FINAL SUPPLEMENT TO THE ENVIRONMENTAL ASSESSMENT:

MANAGEMENT OF AQUATIC RODENT DAMAGE IN MISSOURI

September 7, 2011

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) program completed an Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) on alternatives for reducing aquatic rodent (beaver [*Castor canadensis*], muskrat [*Ondatra zebethica*], and nutria [*Myocastor coypus*]) damage to agriculture, property, and natural resources, and risks to human health and safety in Missouri on January 18, 2005 (USDA 2005). The EA evaluated the need for WS activities and the relative effectiveness and potential environmental impacts of five alternatives to meet the proposed need. The alternative selected was, "*Alternative 3. Fully Integrated Beaver, Nutria, Muskrat Damage Management Program for all Public and Private Land (No Action/Proposed Action)*" in which WS provides technical assistance (advice) and direct control activities to reduce aquatic rodent damage. The alternative allows for the integrated use and recommendation of nonlethal and lethal methods for aquatic rodent damage management (ARDM).

Wildlife Services has prepared this supplement to the EA to:

- report impacts of the program since completion of the EA in 2005;
- review recent information applicable to aquatic rodent damage management (ARDM);
- evaluate the environmental impacts of the ARDM alternatives;
- allow for public review and comment on WS' involvement in ARDM in Missouri.

Information from this process will be used to guide WS' selection of a management alternative and determination regarding the magnitude of the impacts from the management alternative. This supplement adds to the analysis in the 2005 EA and FONSI and all information and analyses in the 2005 EA remain valid unless otherwise noted below.

The mission of the WS program is to provide federal leadership in managing conflicts with wildlife as authorized by Congress in the Act of March 2, 1931 (46 Stat. 1468; 7 U.S.C. 426-426b) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 U.S.C. 426c). Wildlife Services recognizes that wildlife is an important public resource greatly valued by the American people. By its very nature, however, wildlife is a highly dynamic and mobile resource that can cause damage to agriculture and property, pose risks to human health and safety and affect industrial and natural resources. WS conducts programs of research, technical assistance, and applied management to resolve problems that occur when human activity and wildlife conflict with one another. Wildlife damage management is the alleviation of damage or other problems caused by or related to the presence of wildlife, and is recognized as an integral part of wildlife management (The Wildlife Society 1992). WS uses an Integrated Wildlife Damage Management (IWDM) approach, commonly known as Integrated Pest Management (WS

Directive 2.105) in which a combination of methods may be used or recommended simultaneously or sequentially to reduce damage. The WS Decision Model (Slate et al. 1992, USDA 1997 Revised, WS Directive 2.201) is used to develop site-specific management strategies.

NEED FOR ACTION

The EA provides detailed information on the conflicts with and damage caused by beaver, muskrat, and nutria in Missouri. Some of the types of damage that resource owners seek to alleviate are: flooding of agricultural lands and roads, burrowing in levees and water control structures, road bed failures due to impounded water, damage to commercial timber and ornamental trees and shrubs from flooding and cutting, structural degradation of storm water ditches, adverse changes in habitat for native wildlife and fish species, and hazards to aviation at airports. The need for action remains as described in the EA.

AFFECTED ENVIRONMENT

The proposed action could be conducted on private, federal, state, county and municipal lands in Missouri where aquatic rodents are adversely impacting agricultural and natural resources, property, and public health and safety. Examples of areas where the proposed action could occur include airports, state and interstate highways and roads, railroads and their right-of-ways where beaver, nutria, and muskrat activities cause damage and risks to human safety; property in or adjacent to subdivisions, businesses, and industrial parks where beaver impound water and gnaw or fell trees; and timberlands, croplands, and pastures that experience financial losses from beaver flooding or gnawing. The proposed action also could include private and public property where beaver, nutria, and muskrat burrowing causes damage to dikes, ditches, ponds, levees and where feeding causes crop damage.

PUBLIC INVOLVEMENT

The original EA was prepared and released to the public for review and comment from November 16 through December 20, 2004. A legal notice of availability was published in the Kansas City Star (Kansas City, MO), St Louis Post Dispatch (St Louis, MO) and the Springfield News Leader (Springfield, MO). The EA was also mailed directly to agencies, organizations, and individuals with probable interest in the proposed program. There were three requests for copies of the EA for review, but WS did not receive any comments on the EA. The Decision/FONSI was made available to the public using the same methods as listed for the EA in January 2005.

The EA, the Decision/FONSI, and this Supplement were made available for public review and comment through a legal notice in the Jefferson City News Tribune, by direct mailing to

agencies, organizations, and individuals with probable interest in the proposed program, and by posting on the WS website at http://www.aphis.usda.gov/ wildlife_damage/nepa.shtml. Public notification was conducted in compliance with WS' NEPA implementation procedures published in the Federal Register March 21, 2007 (Vol. 72, No. 54: 13237-13238). Comments on the EA and Supplement were reviewed for new and substantive issues and to determine whether the Supplement and EA should be revisited and, if appropriate, revised. Issues raised in public comments and WS' response to comments are provided in the 2011 Decision/FONSI.

SUMMARY OF WS' AQUATIC RODENT DAMAGE MANAGEMENT ACTIVITIES

From Fiscal Year (FY)[1] 2005 to 2009, the Missouri WS program protected more than 765,000 acres of public and private land involving 75 cooperators'. Wildlife Services also conducted 97 technical assistance projects. Technical assistance included written and telephone consultations; instructional sessions; distribution of materials on beaver exclusion and pond levelers; exhibits and site visits. During ARDM projects, WS also lethally removed 625 beaver, 1,677 muskrats and 5 nutria, and relocated 1 muskrat[2] while managing aquatic rodent damage and risks to human health and safety. Damage from aquatic rodents reported to or verified by Missouri WS from FY05 - FY09 exceeded $438,650 (WS Management Information System [MIS] 2004-2009). Additionally, 64 of the animals removed by WS for damage management were sampled for wildlife disease surveillance (tularemia) and monitoring.

Data from FY 2009 are indicative of typical damage estimates and management activities for the Missouri WS ARDM program. In FY09 approximately 7% of beaver management projects involved problems with roads and bridges (e.g., blocked culverts) and 58% involved beaver burrowing and beaver dams in drainage and irrigation ditches (does not include incidents were dams caused flooding of adjacent crops). Two percent of the projects involved beaver burrows weakening dikes, dams and water impoundments; 5% involved feeding/gnawing damage and 28% involved flooded crops (usually associated with blocked irrigation canals). Almost all work involving muskrats was conducted to reduce property damage and risks to human health and safety associated with burrowing activity (e.g., burrows that weaken earthen dikes). Similarly, all work involving nutria was for the protection of dikes, dams and impoundments.

MAJOR ISSUES

Seven issues were identified as being of particular concern relative to the scope of the analysis (40 CFR 1508.25). The EA analyzed the impacts of each alternative on the seven issues listed below.

1. Effects on beaver, nutria and muskrat populations
2. Effects on plants and other wildlife species, including threatened and endangered species

[1] The federal Fiscal Year starts October 1 and ends September 30 (ex. Oct. 1, 2004 - Sept. 30, 2005).
[2] Incident involved a dispersing animal which had become entangled in a fence.

3. Effects on public and pet health and safety
4. Humaneness of methods to be used
5. Effects on wetlands
6. Economic losses to property
7. Impacts to stakeholders, including aesthetics

In addition to the identified major issues considered in detail, five other issues were considered but not in detail for reasons provided in the EA (EA Section 2.3). Reasons for not addressing these issues in detail remain as stated in the EA for four of the issues. Supplemental information on improvements to water control devices is provided below.

ALTERNATIVES ANALYZED IN DETAIL

Five alternatives were developed to address the major issues identified above. Six additional alternatives were given a brief review but not analyzed in detail for reasons provided in the EA (EA Section 3.5). The following summary provides a brief description of each of the alternatives analyzed in detail.

