PROGRESS REPORT FOR ARMY FUNDED ACTIVITIES AT ROCKY MOUNTAIN ARSENAL NATIONAL WILDLIFE REFUGE

Commerce City, Colorado

Fiscal Year 2013

U.S. Department of the Interior
U.S. Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

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Introduction

The Rocky Mountain Arsenal (RMA) was established by the U.S. Army (Army) in 1942 as a chemical and incendiary weapons manufacturing facility in support of U.S. military efforts during World War II. Following the war, the Army leased some facilities to the Shell Chemical Company (Shell) for production of pesticides and other chemicals. Weapons production ended in 1969, but the Army continued to use RMA for demilitarization of chemical munitions and other defense uses until 1984. Pesticide production by Shell Chemical Company ceased at the Arsenal in 1982.

During the military/industrial production years, waste handling practices resulted in contamination of soils, structures and groundwater at this site. RMA was added to the National Priorities List (Superfund) in 1987. In 1992, Congress passed the Rocky Mountain Arsenal National Wildlife Refuge Act (P. L. 102-402), designating the future use of the site as a National Wildlife Refuge (NWR), mandating the Fish and Wildlife Service (Service) manage RMA "as if it were" a unit of the National Wildlife Refuge System (NWRS) during the environmental cleanup. All RMA lands were brought into the Refuge System under a "secondary jurisdiction/overlay" Memorandum of Understanding in 1993.

The Record of Decision (ROD) for the On-Post Operable Unit of RMA was signed in 1996. Shortly thereafter, the Service joined the Army and Shell in forming the Remediation Venture Office (RVO), a unique partnership with the dual missions of implementing a safe, cost effective cleanup of RMA and converting the site to its current status as a National Wildlife Refuge.

Just 10 miles from downtown Denver, Colorado, within a rapidly developing urban interface in Commerce City, Adams County; Rocky Mountain Arsenal National Wildlife Refuge (RMANWR) is the largest wildlife habitat area in metropolitan Denver at 15,000 acres (the U.S. Army maintains jurisdiction over about 1,000 acres). Located in the heart of Region 6's largest urban area, and with more Americans living within a 1-hour drive than live in all of North and South Dakota, Wyoming, and Montana combined, RMANWR provides an outstanding opportunity for the Refuge System to expose the public, particularly urban youth, to the values that wildlife and refuges provide to our society.

Refuge wildlife include a significant wintering population of bald eagles (*Haliaeetus leucocephalus*), one of the largest breeding burrowing owl (*Athene cunicularia*) populations in Colorado, and a myriad of other migratory birds and resident wildlife. RMANWR is becoming well known for its herd of American bison (*Bison bison*), currently over 70 animals, which were introduced in 2006. Due to past land uses, including agricultural conversion, military/industrial use, and the cleanup of these sites, most native habitats have been destroyed or degraded. An established weed seed bank has made management of invasive species a priority at the refuge. Habitat management is currently focused on restoring native shortgrass and midgrass (mixed grass) prairie plant communities (approximately 10,100 acres) and emulating natural ecological processes.

The Cooperative Agreement for Conservation and Management of Fish and Wildlife Resources at Rocky Mountain Arsenal (5th Revision) was signed by representatives of the Service and the Army in 2009. The annual schedule of operations for 2010 provides an outline for what is to be

done during the fiscal year (October 1st 2009 through September 30th, 2010). This report follows that outline, which documents Service support to the Army in the areas of Mitigation/Restoration, Remedy/Cleanup, and Access Control.

A. Mitigation and Restoration Work Related to Remediation of RMA

A.1 Restoration of Native Shortgrass and Mixed Grass Prairie

Two basic prairie types are seeded as part of the restoration effort at the Rocky Mountain Arsenal National Wildlife Refuge. Project sites with heavier textured soils, such as Weld or Santana, are seeded to a shortgrass prairie mix. Project sites with sandier textured soils such as Ascalon or Bresser, are seeded to become mixed-grass prairie. Typically, all seeded project sites receive irrigation during the first growing season, but in FY 2010, no sites received irrigation except those done by the irrigation contractor.

