Riparian habitat change along the Isleta-Belen reach of the Rio Grande

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Abstract.—We provide a summary of vegetation changes over a 11-year period (1984-1995) in the middle reach of the Rio Grande. Hink and Ohmart (1984) surveyed and mapped riparian vegetation along the middle Rio Grande as part of an extensive biological inventory conducted for the Army Corps of Engineers. We field-assessed and remapped the Isleta-Belen reach in 1995 to determine whether vegetation classes had changed substantially since the Hink and Ohmart survey. Over the past 11 years, the Rio Grande bosque vegetation has aged, and our assessment of structural types documents this aging process. In addition, the exotic woody species, salt cedar (*Tamarix chinensis*) and Russian olive (*Eleagnus angustifolia*), have increased in cover, appearing as understories in Rio Grande cottonwood (*Populus fremontii* var. *wislizenii*) galleries and as independent vegetational communities. In some cases, these introduced species have replaced other vegetation such as coyote willow (*Salix exigua*). We also detected evidence of 31 fire events that altered vegetation.

INTRODUCTION

One of the largest cottonwood gallery forests in the Southwest is found along the middle Rio Grande. The value of this riparian habitat has become widely recognized over the past 20 years. It serves as habitat for a wide range of wildlife including endangered species such as the southwestern willow flycatcher (*Empidonax trailii extimus*), it provides ample recreation opportunities, and also contributes to flood control by stabilizing soils and river banks.

Hink and Omart (1984) conducted a biological survey of the middle reach of the Rio Grande to identify and describe the major riparian habitat types within the bosque and the wildlife species that inhabit different types. The major vegetation communities that they found were Cottonwood/Russian Olive, Cottonwood/Coyote Willow, Cottonwood/Juniper, Russian Olive, Cattail Marsh, Salt Cedar, and Sandbar/River Channel. The Middle Rio Grande Biological Survey led to the development of six community-structure types which were used to create detailed riparian vegetation maps.

There have been significant natural and human induced changes along the middle Rio Grande since 1984. Fire, exotic plant invasions, changing channel morphometry, reduced flooding, human disturbances such as borrow pits and urban encroachment, and succession and aging of woody plants have all contributed to altering the pattern and structure of the bosque vegetation communities. The vegetation maps generated in 1984 are now of limited value to those interested in the ecology and environmental quality of the middle Rio Grande. In 1995, the U.S. Army Corps of Engineers in Albuquerque contracted the USDA Forest Service Rocky Mountain Forest and Range Experiment Station, Albuquerque Laboratory, to re-map the riparian vegetation along the middle

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Rio Grande. Mapping was performed by the Geometronics Remote Sensing Unit of the USDA Forest Service's Southwestern Region through an interagency agreement. The 1995 middle Rio Grande vegetation maps were displayed on our poster and will be available in our final report to the Albuquerque Corps of Engineers due out by December 1995. They are not reproducible in the format required for the symposium proceedings.

The maps for the poster displayed areas of the bosque where there have been minor and major vegetation changes since 1984 in addition to providing annotations that define the current vegetation type for each polygon. An annotated 1984 vegetation map prepared by Hink and Ohmart (1984) (on file, Albuquerque Corps of Engineers) was used to directly compare and qualitatively assess vegetation changes over this 11-year period. Our final report will visually display the two sets of maps from 1984 and 1995 and provide a statistical analysis of change. For the purposes of this symposium paper, we will briefly describe the methodology we used and the qualitative changes detected by our mapping project.

METHODS

The scope of the mapping project began at the Interstate 25 overpass south of Albuquerque and continued for 25 miles to the Bosque Bridge south of Belen. Vegetation between the flood control levees on both sides of the river was mapped using 1:3,000 scale black and white aerial photography. Vegetation polygons were defined through stereoscopic interpretation of the imagery. Particular emphasis was paid to polygons that seemed to differ structurally from those on the 1984 maps: these polygons were marked and checked in the field.

Vegetation type and structure were visually classified based on Hink and Ohmart's (1984) definition. Imagery for current vegetation was acquired in January when the vegetation was not in leaf. Vegetation classes were often difficult to interpret in many polygons as a result. Polygons that could not be confidently classified using image interpretation were also marked for on-the-ground field assessment. Because of the difficulty in interpreting vegetation structure or type from the photography, especially understory species, and because vegetation structure and type seemed

to have changed considerably from what is shown on the 1984 maps, nearly every mapped polygon was visited and assessed on the ground. Consequently, it was unnecessary to perform a traditional remote sensing accuracy assessment, and none was undertaken.

Vegetation structure and type were assessed on the ground using an ocular methodology. Field personnel were "calibrated" by placing two bisecting, 50 meter line-intercept transects in each structural class. The intercept of all individual trees in excess of four meters high was cumulatively measured and recorded by species; heights were measured using a clinometer. The cumulative intercept distance for understory species (those less than four meters high) was also recorded by species. Percentage cover by species and structural class was calculated from the data. This methodology allowed field personnel to develop a familiarity with the vegetation communities making ocular assessment on successive polygons possible. Field personnel periodically collected additional line-intercept transect data to assure that their ocular estimates were correct. In excess of 50 sites were measured using line intercept techniques, 43 of which were located using a Global Positioning System.