Alternative 1 - No WS Beaver, Nutria, or Muskrat Damage Management in Missouri: This alternative would result in no assistance from WS in reducing beaver, nutria, or muskrat damage in Missouri. All requests for beaver, nutria, or muskrat damage management assistance would be referred to the Missouri Department of Conservation (MDC), local animal control agencies, or private businesses or organizations as appropriate.

Alternative 2 - Only Lethal Beaver, Nutria, and Muskrat Damage Management: Under this alternative, WS would only use and recommend lethal methods for aquatic rodent damage management. Nonlethal capture devices such as snares, foot-hold traps, and cage traps could be used under this alternative, but all aquatic rodents captured in these devices would subsequently be euthanized. The WS Decision Model (Slate et al. 1992) would be used to select among the lethal management alternatives available to WS in order to meet the needs of the specific damage situation while minimizing potential harmful effects of damage management measures on humans, target and nontarget species, and the environment. Requests for information regarding nonlethal management approaches would be referred to MDC, local animal control agencies, or private businesses or organizations. WS would not remove or breach beaver dams under this alternative. Individuals or agencies might choose to implement WS lethal recommendations on their own implement nonlethal methods or other methods not recommended by WS, obtain WS assistance with lethal management techniques, use contractual services of private businesses, use volunteer services, or take no action. WS would provide assistance with lethal aquatic rodent damage management when requested on private or public property only after an *Agreement for Control* or other comparable document has been completed and funding has been secured. All WS aquatic rodent damage management would be consistent with other uses of the area and would comply with applicable federal, state and local laws.

Alternative 3- Fully Integrated Beaver, Nutria, and Muskrat Damage Management for all Public and Private Land (No Action/Proposed Action): The No Action alternative, as defined here, is consistent with guidance from the CEQ (CEQ 1981). In this guidance, the No Action alternative for situations where there is an ongoing management program may be interpreted as "no change" from current management direction or level of management intensity. The No Action alternative is a viable and reasonable alternative that could be selected and serves as a baseline for comparison with the other alternatives.

WS proposes to continue the current aquatic rodent damage management program in the state of Missouri. An IWDM approach, including technical assistance and operational damage management services, would be implemented to reduce beaver, nutria and muskrat damage to property, roads, bridges, railroads, agricultural and natural resources, and risks to public health and safety. Damage management would be conducted on public and private property in Missouri where a need exists and when landowners/managers request WS assistance. The IWDM strategy would encompass the use of practical and effective nonlethal and lethal methods of preventing or reducing damage while minimizing harmful effects of damage management measures on humans, target and nontarget species, and the environment. The WS Decision Model (Slate et al. 1992) would be used to select among the full range of management methods available when developing site-specific plans to address aquatic rodent damage. When appropriate, physical exclusion or habitat modification could be recommended and utilized to reduce aquatic rodent damage. Other nonlethal methods may include but are not limited to textural barriers, water control devices, wrapping individual trees, and dam removal. Aquatic rodents captured in nonlethal devices (foot-hold traps, snares, cage traps, etc.) would usually be euthanized (See “Live Trap and Relocate” section below). In other situations problem animals would be removed as humanely as possible using body gripping traps, snares (set for lethal removal), zinc phosphide bait (for muskrats and nutria), foot-hold traps (set for lethal removal) and shooting. When appropriate, beaver dams could be removed by using binary explosives or by hand. Preference would be given to practical and effective nonlethal methods, but nonlethal methods may not always be applied as a first response to each damage problem. The most appropriate response could be a combination of nonlethal and lethal methods, or there could be instances where application of lethal methods alone would be the most appropriate strategy. All WS aquatic rodent damage management would be consistent with other uses of the area and would comply with applicable federal, state and local laws.

Alternative 4- Technical Assistance Only: This alternative would only allow Missouri WS to provide technical assistance (advice) to individuals or agencies requesting beaver, nutria, or muskrat damage management in Missouri. The WS Decision Model (Slate et al. 1992) would be used when recommending management alternatives that meet the needs of the specific damage situation. Landowners/managers could implement their own aquatic rodent damage management program, use contractual services of private businesses, use volunteer services, or take no action. This alternative would place the immediate burden of operational damage management work on the property owners and other federal, state, or county agencies. All WS technical assistance for

aquatic rodent damage management would be consistent with other uses of the area and would comply with applicable federal, state and local laws.

Alternative 5- Nonlethal Beaver, Nutria, and Muskrat Damage Management: Under this alternative, only nonlethal operational damage management and technical assistance would be provided by WS. The WS Decision Model (Slate et al. 1992) would be used to select among the nonlethal management alternatives available to WS in order to meet the needs of the specific damage situation. Requests for information regarding lethal management approaches would be referred to MDC, local animal control agencies, or private businesses or organizations. Individuals or agencies might choose to implement WS nonlethal recommendations on their own, implement lethal methods or other methods not recommended by WS, obtain WS nonlethal damage management services, use contractual services or private businesses, use volunteer services, or take no action. WS could remove or breach beaver dams by hand or with binary explosives. WS would provide assistance with nonlethal aquatic rodent damage management on private or public property only after an *Agreement for Control* or other comparable document has been completed and funding has been secured. All WS aquatic rodent damage management would be consistent with other uses of the area and would comply with applicable federal, state and local laws.

METHODS FOR BEAVER DAMAGE MANAGEMENT

New information on beaver damage management methods has become available since the completion of the EA. A summary of relevant material is provided below.

Live-trap and Relocate: The EA provides a review of the challenges associated with beaver relocation (EA Section 3.5.5). This method retains popularity because it does not result in the certain death of the animals associated with the damage problem. Relocation may also be preferred in situations where the beaver population is low and establishment of new beaver colonies is desired. However, survival of relocated animals is generally very poor, and relocated animals face many challenges in the new environment (Courcelles and Nault 1983, McNeely 1995, Craven 1992). In Wyoming during the period of 1994-1999, 234 beaver were trapped and relocated to sites where the state wanted to re-establish beaver populations (McKinstry and Anderson 2002). Radio telemetry was used to track the fate of 114 of the beaver. Mortality and emigration (emigration rate included loss of transmitter) rates for tracked beaver were 30% and 51% respectively. Kaplan Meir survival estimates for the year after relocation were 0.43 (SE = 0.084). On average it took relocating 17 beaver to a site for a successful introduction (i.e., a pair established and breeding within 3 km of the release site).

Other challenges to relocation of aquatic rodents are that the animals may cause similar damage problems at the release site or dispersal site. Additionally, the American Veterinary Medical Association, the National Association of State Public Health Veterinarians, and the Council of

State and Territorial Epidemiologists oppose the relocation of mammals because of disease transmission risks, particularly for small mammals (Center for Disease Control 1990).

Aquatic rodents are abundant in much of the suitable habitat in Missouri. For this reason and the reasons noted above and in the EA, Missouri WS does not generally support the relocation of aquatic rodents for damage management. In the EA, WS stated that the program would not relocate aquatic rodents within Missouri. However, subsequent review of available information and discussion with the MDC indicates that, in very limited circumstances, there could be a need to relocate beaver or muskrats (e.g., research). Consequently, under Alternatives 3 and 5, Missouri WS would relocate beaver and muskrat if relocation is specifically authorized by the MDC. Nutria are a nonnative invasive species and will not be relocated.

Beaver Exclusion and Water Control Devices: The EA specifically referenced the use of exclusion and water control devices for beaver damage management. However, there has been ongoing research into the use and development of these methods. This section updates information on these devices.

