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V. Poster Session and Associated Abstracts

ADDRESSING WILDLIFE MORTALITY ON HIGHWAYS IN WASHINGTON

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Abstract: Deer and elk vehicle collisions are a major safety concern for highways. While there are a number of methods which can be used to reduce collisions, the selection of the appropriate method is complicated by the fact that Washington is home to four subspecies of deer, in addition to elk and moose. Differences between the life history of the species and the types of habitat they occupy can lead to differences in what methods may be suitable for reducing vehicle-ungulate collisions. The Washington State Department of Transportation (WSDOT) maintains a deer kill database which contains information on where dead ungulates are removed from the state highways. This information is used along with site-specific information to determine what type of mitigation method may work the best to reduce the ungulate vehicle collisions.

Introduction

Washington State, with its diversity of habitats supports a diverse wildlife assemblage, including four subspecies of deer, two subspecies of elk, moose, woodland caribou, mountain goats and big horn sheep. Of seven ungulate species found in Washington, the deer and elk are the ones most likely to be involved in deer/vehicle collisions. Approximately 2,450 to 3,000 dead deer and elk are removed each year from the state highways by WSDOT maintenance workers. This number does not include the number of animals which die outside the right of way, animals removed by non-WSDOT personnel, and animals hit on county or city roads. While this number does not approach the magnitude of the deer/vehicle collision problems encountered in other states such as Michigan where between 18,000 and 44,374 animals may be killed in a year (Romin and Bissonette 1996), it still has a significant effect on the safety of the traveling public, and may have an effect on local deer and elk populations.

Deer Kill Database

Numerous methods to reduce deer vehicle collisions have been reported in the literature (Feldhamer, et. al. 1986; Romin and Bissonette 1996; Schafer and Pendland 1985; Ward 1982). Selection of the appropriate method must take into account: the species, time of year there is a problem, the terrain, and the specific situation. There will be no one perfect solution. WSDOT maintains a deer kill database, which contains information on deer and elk removed by maintenance personnel. The database can be used to analyze the location of ungulate vehicle collisions, by species, sex, and date. The database shows clear differences between species. Black-tailed deer, which inhabit the western portion of Washington State are non-migratory. See Figure 1.

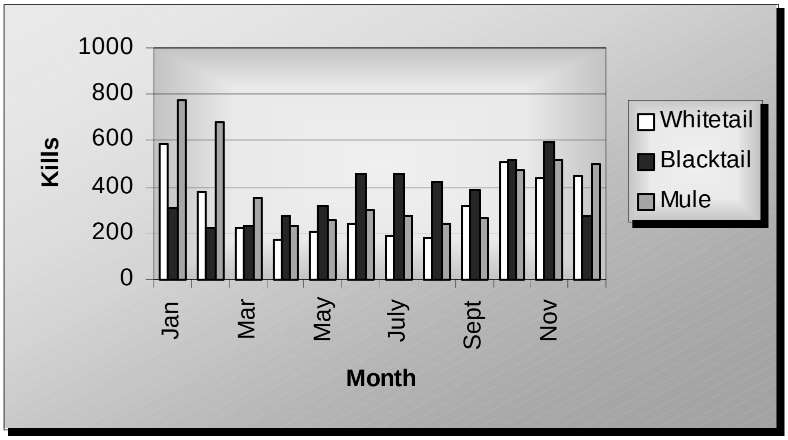

Fig. 1. Deer Kills by Species

Black-tailed Deer

There are two peak collision periods for black-tailed deer, one in June and July, when the does have their fawns and are hiding them, and the second in October and November, during the rut. During both of these times, the deer are more active and may encounter the highways more often. See Figure 1. There are five problem areas on the west side of the state. With the exception of Whidby Island, where there is very low hunting pressure and a high deer population, most of the problem areas are in the Cascade Mountains or their foothills. See Figure 2.

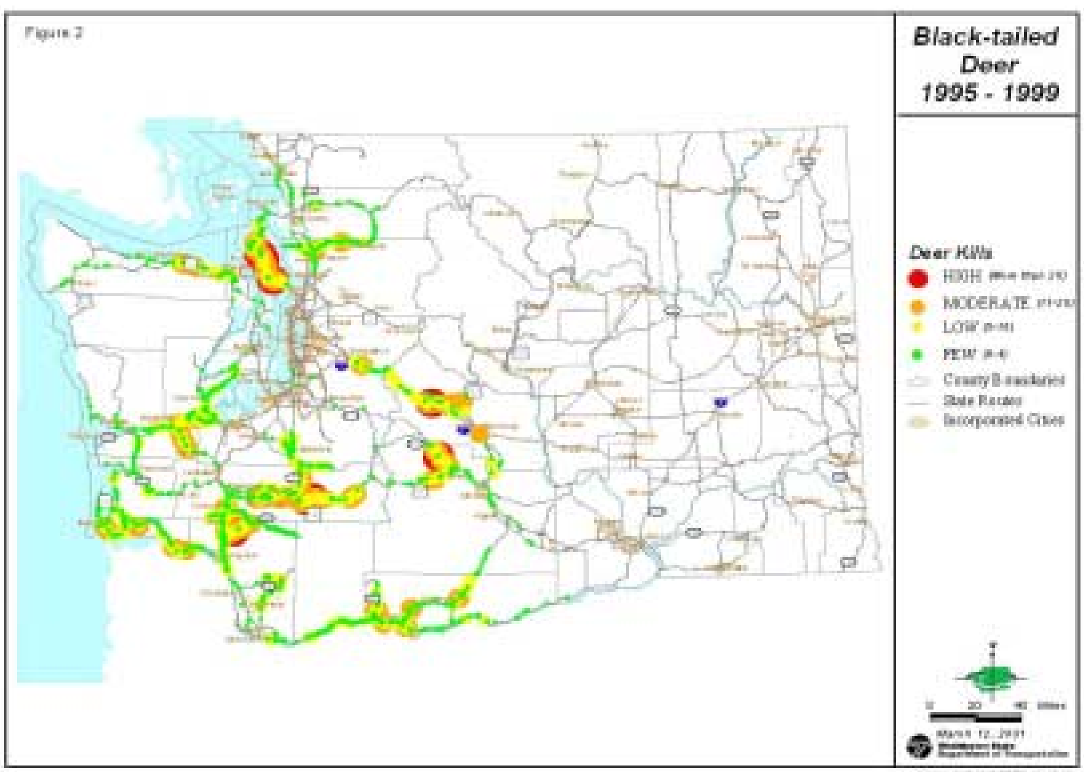

Fig. 2. Black-tailed Deer (1995 – 1999)

Elk

Elk occur in nine ranges throughout Washington State, including a herd on the Hanford Nuclear Range (WDFW 1996). They may be resident in lower elevation habitats and may exhibit seasonal movements in higher elevation habitats as they move between higher elevation summer grounds, and lower elevation wintering grounds. The peak collision period is July. See Figure 3. There are four main problem areas; all associated with passes in the Cascade Mountains. See Figure 4.

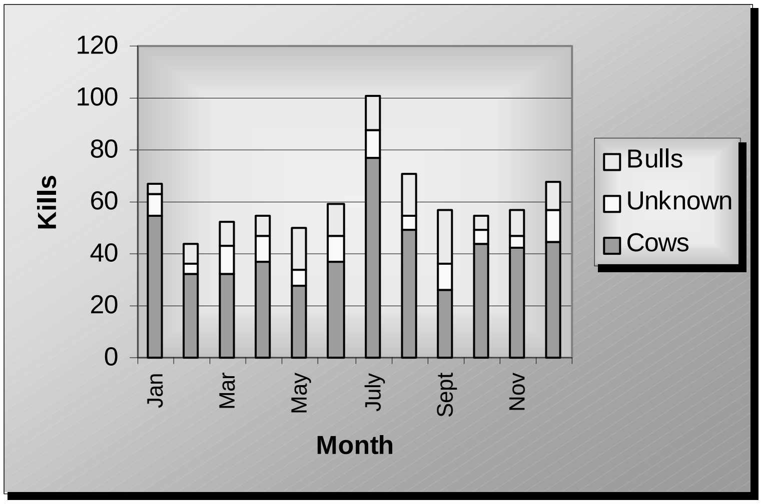

Fig. 3. Elk Killed by Month (1990-1999)

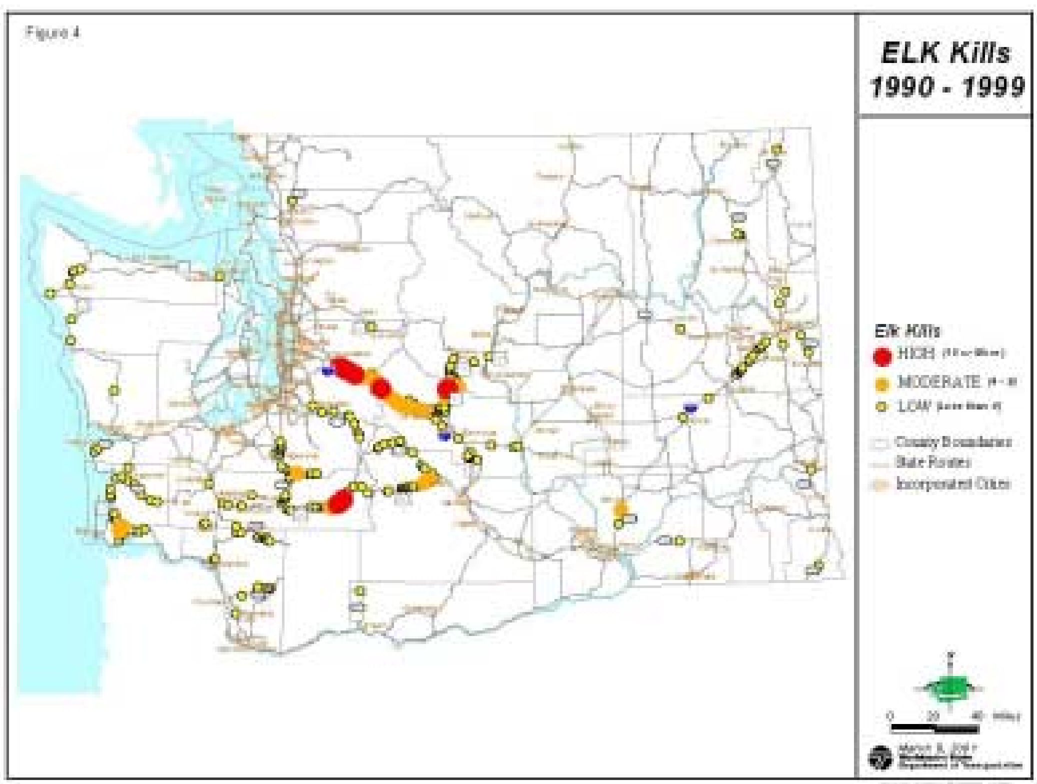

Fig. 4. Elk Kills (1990 – 1999)

White-tailed and Mule Deer

Both white-tailed and mule deer occur in eastern Washington. Both species may exhibit seasonal movements between summer and wintering grounds. Peak collision periods for both species occur in the fall, during the migration and rut, and during the winter, when they congregate on wintering grounds, some of which are near state highways. Wintering ground impacts can be significant. See Figure 1. There are 16 problem areas on the east side of the state. Of these, nine areas involved both species and seven areas involved only one species. Problem areas for mule deer include four major passes in the Cascade Mountains, while the main problem areas for white-tailed deer include three highways outside the city of Spokane. Problem areas for both species include wintering grounds near highways in the Okanogan area, the Selkirk Mountains, and agricultural lands in the southeastern corner of the state. See Figure 5 and 6.

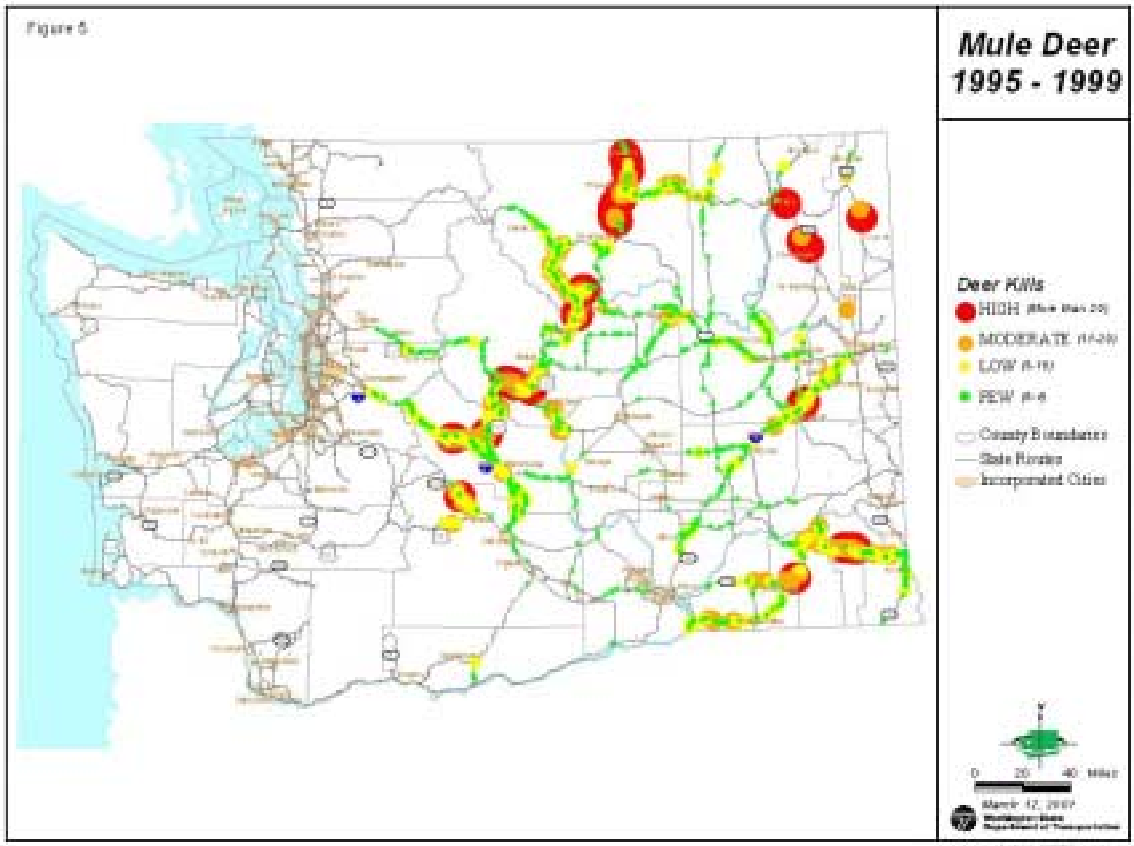

Fig. 5. Mule Deer (1995- 1999)