A.1.a. Permanent Native Seeding

Approximately 466.9 acres were seeded with native seed:

Section	Project Number	Date Seeded	Irrigated acres	Total Acres
26	F31	7/16-7/24	0	170
31	F34	12/6-2/13	0	123.7
31	F37	11/2-12/7	0	91.6
35	F14	5/15-6/10	20	26
3	F26	11/27-12/6	0	55.6
			TOTAL	**466.9**

Table A.1.a.1. FY 2013 permanent native seeding date, irrigation and acreage, RMANWR.

Section	Project Number	Date Seeded	Irrigated acres	Total Acres
24	F21	5/15-5/22	101	101
35	F32	5/15-5/31	120	120
35	86(corral)	6/12-6/18		60
			TOTAL	**281**

Table A.1.a.2. FY 2013 Total acres of supplemental seeding, RMANWR.

A.1.b. Cover Crop Seeding

Cover crop seeding is part of a two-year (sometimes longer) weed control period given to all new project seedbeds. Cover crops provide temporary food and cover to wildlife, prevent soil erosion, collect additional winter moisture, help preserve the existing soil moisture, shade out weeds, and provide additional organic matter to the soil. Seeding directly into one- to two-year-old mowed stubble also saves the cost of having to apply weed-free mulch. Cover crop seeding is part of a conservation tillage system that the Service has adopted to manage levels of residue

on future seedbeds and help provide the above benefits using as little mechanical cultivation as possible. For FY 2013, approximately 36.8 acres were seeded with cover crops:

Section	Project No.	Cover Crop Seeded	Acres
25	F28	sorghum	36.8
		TOTAL	**36.8**

Table A.1.b.1. FY 2013 cover crop seeding, RMANWR

A.1.c. Seedbed Preparation

Restoration seedbeds go through a two-year fallow period prior to permanent seeding, during which time all germinating weeds are controlled by a variety of mechanical (plowing, disking, mowing), and chemical means. Mowing is used to prevent unwanted plants from maturing and producing seed. Disking is used to break up the soil, the vegetation, and root systems. Plowing also breaks up the soil and mixes the vegetation residue in with the soil.

Seedbed preparation entails the above techniques to deplete the existing weed seedbank, minimizing weedy competitors and encouraging germination of newly seeded native vegetation. The following tables list the projects that received mechanical and chemical weed control as part of this fallow period prior to their scheduled permanent seeding:

Section	Project	Action	Site Acres
		plow	0
		Subtotal	**0**
		disk	0
		Subtotal	**0**
		harrow	0
		Subtotal	**0**
3	F26(vc)	imprint	55.6
31	F34	imprint	123.7
31	F37	imprint	91.6
		Subtotal	**270.9**
		TOTALS, ALL METHODS	**270.9**

Table A.1.c.1 FY 2013 mechanical site preparation and type of activity, RMANWR.

A.1.d. Habitat Maintenance Performed on New Restoration Projects

New restoration projects that have been seeded typically do not receive herbicide treatments due to the risk of damaging sprouting vegetation. The most common maintenance for new restoration projects is mowing broad-leafed weeds to no more than one foot in height to prevent shading of emergent vegetation. By mowing the broadleaves, light is able to reach the understory so that native seeds can germinate and grow. Typically, new restoration projects need to be mowed two or three times during the first growing season depending on precipitation. A detailed list of projects mowed in FY2013 is provided in table A.1.d.1.

Section	Project	Action	Acres
4	F60	mow	93
11	90	mow	4
12	91a	mow	10
23	F48/49	mow	44
23	F48/50	mow	170
24	F21	mow	97
24	F57	mow	40
24	54	mow	18
26	F31	mow	152
26	F31	mow	50
31	F34	mow	120
31	F34(2nd app)	mow	25
31	F37	mow	91
35	F14	mow	17
35	F32	mow	68
		Total	**999**

Table A.1.d.1. First-year projects and acreage mowed in FY 2013, RMANWR.

Chemical maintenance preformed on restoration projects is displayed in table A.1.d.2. Staying on top of the project maintenance is a crucial part of restoration efforts on the Refuge, allowing staff to control growing weeds and preventing them from setting seed.