Beaver Exclusion: Beaver exclusion generally involves the placement of fencing to prevent beaver access to water intake areas such as culverts or fencing individual trees or small areas to protect a group of trees. A variety of systems have been used to prevent beaver from blocking water intake structures including the Beaver Deceiver™, Beaver Bafflers™ and pre-dams (Lisle 2003, 1999, 1996, Partington 2002, Brown et al. 2001, Brown and Brown 1999). The Beaver Deceiver™ is a fencing system that is installed to prevent beaver blockage of culverts by minimizing environmental cues which stimulate dam construction, and by making culverts less attractive as dam construction sites (Lisle 2003, 1999, 1996). Beaver are deterred from blocking culverts by the installation of a fence around the upstream end of the culvert. Installation of a fence increases the length of the area which must be dammed, and may also increase the distance between the beaver and the source of the cues which stimulate damming behavior (e.g., water moving through culvert; Callahan 2005, Lisle 2003, 1999, 1996). Beaver prefer to build dams perpendicular to water flow, so fences are oriented at odd angles to water flow and are set so that they do not block the stream channel. Usually, fencing is also installed directly on the up and downstream ends of the culverts to prevent beaver from entering the deceiver from the downstream side of the culvert to prevent any beaver which might make it past the outer fence from plugging the interior of the culvert. Efforts are made to reduce the sound of water flowing through the culvert by raising the water level on the down-stream side of the culvert with dam boards or beaver-made dams; by constructing flumes to replace waterfalls, or, in extreme cases, by resetting the culvert (Lisle 1996). In situations where extra care is needed to ensure sufficient water flow through the culvert, Beaver Deceivers™ may be used in combination with water control devices (see below).

Cylindrical exclusion devices like the Beaver Bafflers™ are attached to culvert openings and reduce the likelihood that beaver will plug a culvert by spreading the water intake

over a larger area (Brown et al. 2001). While effective in some situations (Partington 2002), in a study of beaver exclusion and water control devices, cylindrical shapes attached in-line with the culvert had a higher failure rate (40%) than trapezoidal shapes (e.g., Beaver Deceivers™ - 3% failure) and use of the cylindrical devices was discontinued in favor of trapezoidal fences (Callahan 2005).

Unlike Beaver Deceivers™ and cylindrical fences, pre-dam fences (aka, deep water fences, diversion dams; Brown and Brown 1999) are designed with the specific intention that the beaver build the dam along the fence. Pre-dam fences are short semicircular or circular fences that are built in an arc around a water inlet. The fence serves as a dam construction platform which allows beaver to build a dam and pond at the site but prevents beaver from plugging the water intake. If the size of the upstream pond is not an issue, no further modifications of the pre-dam are needed. However, in most cases, pre-dams are used in combination with water control devices to manage the size of the upstream pond.

Fence mesh size should be selected to minimize risks to beaver and nontarget species. Brown et al. (2001) noted that beaver occasionally became stuck in 6 inch mesh and that the risk of beaver entrapment was lower with 5 inch mesh. Lisle (1999) noted that the size of the mesh on the fence of the Beaver Deceivers™ (6 inch mesh) was such that it allowed most species to pass through the fence except beaver and big turtles. In remote areas where there is little traffic it may be acceptable for animals which cannot pass through the deceiver to travel across the road. However, for culverts under busy roads, it is necessary to design special "doors" which can allow the passage of beaver and large turtles through the device. For example, 30 cm-diameter T-joints have been used to allow access through Beaver Deceiver™ fences. The T shape reduces the likelihood that beaver can haul woody debris for dam construction inside the device (Lisle 2003). Fence caps are not attached to the up and down-stream ends of the culvert when it's necessary to allow passage of species like large turtles and beavers through the culvert.

Water Control Devices: Water control devices (aka pond levelers) are systems used to allow the passage of water through a beaver dam. The devices are used in situations where the presence of a beaver pond is desired but it is necessary to manage the level of water in the pond. Various types of water control devices have been described (Perry 2007, Clemson University 2006, Spock 2006, Simon 2006, Close 2003, Lisle 2003, 1999, 1996, Brown et al. 2001, Brown and Brown 1999, Organ et al. 1996, Wood et al. 1994, Miller and Yarrow 1994, Laramie and Knowles 1985, Roblee 1984, Arner 1964). The devices generally involve the use of one or more pipes installed through the dam to increase the flow of water through the dam. Height and placement of pipes can be adjusted to achieve the desired water level in the beaver pond. Beavers generally only check the dam for leaks, so, when site conditions permit, the inlet of the pipe is placed away from the dam to make the source of the water flow more difficult to detect and decrease the likelihood that beaver will attempt to plug the device. To minimize the sound/sensation of water movement and associated beaver damming behavior, the end of

the pipe may be capped and water allowed to flow into the pipe through series of holes or notches cut through the pipe. Holes and notches may be placed on the underside of the pipe to further reduce signs of water movement. Alternatively, ninety-degree elbow joints are placed facing downward on the upstream end of the pipes to prevent the noise of running water from escaping and attracting beaver. A protective cage is placed around the upstream end of the inlet pipe to prevent beaver from blocking the pipe and reduce problems with debris blocking the pipe. As noted above, water control systems can be combined with exclusion devices to prevent beaver from blocking culverts while still maintaining a beaver pond at an acceptable level.

Efficacy of Beaver Exclusion and Water Control Systems: Exclusion devices and water control systems have been used for many years with varying degrees of success (USGAO 2001). Landowner management objectives play a role in how the efficacy of a water control system is perceived (Nolte et al. 2001). Survey respondents classified pond levelers installed to manage wetlands for waterfowl habitat more successful than levelers installed to provide relief from flooding (Nolte et al. 2001). Success rates as low as 4.5% and 3% have been reported by the Massachusetts Division of Fisheries and Wildlife and New York Department of Natural Resources (Langlois and Decker 1997). Nolte et al. (2001) reported only 50% of installed pond levelers in Mississippi meet landowner objectives and found that pond levelers placed in sites with high beaver activity more frequently failed if installed without implementing population control measures. Higher success rates have been reported for newer exclusion and water control systems ranging from 87% - 93% (Boyles and Savitzky 2007, Boyles 2006; Simon 2006; Callahan 2005). Lisle (2003) reported that use of the devices or a combination of a Beaver Deceiver™ and flow management device virtually eliminated the need for maintenance and beaver removal at 20 sites where clogged culverts and flooded roads had previously been a routine issue.

Exclusion and water control systems must be specifically designed to meet the needs of each site. Consequently, devices installed by inexperienced individuals may have a higher failure rate than those installed by a professional (Boyles 2006, Simon 2006, Spock 2006, Callahan 2003, Lisle 1996). Higher success rates reported for newer exclusion and water control devices may be indicative of increased understanding of the kinds of situations where these devices work best. For example, Callahan (2005) noted that exclusion and water control systems installed at culvert sites were more successful than similar systems installed at free-standing dams. Callahan (2005, 2003) also provides a list of sites that are not well suited to the use of exclusion or water control devices. Boyles and Savitzky (2007) and Boyles (2006) reported some of the highest success rates for the new exclusion and water control systems, but only tested the devices for use in managing conflicts with roadways (blocked culverts and high water levels).

Beaver build dams to raise water levels to meet their needs for security and access to forage. While pond levelers allow for the retention of some water, if the water level does not meet the needs of the beaver, they may move a short distance downstream and build a

new dam (Clemson University 2006, Callahan 2003). This may merely result in moving the problem to a new landowner or, depending upon site characteristics, the resulting pond may result in new or increased damage problems for the original landowner. McNeely (1995) reported the most common reasons cited for lack of success were blocking caused by debris or silt and beaver construction of additional dams slightly upstream or downstream of the management device. In the study by Callahan (2005), construction of a new dam upstream or downstream of the device was the most common cause of failure for free-standing dams (e.g., dams not associated with a culvert or other similar constriction in water flow, 11 of 156 sites), but insufficient pipe capacity (6 sites) and lack of maintenance (2 sites) were also problems. At culvert sites, lack of maintenance was the primary cause of device failure (4 of 227 sites). There was also a problem with vandalism at one of the culvert sites. At two culvert sites and two free-standing dams, the beaver appeared to be able to thwart the exclusion devices and water control systems and build dams that reduced or completely impeded the operation of the devices (Callahan 2005). Nolte et al. (2001) also reported need to address problems with dams upstream or downstream of the device.