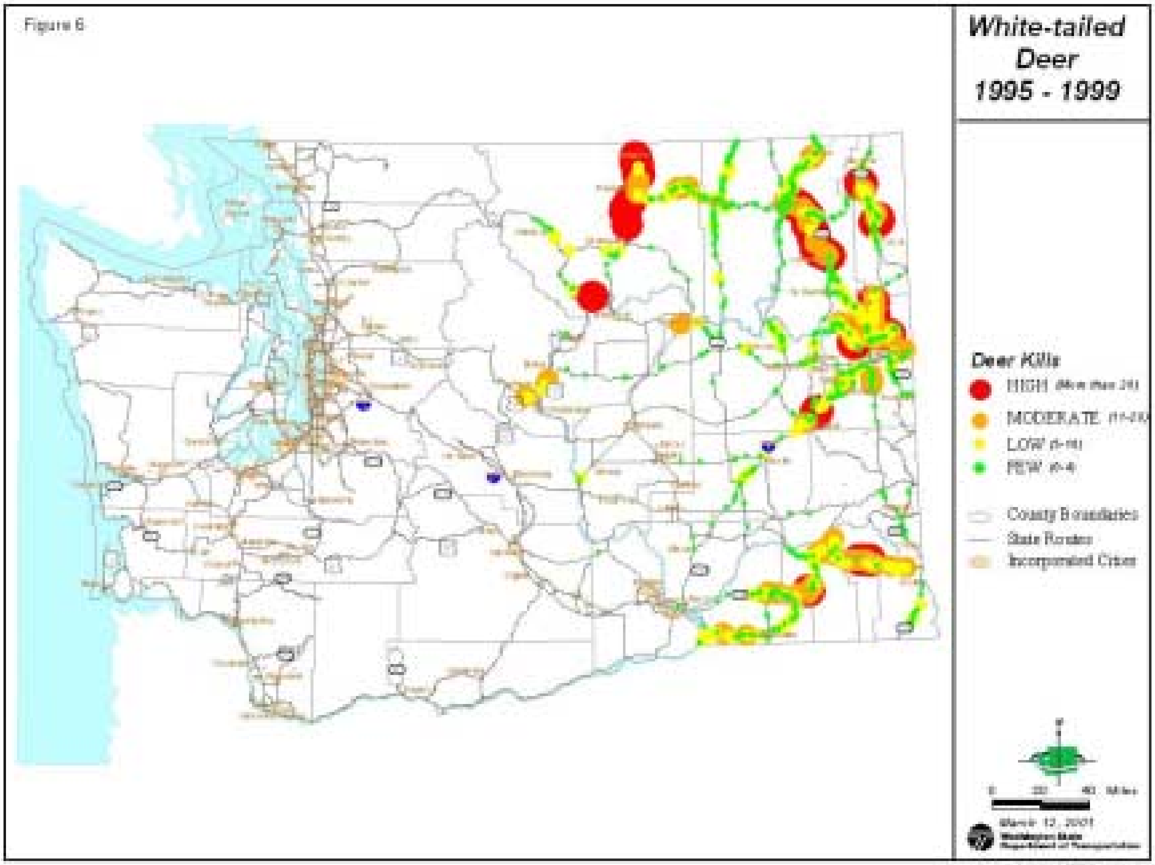

Fig. 6. White-tailed Deer (1995 - 1999)

Mitigation Methods

By using the database to determine where and when animals are being killed and combining that information with site-specific information on terrain and other special circumstances, the correct mitigation method can be selected. Examples of some of the different methods that are being used are provided below.

Radio Collar Activated Crossing Signs

Radio collar activated crossing signs are being used with elk in the Olympic Peninsula where there is a herd of 50 resident elk which readily move from forest land in the foothills of the Olympics, across SR 101 to farm pastures just outside of the city of Sequim. To alleviate an elk-vehicle collision problem on this highway, the Washington State Department of Fish and Wildlife in partnership with WSDOT, the tribes, and the Rocky Mountain Elk foundation, put sign activating radio collars on six members of this herd. These collars trigger the flashers on the elk crossing signs when the collared elk are within a quarter of a mile of the signs. The signs have helped reduce the number of elk vehicle collisions, but one problem with the system is that it often flashes when no elk are visible, but they are somewhere within the quarter mile of the sign. Since this technique is dependent on motorists slowing down in response to the flashing lights, false positives will not help maintain the desired response. This technique may prove useful for resident elk herds but will not be useful for deer.

Special Signs

These signs focus on slowing down traffic in the high kill areas. They range from informing motorists on the number of deer which have been killed that year to date on that specific stretch of roadway, to reduced nighttime speed limit signs, to signs identifying high kill zones. These methods are being used in north-central Washington. We have not conducted any studies to determine the effectiveness of these signs.

Reflectors

Reflectors have been installed along miles of highway in eastern Washington. Our studies on reflectors have indicated that there may be some effectiveness in Eastern Washington, but not in Western Washington (Schafer and Penland 1985; and Ossinger 1992). Reflectors are not effective during the day, during snowstorms, when covered with snow from a snow-plowed road, and when out of alignment or dirty.

Crossing Structures

Crossing structures (underpasses) have been installed for deer and elk on several highways. Structures are planned for a major up-grade on Interstate 90, where it crosses the Cascades Mountains on primarily U.S. Forest Service managed land. Crossing structures are most suitable in areas where there is suitable habitat and an assurance that the habitat will be available to the animals in the future.

Deer Detectors

WSDOT is developing a detector system that will detect the presence of large mammals such as deer along selected roadways. Once the animal breaks the beam, an animal crossing sign will flash, warning motorists that the animal has entered the right of way. WSDOT is planning on using these systems at migratory routes and wintering areas. We hope to keep these systems fairly inexpensive and mobile so that they can be moved from place to place as the need arises. Major changes in vegetation (as in the aftermath of a fire) can cause changes in deer and elk movement, which require some warning to motorists. This technology is still in the development phase. We hope to conduct field tests in 2002.

Summary

The WSDOT maintains its deer kill database to analyze where ungulate vehicle accident problem areas exist statewide. The data includes information on location to the nearest 0.10 mile, setting, fencing, date, sex, age and species information. This data is used along with on-site specific information to select the most appropriate method for reducing the ungulate vehicle encounters. Several methods are currently being used, tested or developed in the state, including an experimental radio collar triggered flashing sign system with elk, and the development of a laser beam detector system.

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COMPENSATORY WETLAND MITIGATION BANKING PROJECT AT WASHOE LAKE, NEVADA FOR THE NEVADA DEPARTMENT OF TRANSPORTATION

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Abstract

The Nevada Department of Transportation (NDOT) was required by the U.S. Army Corps of Engineers (Corps) to mitigate for unavoidable wetland losses due to construction and highway widening projects along the U.S. 395 freeway from the Truckee Meadows (Reno) to the Carson Valley. The area chosen for a wetland mitigation bank is south of Washoe Lake, Nevada. It contains 110.5 acres (44.72 Ha) of permanent, palustrine, emergent, persistent wetlands and 110.5 acres (44.72 Ha) of open water for a total of 221 ac (89.44 Ha). The project was constructed in two phases. Phase I was completed in 1988 and was encompassed 89 acres (36.02 Ha) of the total 221 acres (89.44 Ha), and Phase II, completed in June 1999, constructed the remaining 132 acres (53.12 Ha). Monitoring of Phase I was done during the years of 1989-1991, and monitoring of Phase II will be conducted for five years beginning in the year 2002. The objective of the mitigation project is to create a self-supporting wetland system that will meet certain criteria. Analysis of the monitoring data indicated that Phase I of the wetland mitigation project was a success by providing suitable habitat for numerous species of birds and waterfowl. Phase II monitoring is predicted to indicate overall success of the project.

CONFLICTS BETWEEN LINEAR DEVELOPMENTS AND ASIAN ELEPHANTS IN SUB HIMALAYAN ZONE OF UTTRANCHAL (INDIA)

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Abstract

As a consequence of recent habitat fragmentation, the free movement of Asian Elephants all over India has been interfered up to a great extent. This largest terrestrial mammal very existence is now under threat due to various reasons such as persecution for its ivory and blockage of migratory routes due to construction of human developmental activities. Shrinking elephants' habitats due to linear developments such as railroads, motorways and canals and human habitation in and around the protected areas give rise to foraging and migratory problems, resulting ultimately in man-elephants conflicts, confrontation between herds and accidental deaths.

This poster discusses in detail, threats faced by Wild Asian Elephants in the sub Himalayan region in Rajaji National Park, Uttranchal, India. Various case studies of difficulties faced by elephants because of railroad, motorway & irrigation and hydroelectric canals in the region are also discussed. River Ganges flows through the habitat for about 20-km & divides it in two parts. The man-made barriers have shrunk the width of habitat along the river Ganges from 20- km to roughly 4- km. The railroad and motorway on the right and the irrigation & hydroelectric canal on the left of the Ganges have restricted the access of the elephants to the legendary river Ganges, the irresistible attraction for the Wild Asian Elephants, which they have to visit daily for drinking, bathing and beating the heat in summer months. Therefore, the elephants look for alternate sources of water and food and as a result they enter human habitation and croplands, leading to the man-elephant conflicts. Moreover, with rail tracks in the vicinity, there have been numerous elephant' deaths due to speeding trains. The frequent confrontations of elephants with moving traffic on railroad and highway have made them irritable, restless & prone to accidents.

This poster examines the disastrous effects of improper design and construction of crossings on the age-old migration tracks and the existing linear developments and how they could be rectified in an animal-friendly way. The poster also suggests practical solutions to reduce the threats to elephants and to their habitats, ensuring sustainability of viable elephant population in a habitat shrunk by human activity.

CREATING AN URBAN DEER-VEHICLE ACCIDENT MANAGEMENT PLAN USING INFORMATION FROM A TOWN'S GIS PROJECT

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Abstract

Funding Source and Budget: Town of Amherst, New York. $60,000
Project Period: October 2000-September 2001

The Town of Amherst, New York is an urban/suburban community near Buffalo that has experienced considerable development in the past 10 years (1991-2000). In the same time period, the Town has experienced a noticeable increase in deer vehicle accidents. Given the Town's landscape, interactions of deer and people seem highly likely to continue. In addition to commercial uses and residential areas (both high and low density), the town includes substantial agricultural land protected by conservation easements that preserve green space and also perpetuate local agricultural use on selected acreage. This mixture of residential, commercial, green space, and agricultural lands results on ongoing conflicts between humans and deer. The most noticeable is that of increased deer vehicle accidents which, in the past 10 years, have ranged from a low of 298 to a high of 444 collisions per year. The Town is unusual in that, since 1991, planners have been assembling data on land use patterns, locations of deer vehicle collisions, and deer population estimates. These have been compiled into a GIS project that was used to guide the formulation of a deer-vehicle management plan and the State environmental review of that plan. To date, analysis of GIS data has demonstrated spatial and temporal patterns of deer accident "hot spots." It has also shed light on the likely proximate causes of those hot spots which include proximity to green space, speed and vehicle movement, and locations with new development. In addition, the State Department of Environmental Conservation has conducted regular aerial deer counts for several years. Analysis of these counts show the effects of the town's more concerted efforts at lethal control in 1994-1996 that is also reflected in shifts in deer vehicle accident "hot spots." A deer vehicle accident adaptive management plan is being formulated that takes a multifaceted approach to the reduction of deer vehicle accidents including modification of driver behavior, modification of deer behavior (particularly movement), and periodic deer population control. The GIS project also shows promise as a monitoring tool for continued implementation of this adaptive management plan.

Web Sites

www.white-water-associates.com ; www.amherst.ny.us/govt/planning

EARLY CORRIDOR EVALUATION PILOT PROJECT

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Abstract

In 1999 and 2000, the Colorado Department of Transportation (CDOT) gathered a variety of environmental information along US Highway 24 east of Colorado Springs. CDOT mapped wetlands, plant communities, wildlife corridors and habitat of imperiled species using a combination of photo interpretation and field delineation onto Mylar overlays over aerial photography. Data on sensitive species and cultural resource data were gathered using traditional survey methods. Subscription data for Colorado was purchased using corridor funds. All of the information was entered into CDOT's Geographic Information System (GIS).

CDOT evaluated the process of collecting and storing data early in the project planning process and examined its utility for streamlining the environmental process while maintaining or improving environmental compliances. CDOT also evaluated the wetland mapping process for accuracy and its use as a potential substitute for jurisdictional wetland delineations.

CDOT found that aerial photography, although potentially costly, can be a powerful tool for the identification and location of environmental resources early in project planning. GIS provides an efficient way to store, retrieve, share and analyze information on an immediate and long-term basis. Electronically stored data can provide a solid baseline from which a variety of analyses, such as impact assessments, can be completed. Other possible applications include evaluation of transportation alternatives, identification of mitigation strategies and cumulative impact assessments.

Because of the power inherent in this type of data collection, CDOT will continue to develop the corridor evaluation process. Costs of remotely gathered data can be high, therefore, data gathering efforts need to be focused on specific objectives, and a corridor wide environmental database needs to be carefully designed. CDOT presented a poster session that described this process, their results and how CDOT hopes to implement this process in the future on other corridors.

Biographical Sketch: Beth Chase is an Environmental Planner for the Colorado Department of Transportation's Division of Transportation Development, Planning Branch, Environmental Planning and Policy Unit. She has been with CODOT since 1996. Currently, Beth specializes in Corridor Evaluations and Developing Streamlining Procedures at the Corridor Level. Beth earned her B.A. in Environmental Science, with minors in Religious Studies and Psychology, at the University of Denver.

ELM FORK OF THE TRINITY RIVER FLOODPLAIN MANAGEMENT STUDY

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Abstract

Wendy Lopez and Associates, Inc. (WLA) was asked to provide a conservation and ecological restoration overview for the City of Dallas as part of an Elm Fork Floodplain Management Study. This study encompasses a unique portion of the main stem of the Elm Fork of the Trinity River, Dallas County, Dallas, Texas. The project area includes approximately 8.5 square miles, half of which lie within a 100-year floodplain. Approximately 15% of the project area is mature bottomland hardwood forest and serves as an inner city haven for wildlife. Historically, the project area is located in the Blackland Prairie physiographic region, includes 5 to 10 percent jurisdictional waters and wetlands, and contains wildlife habitat typical of bottomland hardwood forest and riparian communities. At least six identified federal and state listed threatened and endangered species have utilized Dallas County as a migratory corridor. Over the last 100 years, the project area has experienced industrial development, including several inactive landfills. Due to the practice of filling the floodplain for development and the resulting seasonal flooding, the City of Dallas has decided to evaluate several flood management alternatives. Critical objectives for this study involved defining areas for valley storage, recreational development, and identifying ecological restoration opportunities. The study deliverables included a local drainage master plan for three tributaries of the Elm Fork and a report outlining overall watershed management concepts and restoration opportunities for the project ecosystem. The WLA assessment included natural and cultural resource impacts, hazardous, toxic, and radioactive waste (HTRW) issues, and general water quality concerns. In order to assess local concerns, coordination with an Elm Fork advisory committee and numerous public meetings with property owners and stakeholders were completed. Additional advisement for the project was sought through federal, state, and city agency coordination. A Section 404 review and a comprehensive natural resources inventory of existing conditions within the main stem and the three tributaries were completed. Existing wetlands, vegetation cover, land use patterns, water and cultural resources, and related wildlife habitat utilization were documented. Assembled information included aerial photographs (historical and existing), soil classifications, and site hydrology. In addition, a modified Phase I environmental assessment (ESA) was performed to assess the risk of hazardous, toxic and radioactive waste (HTRW) impact. Several site visits revealed industrial uses and inactive registered and unregistered landfills occupied most of the project area, while residential areas were minimal. The preferred alternative, selected by an advisory committee, included channel improvements to existing waterways, a new diversion channel, new recreational areas, and habitat restoration opportunities. Recommendations for future work include developing a natural resource and forest management plan, outlining detailed environmental preservation and restoration opportunities and incorporating them into a phased approach and framework plan.

Biographical Sketch for Melinda Clary: Ms. Clary's scholastic background consists of two degrees from Texas Tech University, a Bachelor of Science degree in Wildlife Management received in 1998 and a Master of Science degree in Zoology received in 2000. As a graduate student, she completed and published a study on small mammal communities on Fort Bliss Military Base and participated in numerous mammal surveys throughout state parks and wildlife management areas. In addition, she was hired as a research assistant for the "Texas Park and Wildlife for the 21st Century" project, which involved creating exhibits in ArcView, as well as organizing large conferences for public involvement. As an Environmental Scientist at Wendy Lopez & Associates, Inc., Ms. Clary has served as Task Manager on numerous projects from jurisdictional wetland delineations to wildlife habitat restorations. In addition, she has been responsible for the preparation of several technical documents such as environmental and biological assessments.

