2012 Nest Box Monitoring Report for the Upper Pajarito Canyon Watershed

INTRODUCTION

This report is a follow on to a 2010 report containing information on the cavity-nesting bird monitoring network in the upper Pajarito Canyon watershed (LANL 2010, 111221). Both of these reports address recommendations in the "Pajarito Canyon Investigation Report, Revision 1" (PCIR) (LANL 2009, 106939, p. 77) regarding continued monitoring of the nest box network in a portion of the Pajarito watershed. Specifically, the executive summary in the PCIR stated,

> A baseline ecological risk assessment conducted as part of this investigation evaluates the potential for adverse effects by assessing risks to insect-eating birds, plants, earthworms, aquatic invertebrates, and two threatened and endangered species: the Mexican spotted owl and the southwestern willow flycatcher. Multiple lines of evidence were used to evaluate potential adverse effects on these ecological receptors. Ecological effects data were collected using a cavity-nesting bird monitoring network, seedling germination tests, earthworm mortality tests, and sediment toxicity tests. The assessment lines of evidence are augmented by spatial modeling of wildlife exposure. The weight of evidence that these investigations provide indicates that no adverse effects to terrestrial and aquatic receptors exist from COPCs in the Pajarito watershed. However, there is only a short period of record in the bird monitoring network in the Pajarito watershed, and few samples of eggs or insects from this network have been analyzed to evaluate potential bioaccumulation. *Therefore, continued monitoring of the nest box network in the Pajarito watershed is recommended*. (*Emphasis added*)

The purpose of this report is to address uncertainties in exposure from chemicals of potential ecological concern (COPECs) for invertebrate-eating birds and summarize the potential for adverse effects on invertebrate-eating birds.

Analytical data were obtained from insect samples collected in the upper Pajarito Canyon watershed from 2009 to 2012 at Los Alamos National Laboratory (LANL or Laboratory), as specified in the approved "Nest Box Monitoring Plan for the Upper Pajarito Canyon Watershed" (the monitoring plan) (LANL 2009, 108170; NMED 2010, 109015). This report also addresses recommendations made in the approved "Nest Box Monitoring Report for the Upper Pajarito Canyon Watershed, Revision 1" (LANL 2010, 111221; NMED 2011, 111683). To obtain sufficient sample mass for metals and polychlorinated biphenyl (PCB) analyses, the recent collection period was extended for a year, as requested by the Laboratory (LANL 2011, 205234) and approved by the New Mexico Environment Department (NMED) (2011, 205984).

The study design COPECs for the cavity-nesting bird studies included in this report are cadmium, copper, lead, mercury, vanadium, and zinc, and the PCB mixtures Aroclor-1248 and Aroclor-1254 (or the associated PCB congeners in 2012), based on the evaluation presented in the PCIR (LANL 2009, 106939, p. 77). As discussed in the PCIR, insects collected from nest boxes in five sediment investigation reaches in 2007 were analyzed for inorganic COPECs. The concentrations of some COPECs in insects collected from a single location in reach AW-1 were greater than other Pajarito watershed insect samples and were outside the range of concentrations reported from other canyons (LANL 2009, 106939, Table 8.1-7). In addition, no analyses were obtained for mercury or PCBs because of insufficient sample mass. The single set of elevated metal results, the small number of samples, and the incomplete analytical suite resulted in uncertainties concerning potential ecological risk to these receptors. Therefore, additional analytical data were obtained from insect samples collected from 2009 to 2012 to address these uncertainties.

In the approval with modifications (NMED 2011, 111683) for the "Nest Box Monitoring Report for the Upper Pajarito Canyon Watershed, Revision 1" (LANL 2010, 111221), NMED provided the following modifications:

1. Semivolatile organic chemical analyses of nest box insects are not needed.
2. Although information on gender ratios was presented, eggshell thickness was listed in the Pajarito Biota investigation work plan and thus is to be addressed by LANL.
3. Additional data will be provided to supplement the conclusion of no adverse impacts in reach AW-1. These data will be reviewed by NMED.

This report addresses items 2 and 3.