Most pond levelers and water control devices require maintenance. The amount of maintenance required can vary considerably among sites, depending on site conditions and the type of water control device (Boyles 2006, Spock 2006, Callahan 2005, Nolte et al. 2001). Stream flow, leaf fall, floods and beaver activity will continuously bring debris to the intake of the water control device. Ice damage and damage from debris washed downstream during high water events may also trigger need for maintenance. Although most exclusion and water control devices generally require some level of maintenance, there are reports of devices which have remained effective for a period of years with no maintenance (Nolte et al. 2001). Nolte et al. (2001) reported that post-installation maintenance had been performed on 70% of the 20 successfully operating Clemson pond levels installed by WS. The most common action was to adjust the riser on the pipe to manipulate water levels. Other maintenance included removal of vegetation and secondary dams built after the installation of the devices. In a survey of individuals who had received assistance with exclusion and water control devices from Beaver Remedies program (Simon 2006), half the survey respondents 18 of 36 reported maintaining their devices and device installation program staff monitored an additional 10 devices. Sixty one percent of respondents reported that routine maintenance took 15 minutes or less and 93% reported that maintenance took a half hour or less. Boyles (2006) reported that time spent in device maintenance ranged from 1 to 4.75 hours per year. Illinois WS assists with the maintenance of the 7 levelers used by the Shawnee National Forest to address flooding issues. The pond levelers require maintenance every year to remove roots which can clog the intake pipe. If the levelers were not maintained they would have to be replaced approximately once every 5 years. A fire pump is used to clean out the levelers, and it takes 1-2 days for 3 – 5 people to clean out 2-3 levelers each year.

Costs: Installation and upkeep of water control devices vary from site to site. Callahan (2005) reported that the average cost for an exclusion fence at a culvert was $750 with

average annual maintenance cost of approximately $200. Flexible leveler pipe systems cost an average of $1,000 to install and $100 per year in maintenance. Average cost to install a combination fence and leveler was $1,400 with approximately $150 per year in maintenance. Properly maintained, a fence or pipe system may be expected to last approximately 10 years. Annualizing the costs of maintenance and levelers ranged from $200 – $275/year (Callahan 2005). The cost of a Beaver Deceiver™ may range from $150 - $1,500, and an additional cost would be applied if pipes were needed at the site (S. Lisle, Penobscot Nation, letter to J. Cromwell, WS, September 7, 2000). Spock (2006) reported that exclusion and/or water control device installation costs ranged from < $600 to over $3,000 dollars. Slightly more than half the systems (58.2%) cost between $600 and $1,000 to install. In many cases the cost included the first year of maintenance. Maintenance costs, when available, ranged from $50 - $600 per year with 49.9% of maintenance agreements costing from $100 - $200. The more expensive installations tended to be extensive fence and leveler systems or systems with numerous leveler pipes. Boyles (2006) reported that device installation cost an average of $1,349 per device and $3,180 per site. Subsequent annual maintenance cost an average of $19.75 per site per year. However, unlike the study by Callahan (2005) the devices had only been in place for a relatively short time (Boyles (2006) average time in place 15 months, range 6 - 22 months; Callahan (2005) average time in place 36.6 months, range 3 to 75 months). Cost of maintenance may change over time as site conditions change in response to new conditions resulting from the devices and/or beaver activity. As noted above, IL WS assists with the maintenance of the 7 levelers used by the Shawnee National Forest to address flooding issues. Average annual maintenance cost of just 2-3 of the 7 levelers is $7,358.

CONSISTENCY

All WS activities are in compliance with applicable state, federal and local laws and regulations including but not limited to the Endangered Species Act, the Fungicide, Insecticide and Rodenticide Act, the National Historic Preservation Act, the Clean Water Act, the Food Security Act, the Bald and the Golden Eagle Protection Act and Title 10 of the Missouri Code of State Regulations. When preparing the EA, WS completed an informal Section 7 consultation with the U.S. Department of the Interior, Fish and Wildlife Service on the potential risks to federally-listed threatened and endangered species from the proposed action (letter from C.M. Scott, U.S. Department of the Interior Fish and Wildlife Service [USFWS] April 6, 2004). WS has also consulted with the USFWS regarding potential risks of program activities to species listed since the completion of the EA (letter from R. Hansen, USFWS, February 11, 2010). All WS aquatic rodent damage management activities are conducted in accordance with the provisions of these consultations. WS also consulted with the MDC during preparation of the EA to ensure that the proposed action was consistent with applicable laws and regulations and would not adversely impact state wildlife populations including threatened and endangered species. The MDC has not added any species to the state list of T&E species since the completion of the EA which might be impacted by ARDM.

MONITORING

The Missouri WS program annually reviews impacts of the program on issues identified in the EA to ensure that the analysis adequately addresses program activities and impacts. This supplement summarizes the material and analyses in the annual monitoring reports prepared since the completion of the EA in 2005. Unless Alternative 1 (no beaver damage management by WS in Missouri) is selected, WS will continue to monitor program activities annually.

ENVIRONMENTAL IMPACTS

Impact on beaver, muskrat and nutria populations: The EA concluded that the impacts of WS aquatic rodent damage management activities on beaver, muskrat and nutria populations would be insignificant. The MDC does not directly monitor the state beaver or muskrat population but does monitor the harvest and pelt prices for these species (MDC 2009). Beaver and muskrat populations appear to be healthy and the MDC altered the trapping regulations in 2009 to extend the period of time when muskrats can be trapped. The MDC does not monitor the nonnative, invasive nutria population, and no new data has been obtained on the nutria population since the EA was completed. However, in 2006 the nutria were officially classified as a nuisance species in Missouri and unlimited nutria harvest is permitted for the duration of the state furbearer trapping seasons.

During fiscal years 2005 – 2009, WS removed an average of 123 beaver per year (Table 1). Annual WS beaver removal was below the level analyzed in the EA (1,500 beaver per year). Average annual licensed harvest for the period of 2005-2009 (7,714 beaver per year) has increased since the completion of the EA (2000-2004 – 6,932 beaver per year). The increase may be attributable, in part, to a slight increase in average annual pelt price for beaver (2000-2004: $8.62; 2005-2009: $13.42; MDC 2009). WS take of beaver for the period of 2005-2009 was $\leq$ 2.1% of the total statewide beaver harvest and was not of sufficient magnitude to adversely affect beaver harvest opportunities in the state. Based on the above information, WS' beaver removals did not individually, or cumulatively with other sources of mortality, adversely impact the state beaver population.

WS removed an average of 332 muskrats per year during the period of 2005-2009 (Table 2). Annual WS muskrat removal was below the level analyzed in the EA (3,000 muskrats per year). Average annual take of muskrats by licensed hunters during 2005-2009 (12,221 muskrats per year) was greater than take reported in the EA for 2000-2004 (9,543 muskrats per year). As with beaver harvest, the increase in average annual take by licensed trappers may be partly attributable to an increase in pelt prices (2000-2004: $1.71; 2005-2009: $3.52; MDC 2009). WS take of muskrats for the period of 2005-2009 was $\leq$ 3.4% of the total statewide beaver harvest and was not of sufficient magnitude to adversely affect muskrat harvest opportunities in the state. Based on the above information, WS' muskrat removals did not individually or cumulatively with other sources of mortality, adversely impact the state muskrat population.

Since the completion of the EA in 2005, WS has only taken five nutria for ARDM. Nutria are a nonnative invasive species which can damage habitat and compete for resources used by native wildlife (EA Section 1.6.3). The MDC seeks to prevent their establishment in the state. Although no information on the number of nutria in the state is available at this time, any level of removal, including complete eradication would have a beneficial impact on native ecosystems. However, given the limited number of animals taken and that WS' actions were only conducted at a small number of sites in the state, WS' take of nutria did not substantially impact the number of nutria in the state.

Table 1. A comparison of WS beaver take and the total take of beaver in Missouri from FY2005-FY2009.