Biographical Sketch for Greg Tickle: Mr. Tickle has 27 years of environmental study and project management experience encompassing various aspects of natural resources impact analysis and planning. His areas of expertise encompass environmental assessments and impact statements, jurisdictional wetland delineation, wetland creation, wildlife habitat analysis/planning, threatened/endangered species surveys, baseline natural features inventory, land planning/feasibility studies, environmental site assessments, design and construction administration. As a project manager, Mr. Tickle has been responsible for numerous field investigations and technical reports involving linear corridor studies, facility site development, master planning, and regulatory compliance activities in 16 states and Mexico. In addition to his environmental expertise, Mr. Tickle has the technical expertise of a Registered Landscape Architect. His qualifications to direct technical natural system analyses and impact studies are considerably strengthened by his planning and landscape architectural experience; the two disciplines are complementary when evaluating resources and mitigating potential impacts, since wetland and natural resource restoration require detailed analysis and construction sequencing.

EVALUATION OF A WILDLIFE UNDERPASS ON VERMONT STATE HIGHWAY 289 IN ESSEX, VERMONT

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Abstract: State Highway 289 (a.k.a. circumferential highway) in Essex, Vermont, was constructed in 1993 as a means of shifting growing traffic volumes in the area around Burlington, Vermont, to reduce traffic congestion in some areas. This highway bisects streams, wetlands, upland and deer winter habitats important for the survival of area wildlife such as white-tailed deer, beaver, mink and otter. A divided concrete underpass was installed under the highway to accommodate an existing stream channel on one side and wildlife passage on the other. The underpass was located along the stream to connect wetland habitat that exists both up and down stream from the structure thereby facilitating the movement of wildlife and related ecological processes across the road. This project evaluates the use of this structure by wildlife. We used trailmaster infra-red monitoring and photography equipment and track beds to document the use of the underpass by wildlife. This technology allowed us to determine what species were using the underpass, the time of year they used the structure, the time of day, the direction of movement, and how frequently the structure was used. Based on the results of this project, it appears that the diversity of wildlife using this structure is limited, but raccoons and mink use the underpass frequently. Further, underpass design, substrate, vegetation near entrances, and other parameters may be limiting the ability of wildlife to use the structure for moving across the roadway.

Description of Underpass and Affected Landscape

The underpass structure is composed of a large concrete box culvert that is split in the middle by a large concrete support. The dimensions are as follows: Length 97.54 m (320 feet); Width 3.05m (10 feet); Height 3.96m (13 feet). A stream flows through the northern tunnel and the southern tunnel serves to facilitate animal passage along the riparian zone. During periods of high water flow (e.g., spring runoff), both tunnels pass water. However, the bottom substrate in the wildlife tunnel slopes along its profile and has never been observed to be covered by water even during periods of high flow. The substrate of both tunnels is composed of large, course rock with mud and sand in the interstices. This substrate seems to provide good movement cover for small mammals, but likely restricts the movements of larger mammals such as white-tailed deer.

Fig. 1. The underpass as viewed looking downstream along Alder Brook.

The road is raised above the stream, associated riparian zone and bottom of the underpass by approximately 10.7m (35 feet). The top of the underpass is approximately 6.1m (20 feet) from the edge of the road. Vegetation around the tunnel entrances consists of tall grasses which are a result of road bank stabilization plantings. Approximately 30 feet from the tunnel openings vegetation changes to grasses, shrubs, sedges, and hardwood and softwood trees. (Include map of area showing wetlands, dwa, stream, development, etc.). Woven wire fence (4 feet high) runs along the lower grade of the road embankments and extends above the underpass entrance. The fence is disrupted in several locations near the underpass by fallen trees. The fence presents no substantial barrier for most wildlife in the area since deer are able to jump over the 4-foot-high fence, and other animals can crawl under or through the 6 inch wire mesh.

Figure 2 shows wetland and deer winter habitats in relation to the underpass. Much of the surrounding landscape has been converted into large scale residential subdivisions and commercial strip development. However, as illustrated in figure 2, there are large habitat patches that are connected by the underpass. This area has grown rapidly within the past decade. During 1997, traffic volumes for this road were estimated to be 4,200 vehicles per day.

Fig. 2. Landscape of the underpass and surrounding areas.

Methods

We monitored wildlife use of the underpass during the 6-month period June, 2000 through November, 2000 (the period July 6 through September 17 was not sampled). Wildlife use of the underpass was monitored and recorded using Trailmaster 550 passive infrared monitors, Trailmaster TM35-1 35mm cameras, and track plots. Infrared monitors were used to collect number of crossing events, time of crossing events, date of events, and direction of movement. Direction of movement was determined by using multiple infrared monitors at both ends of the underpass and evaluating the time between recorded events for both monitors. The cameras were used to record the species of animal using the underpass. However, after 6 weeks of recording data in the field, one of the cameras was stolen. We decided to remove the remaining camera and identify species using the underpass by observing animal tracks in a series of 4 plots established along the underpass. One track plot was located within the first 25 feet of the underpass opening on either end, another plot was established in the center of the underpass to confirm complete crossing events, and a fourth plot was located at the north end of the adjoining tunnel for stream passage. This fourth track plot was used to determine whether animals were using that tunnel, but we did not install infra-red monitors and cameras due to the consistently high water in that tunnel and apparent lack of use by animals. Track plots consisted of 3 foot by 3 foot zones of mud, sand, and “black magic” marble dust to collect animal track prints in a systematic fashion. Researchers visited the study site once each week during the study period. The period of July 6 through September 17 was not sampled. This lapse in sampling occurred as a result of the camera theft which caused us to remove all equipment for a period of time to avoid further loss of equipment and data.

Infra-red monitors were secured to metal fence posts along the inside edge of the underpass. Monitors were placed 10 to 15 feet inside each entrance to the underpass. Associated 35mm cameras were placed an additional 5 feet into the tunnel entrance adjacent to the monitors. Cameras were secured to metal fence posts as well. Cameras were aimed towards the tunnel entrances in order to take advantage of any limited ambient light, and further, to avoid easy visibility by humans, in hopes of avoiding theft and vandalism.

Data was analyzed using Microsoft Excel. Descriptive statistics were performed on the information collected to develop a general understanding of wildlife use of the underpass. These data are presented below.

Results

Infra-red monitors recorded 190 events of both confirmed and unconfirmed animal use of the underpass during 96 days of sampling from June 6, 2000, through November 21, 2000. Again, no data was collected during the period July 6 through September 17, 2000, which explains the lack of data for the month of August in figure 4. Photos from 35mm cameras that were triggered by the infra-red monitors, and track plots were used to identify species of animals using the underpass. While 7 species of wildlife were identified as using the areas around the north and south entrances to the underpass, only 4 species were confirmed to have used the underpass for moving under State Highway 289. These species include raccoon, mink, weasel, and skunk, in order of frequency of occurrence. Figure 3 illustrates the use of the underpass by these species. The number of species utilizing the underpass is low, but not necessarily surprising due to the dimensions, substrate and other factors related to the suitability of the underpass for animal use. Tracks of white-tailed deer, great blue heron, and mouse species were observed at both tunnel entrances, but were not confirmed as ever entering or utilizing the underpass.

Tree swallows used the tunnel for nesting purposes, building a nest at the north end of the tunnel (approximately 20 feet into the tunnel entrance) in the spring of 2000 and a nest at the south end of the tunnel in the spring of 1999. However, the presence of this species and its use of the structure was not considered as part of this evaluation because it had nothing to do with the purpose of the tunnel to facilitate wildlife movement across the road. In addition, aquatic invertebrates and fish were not sampled as part of this evaluation due to the purpose of the project, purpose of the underpass, and limitations of the sampling design. Fish and aquatic invertebrates (e.g., crayfish) were observed within the stream channels in the tunnel entrances. Crayfish may serve as an attractive food resource for species such as raccoon and mink which were found to use the underpass.

Figure 4 illustrates the level of underpass use by wildlife over the evaluation period. The level of use increased during the months of September, October, and November, as compared to the spring and summer months. Though we are not certain as to why this distribution of use occurred, it may be due to temporal behavior on the part of some or all of those species using the underpass such as the seasonal dispersal of young into new home range habitat, searching for mates for reproductive purposes, or access to important fall food resources.

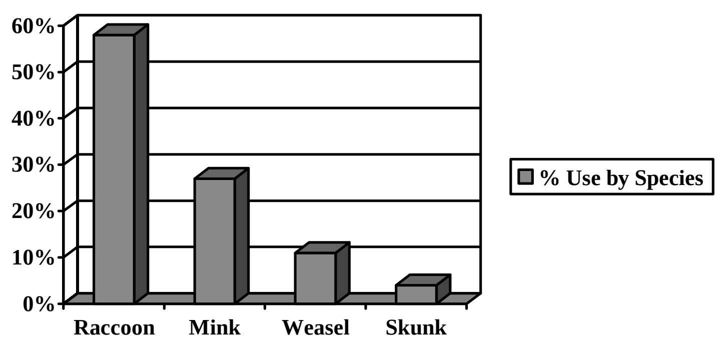

Fig. 3. Percent use of the underpass by wildlife species from June 2000 through November, 2000.

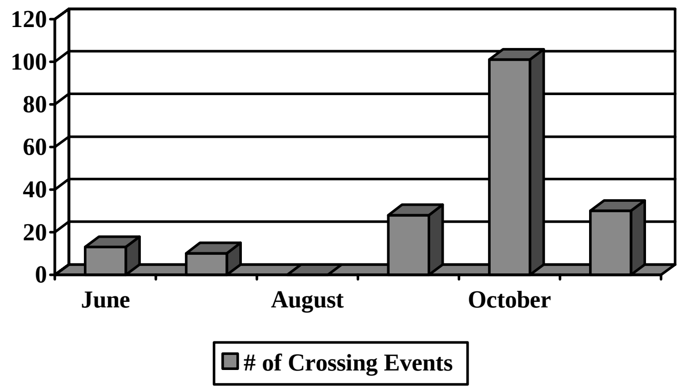

Fig. 4. Number of crossing events by wildlife from June 2000 through November 2000.

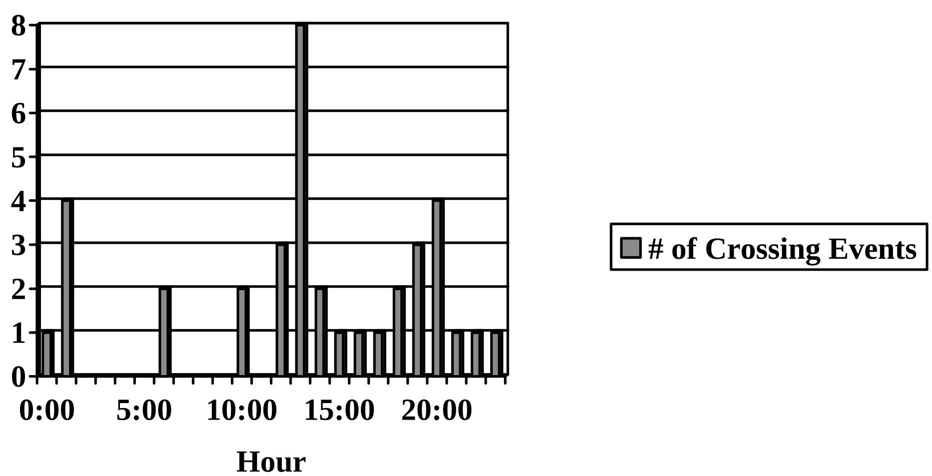

Fig. 5. Number of wildlife crossing events as a function of time of day.

As figure 5 indicates, animal use of the underpass may be a function of time of day. Based on our information, the majority of animal use of the underpass occurs during late evening and early morning hours. Therefore, most animal use of the underpass is nocturnal. Surprisingly, however, animal use of the tunnel appeared high during mid-day hours as well (e.g., 13:00). This may be a function of food availability in the stream, thermal refuge during periods of high air temperatures (air temperatures in the tunnel seemed low compared to ambient temperatures), or other factors.

Discussion

Roads, transportation infrastructure and related development can impact wildlife by destroying and fragmenting habitat, increasing mortality, displacing or disturbing animals from otherwise suitable habitat, and affecting the ability of animals to move within their environment (Jackson, 2000). In addition, vehicle collisions with animals, particularly large animals such as white-tailed deer and moose, present a significant public health and safety risk.

Structures designed to facilitate movement of wildlife under or over roads and highways have been successfully employed in many areas around the United States and in other countries (Jackson). In Vermont, however, the use of underpasses and overpasses to mitigate transportation impacts to wildlife has been limited. Route 289, the subject of this evaluation, represents the first instance in Vermont where an underpass structure was employed to mitigate the effects of road development on wildlife movement. Results from this evaluation indicate that relatively few species of wildlife use the crossing structure. We believe this is due to deficiencies in the design of the underpass and other associated social and environmental variables that are discussed below.

Use of the Underpass by Wildlife

Raccoon, mink, weasel, and skunk were the only species of wildlife confirmed to use the underpass to cross Route 289. Evidence of other species observed as being present in or near the underpass entrances includes great blue heron, white-tailed deer, and peromyscus spp. The objective of the underpass was to allow for a wide diversity of wildlife to cross Route 289 and thereby maintain the riparian link between wetland and upland habitats located up and downstream from the structure. In particular, it was hoped that the underpass would accommodate the movements of wetland dependant wildlife such as beaver, otter and mink. Since Route 289 bisects important deer winter habitat, it may have been possible to accommodate the movement of deer through the structure. Based on our findings, it appears that the underpass has only limited effectiveness at accommodating its intended ecological functions. This evaluation did not consider the possible or potential use of the underpass by reptiles or amphibians. Our techniques were not designed to observe evidence of use by these taxa. While it may be possible that the underpass is used by some turtles, salamanders, frogs or toads, we did not observe any anecdotal evidence of this during our field investigations.

Based on our findings, it appears the species using the underpass may be exhibiting temporal behavior in their use of the structure. Results show an increase in the use of the underpass during September, October, and November. While we are not certain as to why this distribution of use occurred, it may be due to temporal behavior on the part of some or all of those species using the underpass such as the seasonal dispersal of young into new home range habitat, searching for mates for reproductive purposes, or access to important fall food resources. Without additional information related to population dynamics of those species observed to have used the underpass, or specific habitat distribution data for the area, it is not possible to answer this question.

Results are not clear on the extent to which time of day affects animal use of the underpass. We expected to observe a greater frequency of use by wildlife during late evening, night time, and early morning hours which would suggest either nocturnal or crepuscular behavior. To some extent, the results suggest nocturnal behavior due to the frequency of underpass use between the hours of 18:00 and 2:00. Unfortunately, our lack of time of day data has effected our abilities to draw further conclusions on this element of wildlife use. Some data from the infra-red monitors was lost due to operator error. However, the infra-red technology did prove effective at understanding daily and seasonal patterns of use by wildlife. This equipment is highly sensitive and must be used with great care and a good understanding of how it works in order to avoid losing data.

Factors Affecting Wildlife Use of the Underpass

Underpass Location and Design

Although this evaluation was not designed to determine whether the current location of the underpass is appropriate, consideration of surrounding habitat conditions suggests the location of the structure is reasonable. In particular, it was located along the main course of Alder Brook rather than a smaller tributary to Alder Brook. Alder Brook connects a series of beaver influenced wetlands up and down stream from the underpass.

We believe, based on our observations of animal use of the underpass and underpass dimensions and associated light conditions, that the structure was not designed appropriately to accommodate the movement of many mammals that might otherwise have used a structure in this location. The underpass is too long, too narrow and subsequently has very poor light conditions. These features can preclude the use of an underpass by some wildlife such as deer. In addition, its location relative to the channel of Alder Brook may reduce its effectiveness for wildlife movement. The underpass frequently passes water that spills over from Alder Brook, effectively resulting in a second stream channel, rather than an effective riparian corridor for wildlife.