APPROACH

The western bluebird (*Sialia mexicana*) (WEBL) is a cavity-nesting, sexually dichromatic thrush that is distributed throughout western North America. Starting in 1997, a nest box monitoring network for cavity-nesting birds was established at the Laboratory by placing nest boxes in potentially contaminated areas and areas of no known contamination. Insects collected from nest boxes in the Pajarito watershed occupied from 2009 to 2012 in reaches AW-1, PAS-1E, and TWSE-1W, which are close to contaminant sources, were analyzed for key COPECs, as allowed by available sample mass and target detection limits and as specified in the approved monitoring plan (LANL 2009, 108170). In addition, analyses were performed on insect samples collected from nest boxes on an adjacent mesa in Technical Area 14 (TA-14) or in proximity to reach PA-0 or upstream of reach TWN-1W, which serves as reference areas. The monitoring plan also specified analyses of insects collected from a downcanyon reach, PA-2W, but the sample mass was not sufficient for any analyses from this reach from 2009 to 2012. Nest box locations are shown in Figure 1, which is an update to Figure 8.1-1 of the PCIR (LANL 2009, 106939, p. 145).

Insects were sorted from other items collected from the nest boxes, weighed, and taxonomically identified before analysis. Insects from each reach were composited to provide adequate sample mass before submittal to analytical laboratories. The collection of sufficient insect sample mass is a process that is both time-consuming and spatially extensive. Insect materials have been collected from the Pajarito watershed nest boxes from 2007 to 2012 and yielded a total of 14 samples. Even with an expanded time frame for sample collection, between three and seven nest boxes have been composited to obtain sufficient sample mass. Therefore, the nest box insects provide useful site-specific information on exposure but with inherent limitations on the quantity and spatial/temporal characteristics of these data. As such data are spatial and temporal composites, they represent mean concentrations, and further statistical processing of these data for mean or upper confidence limit of mean concentrations is not reasonable.

Insect samples were analyzed for one or more analytical suites, depending on the available sample mass. For samples analyzed in 2010 (collected in 2009), metals analyzed by U.S. Environmental Protection Agency (EPA) Method 6010A (including cadmium, copper, lead, vanadium, and zinc) were obtained first, followed by mercury using EPA Method 7471 and PCBs (Aroclors) using EPA Method 8082, if sufficient sample mass was available. The target detection limits are specified in the approved monitoring plan (LANL 2009, 108170). The insect samples were analyzed in 2012 (collected from 2010 to 2012) using EPA Method 1668A for PCB congeners. Table 1 presents dry weights for insects collected from each area from 2009 to 2012 and analyses performed.

ANALYTICAL RESULTS AND EXPOSURE EVALUATION

The insects collected from nest boxes in the three Pajarito reaches and the TA-14 reference area in 2009 had sufficient mass for analyses of metals using EPA Method 6010A and mercury using EPA Method 7471. In addition, sufficient sample mass was available to analyze the insects collected from reach TWSE-1W for PCBs using EPA Method 8082. These data were presented as Attachment 1 to "Nest Box Monitoring Report for the Upper Pajarito Canyon Watershed, Revision 1" (LANL 2010, 111221).

Because of the limited sample mass available for the insects collected and analyzed in 2012, only PCB congener analysis using EPA Method 1668A was conducted. Sample mass was not sufficient for metal analyses for the 2012 samples. This represents a deviation from the plan as stated in the "Nest Box Monitoring Report for the Upper Pajarito Canyon Watershed, Revision 1" (LANL 2010, 111221, p. 3). The PCB congener data are presented as Attachment 1 (on CD included with this document).

Table 2 presents a comparison of metals concentrations in the 2009 samples with previous data obtained from the Pajarito watershed in 2007 (LANL 2009, 106939) and the Mortandad watershed or reference locations in 2005 (Colestock 2007, 102994). The concentrations of all metals in this table from the 2007 AW-1 samples, except copper, were higher than all other samples collected between 2005 and 2009, showing that the 2007 AW-1 results were anomalously high and were not reproduced in the 2009 samples. The concentrations reported for the 2009 insect samples were within the range of values reported from the Mortandad watershed, with the exception of cadmium and lead, which were highest in reach AW-1. Therefore, the analytical data from samples collected in 2009, in combination with the 2007 data, indicate elevated cadmium and lead in insects in this reach. These metals also have higher concentrations in sediment samples from reach AW-1 than the other reaches sampled for insects (LANL 2009, 106939). Figure 2 shows the concentrations in Pajarito nest boxes compared with all reference locations (TA-14, Cañada del Buey, Cemetery, Golf Course) for cadmium, copper, mercury, and vanadium. There were no statistical differences from reference mean concentrations based on the Dunnett's test. Figure 3 shows the concentrations for lead and zinc in insects. These data are plotted with and without the extreme outlier value from reach AW-1. The extreme outliers for both lead and zinc were from reach AW-1 (Figures 3a, 3c). There was a statistically greater concentration of lead in insects in the Pajarito watershed (without the outlier) compared with reference nest box insect concentrations (Dunnett's test, Figure 3b). No statistical difference was noted for zinc when the outlier was removed (Dunnett's test, Figure 3d).

