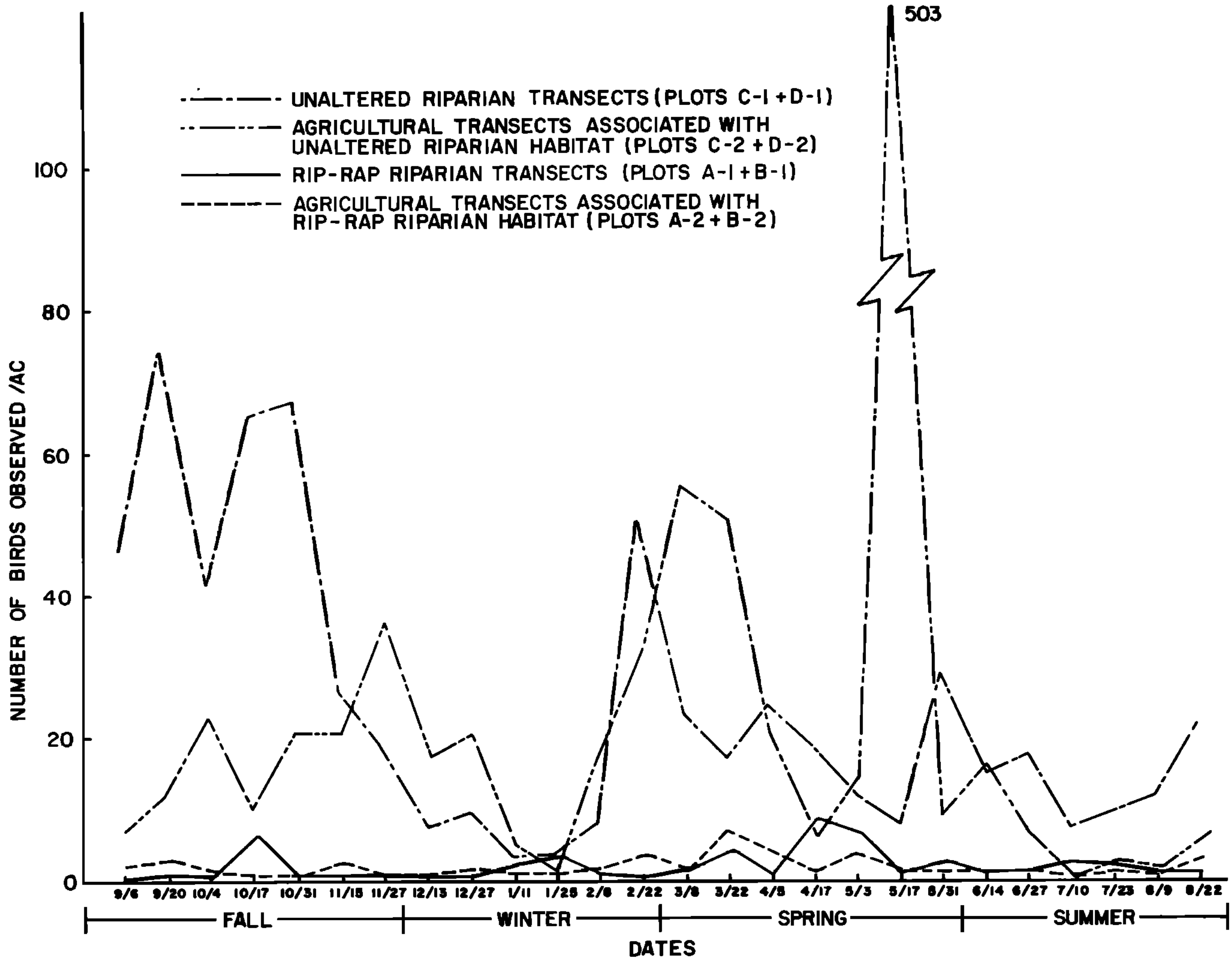


Figure 2. Number of birds observed per acre (density)

supported only 0.5 species/acre/day for a loss for the latter of 85.8%. The UR-A transects supported 1.3 species/acre/day and the RR-A transects supported 0.6 species/acre/day for a loss for the latter of 53%. In all 90 species were observed in the riparian transects, of which 50 were not observed in any of the other habitat types, including several species of woodpeckers, flycatchers, wrens, thrushes, vireos, warblers, and grosbeaks. The rip-rap transects supported a total of 25 species during the study. In the UR-A transects 37 species were observed, ten of which were not observed in the rip-rap transects including the Green Heron, *Butorides striatus,* Snow Goose, *Chen caerulescens,* Cooper's Hawk, *Accipiter cooperii,* Red-tailed Hawk, *Buteo jamaicensis,* Merlin, *Falco columbarius,* California Quail, *Lophortyx californicus,* Belted Kingfisher, *Megaceryle alcyon,* Common Flicker, *Colaptes auratus,* Red-winged Blackbird, *Agelaius phoeniceus,* and Dark-eyed Junco, *Junco hyemalis.* The RR-A transects supported a total of 25 species during the study.