Reed et al. (1979) presented what he termed an openness equation for determining the suitability of an underpass for use by ungulates, and specifically mule deer. This equation has been applied in other circumstances to gauge the relative effectiveness of underpass structures for deer movement and other species. Underpass openness, largely as a measure of the degree of ambient light in the tunnel, appears to be a significant factor in determining whether some species of wildlife, particularly large mammal, will use it. This equation was used by the Department during the planning phase for the Bennington bypass project in Southern Vermont. The equation relies on the dimensions of an underpass to determine its relative openness, which affects the amount of light and possibly cover within the tunnel, and subsequently visibility by deer. The ratio of <u>width x height</u> (in meters) must result in a figure greater than 0.6 to be effective for deer length crossing.

In this case, the dimensions, as a function of this equation, result in an openness figure of 0.12. This figure is well below the proposed minimum openness factor for an underpass to be suitable for deer. This process equates height with width. There is information that suggests width may be a more important factor in determining if deer will use an underpass (Jackson,). This underpass is very long and relatively narrow with poor (very low) light conditions. In addition, the large, jagged rip rap substrate is unsuitable for deer movement. In fact, even if the openness factor were suitable for deer, the substrate in the underpass effectively precludes its use by deer. In order to facilitate deer movement through the tunnel, the existing substrate would need to be removed and replaced with material that created a more even micro topography within the tunnel. This could be accomplished in conjunction with the placement of other habitat such as logs, root wads, and large rocks to create cover for the movement of small and medium sized mammals such as mink, mice and voles. The length, width and lack of light in the tunnel may also restrict use by other wildlife such as beaver, coyote, and fox, among others.

Substrate

Substrate within the underpass is composed of large, course rip-rap material with sand and mud in the rock interstices. This substrate could provide good movement cover for small mammals such as mice and voles, however, no evidence of those species were observed within the underpass. In the alternative, this is very poor substrate for most other mammals. Large animals such as deer are precluded from using the underpass due to the nature of the substrate. Even some medium-sized mammals such as fox and coyote might avoid using the underpass due to the substrate.

Substrate is an environmental variable affecting wildlife use of the underpass that can be changed. A fine substrate of small rocks, stones and sand in conjunction with course woody material such as logs and stumps would allow for easier movement of some mammals. This could increase the diversity of species use of the underpass. Consideration should be given to improving the character of the substrate and interior cover habitat followed up with continued monitoring of animal use to evaluate the effect of substrate change on underpass efficacy.

Vegetation and Cover

Vegetation leading up to the entrances of underpass structures can be important in determining whether some species will use the structure. The suitability of vegetation as cover varies depending on the species of wildlife being accommodated. In this case, the underpass was installed to accommodate the movement of small, medium and large mammals. The vegetative cover near the underpass openings consists of grasses and some shrubs. It is relatively open, and the stream substrate (sand and gravel) seems to preclude the establishment of vegetation at the underpass openings. Vegetation of this character provides poor cover for medium and large mammal, and even some small mammals. For instance, it is possible that small mammals such as mice and voles are not willing to expose themselves to the risk of predation by entering the tunnel where there is no vegetation, or other form of cover. Vegetative cover leading to the underpass entrances is not suitable for wintering deer to access the structure. Planting softwood tree saplings around the tunnel entrances and connecting to the winter habitat would improve the ability of deer to access the tunnel, though existing substrate in the tunnel still precludes use by deer.

Hydrology

The underpass was not raised above the streambed enough to avoid regular inundation by water from the stream channel. Regular water flows within the underpass may effect wildlife use and structure effectiveness. Although expensive, an expanded bridge that maintained existing riparian habitat along one or both sides of the stream channel would have been a more effective method of accommodating wildlife movement, habitat connectivity, and the flow of ecological processes within the affected area.

Landscape and Surrounding Development

Route 289 bisects deer winter habitat in the area of the underpass. The impacts to this significant habitat were not adequately considered during the planning process for this road. The fragmentation effect, and direct loss of significant habitat is severe in this case. The underpass is not located or designed to effectively account for the fragmentation of this habitat, or to allow wintering deer to access or use the structure.

Since the construction of Route 289, a great deal of residential and commercial development has occurred around the area (refer to figure 2). This development has resulted in direct loss and fragmentation of habitat, and essentially resulted in an isolated area of habitat with the road in the center. It is possible that some of the ecological processes that may have existed prior to Route 289 and subsequent development no longer exist. It is also possible that some of the species of wildlife that might have used the underpass, can no longer find suitable habitat due to expanded development. This is a critical component to any review of transportation projects, their effects on wildlife and determining appropriate means of mitigating impacts. It is necessary to consider the broad effects of new or improved roads such as subsequent development and increased traffic volume and speed on wildlife and ecosystems in order to develop an effective mitigation strategy.   These circumstances strongly encourage the use of conservation easements or land acquisition as a means of avoiding habitat loss and fragmentation resulting from road development and potential subsequent residential and commercial development.

Fig. 6. Raccoon using the underpass structure during high water conditions as recorded by the remote monitoring and photography equipment.

Unfortunately, this evaluation did not consider the impact of Route 289 on wildlife in general, nor did it focus specifically on what species of wildlife do not use the underpass and for what reasons. Although, to some extent, we offer speculation on those wildlife species that we know use habitats within the general area of the road and possible reasons why they are not using the underpass. Evidence of white-tailed deer and great blue heron were observed at the entrances of the underpass. On other parts of Route 289, red fox and beaver were observed as roadkill. Another small stream runs through a 4-foot diameter culvert pipe under Route 289 approximately 0.25 miles south from the underpass. This stream flows from a beaver influenced wetland with current beaver activity. This is also an area that is used by wildlife for crossing Route 289. We do not know to what extent, if any, animals use the culvert pipe to move across the road, however, this has proven to be a primary location for vehicle collisions with small to medium sized mammals.

Conclusions

While this underpass structure serves some function for facilitating the movement of wildlife under Route 289, its value is limited by its design, substrate, surrounding vegetation, surrounding development, human activities (ATV use), and possibly location. Considering these issues, there may be some merit to: (1) changing the substrate within the underpass, (2) enhancing the vegetation around the underpass entrances, and (3) coordinating with local enforcement officials to more carefully monitor and control ATV use near the structure. These improvements may significantly enhance the use of the structure by wildlife, which would have the effect of maximizing the public investment in this transportation infrastructure. We recommend continuing this research following manipulation of the tunnel substrate to a less course material such as small stone with root wads or other appropriate cover. This would allow us to compare the use of the tunnel relative to the improvement of substrate.

In light of our current understanding of the affects of roads on wildlife and mitigation strategies, a short span bridge would have been a better investment in this area. A bridge would have maintained some of the existing riparian habitat conditions on either side of the stream as the primary passage routes for wildlife under Route 289. We strongly suspect that, all else being equal, this scenario would have allowed for the movement of many species of wildlife ranging from amphibians and mice, to coyotes and deer.

Perhaps the most important consideration for future projects that can be learned from this experience is to consider the overall landscape effects of transportation development, particularly as it relates to potential residential and commercial development subsequent to the new or improved road. In this case, consideration was not given to future growth and development of the area as a result, in part, of Route 289. This resulted in, essentially, stranded habitat surrounded by extensive commercial and residential development, and bisected by the road. The public's interests in their natural resources, and investment in mitigation of road impacts would have been better served if these issues were considered, analyzed and planned for prior to road design and construction.

This evaluation serves as an example of the value of a collaborative relationship between Vermont's Agency of Natural Resources, Department of Fish and Wildlife, and Vermont's Agency of Transportation to learn from our past experiences and improve our abilities to address similar issues associated with future projects.

Acknowledgements: We wish to thank the Vermont Agency of Transportation's Research Advisory Committee for their interest and funding of equipment for this project. In particular, we wish to thank John Narowski of the Vermont Agency of Transportation for his efforts in supporting this project, assisting with the development of the project grant proposal, assisting in securing the necessary funding, and serving as the critical cooperator for his agency on this multi-agency effort. This project would not have been possible without John's enthusiasm and support. Finally, we wish to thank Tim Appleton and Tina Scharf, technicians for the Vermont Department of Fish and Wildlife. Their technical assistance on this project was invaluable and greatly appreciated. And, thanks to Scott Darling, Director of Wildlife, for allowing us to spend the necessary time to complete this evaluation.

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FOLLOW-UP RESEARCH OF MOOSE AND OTHER WILD ANIMALS AT PERNAJA EUROPEAN HIGHWAY E18

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Abstract

The follow up study at Pernaja has continued now for nearly three years. The follow up research has been started before the road was built, it continued during the construction period 1995 -1998. The amounts of animals and the traces of animals were examined. The semi -motorway was opened to traffic in the year 1998, and then started the follow - up research at under passages. At the road there were 11 under passages, which were built for local traffic, but they were suitable also for animals. The road cut 300 km^2 wide forest area in two pieces and it was fenced with wildlife fence. The only means to cross the road area for bigger animals was to use of under passages. Animals have searched actively passages and they have learned to use them. The species, which have been observed at all under passages, are the moose, the white-tailed deer, the lynx, the mountain hare, the brown hare, the red fox, the racoon dog, the stoat, the red squirrel, the pine marten and the badger. Observations at the district have also been made from the weasel, the roe deer, the wolf, the wild boar and the brown bear.

Constructions have direct and indirect effects to fauna. The direct consequences were the loss of natural land area, 60 ha. The construction noise and presence of human scared animals far from the road line. The effects to smaller game were local. The lost territory areas took a new shape or were replaced with another. The indirect consequences were focused to the moose population, which was split into two parts. The changing pastures became more difficult because the road made a barrier effect to the pasture wanderings. The deaths of small animals increased in spite of the wildlife fence.

Now after three years experience the amounts of animals, which have used the fauna passages, have grown from year to year. The total amount in the first hole year 1999 was 437 animals from which 70-80% was moose. In the second year 2000 the amounts have grown to 547 animals. Now the current year seems to be as good as the former one or even better. The design of underpasses affects to the amounts of users. The small moose bridge transmits twice or three times as much animal traffic than the usual narrow frame bridge. The big moose bridge underpass transmits about 80% of all animal traffic.

Any notable changes has not happened in the population of moose in Pernaja forest area or at Eastern Uusimaa district in consequence of the new fenced highway. The densities of moose have remained the same as before building the road. The moose routes are slightly new shaped after the animals have found the underpasses and the routes are working well. For the smaller wild animals and game the effects of road have been local. The most important thing for them is the proximity of the underpasses rather than the design. New information about the movements of moose has also been attained. The movement pattern of moose is repeated from year to year. Wintertime is quite. In certain week in March the moose start their wandering for their summer pastures. Yong ones start their independent life before Midsummer and whole summer and autumn is busy. The yearly weather changes can be seen in results. The wandering to winter pastures starts, when the permanent snow covers the ground. At summertime, when it is hot moose do not move and when summer is cool and rainy, they move.

As a conclusion the research gave evidence that these underpasses have been well adapted among animals and the animal costs in road constructions have been justified and correct. Traffic safety has also improved. The benefits are in traffic safety in reducing accidents between animals and vehicles but also in the nature. The sound and diversified nature assures the ecological functioning of nature and the ecological network.

Biographical Sketch: Seija Väre is the Finnish coordinator of the European International Ecological Network (IENE). She has worked as an environmental planning designer in the consultant office for road and traffic planning for last 12 years. As a postgraduate student at Helsinki University of Technology, Seija's is studying the interaction between land use and nature, the ecological networks. Seija has specialized in ecology in planning, mitigating the habitat fragmentation, and the follow-up strategies. She has also been developing the first green structures in Finland and the national ecological network, conducting the follow-up research at Pernaja fauna passages.

JOPPA PRESERVE – WETLAND AND WILDLIFE HABITAT RESTORATION

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Abstract

Joppa Preserve is a representative piece of a greater Trinity River, bottomland hardwood forest that once dominated this portion of North Texas. Located in Dallas County, the existing core (327 acres) of the project is located downstream of the Dallas Floodway, a flood damage reduction project completed in 1959. As the project sponsors, Dallas County and the U.S. Army Corps of Engineers (USACE) initiated a feasibility study with project implementation costs estimated at $12,000,000. This study is intended to identify existing natural resources, environmental constraints, and develop a restoration plan for Joppa Preserve. Objectives of this feasibility study included identifying the environmental degradation resulting from previous construction and restoration of Joppa Preserve. Water resources within Joppa Preserve include Lemmon Lake, Little Lemmon Lake, Honey Springs, and an unnamed tributary of Five Mile Creek. This feasibility study identified measures designed to restore critical ecosystem components. Potential ecosystem restoration alternatives included restoration and expansion of wetlands and habitat improvements to existing riparian forests. The most critical hydraulic need included the repair of a large earthen embankment isolating Lemmon Lake from the Trinity River. Numerous field surveys were conducted by personnel of U.S. Fish and Wildlife Service (USFWS) and Wendy Lopez and Associates, Inc. (WLA) to detail existing conditions and define natural resources within the project area, evaluate potential ecosystem restoration opportunities, and identify any constraints that might limit the implementation of future ecosystem restoration measures. Several coordination and workgroup meetings were undertaken with USACE, USFWS, Dallas County, City of Dallas, and WLA, to refine these critical steps in the plan formulation process. Through the use of IWR-PLAN software, WLA completed an Incremental Cost Analysis (ICA) in which multiple alternatives were evaluated in a habitat improvement process. USFWS and WLA modeled wildlife utilization by employing the Habitat Evaluation Procedure (HEP). Possible combinations and solutions were identified and represented the best financial investments through the life of the project. Alternatives included: lake embankment restoration, expanding the boundaries of Joppa Preserve, wetland creation, aquatic habitat improvements to Little Lemmon Lake, maintenance of water levels, restoration of a poison ivy parkland, repair of the water outfall control structure, reforestation, and a recreation plan. The plan of interest derived from this process included acquiring additional buffer areas for Joppa Preserve, improving the lakes complex, restoring 15 acres of grassland/woodland, removing existing and creating new water control structures, reforestation of 3 acres of bottomland hardwood habitat, acquiring 69.5 acres of disclimax communities, and restoring 1500 linear feet of the lake embankment.

Biographical Sketch for Melinda Clary: Ms. Clary's scholastic background consists of two degrees from Texas Tech University, a Bachelor of Science degree in Wildlife Management received in 1998 and a Master of Science degree in Zoology received in 2000. As a graduate student, she completed and published a study on small mammal communities on Fort Bliss Military Base and participated in numerous mammal surveys throughout state parks and wildlife management areas. In addition, she was hired as a research assistant for the "Texas Park and Wildlife for the 21st Century" project, which involved creating exhibits in ArcView, as well as organizing large conferences for public involvement. As an Environmental Scientist at Wendy Lopez & Associates, Inc., Ms. Clary has served as Task Manager on numerous projects from jurisdictional wetland delineations to wildlife habitat restorations. In addition, she has been responsible for the preparation of several technical documents such as environmental and biological assessments.

Biographical Sketch for Greg Tickle: Mr. Tickle has 27 years of environmental study and project management experience encompassing various aspects of natural resources impact analysis and planning. His areas of expertise encompass environmental assessments and impact statements, jurisdictional wetland delineation, wetland creation, wildlife habitat analysis/planning, threatened/endangered species surveys, baseline natural features inventory, land planning/feasibility studies, environmental site assessments, design and construction administration. As a project manager, Mr. Tickle has been responsible for numerous field investigations and technical reports involving linear corridor studies, facility site development, master planning, and regulatory compliance activities in 16 states and Mexico. In addition to his environmental expertise, Mr. Tickle has the technical expertise of a Registered Landscape Architect. His qualifications to direct technical natural system analyses and impact studies are considerably strengthened by his planning and landscape architectural experience; the two disciplines are complementary when evaluating resources and mitigating potential impacts, since wetland and natural resource restoration require detailed analysis and construction sequencing.