Table 3 presents a summary of the total PCB congener concentrations and the 2,3,7,8-tetrachlorodibenzodioxin– (TCDD-) equivalent concentrations calculated for the 2012 nest box insect analysis. The TCDD-equivalent concentration data were calculated using the TCDD toxicity equivalent factors (TEFs) for birds in Van den Berg et al. (1998, 106987), and the TEFs are presented in Table 4.

The potential dose to robins as representative invertebrate-eating birds was calculated using the metal concentrations in the nest boxes insects analyzed in 2007 or 2010 following the process used in previous investigations (LANL 2009, 106939). The equation for calculating hazard quotients (HQs) was presented in section 8.1.3.2 of the PCIR (LANL 2009, 106939, p. 74), and exposure parameters for the robin are from the screening-level ecological risk assessment methods document (LANL 2012, 226715, p. 28) and are listed in Appendix E-1.0 of the PCIR (LANL 2009, 106939). The toxicity reference values (TRVs) used for the robin are from the ECORISK Database, Version 3.1 (LANL 2012, 226667), except for the avian TCDD TRV, which is from the ECORISK Database, Version 2.0 (LANL 2003, 080117). The TRVs for cadmium, copper, and zinc in the latest version of the database differ from those used in the PCIR (although none of these TRVs had significant changes). In addition to HQs calculated using the no

observed adverse effect level (NOAEL) TRVs, a lowest observed adverse effect level (LOAEL) HQ analysis was also conducted.

Table 5 shows the calculated HQs for the robin based on exposure to concentrations measured in nest box insects. In all cases, there is a single sample result for insects in each reach for a given year.

The HQs for the insect ingestion pathway indicate a potential for adverse ecological effects for the metals based on HQs greater than 1 for the NOAEL and LOAEL. HQs greater than 1 were observed for all reaches or locations where insects were sampled (AW-1, PAS-1E, PA-2W, PA-3E, TWSE-1W, TA-14 mesa, PA-0, and upstream of TWN-1W). The last three locations are reference areas for comparison with the Pajarito watershed reaches. All of the HQs for the TCDD-equivalent concentrations were less than 0.01.

Calculating exposure to be greater than the effect level (as the HQ >1 indicates) is one factor in establishing a link between contamination and ecological effects. Another consideration is the relationship of exposure to potential contamination sources. In the Pajarito watershed, reaches AW-1, PAS-1E, and TWSE-1W are closest to contaminant sources and, therefore, are expected to have greater levels of contamination than the other reaches. Reaches AW-1 and PAS-1E have the highest exposure concentrations and HQs for the 2007 insect pathway results for five of the six COPECs (all but copper) (Table 5). This trend does not hold for the majority of the 2009 insect sample results, and potential exposures (HQs) are comparable for four of the six COPECs (copper, mercury, vanadium, and zinc). However, insect concentrations of cadmium and lead in 2009 are greatest in reach AW-1, with lower concentrations reported in reach PAS-1E and other locations (Table 5). Therefore, concentrations of cadmium and lead in insects represent a potential for adverse ecological effects (based on the HQ >1), and their distribution is consistent with a Laboratory source. Other than the 2007 samples in reach AW-1, the LOAEL-based HQs for cadmium and lead were equivalent to or less than 1.

In summary, the exposure evaluation results for 2009 also show that two inorganic COPECs (cadmium, mercury) have LOAEL-based HQ equal to or less than 1 for all samples and two inorganic COPECs (copper, vanadium) have LOAEL-based HQs greater than 1 for all samples. However, as shown in Figure 2, neither copper nor vanadium insect concentrations are greater than reference site concentrations. This indicates no difference in risk from these COPECs between the Pajarito reaches and reference locations. Only two inorganic COPECs, lead and zinc, had a LOAEL HQ and a concentration greater than the reference sites in 2007. However, neither lead nor zinc was elevated in samples collected after 2007. It was a nest box sample from reach AW-1 in 2007 for lead and zinc that was the reason for the extended monitoring of nest box insects and associated reproductive measures.