Fiscal Year	WS Take	Estimated Harvest by Licensed Trappers[1]	Total Take	WS Take: % of total take
2005	118	7,310	7,428	1.58
2006	136	10,286	10,422	1.30
2007	136	8,786	8,922	1.54
2008	130	6,107	6,237	2.10
2009	96	6,081	6,177	1.55

[1] Estimate is based on reports of the number of pelts sold or registered and may be an underestimate of total harvest because some individuals may keep pelts for their own use.

Table 2. A comparison of WS muskrat take and the total take of muskrat in Missouri from FY2005-FY2009 .

Fiscal Year	WS Take[1]	Estimated Harvest by Licensed Trappers[2]	Total Take	WS Take: % of total take
2005	392	11,240	11,632	3.37
2006	313	16,221	16,534	1.89
2007	503	16,213	16,716	3.0
2008	241	8,125	8,366	2.99
2009	212	9,308	9,520	2.22

[1] Includes unintentional take of muskrats during projects to address beaver or nutria damage.

[2] Estimate is based on reports of the number of pelts sold or registered and may be an underestimate of total harvest because some individuals may keep pelts for their own use.

The analysis above indicates that implementation of the preferred alternative (Alternative 3) has not adversely impacted beaver, muskrat or nutria populations in the state. Improvements in beaver exclusion devices and pond levelers and rare instances of beaver relocation may reduce the need for lethal removal of beaver but are not expected to completely replace the need for

lethal beaver removal. For example, problems with burrowing cannot be addressed through the use of levelers or water control devices. Callahan (2003, 2005) and Simon (2006) noted that exclusion and water control systems installed at culvert sites were more successful than similar systems installed at free-standing dams, especially devices installed in channels of uniform width such as irrigation canals and drainage ditches. In FY 2009, approximately 60% of the beaver damage complaints involve burrowing or blocking irrigation canals and drainage ditches or beaver burrowing in dams, dikes or water impoundments. An additional 28% of damage requests involved damage to agriculture, primarily flooding caused by blocked irrigation canals.

As noted above, improvements in exclusion and water control devices would not alter lethal take of muskrats or nutria. Based on current activity and requests for assistance, WS expects that program activities under Alternative 3 would remain within the parameters analyzed in the EA and would not adversely impact state populations of target species. The relative impacts of the other alternatives on target species populations would also continue to be as described in the EA.

Impacts on other wildlife species, including Threatened and Endangered (T&E) species:

Species not on the State or Federal List of Threatened and Endangered. The EA determined that any nontarget take would be minimal (less than 50 individuals/per mammal species/year, less than 10 birds per year all species combined) and should have no adverse effect on state nontarget species populations. Program activities and their potential impacts on nontarget species are within parameters analyzed in the EA. The level of nontarget take was lower than projected and ranged from five to 38 animals killed/year and two to 27 freed/year (Table 3). The mean nontarget take for this period was 17.4 animals killed and 10.2 animals freed or a combined total of 27.6 animals annually. For hunted species, WS take was very low relative to licensed harvest (Table 4). Wildlife Service's lethal take of nontarget species was less than 0.4% of harvest by licensed hunters and had a low magnitude of impact on state nontarget species populations and hunting and trapping opportunities

Species on the State or Federal List of Threatened or Endangered Species. There have been eight changes to the federal list of threatened and endangered species since the EA was completed in 2005 (USDI 2010*a*). The winged mapleleaf (*Quadrula fragosa*) has been listed as endangered and the Sheepnose mussel (*Plethobasus cyphyus*), spectaclecase (*Cumberlandia monodonta*), grotto sculpin (*Cottus sp.),* and rabbitsfoot (*Quadrula cylindrical cylindrical*) have been listed as candidate species. Status of the tumbling creek cavesnail (*Antrobia culveri*) changed from candidate to endangered. The shovelnose sturgeon (*Scaphirhynchus platorynchus*) was listed as a threatened species in some portions of Missouri due to similarity of appearance and overlapping habitat with the endangered pallid sturgeon. Bald Eagles (*Haliaeetus leucocephalus*) were removed from the federal list of threatened and endangered species. Although beaver dam removal could impact aquatic species, review of the data on spectaclecase, sheepnose mussel, rabbitsfoot, shovelnose sturgeon, and winged mapleleaf indicate the habitat that these species live in are either large rivers that would not be stopped by beaver dams and/or the species prefers sites without impounded water. The grotto sculpin is a cave dewelling fish and is also unlikely to live in waters affected by beaver dams. Therefore, we

have concluded that WS beaver damage management activities would have no effect on these species. In an informal Section 7 consultation, the USFWS Missouri Field Office has concurred with this determination (letter from R. Hansen, USFWS, February 11, 2010). In the 2004 Section 7 consultation conducted for the EA, the USFWS concurred with WS' determination that the proposed action may affect but was unlikely to adversely affect the tumbling creek cavesnail.

Table 3. Wildlife Services' impact on nontarget species during aquatic rodent damage management activities in Missouri from FY2005-FY2009. K - animal was killed, R - animal was released.

Species	FY 2005		FY 2006		FY 2007		FY 2008		FY 2009	
	K	R	K	R	K	R	K	R	K	R
American Coot	0	0	0	0	2	0	0	0	0	0
Canada Geese	0	0	0	0	1	3	0	0	0	0
Green-winged Teal	0	0	0	1	0	0	0	0	0	0
Great Blue Heron	1	1	0	0	0	0	0	0	0	0
Mink	2	0	1	0	0	0	0	0	0	0
Muskrat[1]	0	0	0	0	2	0	2	0	3	1
Raccoon	9	0	5	0	8	15	3	2	2	1
River Otter	10	1	3	0	4	1	0	0	3	0
Snapping Turtles	16	5	4	1	0	0	0	0	4	7
Other Turtles	0	0	0	0	0	8	0	2	2	2
Total	**38**	**7**	**13**	**2**	**17**	**27**	**5**	**4**	**14**	**11**

[1] Unintentional take of muskrats occurred during actions to manage beaver or nutria damage. Unintentional take is included in analysis of impact on muskrat population above.

Table 4. Estimated harvest by licensed hunters and trappers in Missouri 2005-2009[1].

Species	Average Annual Harvest	Range of Annual Harvest
American Coot	1,240	100-3,000
Canada Goose	60,132	39,270-81,880
Mink	1,261	702 – 1,525
Raccoon	110,091	84,654 – 122,155
River Otter	2,225	1,454 - 3274

[1] Data for furbearers is from the 2004/2005 through 2008/2009 harvest seasons (Beringer 2010, 2008, Hamilton 2006). Estimate of furbearer harvest is based on reports of the number of pelts sold or registered and may be an underestimate of total harvest. Data for migratory birds is from 2005-2009 harvest seasons (Raftovich et al. 2010, 2009, Richkus et al 2007).

Although Bald Eagles have been removed from the federal list of threatened and endangered species, they are still protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. The national WS program is consulting with the USFWS regarding the protection of eagles under the Eagle Act. In the interim, WS continues to implement

measures to protect Bald Eagles established in the 1992 Biological Opinion on the impacts of the national WS program on Bald Eagles (USDA 1997 Revised). Missouri WS has never unintentionally captured a Bald Eagle, but eagle populations are increasing and it is theoretically possible that WS could accidentally capture and/or kill an eagle in a trap set for beaver or nutria. However, the probability of this happening is extremely low. For comparison, based on surveys conducted in 2006, there were 1,065 breeding pairs of eagles in Wisconsin (USDI 2010*b*), and the Wisconsin WS program routinely takes between 900 and 1,500 beaver per year. However, the Wisconsin WS program has only unintentionally captured three Bald Eagles in the last 20 years and only one of the eagles was taken after additional measures for the protection of eagles were implemented in 1992. Missouri has a much lower density of eagles (approximately 200 breeding pairs in 2010; MDC 2010) and usually takes fewer beaver per year (approximately 96-136 beaver per year). WS is working with the USFWS to obtain a non-purposeful take permit (50 CFR parts 13 and 22) to address risks to eagles from Missouri WS program activities and will abide by the protective measures established in the permit. Although WS does not anticipate inadvertently killing an eagle, even if WS were to inadvertently take 1 eagle in the course of the next 57 years, this level of non-purposeful take would not adversely impact the overall state or regional eagle population (USDI 2009).