MITIGATING DISTURBANCE OF MIGRATING MULE DEER CAUSED BY CYCLISTS AND PEDESTRIANS AT A HIGHWAY UNDERPASS NEAR VAIL, COLORADO

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Note: The authors intend to publish results of the study abstracted below in a peer-reviewed journal. Publishing complete results herein would preclude journal publication so the authors provide the following abstract in lieu of a full paper.

Abstract

A wildlife underpass and associated "deer-proof" fence were constructed at Mud Springs Gulch in 1970 to reduce numbers of deer on Interstate 70 (I-70) and to facilitate their movements through a historical migration corridor. Located 6.9 km west of the Town of Vail, Colorado, the underpass is a concrete box 3.05 m high, 3.05 m wide, and 30.5 m long. In July 1997, the Town of Vail completed a recreation path paralleling I-70 between the highway and Gore Creek. Deer move through the underpass from north to south during spring migration. Deer approaching the underpass from the north can clearly see vehicles on the highway and humans on the recreation path. Part of the path is an elevated bridge at the south end of the underpass. Deer exiting the south end of the underpass must travel under the bridge, and if humans are present they are visible and very close to the deer. Concern arose that people on the path would inhibit deer from using the underpass. The Town of Vail funded and participated in a study to address this concern. During spring and early summer, 1998-2000, we studied deer use of the underpass and human use of the path to ascertain potential impacts and develop mitigation.

Beginning in 1998, we monitored the underpass during spring migration with the recreation path closed to humans to determine temporal patterns of deer use and observe deer behavior. We used remote sensing devices, track counts, and an observer hidden in a blind recorded deer behavior and passages through the underpass during daylight hours. Although the underpass had been in service for 27 years, deer appeared reluctant to enter it, and most approached and retreated several times before passing through. Results indicated that most deer used the underpass during early morning daylight hours (range 0600-0900 h, mode 0726 h), a likely peak time period for commuter cyclist traffic. Deer were observed to flee the tunnel entrance area due to vehicular traffic and presence of trespassing cyclists and pedestrians on the path. Thus, deer already agitated by vehicular traffic on the highway were further disturbed by humans on the path.

We designed and conducted a control-treatment experiment in 1999 to evaluate efficacy of using a visual barrier to screen humans on the path from view of deer approaching the north entrance of the underpass. Observations extended from 11 May to 4 July and methods were similar except that visual observations were between 0500 h and 0900 h daily. The Town of Vail constructed a moveable curtain (91.44 m long and 2.44 m high) to serve as a visual barrier between the recreation path and the hillside used by deer approaching the tunnel. We regulated bicycle traffic to arrive at the underpass while deer were closely approaching the north entrance of the tunnel (using volunteer cyclists in radio contact with an observer in the blind). Experimental treatment consisted of alternating 3-day periods with the visual barrier in place and removed. Starting treatment was randomly assigned and 12 days were monitored for each treatment. Sixty-five percent more deer crossed through the underpass when the visual barrier was in place (38) than when it was not (23). Fewer deer appeared disturbed by cyclists when the curtain was in place (16% of 136 deer) than when it was removed (30% of 125 deer).

In 2000, the Town of Vail installed temporary visual barriers on both sides of the path prior to deer spring migration. The path was open to public use and we again monitored responses of deer during the same time

period as in 1999 to verify efficacy of the visual barriers (continuously in place in 2000). In 68 occasions involving deer approaching the north entrance to the underpass when humans were nearby on the path, only 1 of 130 deer appeared disturbed. In 11 occasions when deer were exiting the south end of the underpass while humans were present, only 2 of 20 deer appeared to be frightened and one of these cases involved a pedestrian that stopped on the bridge to look over the barrier. We concluded that visual barriers should greatly reduce disturbance to migrating deer caused by humans on the recreation path and recommendation that solid (versus fabric) barriers be installed for long-term mitigation.

Biographical Sketch: Greg Phillips received his Ph.D. degree in Wildlife Biology in 1998 from Colorado State University. Previous education includes a M.S. degree in Wood Science and Technology, also from Colorado State University, and a B.S. degree in Natural Resources from the University of Michigan. Dr. Phillips specializes in population ecology, experimental design, and quantitative methods for evaluating and mitigating effects of human activities on vertebrate populations. He is experienced in stochastic population modeling (spreadsheet and SAS programming) to project population trajectories, assess population viability, and estimate effects of management and mitigation actions. Greg's skills also include developing field surveys to estimate population parameters (e.g., survival, fecundity, and growth rates), population size and density, spatial use, dispersal, and migration. He has advanced training and experience with state-of-the-art wildlife computer software and general statistical software.

Representative projects include designing and implementing a study to estimate avian collision mortality rates and efficacy of wire-marking techniques to reduce mortality at electric power lines; participating as an analyst in region-wide meta-analysis of northern spotted owl demographic data; projecting and contrasting responses of pronghorn populations with and without coyote control; estimating effect of human-induced disturbance on reproductive success of elk; and evaluating effectiveness of screening humans on a recreation path from the view of migrating mule deer to enhance deer security and use of a highway underpass.

MITIGATION MEASURES FOR IMPACTS TO FISH HABITAT: MAINE TURNPIKE MODERNIZATION AND WIDENING – A CASE STUDY

Scott Farrell and Richard Simmons

Abstract

Funding Source: Maine Turnpike Authority
Total Budget: $25,000

Problem Statement

A 30-mile segment of Maine Turnpike from mile 12 in the Town of York to mile 42 in Scarborough is proposed for widening and modernization. There are 53 different crossings associated with various streams, rivers and unnamed tributaries that are part of Maine's southern coastal drainage system. At least 17 out of the 51 streams support native populations of brook trout or brown trout. An estimated 1,892 linear feet of streambed will be lost due to extensions of existing culverts. This represents an average of about 36 feet per stream or 18 feet of streambed on each side of the Turnpike. There are also 17 streams in which some portion of the channel will need to be relocated due to either encroachment from the new embankment location or to connect the stream to the new culvert outlet location.

Project Objective

To mitigate for impacts to fish habitat caused by the stream crossings and relocations through a combination of habitat enhancement measures and fish passage improvements.

Methodology

Habitat Enhancement – The habitat enhancement measures were designed to improve the productive habitat and carrying capacity in selected streams that are degraded by implementing instream habitat enhancement measures. Two streams designated by Maine Department of Inland Fisheries and Wildlife (MDIFW) as high quality trout streams deserving of special consideration were selected for instream habitat enhancement. Both streams contained segments in the immediate vicinity of the Turnpike crossings where existing habitat conditions could be substantially improved. The segments targeted for improvements in each of the streams provided relatively homogeneous habitat conditions with limited instream cover due to a general lack of boulders, woody debris and undercut banks. One of the habitat enhancement measures implemented was installation of log flow deflectors, which have been found to increase the depth and velocity of the main channel, create pools, scour fine sediments and divert water flow from an eroding bank. Another enhancement measure involved installation of submerged woody debris and boulder clusters to provide additional instream cover. A third enhancement measure involved construction of submerged log bank undercut structures to provide additional instream cover and stabilize the stream bank.

At six of the streams that need to be relocated additional habitat enhancement will be accomplished by creating new channels for sections of the six streams that now flow within roadway drainage swales. This will be done by either benching the swale into the embankment above the new streambed or by building a low profile berm between the swale and the stream at the same grade elevation. The substrate of the new stream channel will consist of a mixture of gravel and cobble material.

Fish Passage Improvements – The fish habitat improvement measures were designed to enable fish to enter and pass through culverts more freely by concentrating or backing up flow to increase water depths within the culverts under normal low flow conditions. Corrective actions that were implemented included creation of low flow channels through single barrel culverts, placement of a dam across one side of a two-barrel culvert to increase water depth on the other side during low flow periods and elimination of hydraulic jumps resulting from the culvert apron being higher than the existing streambed. Grades were also evened and redirected to facilitate entry into the channel within the culvert.

Summary of Findings

The above stream mitigation plan involved a combination of effective measures that are known to enhance instream habitat conditions. These habitat improvement measures were implemented in two separate reaches of high quality trout streams that lacked habitat structure and cover. The combined net benefit of all these measures adequately offset the net loss of streambed habitat associated with the proposed project. It should be noted that although the benefits associated with both the fish passage improvements and the separation of existing streams from swales are difficult to quantify, these efforts will result in substantial improvements over existing conditions. Improving fish passage opportunities at the various culverts will allow fish species to utilize additional productive habitat upstream of the Turnpike.

Implications for Future Research/Policies

The results of this mitigation effort have demonstrated that our understanding of the science and technology of fish habitat improvement enables fishery scientists to design and implement a variety of plans that can mitigate for unavoidable impacts of highway improvement projects on fish habitats.

NOBILITY EM: A VALUABLE TOOL FOR AUTOMATED NEPA SCOPING, SCREENING, AND ANALYSIS

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Problem Statement

Applying a consistent and defensible approach to the evaluation of projects is a key challenge to today's resource/land manager. Many projects require a high degree of planning and analysis to ensure that the impacts on natural resources are minimized, and that all relevant issues affecting the project are brought forward for consideration. Achieving these goals are often hindered by the cumbersome planning and evaluation process itself, and the accessibility of relevant policy, knowledge, procedures and regulations.

Project Objective

Nobility EM, a GIS decision support system, was implemented within a federal government agency in 2000/01, and is now being used operationally to flag direct and indirect impacts and relevant land use policy and regulations as part of a NEPA screening process. The goal of this project was to introduce a structured methodology for the evaluation of projects, and give decision makers easy access to all relevant knowledge, policy, procedures and regulations so that key issues are identified early on in the project screening process.

Methodology

In this, and many cases, Nobility employed a phased-approach to the delivery of the *Nobility EM* decision support system. A proof-of-concept or pilot system was initially delivered, and once proven and accepted, it was expanded to incorporate additional business issues.

Nobility applied the following methodology for the successful implementation of the *Nobility EM* system:

- spent time with system users and managers to identify their specific needs
- developed a project plan that incorporated system scope and specifications, project team members and a time line
- identified sources and types of data, policy, knowledge, procedures and regulations to be incorporated into the system
- conducted knowledge engineering (with input/assistance from the customer's team members) to encode the necessary data, policy, knowledge, procedures and regulations into what is referred to as an impact rule set, or knowledge base
- implemented the system at the operational level for evaluation/ test purposes
- solicited comments and feedback from users and managers, and made revisions to the system
- once initially accepted, Nobility expanded the system to incorporate additional business issues

Summary of Findings

After *Nobility EM* was configured and delivered, it was quickly embraced as a system that effectively:

- Identifies impacts on natural and cultural resources by the proposed action by querying GIS data layers and the impact rule set
- Flags relevant land use policy and regulations that apply to proposed activities and resources that are impacted by the proposed project
- Screens projects normally addressed in an Environmental Impact Statement (EIS), Environmental Assessment (EA) or Categorical Exclusion (CX)
- Completes a description of impacts for each issue or resource identified as potentially affected by the proposed project
- Generates draft Environmental Assessments (EA) in HTML format, (including an ArcView map) for review or distribution

Implications for Transportation Development

The *Nobility EM* decision support system has wide applicability to many federal and state transportation agencies. The system brings structure, consistency and defensibility into a process that is often complex and cumbersome. The proactive identification of impacts and the flagging of critical land use issues help maintain a better connection between land use, resource management and surface transportation development.

In addition to identifying impacts on natural resources, *Nobility EM* can flag a variety of issues resulting from transportation development, some of which include:

- Community Fragmentation
- Agricultural Encroachment
- Wetlands
- Utilities and Roads
- Severe Slopes
- Wildlife Habitats
- Zoning Conflicts
- 100 year flood zones
- Open Space and Park Conservation
- Water Resources
- Sensitive Soils

Nobility EM can be used to leverage existing GIS data, policy, knowledge, procedures and regulations. It has been proven to save agencies both time and money while improving the consistency and defensibility of the NEPA screening process.

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RESPONSES OF ELK AND BISON TO WINTER RECREATION IN YELLOWSTONE NATIONAL PARK

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Abstract

Funding source and budget: US Department of the Interior, National Park Service. Total budget approximately $90,000.

Project Period: October 1998 through June 2001.

The effect of winter recreation on animal populations is widely debated, particularly since a recent decision by the US Department of the Interior to ban snowmobiles from National Parks. This study assesses effects of over-snow vehicle traffic on an elk (*Cervus elaphus*) and bison (*Bison bison*) population in Yellowstone National Park. We relate behavior and distribution to variation in over-snow vehicle traffic. We use immunoassays of fecal glucocorticoid levels as a noninvasive method of measuring physiological stress responses to disturbances, to relate over-snow vehicle activity to glucocorticoid levels. In preliminary results for elk, day-to-day variation in fecal glucocorticoid levels tracked variation in the number of snowmobiles, after controlling for effects of weather and age. Glucocorticoid concentrations were higher in response to snowmobiles than in response to wheeled vehicles, after controlling for effects of weather, age and number of vehicles. Results for bison are pending, as are behavior and distribution analyses. Despite these stress responses, there is no evidence that current levels of snowmobile activity are affecting population dynamics for either species.

ROAD TECHNOLOGIES TO MAINTAIN AND RESTORE RIPARIAN AREA FUNCTIONS

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Abstract

The current management of roads on national forests, as well as, other public and private roads in forested areas across the United States are being reviewed. Along with public safety, a major concern is how roads impact riparian areas and wetland values such as animal populations and water quality. The effects of roads can directly and indirectly affect fish and wildlife species, some of them federally listed as threatened and endangered. Nationally there is an urgent need to communicate successful road restoration techniques and treatments (applicable to riparian areas and wetlands), and to promote the development and application of new technologies
The U.S.D.A. Forest Service alone manages an estimated 611,534 km of classified roads. In recent years, forest service personnel have recognized how traditional road construction and maintenance practices can be detrimental to riparian areas. Our ability to best manage these areas continues to evolve as our understanding of the linkages between landscape processes and human perturbations expands. Resource managers working in interdisciplinary teams, have traced the sources of a variety of problems, such as decreased fish spawning habitat, back to roads and related features (i.e., surface treatments, culverts, and ditches). Working with road engineers, they have developed solutions to restore and enhance natural processes and functions to riparian ecosystems, and maintain road passage.

Solutions to some road-related problems can be as simple as diverting surface runoff to the side of the road away from a bordering stream, thus reducing sediments deposited into the channel. Hardening of road surfaces can also reduce sediment detachment and movement. These techniques and others can hydrologically break the continuous flow paths of water and sediments, reduce the negative effects of roads on the environment, and in a sense make the impacts of roads on the environment seem invisible.

USDA Forest Service engineers and scientists in partnership with other federal agencies (FHA, EPA, BLM, F&WS, NMFS, NRCS, BIA, ACOE) state agencies, and organizations such as Ducks Unlimited and Trout Unlimited are working together to protect, maintain, and restore riparian areas and wetlands influenced by roads in varied environments across the country. This partnership is formally known as the Riparian, Roads, Restoration Team. Through field evaluations, assessments, and literature reviews, over the past 18 months, this interdisciplinary team has identified, documented and developed a training program to communicate to others, successful, tested, experimental, and leading-edge technologies designed to restore and maintain riparian areas and wetlands. An overview of the findings of this committee will be given in this presentation. Additional information about Riparian, Roads, Restoration team related links are available on our website at: www.fs.fed.us/albuq/RRR.html.