Section	Project	Action	Acres
1	F06	Spray (ground)	13
1	spboa	Spray (ground)	16
1	Spboa1	Spray (ground)	10
1	81a	Spray (ground)	.25
1	55	Spray (ground)	.125
2	F16	Spray (ground)	109.56
3	F26	Spray (ground)	30.8
3	53	Spray (ground)	1
4	F60	Spray (ground)	151.61
4	F08	Spray (ground)	85.5
5	80	Spray (ground)	170.57
6	F66	Spray (aerial)	64
6	F66	Spray (ground)	111.76
6	F16	Spray (aerial)	70
6	F56	Spray (ground)	6
7	88	Spray (ground)	17.61
12	42	Spray (ground)	10.61
12	54	Spray (ground)	38.81
12	91b	Spray (ground)	18.37
20	F40,52,52-04	Spray (aerial)	87
23	F48/49	Spray (ground)	247
24	F21	Spray (ground)	67.5
24	71	Spray (ground)	1
24	F54	Spray (ground)	150.73
26	F32	Spray (ground)	117
30	F12	Spray (aerial)	202
31	F35	Spray (ground)	1
32	72	Spray (aerial)	550
34	57/57b	Spray (ground)	8
35	86	Spray (ground)	39
35	86	Spray (ground)	52
35	70	Spray (ground)	13
35	F32	Spray (ground)	130
36	F30/29	Spray (ground)	26
36	86	Spray (ground)	13
		Total	**2629.805**

Table A.1.d.2. First-year projects with chemical controls applied in FY 2013, RMANWR.

A.2. Maintenance and Monitoring on Habitat Restored in Prior Years

A.2.b. Integrated Pest Management Program (IPM)

Introduction

The State of Colorado Noxious weed list includes 71 weed species, 26 of which occur or have occurred on the Refuge. Weed species pose a significant threat to habitat restoration efforts by outcompeting native vegetation. The Service therefore employs an Integrated Pest Management (IPM) approach to weed control which utilizes mechanical, biological, chemical, and cultural (prescribed burns) methods as appropriate throughout the Refuge.

Methods

The Service used nineteen Pesticide Use Proposals (PUP's), approved by the Refuge Project Leader, for treating the increasing acres and diversity of weeds in FY 2013. These PUP's have been submitted for re-approval for FY 2014. The existing Refuge IPM plan expired in October of 2008; a new plan is currently being reviewed. The new IPM plan, once approved, will be valid through 2015.

New restoration projects typically receive two years of weed control in an attempt to exhaust the existing weed seedbank. These areas are closely monitored to observe weed phenology and germination in order to determine the best chemical control.

The Service continues to utilize contract helicopters as a cost effective method to apply herbicides to large areas. A total of 1,003 acres were sprayed in FY 2013, most with glyphosate and some with dicamba. Depending on the proximity of spray sites to each other, the helicopter can spray up to 100 acres per hour. The speed at which this operation is completed allows for a more temporally relevant application while the use of GPS technology prevents "striping", a phenomenon associated with ground-spraying rigs when not enough overlap occurs between spray passes.

Mechanical methods were also used to control a variety of weeds outside habitat restoration areas. These methods included mowing, digging, hand pulling and light disking. In FY 2013, Mile High Youth Corps, Groundwork Denver crews, and seasonal employees surveyed and treated 102.4 acres of houndstongue (*Cynoglossum officinale)* and other invasive species.

The following table shows chemical weed control that was completed in non-restoration project areas throughout the Refuge in FY 2013. Nearly all these areas are adjacent to existing restoration projects, with some being newly seeded while others are in remnant vegetation communities which require protection from degradation by weed species.

Section	Treatment	Treated Acres
1	Spray (ground)	14.48
2	Spray (ground)	5.5
5	Spray (ground)	31.72
6	Spray (ground)	3
7	Spray (ground)	2.5
8	Spray (ground)	.5
11	Spray (ground)	.75
12	Spray (ground)	48.17
23	Spray (ground)	7.75
33	Spray (ground)	57.37
35	Spray (aerial)	30
roads	Spray (ground)	22
trails	Spray (ground)	2.1
	TOTAL TREATED	**225.84**

Table A.2.b.1. IPM weed control conducted on projects in FY 2013, RMANWR.

Results and Discussion

In FY 2013, a total of 2,856 acres received chemical control for exotic or invasive species, 270.9 acres were imprinted, 999 acres were mowed, and 102.4 acres were treated by hand for a total of 4,228.3 acres treated in FY 2013.

The Service maintains an early detection and rapid response program for houndstongue, knapweed (*Centaura spp.*), St. John's wort (*Hypericum perforatum*), and other invasive species that have a high potential for rapid spread, in order to prevent them from establishing and becoming a serious control problem. The Service partnered with Denver Botanic Gardens, Mile High Youth Corp, and Shell Oil Company in the weed control effort throughout the year.