During the course of each year in the Sacramento Valley avian density and species richness varied with the greatest concentrations falling in spring and fall. Density and species richness in each of the habitat types followed a somewhat similar cycle as illustrated in Figures 2 and 3. A statistical analysis was performed on the cycles, and some interesting relationships were revealed. When a standard Chi-Square test was applied, the annual cycles for carrying capacity and species richness in the UR transects were found to be significantly different from the corresponding cycles in the RR transects ($p < 0.01$). In addition, the annual cycles for carrying capacity and species richness in the UR-A transects were found to be significantly different from those in the RR transects ($p < 0.01$). However, the difference is only $p < 0.05$ if an unusual sighting of 3000 Brewer's Blackbirds in the UR-A transects May 17, 1975, is omitted. A positive correlation ($p < 0.05$) was found between the UR and UR-A transects when the annual cycles for carrying capacity were compared. A similar correlation exists for diversity only if all the blackbirds are omitted from the figures.

By breaking the annual cycles for carrying capacity and diversity into seasons, a comparison of the losses at different times of the year can be established. The number of birds/acre/day in the RR transects was 97% less than that in the UR transects in fall, 91.5% less in winter, 88.5% less in spring, and 91.5% less in summer. The losses between the RR-A transects and the UR-A transects was 94.7% in fall, 90.0% in winter, 97.0% in spring, and 78.4% in summer. The number of species/acre/day in the RR transects was 93.0% less than that in the UR transects in fall, 86.9% less in winter, 79.4% less in spring, and 82.3% less in summer. The losses between the RR-A transects and the UR-A transects was 83.8% in fall, 58.1% in winter, 27.1% in spring, and 36.4% in summer.

Discussion

The results demonstrate a significant loss in carrying capacity and diversity of avian wildlife was sustained by the rip-rap and rip-rap associated

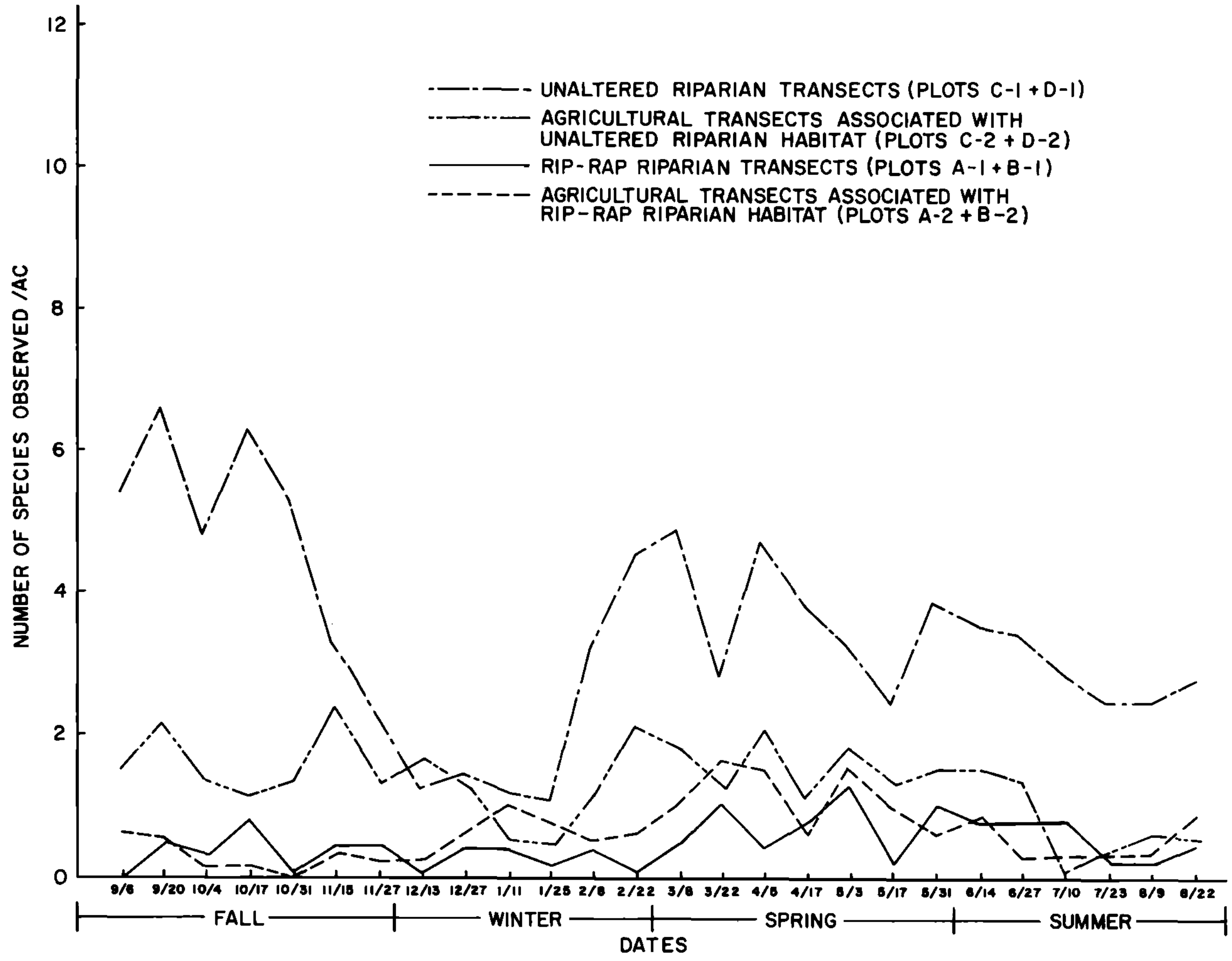


Figure 3. Number of species observed per acre (diversity)