ROOT-ZONE AMENDMENTS FOR HIGHWAY RIGHT-OF-WAY TREE PLANTINGS: A DEMONSTRATION PROJECT

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Abstract: The Texas Department of Transportation (TxDOT) and the Texas Transportation Institute's (TTI) Environmental Management Program work with TxDOT Districts to develop roadside management practices that mitigate the highway right-of-way environment and promote healthier, more rapid plant establishment. This research study compared the effects of different root-zone soil amendments on tree establishment and growth within the highway right-of-way environment. The demonstration project site was selected at the intersection of Interstate Highway (IH) 27 at Business IH 27 in Plainview, Texas. The funding for the project was from TxDOT's Construction Landscape Program with a design budget of $185,000. Project installation was in the spring of 1996. Results show that the majority of the trees receiving the treatment consisting of mycorrhizal inoculation, acrylamide copolymer, dry soluble yucca plant extract, soluble sea kelp extract, and humic acid had a positive response compared to the control groups and other treatment types. However, the treatment types are species specific in their overall effectiveness. Further research addressing the issues of a larger sampling of trees, more effective identification methods, and a concerted maintenance program for the demonstration site should be examined prior to making any recommendations for field application.

Introduction

The Texas Department of Transportation (TxDOT) and the Texas Transportation Institute's (TTI) Environmental Management Program work with TxDOT Districts to develop management practices that mitigate the harsh highway environment and promote healthier, more rapid plant establishment. A demonstration project site was selected at the intersection of Interstate Highway (IH) 27 at Business IH 27 in Plainview, Texas. TxDOT's Lubbock District and the City of Plainview wanted an entrance to the city defined by landscape development at this intersection. The design budget for the project was $185,000. Since the planting design consisted of trees only, this site was selected for the study. This intersection is typical of many highways in rural/semi-rural conditions within the Texas highway system. Characterized by expansive areas surrounding the highways and frontage roads, the project consists of approximately 65 acres. Adjacent to the site lies undeveloped areas, agricultural land, and a corn-processing factory.

The highway right-of-way is typically composed of highly disturbed soils. Construction practices that involve soil manipulation, compaction, and topsoil removal leave post-construction conditions that are often unfavorable for plant growth. Changes in soil structure, strata, and a reduction in available organic matter can create difficulties for the plant material's nutrition and water uptake. Site soil conditions also contribute to the trees' high evapo-transpiration rates. These elements, combined with the hot, dry Texas weather and the heat generated by the pavements of highway corridors, produce a microclimate that may not be conducive to plant establishment. Trees planted in the highway right-of-way environment are subjected to conditions that may not be characteristic of most urban forestry and horticultural practices. Typically, highway landscape enhancement projects in the Lubbock District have an environment consisting of very open sites with persistent winds. These factors can increase the trees' establishment period and affect growth rates.

Study Design

Research Goal

The goal of this research study was to compare the effects of different root-zone soil amendments on tree growth during establishment.

Proposed Root-Zone Amendments

Proposed amendments used to ameliorate root-zone soil conditions include surfactants, super-absorbent polymers, mycorrhizall inoculum, and additional amendments at the time of planting. The Principle of Limiting Factors states that the rate of plant processes can occur only as fast as allowed by the factor that is most limiting. If this limiting factor is water or nutrient up-take, soil amendments should facilitate plant responses (Grissimo-Mayer, 2000).

Surfactants

Surfactants are typically used to provide for greater absorption of the water solution chemicals when combined with fertilizers, herbicides, and pesticides. The surfactant allows the plant to more readily absorb the available water at the roots by reducing the cohesive surface tension of the water molecules. The surfactant used for this study consisted of a dry soluble yucca plant extract (Yucca schildigera).

Super-absorbent Acrylamide Copolymers

Super-absorbent acrylamide copolymers have a wide variety of uses from toxic material clean-up to baby diapers. The acrylamide copolymer absorbs, in general, 200 to 600 times its weight in liquid. When used in the soil, it may provide better aeration and drainage in compacted soils, reduce transplant shock, and increase soil water-holding capacity, thereby increasing water availability to plant material during water-stress periods.

Mycorrhizal Fungi

Mycorrhizal fungi applications have demonstrated effectiveness in many agricultural and forestry applications. Mycorrhizal inoculation can: "increase the effective absorptive surface area of the plant. In nutrient-poor or moisture-deficient soils, nutrients taken up by the extramatrical hyphae can lead to improved plant growth and reproduction. As a result, mycorrhizal plants are often more competitive and better able to tolerate environmental stresses than are nonmycorrhizal plants" (Sylvia et al 1998).

Additional Amendments

Other biological amendments used in this study include soluble sea kelp extract (*Ascophylum nodosum*), and humic acid (*Leoardite humates*). The sea kelp extract is considered to be a bio-stimulant which provides for the microbial life in the soil. Humic acid assists the plant with nutrient uptake, which may improve drought tolerance.

Application of Study Treatments

The study treatments, including control (CTRL) groups, consisted of the following applications and are grouped as shown in Figure 1.

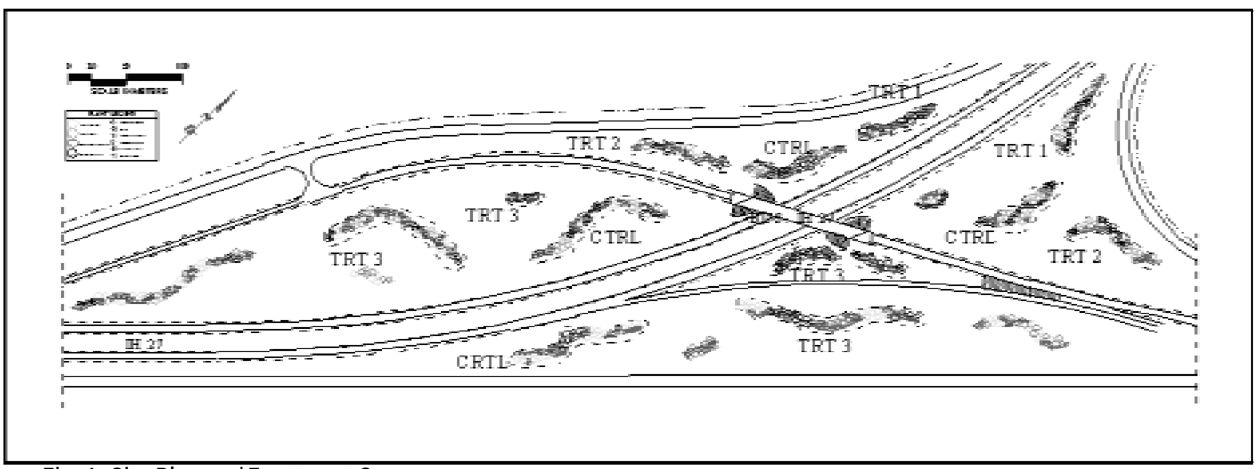

Fig. 1. Site Plan and Treatment Groups

Study Treatment 1 (TRT 1)

1. A 5-gallon soil drench at a rate of 5 ounces surfactant, dry soluble yucca plant extract (*Yucca schildigera*), per 100-gallon of water was applied in the root zone at the time of planting. The application was repeated every 30 days with the last application applied at the end of the 90-day establishment period (a total of 4 applications).

Study Treatment 2 (TRT 2)

1. 1. A 5-gallon soil drench at a rate of 5 ounces surfactant, dry soluble yucca plant extract (*Yucca schildigera*), per 100-gallon of water was applied in the root zone at the time of planting. The application was repeated every 30 days with the last application applied at the end of the 90-day establishment period (a total of 4 applications).
2. 2. At the time of planting only, the backfill soil in the root zone was mixed at a rate of a minimum of 1,000 spores of *Vesicular-Arbuscular* (VA) fungi to include *Entrephosopora columbiana, Glomus etuncatum, Glomus clarum*, and *Glomus sp.* per 1-inch caliper of tree.

Study Treatment 3 (TRT 3)

1. A 5-gallon soil drench at a rate of 5 ounces surfactant per 100-gallon of water was applied in the root zone at the time of planting. The application was repeated every 30 days with the last application applied at the end of the 90-day establishment period (a total of 4 applications).
2. At the time of planting only, the backfill soil in the root zone was mixed at a rate of a minimum of 1,000 spores of *Vesicular-Arbuscular* (VA) fungi to include *Entrephosopora columbiana, Glomus etuncatum, Glomus clarum*, and *Glomus sp.* per 1-inch caliper of tree.
3. This application also included a super-absorbent acrylamide copolymer, soluble sea kelp extract (*Ascophylum nodosum*), and humic acid (*Leoardite humates*).

Data Collection

Each treatment group contains a variety of tree species along with control groups as shown in Figure 1. Of the 1,238 trees installed at the site, 209 were involved in this study. Table 1 shows the species used, quantities planted, and mortality rates per species.

Table 1.
Trees Species, Quantities, and Mortality

Species	Total Planted	TRT1	No. Dead	TRT2	No. Dead	TRT3	No. Dead	CNTL	No. Dead	Total % Dead
Desert Willow	25	5	0	5	0	5	0	10	0	0
Bradford Pear	25	5	1	5	0	5	0	10	1	8
Eldarica Pine	20	5	1	5	0	5	0	5	0	5
Chinese Pistache	18	-	-	3	0	5	0	10	1	5.5
Texas Redbud	20	-	-	5	2	5	3	10	0	25
Russian Olive	34	-	-	9	5	15	2	10	0	20.5
Shumard Oak	15	-	-	-	-	5	1	10	1	13.3
Cedar Elm	21	-	-	-	-	10	2	11	5	27
Burr Oak	26	5	1	5	1	5	0	11	5	27
Pinion Pine	5	-	-	-	-	5	2	-	-	40
Total TRT Planted		20		37		65		87		
Total No. Dead		3		8		10		13		
Total % TRT Dead		15		21.6		15.4		14.9		

Each tree involved in this study was tracked throughout its establishment period. All trees were subject to inspection at the time of planting for size and general health. Project installation occurred in the spring of 1996. At this time, study trees were tagged with a metal identification strip. This tag identified treatment type and tree number, coordinated with a base map. Only samplings of trees within treatment groups were tagged for the study. All trees on site were irrigated using a drip irrigation system. Post installation measurements were taken on July 10, 1997 and subsequently on June 23, 1999.

Problems that affected data collection include absent identification tags, removed trees, incorrect specie for replacement trees, and death from other than biological function (such as vehicle impact). Over the course of the study, persistent winds and harsh weather conditions degraded the integrity of the tree tags, making identification of the study trees difficult. Ninety percent of the tags were destroyed, leaving only the base map with which to identify the specific trees. Replacement trees, for those that did perish, were occasionally not the same species or size as originally specified, some were not replaced at all, and some are still designated for replacement.

Results

Some of the results showed a negative rate of growth for height and caliper growth. This decreased height and caliper size may be due to replacement trees that were not recorded as part of the study. Other reasons for height reduction may include pruning by maintenance crews and wind breakage. These factors limited a meaningful determination of each species response to treatment type, and the death rate per treatment and species. These qualifying factors proscribed the accuracy and usefulness of the study results.

Treatment Effects on Individual Species

Results show some effectiveness of treatments and a possible relationship between treatment type and plant species. The graphed results for Pinion Pines are not shown. There were 5 Pinion Pines used in this study. Two of the five died and the remaining Pinion Pines were at least 50 percent dead. They are, however, included in the quantities as part of Table 1.

As shown in Figure 2 for Eldarica Pine, the Treatment 2 trees had almost twice the caliper growth, twice the height growth, and a 32 percent increase in spread compared to the Control group. Treatment 3 had comparable results to the Control group, yet Treatment 1 did not do as well as the Control. Desert Willow (see Fig. 3) responded best to Treatment 3 with a 250 percent increase in caliper, 21 times the growth in height, and 2.5 times the spread compared to the Control group. As with the Eldarica Pine, the Treatment 1 group did not respond as well in caliper and spread increases compared to other treatments and Control.

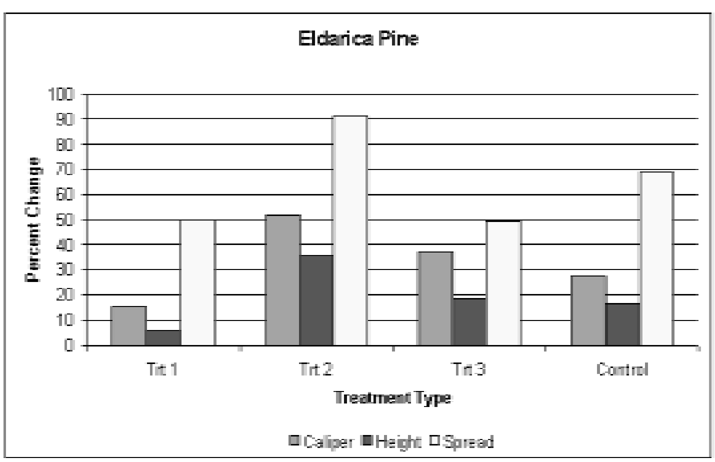

Fig. 2. Treatment Effects on Eldarica Pine

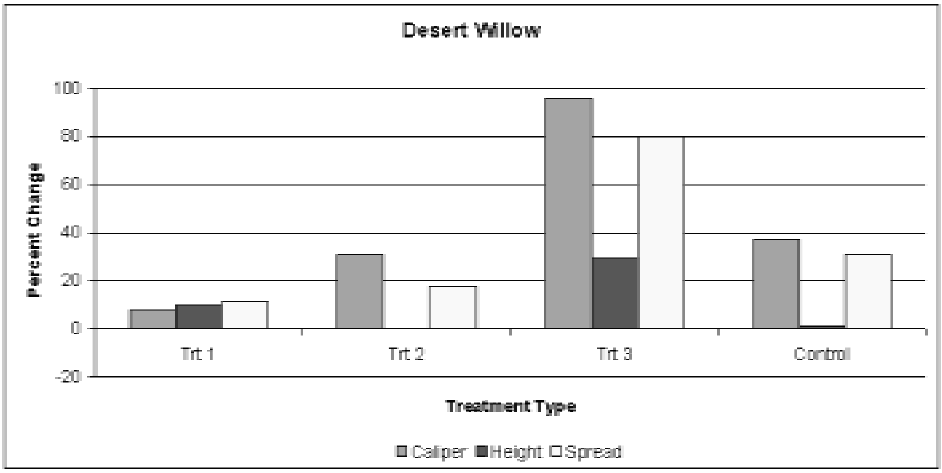

Fig. 3. Treatment Effects on Desert Willow

Treatment 3 appears to have the best response rates for Bradford Pear as shown in Figure 4. The caliper growth was twice that of the Control group. The height growth is 150 percent that of the Control with the spread only increasing slightly. Figure 5 shows that the Chinese Pistache groups responded similarly with all treatments. The only significant difference was a 40 percent increase in the spread of Treatment 3 groups as compared to Control. As with the Chinese Pistache groups, the Texas Redbud (see Figure 6) growth rates were similar in all groups with a 40 percent increase in spread with Treatment 3 compared to the Control.