A review of the MDC list of endangered species showed that there have been no new listings since the EA was completed. However, mountain lions (*Felis concolor*), Bald Eagles and Barn Owls (*Tyto alba*) have been removed from the state list of endangered species.

WS has not taken, or captured any state or federally-listed threatened or endangered species during aquatic rodent damage management. Given the information above, WS determinations of no effect or "not likely to adversely affect" state and federally-listed threatened and endangered species are still valid for the proposed action.

Based on current activity and requests for assistance, WS expects that program activities under Alternative 3 would remain within the parameters analyzed in the EA and would not adversely impact state populations of nontarget species. Improvements in exclusion and water retention devices are not expected to adversely impact nontarget species populations. The relative impacts of the other alternatives on nontarget species populations would also remain as analyzed in the EA.

Effects on public and pet health and safety

The EA concluded that WS aquatic rodent damage management activities would not adversely affect public or pet health and safety. No pets or members of the public were injured by WS aquatic rodent damage management activities. Program activities and their potential impacts on public and pet health and safety have not changed from those analyzed in the EA. The effects of aquatic rodent damage management activities are expected to remain insignificant. Based on current activity and requests for assistance, WS expects that program activities under Alternative 3 would remain within the parameters analyzed in the EA and would not have a substantial adverse impact on the health and safety of the public or pets. The improvements in beaver

exclusion and water control devices could reduce the need to use traps snares to resolve beaver damage, but would not affect the use of these devices for muskrats or nutria. Where these improvements reduce use of traps and snares, there would be a slight reduction in the already very low risk to human and pet safety from WS' actions under Alternatives 2, 3 and 5. With the exception of the impact of the improvements in water control and beaver exclusion devices, the relative impacts of the other alternatives on the health and safety of the public and pets would remain as analyzed in the EA.

Humaneness of methods to be used

As noted above there has been considerable research and development in the area of beaver exclusion and water management devices. Most individuals consider nonlethal methods more humane and preferable to lethal techniques. WS works to incorporate the latest information on damage management methods into program activities, and WS policy specifically directs that preference be given to nonlethal methods where practical and effective (WS Directive 2.101). However, even with the improvements in these techniques, there may still be a need for lethal beaver removal. For example, beaver removal may still be needed in some situations even though a flow device or water control system has been installed (Simon 2006, Spock 2006, Nolte et al. 2001, Wood et al. 1994). Beaver may build dams upstream and downstream of water control devices which moves the pond, but could result in ongoing or different problems in the new pond location. In these situations, some level of beaver removal is usually needed to resolve the problem. Callahan (2005) reported that it may be necessary to remove beaver prior to device installation at sites where it is necessary to lower the water level by at least one vertical foot. Spock (2006) reported that beaver had to be trapped out of one site when an exclusion system was augmented by the installation of a water control device. Lisle (1996) noted that it may be necessary to remove beaver that have learned to dam around exclusion and water control devices. Some authors reported that trapping continued at or near the area were the devices were installed, but wasn't prompted by the failure of the devices (e.g., licensed trapping; Simon 2006, Spock 2006, Lisle 1996).

Exclusion and water control devices are most effective in specific types of terrain and are not suitable for every site (Callahan 2005, Nolte et al. 2001, NYDEC 1997, Wood et al. 1994). Callahan (2005, 2003) and Simon (2006) reported that exclusion and water control devices are not suitable for man-made, uniform channels such as agricultural drainage ditches and irrigation canals; reservoirs; areas where human health, property or safety would be threatened with even minor elevation in water level; and areas where the landowner has expressed zero tolerance for beaver activity on the property. Water control devices may be ineffective in beaver ponds in broad, low-lying areas because even a slight increase in water depth can result in a substantial increase in the amount of area flooded (Organ et al. 1996). Increased soil moisture both within and surrounding beaver flooded areas can result in reduced timber growth and mast production.

Water control devices may also be inappropriate in areas that are managed for aquatic species that need free-flowing water conditions and gravel substrate to survive. The still water and silt

that accumulates behind beaver dams is detrimental to these species. For example, the Louisiana WS program has conducted beaver damage management activities to protect the Louisiana pearlshell (*Margaritifera hembeli*), which requires clear, free-flowing water to survive. Beaver dams have been removed by Illinois WS to reduce water levels threatening the leafy prairie clover (*Dalea foliosa* - federal and state-listed endangered). As discussed in the EA (Section 1.2.4), beaver ponds can have a detrimental impact on trout streams in the Midwest by raising water temperatures, destroying immediate bank cover, changing water and soil conditions, and causing silt accumulations in spawning areas. Beaver dams also appear to be a significant impediment to movement of trout. In 13 treatment zones in Wisconsin with wild brook trout, removal of beaver dams resulted in substantial increases in the amount of area where trout can be found (Avery 2004). The Minnesota Department of Natural Resources has experimented with modifications to water control devices to improve fish passage (Close 2003) which would appear to indicate that the devices can be modified to improve fish passage, but these devices would not resolve other adverse impacts of beaver dams on brook trout noted above.

Exclusion and water control systems will not resolve problems related to beaver construction of bank dens. Depending upon site characteristics, beaver may build bank dens instead of lodges. When bank dens are built in earthen levees or in banks supporting roadways or railroad tracks, they can greatly weaken the earthen structure. In these situations, removal of the beaver may be the only practical solution to the problem.

Although beaver serve a valuable role in wetland ecology, the presence of beaver dams in intensively managed wetlands can be problematic. In these areas, man-made water control structures are used to manage the water level in the wetland area in order to maximize habitat value for waterfowl and specific types of wetland-dependant wildlife (IDNR 2008, USDI 2008). While general elevations or reductions in water levels might conceivably be achieved by installing pipe systems through beaver dams, the devices tend to be more difficult to adjust than the water control structures. More importantly, the primary difficulty comes when drawdowns are used to achieve wetland management objectives. Drawdowns generally involve reducing the water level until large sections of mudflat are exposed. Many plant species valuable to waterfowl and other wetland bird species need exposed mudflats to sprout. Shorebirds use the mudflats to forage for invertebrates (IDNR 2008, USDI 2008, WDNR 2007). Once the plants have matured, the water level is gradually increased until approximately half of the marsh has open water and half has standing plants (USDI 2008). Drawdowns may also be used in fall as a means of eliminating invasive fish (USDI 2008). The extent of the water level reduction conflicts with the beaver's desire for water deep enough to provide protection, and water area of sufficient extent to provide relatively easy access to foraging sites. The extent of the water level reduction during a drawdown will likely increase the risk of new dam creation in other locations which may cause new problems (Callahan 2003).

Use of new technologies for nonlethal damage management likely improves general perceptions of the humaneness of the current program. These methods would also be incorporated into Alternatives 4 (Technical Assistance Only) and 5 (Nonlethal Beaver, Nutria, and Muskrat Damage Management). The new developments in the use of exclusion and water flow devices

are not expected to impact perceptions of the humaneness of the nonlethal-only alternative (Alternative 5). However, technical assistance on these methods may improve the perception of the humaneness of Alternative 4. With the exception of the impact of the improvements in water control and beaver exclusion devices, the relative impacts of the other alternatives on the health and safety of the public and pets would remain as analyzed in the EA.

Effects on wetlands

As noted in the EA, there are many benefits from beaver including ecological benefits associated with the creation of wetland habitats (Fouty 2008a, b; Hood and Bayley 2008; Pollock et al. 2007; Bergman et al. 2007; Rossell et al. 2005; Wright 2002; Munther 1982), aesthetic and recreational opportunities for wildlife observation (Ringleman 1991, Wade and Ramsey 1986), and cultural and economic gains from fur harvest (IDNR 2006; Lisle 2003, 1996; McNeely 1995; Hill 1976).