agricultural transects as compared to the unaltered riparian and unaltered riparian associated agricultural transects. The superiority of unaltered riparian habitat in supporting wildlife is particularly apparent during times of peak avian density in the valley. Each year the bird populations increase during the breeding and nesting season in spring and during fall when migratory activity increases. In addition, many species which are primarily winter residents, such as Savannah Sparrow, *Passerculus sandwichensis*, and many summer residents, such as Barn Swallow, *Hirundo rustica*, utilize the areas simultaneously in the spring and fall. These populations combine to further increase avian densities during the peak seasons. As expected, two distinct peaks in carrying capacity and diversity were observed in the riparian and riparian associated agricultural transects in this particular year falling in the late winter through early spring and during the fall. However, similar increases were not observed in the rip-rap or rip-rap associated agricultural transects. Instead, the annual cycles for carrying capacity and diversity were found to be significantly different in the rip-rap and rip-rap associated agricultural transects. It is only the unaltered riparian habitat which supports the increased avian population. The necessary resources for food, protection, nesting and rearing young are not available in the rip-rap habitat. Therefore, its carrying capacity is low and probably near its maximum when the avian populations are low during winter and summer.

As a result, the greatest losses in carrying capacity and diversity were sustained by the rip-rap and rip-rap associated agricultural transects during late-winter through early-spring and fall. Because of this seasonal variability in losses, the true value of the riparian habitat can only be accurately described in a full-year study. A census which only covers a few months would be incomplete and inconclusive.

The results demonstrate that not only is the riparian habitat utilized by a greater number of birds, but that it is also utilized by greater species number. The greater heterogeneity of the vegetation in the unaltered riparian habitat as compared to the rip-rap habitat increases the available niches, and consequently increases the number of species which can be supported The riparian forests studied were structured into a three-layered community consisting of an overstory, a midstory, and a ground cover. Previous studies have demonstrated that the degree of vegetative layering is directly related to the diversity of bird life it can support (MacArthur *et al.* 1962, MacArthur 1964, Wolcheck 1970).

The value of riparian habitat as a resource for avian populations is not confined to a forest proper. The positive correlation between the annual cycles for carrying capacity and diversity in the unaltered riparian transects and in the riparian associated agricultural transects indicates that the value of unaltered riparian habitat extends at least 0.25 mile into adjacent areas and probably extends farther. The losses caused by the rip-rap habitat also extend at least 0.25 mile into the adjacent area and probably extend farther. Therefore, the impact of the loss of riparian habitat may be of much greater scope than previously recognized.

The value of riparian habitat is further substantiated when the results are compared with the density limits of avian habitats established by Peterson (1941). The average number of birds/acre/day in the unaltered riparian and riparian associated agricultural transects are well above that established by Peterson as being a high density area. His figures indicate a high density area to support six to 18 birds/acre with a mean of 9.4. On only two days studied were the birds/acre observed in the riparian transects lower than this range, and on only four days studied were they lower in the riparian associated agricultural transects. The rip-rap and rip-rap associated agricultural transects were within the limits of a low density area of one to 3.5 birds/acre on all days studied except four. These results are similar to those of Michny *et al.* (1975) who studied several riparian transects and one rip-rap transect in Glenn and Sutter Counties, California. He discovered the density of the riparian areas to exceed that of a high density area, and the density of the rip-rap area to fall below the range of a typical low density area.

The results of the vegetation study indicate that drastic losses in the diversity of plant life resulted from conversion of unaltered riparian to rip-rap habitat, along with a complete elimination of all vegetative layering. The vegetation was removed by mechanical means, burning, and herbicide treatment. None of these methods is effective for very long and must be repeated annually to be effective. The removal of natural riparian vegetation not only drastically reduces the available habitat for avian wildlife, but negatively affects streambank preservation. The presence of woody vegetation, with its root system network, not only reduces soil erosion, but acts to reduce the velocity of floodwaters. Conversely, the soil-holding capacity of the low-growing rip-rap vegetation is limited, and the quarry stone and *Lippa* spp planted there have not eliminated erosion.

It is our conclusion, therefore, that the removal of natural riparian vegetation is extremely detrimental environmentally, both to the avian (and undoubtedly the piscine and mammalian) wildlife, and that the practice of riverbank clearing with attendant rip-rapping should be abandoned and replaced with bank protection practices more environmentally sound.

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