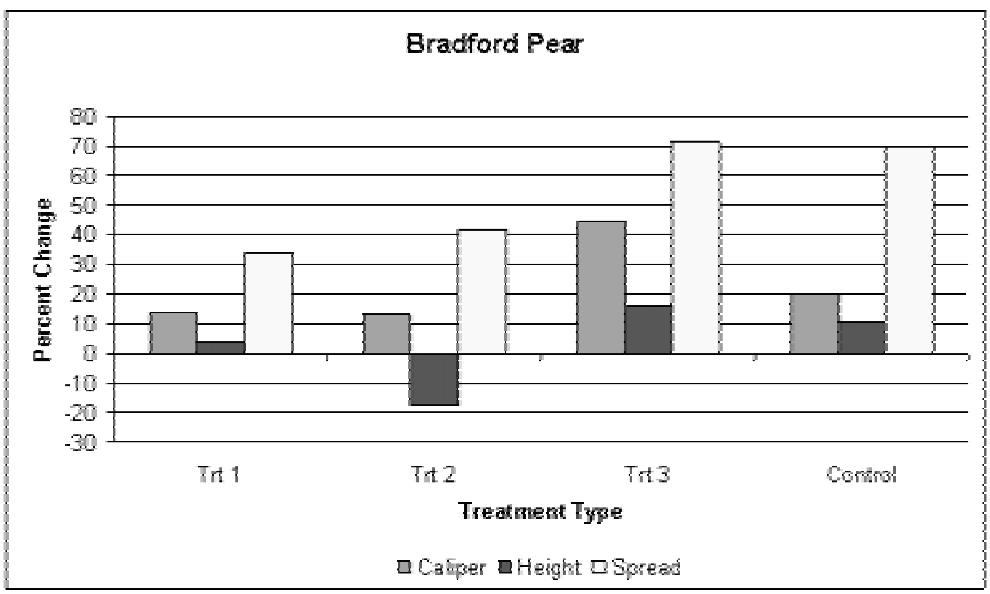

Fig. 4. Treatment Effects on Bradford Pear

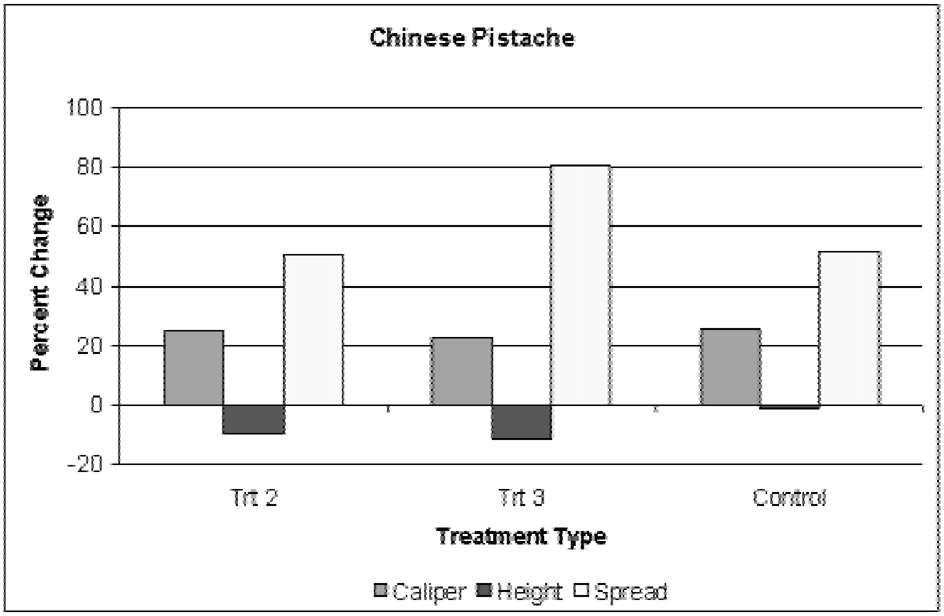

Fig. 5. Treatment Effects on Chinese Pistache

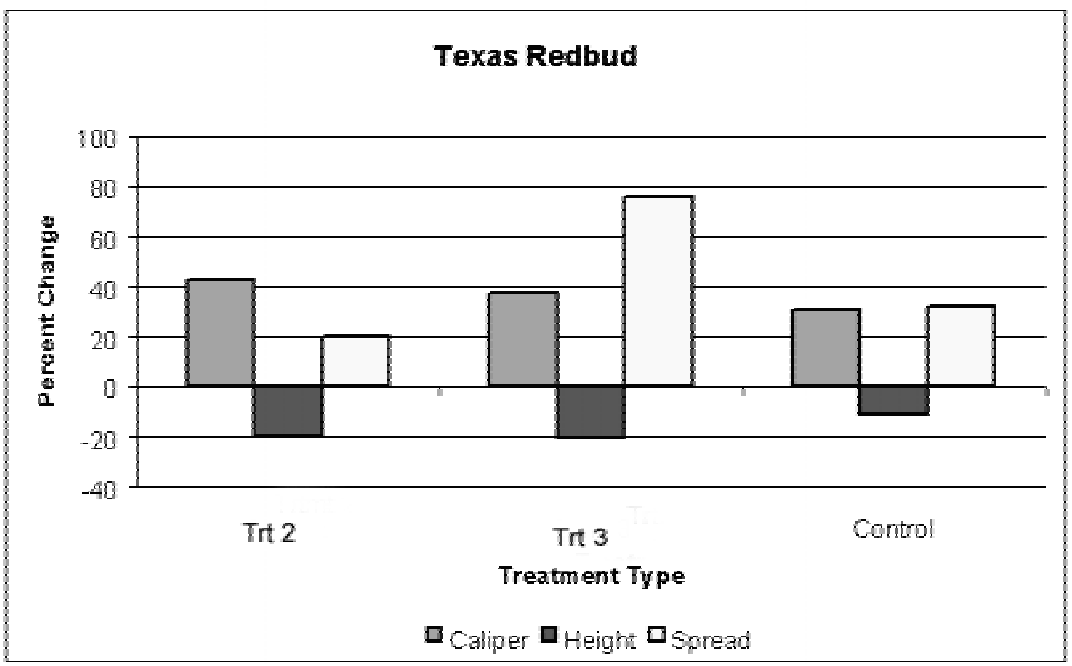

Fig. 6. Treatment Effects on Texas Redbud

Unlike the other tree species tested in this project, Figure 7 shows that the Control group did better than the other treatment groups in the Russian Olives. Clearly, the Control had over 1.5 times the spread of the Treatment 3 group and over 2.5 times the growth in height than either Treatment 2 or Treatment 3.

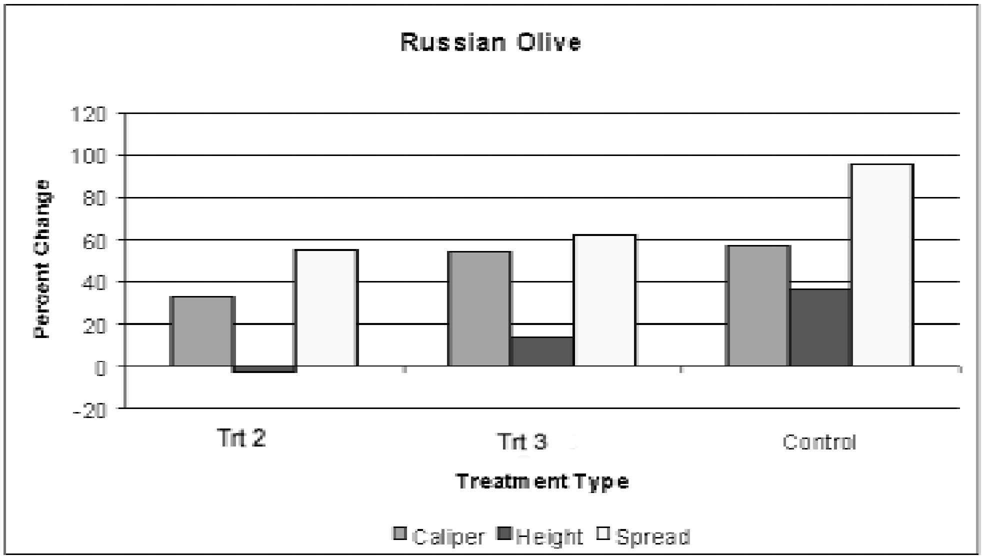

Fig. 7. Treatment Effects on Russian Olive

For Burr Oak, shown in Figure 8, Treatment 1 and Treatment 3 had a better response for spread growth, but Treatment 2 surpassed both the Control and Treatment 1 for percentage of caliper increase. As with the Burr Oaks, Cedar Elm seemed to respond best to Treatment 3 with almost twice the performance of the Control group (see Figure 9).

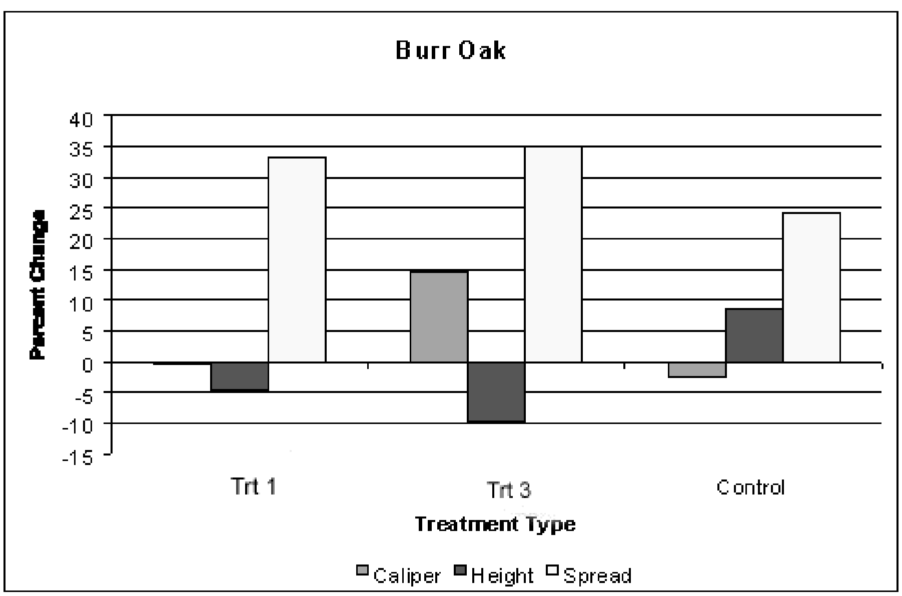

Fig. 8. Treatment Effects on Burr Oak

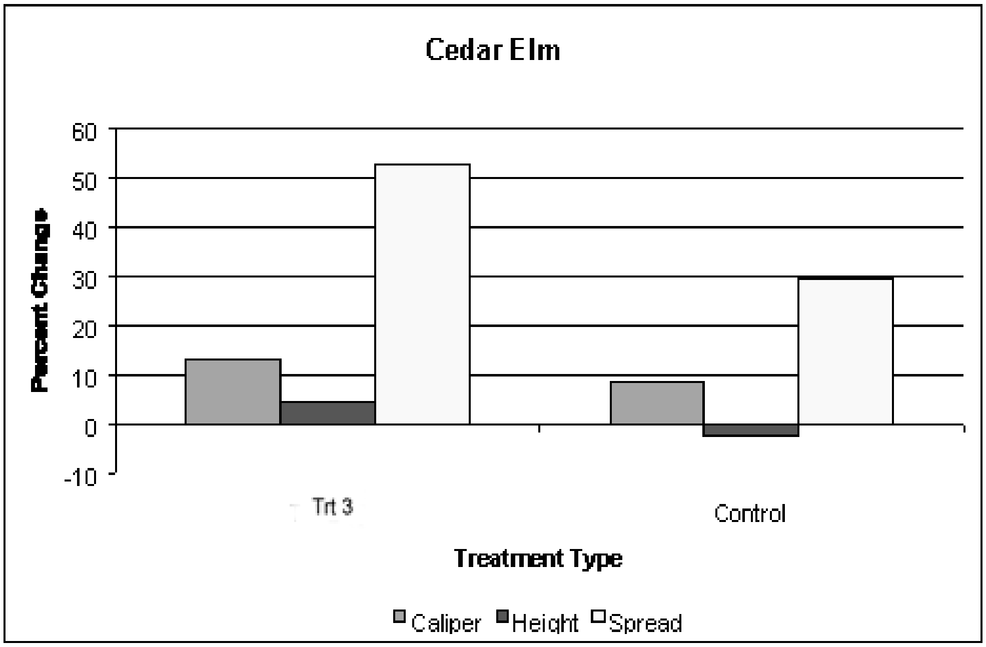

Fig. 9. Treatment Effects on Cedar Elm

In Figure 10, the results show that Treatment 3 demonstrated a better performance over the Control group for Shumard Oak. The increase in caliper growth was almost 60 percent more than the Control and 20 times the growth in spread.

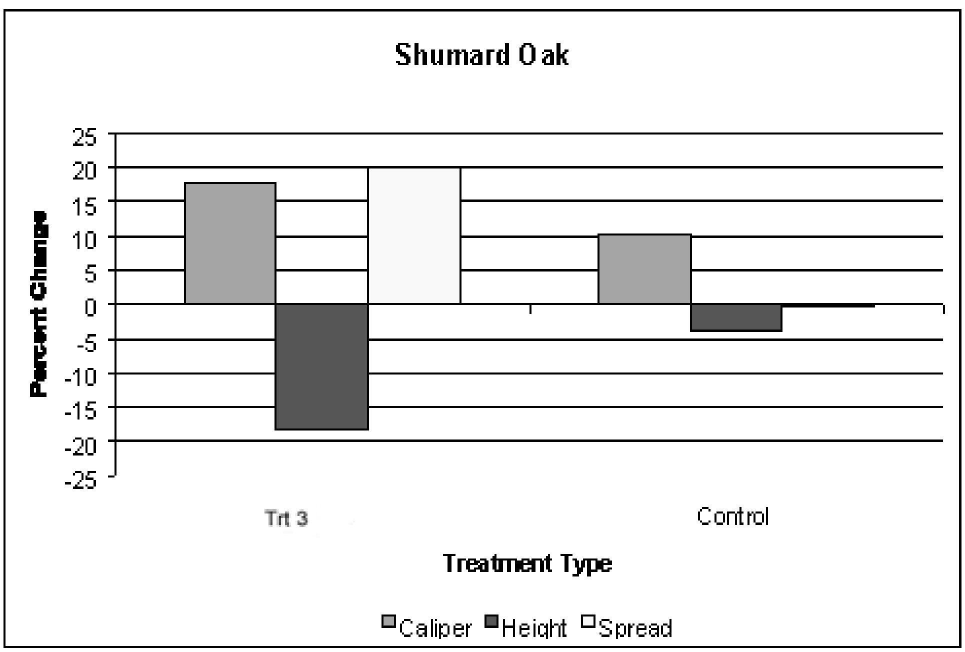

Fig. 10. Treatment Effects on Shumard Oak

In overall performance per treatment type, Figure 11 shows that the Treatment 3 groups had the most positive response in all categories, closely followed by the Control groups. Figure 12 shows the average percentage change of the treatments as compared to the control groups. In this comparison Treatment 3 is the only treatment type that indicates a positive growth rate in all three categories, caliper, height and spread.