A.2.c. Vegetation Monitoring

Introduction

The objectives of the vegetation monitoring program are to:

1. Objectively assess the overall success of habitat restoration efforts by comparing baseline vegetation data with post-implementation data.
2. Determine if seeded species are represented in the vegetative community in the same proportion as they were seeded.
3. Reveal which species have established the most and least successfully from the overall seed mix on the restoration site.
4. Determine the actual composition, density, and diversity of seeded sites over time to determine range trend and condition.

Methods

Each year, data are collected from randomly placed 50-meter fixed point-line transects. Points along the transects are placed at one meter intervals, a half-meter on each side of the transect and observed using an Optical Sighting Device (OSD) placed directly overhead and perpendicular to it. The general rule is a minimum of one transect for each restoration project with one transect for every six acres, and a maximum of 20 transects per site. Baseline data are ideally taken prior to restoration fieldwork commencing on an area. Once an area is seeded, vegetation monitoring took place in the third and fifth growing season and then every five years thereafter until restoration sites became successful according to the established criteria.

Results and Discussions

A total of 127 transects was sampled in 13 projects during FY 2013. Success status and data analysis for the following projects are not stated in this report due to an inability to access the vegetation monitoring database that has been used in previous years to calculate success of restoration stands and track changes in vegetation trends.

Section	Project	Acres	Age	Number of Transects	Seed Mix Used	Successful?
2	82	33.1	10	6	Bresser	
6	79-04	18.5	10	3	Weld	
20	52	72.7	15	12		Yes, in 2008
	52-04	55.9	10	9	Weld	
24	F54	146.6	3	20		No – has to be at least 5 yrs old
	F57	43.0	3	7		No – has to be at least 5 yrs old
26	76	159.4	10	20		Yes, in 2008
29	29-04	13.6	10	2	Weld	
31	F35E	113.1	3	17		No – has to be at least 5 yrs old
	F35W	45.4	3	10		No – has to be at least 5 yrs old
34	57B	116.4	15	19	Bresser	
35	41-03	5.0	10	1		No – too much PD damage
1,2	FAC MAINT	24.3	15	1		
Totals:		847.0		127		

Table A.2.c.1. Summary of vegetation monitoring efforts in FY 2013, RMANWR.

B. Remedy and Cleanup Activities and Support to Army and Remediation Venture Office

B.1. Wildlife Health Monitoring Studies and Designated Species Collections per the Contaminant Biomonitoring Plan

B.1.a. American Kestrel Population Monitoring FY 2013

Background

The American kestrel (*Falco sparverius*) was selected as one of the sentinel species for the refuge biomonitoring program because its foraging activities result in bioaccumulation of Persistent Organic Pollutants (POPs) from insects and small mammals, aldrin and dieldrin being the chief chemicals of concern at RMANWR (see the Biomonitoring Plan (BMP) for a complete description).

Introduction

Collecting eggs for contaminant analysis under the BMP began in FY 2010 with the directive to collect three years of egg samples from each designated nest box. Sample collection proceeds as a 2-phase process: Phase 1 – Detection of Dieldrin Levels in Eggs, and Phase 2 – Detection of Dieldrin in Brains (only if needed). Phase 1 evaluates dieldrin concentration in eggs at both the individual nest box site and by groups of nest boxes for exceedance of detection limits above No Observable Adverse Effect Concentrations (NOAEC, 0.5µg/g) and the Maximum Allowable Total Concentration (MATC, 1.0µg/g). If dieldrin concentrations at one or more sites exceed the MATC, the BMP directs implementation of Phase 2 requiring the collection of a chick and evaluation of dieldrin concentrations in brain tissue. Monitoring activities in FY 2013 relate to both phases I and II.

There were 37 existing kestrel boxes from the 1997 Roy study at RMA and the Biological Advisory Subcommittee (BAS) proposed using 22 of those for the study in the BMP. For unknown reasons, all 37 were monitored for sample collection during FY's 2010-2012. Following the FY 2012 monitoring season, the fifteen non-BMP nest boxes at 3SW, 4NW, 4SW, 5NE, 8NE, 8SE, 8SW, 11SW, 12SW, 20NE, 20NW, 23NW, 29NE, 32NE, and 33NW were closed with wire cloth and only the 22 proposed in the BMP were monitored in FY 2013. Boxes are located approximately one mile apart in each direction, at or near the intersection of primary and secondary roads and along perimeter fences. The locations are categorized as "core" and "periphery" with 12 core and 10 periphery nest boxes. This strategy accommodates biomonitoring of the forage and reproductive range of nesting kestrels utilizing the nest boxes throughout the Arsenal, although periphery nest boxes accommodate birds potentially foraging both within and outside of the Arsenal boundaries.