Beaver ponds increase surface and groundwater storage which can help reduce problems with flooding by slowing the downstream movement of water during high-flow events and help to mitigate the adverse impacts of drought (Fouty 2008*a*, Hey and Phillips 1995, Naiman et al. 1988, Wade and Ramsey 1986). Hood and Bayley (2008) determined that the presence of beaver can help reduce the loss of open water wetlands during warm, dry years. The presence of active beaver lodges accounted for over 80% of the variability in the amount of open water wetlands in the mixed-wood boreal region of east-central Alberta. Temperature and rainfall also influenced the amount of open-water wetlands, but to a much lesser extent than the presence of beaver. During wet and dry years, the presence of beaver was associated with a 9-fold increase in open water area over the same areas when beaver were absent. The authors note that beaver could mitigate some of the adverse impacts of global warming through their ability to create and maintain areas of open water. Beaver ponds and associated wetlands can provide a potential water source for livestock, serve as basins for the entrapment of streambed silt and eroding soil (Hill 1982), and help to filter nutrients from the water thereby maintaining the quality of nearby water systems (Arner and Hepp 1989).

Beaver may increase habitat diversity by opening forest habitats via dam building and tree cutting which results in a greater mix of plant species, and different-aged plant communities (Hill 1982, Arner and Hepp 1989). Creation of standing water, edge habitat, and plant diversity, all in close proximity, results in excellent habitat for many wildlife species (Medin and Clary 1991, 1990; Arner and Hepp 1989; Arner and DuBose 1982; Hill 1982; Jenkins and Busher 1979). The wetland habitat associated with beaver ponds is beneficial to some fish (primarily warm water species), reptiles, amphibians, waterfowl, shorebirds, and furbearers such as muskrats, otter, and mink (Miller and Yarrow 1994, Naimen et al. 1986, Arner and DuBose 1982). In Mississippi, beaver ponds over three years in age were found to have developed plant communities valuable as nesting and brood rearing habitat for wood ducks (Arner and DuBose 1982). Reese and Hair (1976) found that beaver pond habitats were highly attractive to a large number of birds year-round and that the value of beaver pond habitat to waterfowl was minor when compared to other species of birds (Novak 1987). Beaver ponds are beneficial to some

threatened and endangered (T&E) species. The USFWS estimates that up to 43% of T&E species rely directly or indirectly on wetlands for their survival (EPA 1995).

Where effective, implementation of the improvements in exclusion and water flow devices can allow for a reduction in damage while still retaining benefits associated with beaver ponds. These improvements would be incorporated in Alternatives 3, 4 and 5. However, these methods are not suitable for many of the situations where Missouri WS is requested to provide assistance such as situations were beaver burrows are weakening water containment structures, roadbeds or similar earthen structures; beaver dams in irrigation canals (Callahan 2005, 2003; Simon 2006); and situations where site use is incompatible with accommodation of a new or restored wetland.

Given that WS' aquatic rodent damage management actions are limited to a relatively small number of isolated locations within the state and that the improved exclusion and water flow devices will only be applicable to a portion of the damage complaints, incorporation of the new information and devices will not be of sufficient magnitude to substantially increase the amount of wetlands in the state. The remaining potential for impacts on wetlands under each of the alternatives remains as analyzed in the EA.

Economic losses to property

The impact of each alternative on economic losses to property was addressed in the EA in context of effectiveness of the alternative. Information on the efficacy and cost of beaver exclusion and water control devices is provided above in the section on "Beaver Exclusion and Water Control Devices". The improved devices would be available for use or recommendation by WS under alternatives 3, 4 and 5. Where practical and effective, these devices could improve the efficacy of WS program activities. However, as noted above in the sections on "Humaneness" and "Impacts on Beaver, Muskrat and Nutria Populations", the majority of beaver damage management requests received by Missouri WS are not well suited to the use of these devices. Consequently, the impact of these devices on program efficacy will be limited in scope. Improvements would likely be greatest for Alternative 4 (Only nonlethal methods). Under alternatives 3 and 5, the improved water control and beaver exclusion devices may be recommended instead of other effective management strategies which may use lethal methods or a combination of nonlethal and lethal methods. In these cases, there would be little change in the efficacy of the programs at the sites. Consequently, incorporation of the improved devices in Alternatives 3 and 4, while valuable as a means of reducing the need for lethal beaver removal, may not have as great an impact on overall program effectiveness as for Alternative 4.

Alternative 3 is anticipated to be the most effective because it allows WS to select nonlethal and lethal damage management techniques when developing site-specific damage management plans. Neither nonlethal nor lethal management strategies are suited to all damage situations, and some situations require a mix of both strategies to most effectively address damage problems. With the exception of the impact of the improvements in water control and beaver exclusion devices discussed above, the relative efficacy of the alternatives remains as analyzed in the EA.

Impacts on stakeholders, including aesthetics

Impacts on stakeholders, including aesthetics would generally remain as described in the EA. In general, the impacts of the beaver damage management alternatives would vary among individuals depending on each stakeholder's values and compassion toward wildlife. Improvements to the water control and beaver exclusion devices would have no effect on the impacts of alternatives 1 and 2. Under Alternatives 3, 4 and 5 the improved devices could allow for the effective resolution of some beaver damage problems while also retaining the positive aesthetic benefits which may be derived from viewing beaver, beaver ponds and associated wildlife. However, as noted in the Section describing these devices and in the sections on "Humaneness" and "Impacts on Beaver, Muskrat and Nutria Populations" these devices may only be applicable for a small portion of the beaver damage problems addressed by Missouri WS. With the exception of the impact of the improvements in water control and beaver exclusion devices, the relative impacts of the other alternatives on stakeholders and aesthetic values would remain as analyzed in the EA.

CUMULATIVE IMPACTS

Cumulative impacts, as defined by CEQ (40 CFR 1508.7), are impacts to the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts may result from individually minor, but collectively significant, actions taking place over time.

Under Alternatives 2, 3, 4 and 5, WS would address damage associated with aquatic rodents in a number of situations throughout the state. The WS ARDM program would be the primary federal program with ARDM responsibilities; however, some state and local government agencies may conduct ARDM activities in Missouri as well. Through ongoing coordination with these agencies, WS is aware of such ARDM activities and may provide technical assistance in such efforts. WS does not normally conduct direct damage management activities concurrently with such agencies in the same area, but may conduct ARDM activities at adjacent sites within the same time frame. In addition, commercial pest control companies may conduct ARDM activities in the same area. The potential cumulative impacts analyzed below could occur either as a result of WS ARDM program activities over time, or as a result of the aggregate effects of those activities combined with the activities of other agencies and individuals.

Cumulative Impacts on Wildlife Populations

Aquatic rodent damage management methods used or recommended by the WS program in Missouri will likely have no cumulative adverse effects on target and nontarget wildlife populations. As analyzed above, WS limited lethal take of target aquatic rodent species is anticipated to have minimal impacts on target populations in Missouri. WS works with the MDC and the USFWS to determine that aquatic rodent removals

conducted by WS in combination with all other known aquatic rodent removals, including sport harvest, are not adversely impacting wildlife populations.

Cumulative Impact Potential from Chemical Components

Aquatic rodent damage management programs which include the use of pesticides as a lethal population management component may have the greatest potential for cumulative impacts on the environment as such impacts related to deposit of chemical residues in the physical environment and environmental toxic sis. The toxicant Zinc Phosphide is the only lethal chemical used or recommended by the Missouri WS ARDM program for the purpose of obtaining lethal effects on nutria and muskrats. This chemical has been evaluated for possible residual effects which might occur from buildup of the chemicals in soil, water, or other environmental sites. Based on use patterns, the chemical and physical characteristics of Zinc Phosphide, and factors related to the environmental fate of this pesticide, no cumulative impacts are expected from Zinc Phosphide used or recommended by the WS ARDM program in Missouri.