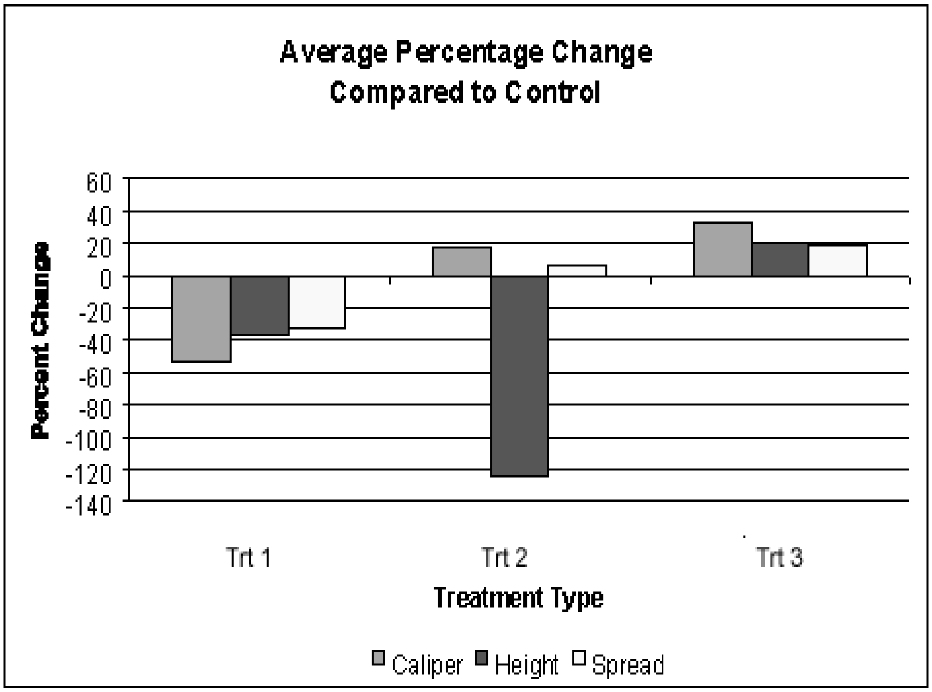

Fig. 11. Average Percentage of Change per Treatment Type

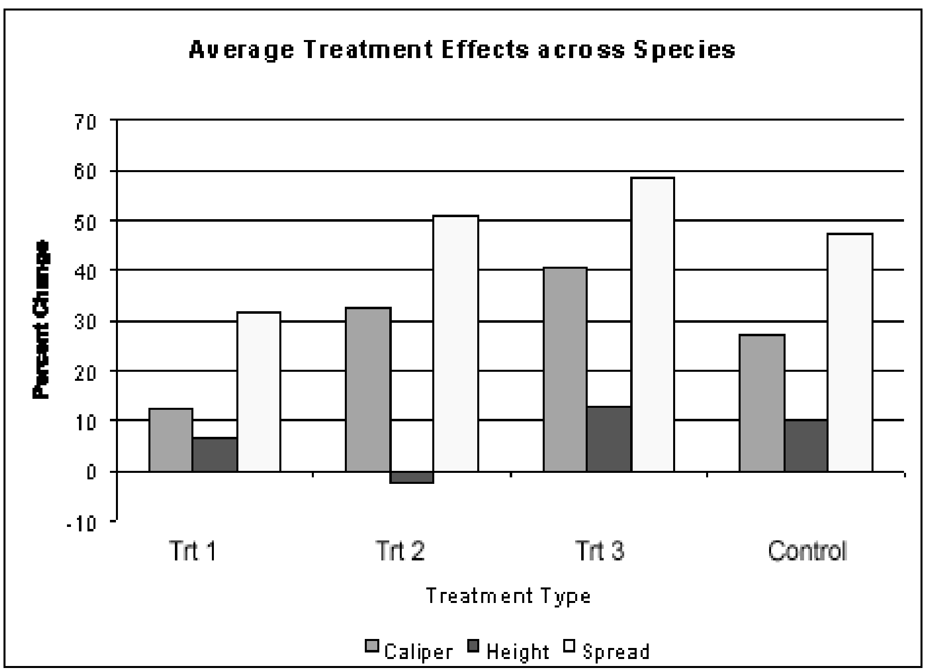

Fig. 12. Average Percentage Change Compared to Control

Conclusion

The majority of the trees receiving Treatment 3, consisting of dry soluble yucca plant extract, mycorrhizal inoculation, acrylamide copolymer, soluble sea kelp extract, and humic acid, had greater growth response compared to the other groups. However, the treatment types are species specific in their overall effectiveness. Due to the methods used for data collection and the number of trees used per treatment type, a definitive conclusion about treatment effectiveness cannot be accurately formulated. Further research addressing the issues of a larger sampling of trees, a more effective identification method, and a concerted maintenance program for the demonstration site should be examined prior to making any recommendations for field application by TxDOT's Lubbock District.

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SYNTHESIS OF FACILITATION, COMMUNICATION, INFORMATION, AND TECHNOLOGY TO ENHANCE PUBLIC INVOLVEMENT THROUGH THE TRANSPORTATION RESOURCE EXCHANGE CENTER (T-REX) WEB SITE IN ACCORDANCE WITH THE NEPA PLANNING AND DECISION-MAKING PROCESS: A BEST PRACTICE

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Abstract

The Transportation Resource Exchange Center (T-REX) is a first-of-its-kind Virtual Library dedicated to providing information about the transportation of radioactive materials to stakeholders. Guided by the principles of the National Environmental Policy Act (NEPA) planning and decision-making process, the Web site was created to serve as a "one-stop shop," neutral source for information, to facilitate public involvement, overcome information gaps, and foster clearer communication and understanding among and between stakeholders regarding their issues of concern. Stakeholders are a diverse group with varying knowledge and interest. The T-REX was designed and is maintained to meet their differing needs. Several innovative features were created and implemented to maximize user friendliness and application utility of the T-REX.

Prior to the creation of the T-REX Web site, two tools were developed to identify the gaps between potential users' questions and the information that was available regarding stakeholder issues, so that user friendliness and application utility might be maximized by the Web site. The T-REX User Needs Assessment assessed the information needs and preferences of potential users representing the US Department of Energy (DOE) and non-DOE stakeholders. The National Transportation Information Resource Survey surveyed libraries and DOE reading rooms to identify what documents and kinds of information were available and where they were housed. In the most basic sense, the results produced by these two tools informed the T-REX designers of what information related to radioactive material transportation is available and which information is the most highly prized by the users. As an example, environmental issues and current news are two of the most-highly prized subjects of both DOE and non-DOE stakeholders. Daily updates from the US and around the world can be found on the Headlines Web page at http://www.trex-center.org/nuevo.asp.

From the user assessment information, a broad range of subject categories were complied, including Carriers, Education/Training, Emergency Management, Health, Laws/Regulations, Packaging, Public Participation, Routes, States, Students/Teachers, and Tribal. Another aspect of study identified, compiled, and categorized all public comments and responses regarding transportation issues from DOE Environmental Impacts Statements (EIS) from 1995 to the present. The EIS is a detailed report, which must include any adverse environmental effects that cannot be avoided should the proposal be implemented, as well as include alternatives to the proposed action. Furthermore, as mandated by NEPA, the EIS must include the relationship between local short-term uses of the human environment and the maintenance and enhancement of long-term productivity, as well as any irreversible and irretrievable commitments of resources that would be involved in the proposed action. At specified times in the EIS process, the federal agency that seeks to initiate the proposed action is required to provide early notification to interested parties and solicit their views. During the comment periods, the stakeholders may ask questions or offer comments/responses orally or in writing to the federal agency in charge regarding the environmental impact or proposed remedies of the action. This T-REX study of EIS comments/responses was conducted to determine comment trends and produce a user-friendly set of frequently-asked-questions-and-answers. In addition to the resultant EIS Comment/Response Searchable Database, the products emerging from this effort are the Risk Communication Annotated Bibliography and the Routes Annotated Bibliography.

Within the T-REX Virtual Library, the TRAM Search Engine was designed to provide instantaneous results when a user queries the system for the DOE or non-DOE individuals or organizations that possess expertise or specific information regarding any aspect of the transportation process. There are over 850 individuals or groups listed in the TRAM. The TRAM database provides information including background or history, corporate

affiliates, geographic scope, information products, and contact information of the individuals or organizations that possess expertise or specific information regarding the transportation process. The logical data design of the TRAM is also based on the results of the user assessment and provider survey. The TRAM is located at http://trex-center.org/thetram.asp.

Several other features of the T-REX have been established to overcome information gaps. The T-REX-L, the listserv® to provide bulletins to T-REX patrons, is located at http://www.trex-center.org/list.asp. A toll free telephone information hotline is available at (877) 287-TREX (8739). Queries for information can also be made through the email address trex@unm.edu. The T-REXDEX is the searchable database of over 1,500 online documents in the T-REX Virtual Library and is located at http://trex-center.org/dexsearch.asp. The Reference Desk Web page links the T-REX pages that contain links to reference sources such as DOE Databases, DOE Public Reading Rooms and Libraries, DOE and other pertinent Online Serials, Glossaries, and Fact Sheets. The Reference Desk is located at http://trex-center.org/reference.asp. Portions of the T-REX also have been translated into the Spanish language, with plans to translate more sections in the future. Recursos en Español: or Resources in Spanish are located at http://trex-center.org/spanish.asp.

The T-REX is built on the assumption that the management of radioactive materials transport information for DOE and non-DOE stakeholders is like other bodies of knowledge. The collection, organization, and dissemination of this information is a complex and time-consuming process. The T-REX staff will ensure that users have the stakeholder information they need and that it is provided with maximum efficiency, user friendliness, and reliability. The two overarching goals in establishing and maintaining the T-REX Web site regarding the transportation of radioactive wastes and materials are: (1) Creating the premier online information resource for the "Nuclear Family," as well as the Global Community, and (2) Ensuring that the T-REX Web site is highly-visible, well-known, and trusted by stakeholders.

To the degree that the current trend continues toward greater collaboration among nations regarding radioactive waste management decisions, solutions, and transportation, the T-REX Web site is apt to become increasingly international in scope. In the future, the T-REX Web site may develop more international features and emphasis to better reach world audiences and international stakeholders.

Telephone queries and correspondence should be directed to Mary E. White. More information regarding the authors can be found on the ATRI Website at http://www.unm.edu/~atr/. The T-REX Web site is located at http://www.trex-center.org/.

The five-year contract from the US Department of Energy (DOE) National Transportation Program to the ATRI to create and maintain the T-REX will expire October 1, 2002. The total budget for the life of the contract is $1.5 million.

TACKLING FISH PROTECTION IN TRANSPORTATION PROJECTS IN THE PACIFIC NORTHWEST

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Problem Statement
Providing adequate transportation infrastructure and protecting fisheries are two objectives with acknowledged social and economical benefits, but are often perceived to be incompatible in transportation projects.

Study Objective
By examining several transportation projects in the Pacific Northwest, lessons are learned from planning efforts, best management practices, and mitigation that protect fisheries.

Methodology
Case studies of projects that range in size, context and purpose were analyzed to assess site-specific fisheries issues and the approach taken to avoid, minimize or mitigate potential impacts.

Case Study Findings

Twin Creeks TOD, Central Point, OR
The developer building a transit-oriented development wants to increase the utility and beauty of a channelized creek and enhance fish habitat.

Fisheries Issues
- Existing run of steelhead and past runs of coho.
- Restoration of degraded creek to proper function requires major channel reconstruction.

Approach
- Let optimal design for creek channel and habitat function dictate where development occurs.

Lessons Learned
- High quality, functioning ecosystems are a valuable amenity to developments.
- Let appropriate environmental design dictate the design of the development.

Fiber Optic Cable, Issaquah, WA
A fiber optics line over the Cascade Mountains on a degraded Forest Service Road had 11 creek crossings.

Fisheries Issue
- 11 culverts were barriers to fish migration.
- Road causing sedimentation of a fish-bearing river.

Approach
- Agreement with Forest Service included replacing culverts to allow fish passage and upgrading road.

Lessons Learned
- Fiber optic project benefited fisheries and transportation by partnering with Forest Service.

SR-500 Intersection Removal, Vancouver, WA
A bridge over a small salmon stream will be widened to reduce accident rates.

Fisheries Issue

- Designated Critical Habitat for chum, chinook, coho salmon, steelhead and bull trout.
- Bridge widening would remove existing riparian vegetation near best spawning area in system.

Approach

- Early discussions with NMFS and USFWS during conceptual design to identify fish protection tactics.

Lessons Learned

- Considering fisheries issues early in the process avoided design changes later.
- Regulatory agencies have a stake in project design and are familiar with it prior to permit application.

Jordan Road Bridge Repair, Madras, OR
Deck replacement on two narrow bridges over Lake Billy Chinook, a heavily used recreational area.

Fisheries Issues

- Water quality for a world-class bull trout fishery.
- Recreational and local traffic cannot be obstructed.

Approach.

- Use state of the art BMP's to prevent spills into lake.
- Develop innovative construction and traffic plan to allow access, particularly on summer weekends.

Lessons Learned

- Fisheries protection must not preempt local concerns.
- Public opinion may severely restrict the amount of protection afforded.

SR-35 Columbia River Crossing, Hood River, OR
Improve Columbia River crossing, by building a new bridge with or without removing the existing bridge.

Fisheries Issues

- Designated Critical Habitat for salmon and trout.
- Bridge design impacts fishery predation.
- In-water work will require major minimization and mitigation measures.

Approach

- Utilize environmental streamlining process to incorporate early involvement of agencies.

Lessons Learned

- Agencies recommend that fish issues be elevated to the same level as transportation and engineering issues in the early decision-making project stages.

"Tackle Box" of Recommended Practices
To successfully achieve seemingly contradictory objectives to protect fisheries while meeting transportation needs, key practices are recommended:
- Engage agencies in early project planning.
- Consider protection and enhancement of fish habitat very early in project design.
- Invest in habitat enhancement.

Early planning, design and resource agency involvement are cost effective and time efficient strategies. Benefits from agency coordination and wise investment in habitat enhancement reconcile resource protection and transportation development objectives.

Biographical Sketches: *Doug Corkran, Senior Environmental Planner, Parsons Brinckerhoff* – with a background in environmental planning, fisheries biology, and regulatory permitting, Doug has over 10 years experience in managing environmental projects. He has experience conducting resource surveys, writing NEPA documents and Biological Assessments, designing mitigation measures and working with federal, state and local agencies for land use and environmental permitting.

Angela Findley, Senior Environmental Planner, Parsons Brinckerhoff – has over seven years of experience that includes preparing NEPA documents; obtaining federal, state and local environmental permits; facilitating permit compliance; developing client / agency relationships; and integrating environmental policy and public involvement. Her background is in forestry policy, socioeconomics and conflict management

WSDOT LIAISON PROGRAM AT THE U.S. FISH AND WILDLIFE SERVICE: BENEFITS TO TRANSPORTATION AND ENDANGERED SPECIES

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Abstract

Funding Source: TEA-21; FHWA; WSDOT with In-Kind Contributions from the USFWS
Project Period: Ongoing

The Western Washington Office (WWO)of the U.S. Fish and Wildlife Service (USFWS) is one of several state and federal agencies participating in the Washington Department of Transportation (WSDOT) Liaison Program. Through this program, WSDOT provides funding to support staff that is dedicated to working on transportation projects. The WWO currently has two liaisons positions. These positions are filled with Fish and Wildlife Biologists. The liaisons work on transportation projects directly or support other staff so that they can work on transportation projects.

USFWS liaisons participate in a wide variety of transportation-related tasks and projects including:

- Representation on steering and technical committees for transportation planning projects undergoing NEPA review;
- Conduct consultations under Section 7 of the Endangered Species Act;
- Review Environmental Impact Statements;
- Assist with the development of Programmatic Biological Assessments;
- Review wetland mitigation banking instruments and agreements;
- Assist with the development and refinement of policy and guidance related to identifying and evaluating transportation impacts (stormwater treatment and assessing indirect effects);
- Develop training curriculum and materials for WSDOT biologists; county and city transportation agencies, and consultants on endangered species, consultations, and minimizing adverse effects;
- Fulfill additional USFWS responsibilities under the Fish and Wildlife Coordination Act; the Clean Water Act; and the Migratory Bird Treaty Act;
- Provide for rapid response to emergency situations and violations.

Liaisons receive specialized training on transportation-related topics such as:

- Road maintenance activities;
- Erosion control measures;
- NEPA streamlining; and
- Construction methods

Benefits to WSDOT include:

- Early involvement of agency personnel;
- Dedicated staff time for project review;
- Staff within the agency that are familiar with their methods (speak their language), needs, and constraints;
- Known points-of-contact and communication conduits for sharing the latest policy updates and best available science;
- Contacts available during emergency situations (i.e. earthquakes; floods) that may impair road systems
- Enhancement of opportunities for streamlining

Benefits to the USFWS include:

- Minimization of impacts to endangered species
- Staff availability in an environment of decreased funds and increased workload;

- Biologists with transportation expertise;
- Avenue for early involvement in transportation planning;
- Improved project tracking and monitoring;
- Better understanding of transportation impacts to endangered species and baseline conditions;
- Enhanced awareness of streamlining opportunities

The Liaison Program creates a framework for streamlining the regulatory process with people dedicated to the both the needs of the transportation industry and the needs of the environment.