Updated map polygon boundaries and classification data were subsequently entered into Arc/Info and the Intergraph Microstation GIS and mapping environments for quantitative analysis and map production. The quantitative analysis of vegetation change in the Middle Rio Grande will be completed by November 1, 1995.

MAPPING RESULTS

A qualitative analysis of the vegetation change along the newly mapped portion of the middle reach of the Rio Grande indicates significant differences in vegetation class and species presence between 1984 and 1995. In particular:

- An increase in cover by Russian olive.

- Continued invasion of salt cedar, and attendant replacement of coyote willow by salt cedar.

- Evidence of fire (both natural and that of human origin) indicates it to be significant factor in vegetation change in the bosque.

- The bosque is maturing as indicated by an increase in the number of polygons in the

larger structural classes, and also by a decrease in the number of coyote willow polygons.

In numerous polygons that contained Russian olive in 1984, vegetation structure has changed as individual plants have matured. Numerous polygons have changed from structural class 5 to 3 (see fig. 1 for general depiction of vegetation structural types) as a result of increased height and density of Russian olive in the middle story of the canopy. Further, a number of polygons that did not support Russian olive in 1984 now have the species in the understory.

Salt cedar has been a vigorous invader of southwestern riparian habitats, and continues to advance steadily in the Rio Grande bosque. Numerous vegetation polygons that did not have salt cedar in 1984 now contain the species. Further, coyote willow has been replaced by salt cedar in a number of polygons. The addition of salt cedar as a polygon component is perhaps the most widespread and obvious change that has occurred since the 1984 maps were produced.

Our field assessment identified 31 fires within the study area since 1984, making fire a significant contributor to vegetation change. On burned polygons, the first woody species that appeared to return was coyote willow, followed by salt cedar, then Russian olive, and finally, cottonwood.

A number of changes in vegetation structure and types within the mapped polygons indicates that the Rio Grande bosque is maturing. Numerous polygons have changed from structure class 5 to 3 as previously mentioned, and a few stage 3 polygons have reached structure stage 1. Furthermore, most of the stage 1 polygons have additional species (e.g., salt cedar, Russian olive) in their understory, and the number of sites containing coyote willow is decreasing - pointing to successional, maturing vegetation. Interestingly, field assessment showed that while the bosque vegetation is aging, cottonwood recruitment appeared low. The majority of cottonwood trees in the bosque date back to 1941, when the Rio Grande experienced a major flood (Funk 1993). Regulation of flooding events and reduction of water quantity in the Rio Grande may contribute to low cottonwood regeneration.

CONCLUSION

The 1995 middle Rio Grande vegetation maps indicate that vegetation classes and species composition have changed extensively since 1984. Over-

all, the bosque is aging as detected by vegetation growth and maturation using structural stage assessment. Non-endemic woody species are becoming more prominant, often appearing as understory species in cottonwood woodland, and also as shrub communities without cottonwoods (see fig. 1 on next page). Because wildlife species are associated (sometimes strongly) with vegetation type and structure, it is clear that as bosque vegetation changes and matures, species composition and population sizes of various species of bosque fauna will change. Such shifts may have already taken place, but long-term monitoring data are needed to detect changes in animal populations. We recommend long-term monitoring programs be established to detect further changes in bosque flora and fauna. Monitoring data are necessary to ensure a scientific basis for establishing goals and priorities for bosque conservation and restoration.

The middle Rio Grande vegetation maps were created to provide baseline vegetation data to help address this and many other topics critical to the successful management of the Rio Grande.

ACKNOWLEDGMENTS

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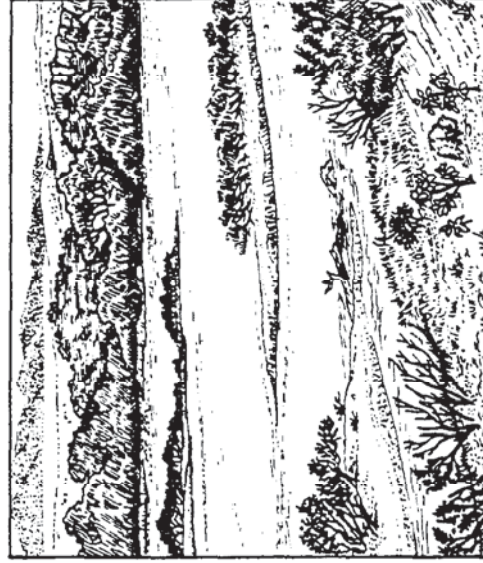
Figure 1. Vegetation structural types I-VI along the middle Rio Grande (from Crawford et al 1993, Hink and Ohmart 1984).