Personnel

RVO toxicologist Scott Klingensmith provided oversight of biomonitoring activities throughout FY 2013. Field activities were coordinated and supervised by Brian Fairchild, USFWS

biological science technician (STEP) with assistance from biological science technician (STEP) Abby Wright. In addition, intermittent assistance was provided throughout the summer by other Biological Science Technicians (SCEP/STEP students), and volunteers.

Pre-season Activities

Twenty-two nest boxes were prepared for monitoring in FY 2013. Sites were in good condition and required only minor preparation such as clean-out, addition of aspen chips, and repainting of numbers.

Biomonitoring Field Activities

Nest boxes were visited approximately twice weekly during the monitoring season; reproductive activities were observed and recorded, including competition from European starlings (*Sturnus vulgaris*) and northern flickers (*Colaptes auratus*) precluding kestrel utilization (competitor nesting attempts were removed when observed). Eggs in developing kestrel clutches were sequentially marked with a pencil as each new egg was observed. A total of 1,059 nest box visits were carried out at the 37 kestrel sites, averaging 28.6 checks per box throughout the reproductive season.

Protocol required collection of a random egg when the clutch reaches five eggs. Review of the FY 2010 egg collections revealed opportunities to collect eggs that were lost to progressive decline of nests with fewer than five eggs. To prevent lost sampling opportunities, the protocol was slightly modified prior to the FY 2011 season to allow collection from these sites (per discussion between Scott Klingensmith and Brian Fairchild).

When clutches reached five eggs, or when a clutch was observed in decline, a random egg was collected from each clutch. Eggs were placed in a certified-clean two-ounce glass jar and insulated with VWR light-duty tissue wipes to prevent breaking during handling and transport. Jars containing eggs were placed in a cooler containing H_2O ice to halt development, and then stored in a freezer at -10°C upon completion of daily biomonitoring activities. Ten of 59 eggs laid were collected, five each from core and periphery nest boxes.

The six Phase II nest boxes were designated for fledgling collection only; no eggs were removed for sampling. One random nestling was collected from box 35SE approximately 18 days post-hatch. No other Phase II boxes progressed to the point where a collection could be made. The collected nestling was euthanized in a pre-charged CO_2 saturated chamber and given a unique identification number according to the site, nest box, and date collected. It was frozen at -20° C until ready for dissection.

Nesting Activity

Table B.1.a.1 shows the proportional use of available nest boxes. Single clutches were observed in most nest boxes used for reproduction, however two boxes had two each. In the 13 nest boxes used for reproduction, 15 nest attempts were observed; nine in core sites and six in the periphery. 60.0% of all the nest attempts failed (9/15), 4/9 in the core (44.4%), and 5/6 in the periphery

(83.3%) (See Table B.1.a.2). European starlings attempted to nest 122 times in the nest boxes and there were seven northern flicker attempts. All non-kestrel nest attempts were removed to promote nesting of the target species.

Nest Box Usage	Core (12)	Periphery (10)	Total (22)
# of boxes used for reproduction	8	5	13
% Nest box used	66.7	50.0	59.1

Table B.1.a.1 FY 2013 American Kestrel nest box usage, RMANWR.

AK Nesting Activity	Core (12)	Periphery (10)	Total (22)
Nest Attempts	9	6	15
Abrupt Ends	4	5	9
% Nest Failures	44.4	83.3	60.0

Table B.1.a.2 FY 2013 American Kestrel nesting activity, RMANWR

Eggs Collected

The egg collection protocol changed slightly in FY 2011. Scott Klingensmith rescinded the changes (collection of the 1st egg laid in each clutch) because it was not in compliance with the Biological Monitoring Plan (BMP) requirement to collect one random egg from the clutch. Collection in FY 2013 continued to follow BMP protocols. In addition, review of the FY 2010 egg collections revealed opportunities to collect eggs lost due to clutch decline. To preclude lost opportunities to collect samples, standards were slightly modified to allow collection of a random egg from declining clutches with less than 5 eggs (per discussion between Scott Klingensmith and Brian Fairchild).