Cumulative Impact Potential from Non-chemical Components

Non-chemical methods used or recommended by WS IWDM program may include exclusion through use of various barriers, habitat modification, live trapping and euthanasia, trapping, snaring, and shooting. No cumulative impacts from WS use of these methods to take animals are expected, since take would be authorized and/or permitted with MDC oversight.

SUMMARY

No significant cumulative environmental impacts are expected from any of the alternatives, including the proposed action. Under the proposed action, the lethal removal of beaver, muskrats and nutria would not have a significant impact on state populations of these species although reductions could occur at the specific sites where ARDM is conducted. Although a limited number of nontarget animals may be killed through the use of traps and snares during ARDM, the expected level of take will not have a significant cumulative adverse impact on nontarget species populations. Program activities will either have no effect on or may affect but are not likely to adversely affect state or federally-listed threatened or endangered species. No risk to public safety is expected when activities are provided and accepted by requesting individuals in Alternative 3 because only trained and experienced personnel would conduct and recommend damage management activities. There is a slight increased risk to public safety when persons who reject assistance and recommendations in Alternatives 2, 4 and 5 and conduct their own activities, and when no assistance is provided in Alternative 1. In all Alternatives, however, it would not be to the point that the impacts would be significant. Program activities are not expected to have a significant impact on the amount of wetlands available in the state, but the inclusion of the improved water control and beaver exclusion devices may slightly increase

the number of beaver damage situations which can be resolved while retaining the ecological and aesthetic benefits of beaver and beaver ponds. Although some individuals will likely be opposed to lethal removal of beaver, muskrats and nutria, the analysis in this EA indicates that an integrated approach to ARDM would not result in significant cumulative adverse impacts on the quality of the human environment.

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THREATENED & ENDANGERED SPECIES IN MISSOURI

SCIENTIFIC NAME	COMMON NAME	STATE STATUS[1]	FEDERAL STATUS[2]
PLANTS			
Asclepias meadii	Mead's Milkweed	Endangered	Threatened
Boltonia decurrens	Decurrent False Aster	Endangered	Threatened
Geocarpon minimum	Geocarpon	Endangered	Threatened
Helenium virginicum	Virginia Sneezeweed	Endangered	Threatened
Isotria medeoloides	Small Whorled Pogonia	Endangered	Threatened
Lidera melissifolia	Pondberry	Endangered	Endangered
Physaria filformis	Missouri Bladder -pod	Endangered	Threatened
Plantanthera leucophaea	E. Prairie Fringed Orchid	Endangered	Threatened
Plantanthera praeclara	W. Prairie Fringed Orchid	Endangered	Threatened
Trifolium	Running Buffalo Clover	Endangered	Endangered
MOLLUSKS			
Antrobia culveri	Tumbling Creek Snail	Endangered	Endangered
Cumberlandia monodonta	Spectaclecase		Candidate
Elliptio crassidens	Elephantear	Endangered	
Epioblasma florentina curtisii	Curtis Pearlymussel	Endangered	Endangered
Epioblasma triquetra	Snuffbox	Endangered	
Fusconaia ebena	Ebonyshell	Endangered	
Lampsilis abrupt	Pink Mucket		Endangered
Lampsilis higginsii	Higgins Eye	Endangered	Endangered
Lampsilis rafinesqueana	Neosho Mucket		Candidate
Leptodea leptodon	Scaleshell	Endangered	Endangered
Plethobasus cyphyus	Sheepnose	Endangered	Candidate
Potamilus capax	Fat Pocketbook	Endangered	Endangered
Quadrula fragosa	Winged Mapleleaf	Endangered	Endangered
Quadrula cylindrical Cylindrical	Rabbitsfoot	Endangered	Endangered
CRUSTACEANS			
Cambarus aculabrum	cave crayfish		Endangered
INSECTS			
Nicrophorus americanus	American Burying Beetle	Endangered	Endangered
Somatochlora hineana	Hine's Emerald Dragonfly	Endangered	Endangered

SCIENTIFIC NAME	COMMON NAME	STATE STATUS[1]	FEDERAL STATUS[2]
FISH			
Acipenser fulvescens	Lake Sturgeon	Endangered	
Amblyopsis rosae	Ozark Cavefish	Endangered	Threatened
Cottus Sp.	Grotto Sculpin		Candidate
Crystallaria asprella	Crystal Darter	Endangered	
Etheostoma cragini	Arkansas Darter		Candidate
Etheostoma fusiforme	Swamp Darter	Endangered	
Etheostoma histrio	Harlequin Darter	Endangered	
Etheostoma nianguae	Niangua Darter	Endangered	Threatened
Etheostoma parvipinne	Goldstripe Darter	Endangered	
Etheostoma whipplei	Redfin Darter	Endangered	
Forbesichthys agassizi	Spring Cavefish	Endangered	
Hybognathus hayi	Cypress Minnow	Endangered	
Notropis maculates	Taillight Shiner	Endangered	
Notropis sabinae	Sabine Shiner	Endangered	
Notropis Topeka	Topeka Shiner	Endangered	Endangered
Noturus eleutherus	Mountain Madtom	Endangered	
Noturus placidus	Neosho Madtom	Endangered	Threatened
Percina nasuta	Longnose Darter	Endangered	
Platygobio gracilis	Flatheat Chub	Endangered	
Scaphirhynchus albus	Pallid Sturgeon	Endangered	Endangered
Umbra limi	Central Mudminnow	Endangered	
AMPHIBIANS			
Cryptobranchus a. alleganiensis	Eastern Hellbender	Endangered	
Cyprtobranchus a. bishop	Ozark Hellbender	Endangered	Candidate
REPTILES			
Deirochelys reticularia minaria	Western Chicken Turtle	Endangered	
Elaphe vulpine vulpine	Western Fox Snake	Endangered	
Emydoidea blandingii	Blandings's turtle	Endangered	
Kinosternon f. flavescens	Yellow Mud Turtle	Endangered	
Kinosternon f. spooneri	Illinosi Mud Turtle	Endangered	
Nerodia cyclopion	Missippi Green Water Snake	Endangered	
Sistrurus c. catennatus	Eastern Massasauga	Endangered	Candidate
BIRDS			
Ainophila aestivalis	Bachman's Sparrow	Endangered	
Botaurus lentiginosus	American Bittern	Endangered	

SCIENTIFIC NAME	COMMON NAME	STATE STATUS[1]	FEDERAL STATUS[2]
BIRDS Continued			
Circus cyaneus	North Harrier	Endangered	
Egretta thula	Snowy Egert	Endangered	
Falco pereginus	Peregine Falcon	Endangered	
Limnothlypis swainsonii	Swainson's Warbler	Endangered	
Rallus elegans	King Rail	Endangered	
Sterna antillarum athalassos	Interior Least Tern	Endangered	Endangered
Tympanuchus cupido	Greater Prairie-chicken	Endangered	
Charadrius melodus	Piping plover		Threatened
MAMMALS			
Corynorhinus townsendii ingens	Ozark Big-eared Bat	Endangered	Endangered
Lupus californicus	Black-tailed Jackrabbit	Endangered	
Myotis grisescens	Gray Bat	Endangered	Endangered
Spilogale puturius interrupta	Plains Spotted Skunk	Endangered	
Myotis grisescens	Indiana bat	Endangered	Endangered

1 Listed in the Wildlife Code of Missouri, Rule 3 CRS10-4, 111 Endangered Species.

2 Federally Listed Species under the Endangered Species Act (ESA) of 1973 as Amended:
Endangered= Any species that is in danger of extinction throughout all or a significant portion of its range.
Threatened= Any species that is likely to become endangered within the foreseeable future.
Candidate= Plants or animals that the U.S. Fish & Wildlife Services is reviewing for possible addition to the list of Endangered and Threatened species.