Lab Activities

Collected samples were prepared in the RMANWR lab and submitted for contaminant analysis following the reproductive season. Eggs were allowed to partially thaw at room temperature for approximately 30 – 45 minutes to allow removal of the shell. Egg content was transferred to certified-clean 2 oz. jars, labeled, chains of custody generated, and packaged for submission to the NWRC lab for contaminant analysis.

The American Kestrel nestling brain was removed from the individual and stored in a chemically cleaned jar at -20° C until sent to Southwest Research Institute (SWRI) in San Antonio, Texas for contaminant analysis. The sample was tracked with chain of custody information submitted electronically through the Army laboratory and a hard copy was delivered to SWRI with the sample.

Activity	Refuge-wide	Core	Periphery
Nest boxes Available	22	12	10
Nests initiated	15	9	16
Single Clutch	13	8	5
Second Clutch	2	1	1
# Successful Nests (clutches with ≥ 1 fledgling)	6	5	1
Total # Eggs Laid	59	39	20
Average Clutch Size per Nest	3.9	4.3	3.3
Total # Hatchlings	18	14	4
Hatching Success (#nestlings/ # eggs)	30.5%	35.9%	20.0%
Total # Fledglings	16	13	3
Reproductive Success (clutches with ≥ 1 fledgling/ #clutches)	27.1%	33.3%	15.0%

Table B.1.a.5 FY 2013 American kestrel summary activity data, RMANWR.

Summary Contaminant Data Analysis

Ten samples were submitted to SWRI, five each from core and periphery nests. Two sample results were over the No Observable Adverse Effect Concentrations (NOAEC) of 0.05 µg/g (one each from 11NW and 35NW), and none of these were greater than the Maximum Allowable Total Concentration (MATC) value of 1.0 µg/g. The dieldrin concentration in the hatchling's brain was 0.05 µg/g and did not exceed the MATC of 1.0 µg/g.

B.1.b. European Starling FY 2013

Sample Locations

The BMP identified 24 sites for placement of starling nest box arrays. These sites provided a representative number of arrays from each of the five Soil Remediation Types, described in the BMP as: None (No Remediation), Excavation (Priority 1 borrow area), Excavation and backfilled remediation sites, Tilled TRER Sites, and Engineered caps and covers. An additional site (35A), located west of Building 111, was included due to USFWS interest when samples collected from this array in previous years continued to have measurable levels of organochlorine pesticides despite several local clean up projects (excavation and backfill). This addition brings the total potential sites to be monitored to 25. An evaluation of the suitability of the four sites monitored in the 2013 field seasons included identifying areas of current construction and restoration activities as these can negatively affect habitat in the starling's foraging area.

In addition, an evaluation of the habitat within the estimated forage area was performed. Evaluation of nest box sites for suitable habitat is very important as starlings are omnivores and primarily feed insects to their young. Starlings are essentially grassland feeders and take invertebrates from foliage, the surface of the ground, and the upper few centimeters of the soil.

During breeding season and while feeding young, their diet consists almost entirely of invertebrates obtained from the surface or from the upper few centimeters of the soil of grass fields. Sparse habitat in the feeding range around the nest box arrays may result in a lower density of invertebrates and an increase in forage area which in turn may adversely impact nest box occupancy and nest success.

Four sites were monitored in FY 2012. The remediation strategy in the foraging range for each nest box array is listed in Table B.1.b.1, and a description of each remediation strategy can be found in the BMP. Each nest box array contains ten boxes. The two cap and cover arrays (1NC, 36SC), two of the tilled Terrestrial Residual Ecological Risk (TRER) arrays (25CC, 26NW), and three of the Priority 1 borrow area (excavation with no backfilling) arrays (23SC, 24SW, 26WC) were not monitored in FY's 2007, 2008, and 2009 because of remediation and restoration activities. In FY 2010, array 25CC (TRER) was the only one not monitored for the same reasons. Following the FY 2010 monitoring season, several arrays met BMP monitoring requirements (minimum three years) and nest-boxes were progressively closed (2SW, 4NC, 4SW, 6NC, 6NW, 7, 20NW, 20SE, 24NW, 26CC, 27, 30SW, 31SW, 35A, 35WC, 36NW), but not dismantled pending analytical results and guidance from regulatory agencies. Following FY 2011, an additional five arrays 1WC, 25NE, 4NC, 4SW, 24NW met BMP monitoring requirements and were closed but not dismantled. Additionally, during FY 2010, development of adequate habitat supporting nesting/ reproductive activity in Section 25 allowed installation of the array at site 25CC prior to the FY 2011 reproductive season. After FY's 2011 and 2012, all sites, except the four monitored in FY 2013, met the BMP requirements, and these four will meet the BMP requirements after this season, thus this will be the last year of biomonitoring at RMANWR.

Site ID	Remediation Strategy	Site ID	Remediation Strategy
23SC	Excavation (Priority 1 Borrow Area)	26NW	TRER
25CC	TRER	36SC	Caps and Covers

Table B.1.b.1. FY 2013 nest box arrays monitored in with remediation strategy for each array, RMANWR.

Nest Box Monitoring

An effort was made to monitor all nest boxes at least twice each week during the monitoring season. Information from each site was recorded on a nest box monitoring sheet, one of which was used for each monitoring date. Nest condition was rated 1-4 using the following criteria:

1 -no nesting material present
2 -some nesting material present but no nest cup formed
3 -partially formed nest cup present
4 -completely formed nest cup present

Other information recorded on the monitoring data sheet included the number of eggs present, number of chicks present, and the presence of any unhatched eggs or dead chicks. Abnormalities found during monitoring were recorded in the comments section of the nest box monitoring form. Results from nest visits and reproductive success endpoints derived from these data are summarized in the raw data files for this project. For further details on the procedures used for

nest box monitoring and analysis of reproductive endpoints, refer to the *U.S. Fish and Wildlife Service Rocky Mountain Arsenal National Wildlife Refuge Fiscal Year 1994 Annual Progress Report*, Appendix A.

Sample Collection

Starling nestlings were collected as close to 15 days post-hatch as possible, allowing for maximum potential exposure. At day 21, fledging occurs, and the starling young are independent of their parents. Some variability occurred in the collection of chicks due to holidays, weekends and workload, but chicks were at least 15 days of age at time of collection. Nestlings were euthanized in a pre-charged CO_2 saturated chamber and given a unique identification number according to the site, nest box and date collected. Whole birds were frozen at -20° C until ready for dissection. Brains were removed and stored in a chemically cleaned jar at -20° C until they were transported for chemical analyses at the Southwest Research Institute (SWRI) in San Antonio, Texas. Samples were tracked with chain of custody information submitted electronically through the Army laboratory and hard copies were delivered to SWRI with the samples.

Nesting Data

During FY 2013, all sites showed evidence of starling activity with various stages of nest building observed in most nest boxes (Table B.1.b.2). Individual nest boxes can be occupied for up to two complete cycles of nesting during the reproductive season (March-July). Occupation of nest boxes varied between the different sites and ranged from 14 to 18 nests initiated (a full clutch was laid) per site.

Site ID	Nests Initiated	Nests w/at Least One 15-day-old Chick	% Nests Initiated w/at Least One 15-day-old Chick
23SC	18	10	56
25CC	14	11	79
26NW	17	12	71
36SC	17	11	65
Totals	66	44	67

Table B.1.b.2. FY 2013 nesting activity in monitored arrays, RMANWR.

Summary Contaminant Data Analysis

Forty-three samples were submitted to SWRI in FY 2013. The target sample weight for a method detection limit of 0.05 µg/g is 1.0 gram. If a sample weight was less than 1.0 gram, the sample was analyzed with a resulting Detection Limit (DL) greater than 0.05 µg/g. The detection limit varies according to the sample weight with an increasing detection limit

associated with a decreasing sample weight. All samples had weights that were equal to or greater than 1.0 gram. Sample weights were variable as brain weight is dependent on the size of the nestling. No sample results were equal to or greater than the MATC value of 1.0 µg/g.

B.9. Direct Administrative Support of Service Staff

B.9.a. Direct Administration Support of Service Staff

Funding:

Biomonitoring and Remedy Funding	FF06RRKM00	FRRS17900660090
FLD		$849.31
FUEL		$2562.81
LABOR		$116,980.25
OFF		$608.66
OVERHEAD (17%)		$20,923.08
TRNG		$918.91
TRVL		$15.00
UNIF		$1,129.71
Total FY 2013 Army Funding		**$144,000**