NEST BOX REPRODUCTIVE MEASURES

Data have been collected for reproductive parameters, including eggshell thickness, for years 1997–2011 for watersheds located on the Pajarito Plateau. The design and analysis of these data have been reported in a number of publications, including Colestock and Fair (2005, 093691); Fair and Colestock (2003, 098046); Fair and Myers (2002, 082655); and Fair and Sommer (2002, 098047). The averages for the reproductive measurements across the complete monitoring record for the western bluebird are presented in Table 6 for each watershed. These data have not been previously published.

Eggshell thickness. Previous studies at the Laboratory showed more variation with the eggshell index for the western bluebirds in regards to location, ranging from 11.3 to 18.2 for the eggshell index ($F_{6, 72} = 3.33$, $p = 0.007$) (Fair and Myers 2002, 082655). The analysis of the 1997–2011 data shows no difference in eggshell thickness between locations, including locations in the Pajarito watershed. There

was also no decrease in the thickness of the Pajarito watershed eggshells compared with reference locations (In Figure 4, Dunnett's shows that Pajarito eggshells are thicker than reference locations).

Hatch date. Julian hatch was variable over the 15 yr of monitoring for the western bluebird, showing a pattern of breeding earlier later in the study, although the years were different ($F_{14,930}$ = 9.30, P <.0001). The canyon dates for hatched western bluebirds varied for the WEBL ($F_{11, 784}$ = 2.45, P = 0.005). The six canyons that had earlier hatching western bluebirds were the six lowest elevation locations in the study, with Pajarito watershed having breeding birds later because of the higher elevation.

Clutch size. Clutch size did not show a pattern of an increase or decrease over the 15 yr of the study; however, significant annual variation in the number of eggs laid for the WEBL (F_{14} = 3.69, P < 0.0001) was evident. Clutch size tended to decrease over the breeding season and varied with the location of the canyon for the WEBL (F_{11} = 2.17, P = 0.01), with Pajarito watershed not being significantly different from the majority of other locations (Sandia and Water watersheds have the smallest clutch size). Clutch size was not affected by the distance to a solid waste management (SWMU) or area of concern (AOC) for the WEBL ($F_{1, 356}$ = 0.38. P = 0.54). Clutch size also did not vary with the type of SWMU/AOC or between potentially contaminated sites and sites farther away.

Hatching success. The overall average hatching rate over all years was 71.9% (standard deviation = 38.2) for the WEBL. The lowest year for the WEBL was 2010, with a total of 52.3% of eggs hatching. The number of eggs hatching for the WEBL were highest in 2005 and 2006, with 86% and overall the differences between years was large ($F_{14.912}$ = 4.18, P < 0.0001).

Fledging success. The overall average fledging success of the WEBL was 67.6% (standard deviation = 43.9). The lowest fledging rate for the WEBL was in 2001 with only 50.4% of the nestlings fledging and the highest year was in 1997 with 85.6%. No clear patterns for annual variation with fledgling rate were evident. The WEBL had significant annual variation in fledgling success (F = 2.10, P = 0.01), but this did not vary with hatch date (F = 0.01, P = 0.91). The fledgling rate of was not correlated with watershed (F = 1.5, P = 0.22).

In summary, the variability of the nest box monitoring results are related to a number of environmental factors such as drought, fire, or elevation (Fair and Sommer 2002, 098047; Fair and Colestock 2003, 098046) but are not related to proximity to SWMU/AOC, nor do the nest box measures in the Pajarito watershed differ in any substantial way from other watersheds.

WEIGHT OF EVIDENCE

Table 7 presents the weight of evidence for the avian ground invertevore assessment endpoint. Lines of evidence for evaluating risks to cavity-nesting birds include field measures of nest success, which have not identified any potential ecological risk to birds in the Pajarito watershed. For example, robust evaluations based on a long record of observations of sex ratios of fledgling birds have shown no statistically significant differences in sex ratios between canyons or watersheds (Fair et al. 2009, 106686). Thus, there is no indication of contaminant effects on sex ratios or eggshell thickness across the monitoring network or on the field measures of nest success evaluated in this report (Table 6). Overall, the weight of evidence indicates COPECs in the Pajarito reaches do not pose a potential risk to population abundance or persistence and species diversity of avian ground invertevore feeding guild species.

This conclusion is not affected by the lack of additional metals data from nest box insects. The samples collected in 2009 and presented in the 2010 report represented a more comprehensive temporal and spatial coverage of the upper Pajarito watershed (LANL 2010, 111221, p. 5). Qualitative evidence for a

viable community of birds is also indicated by the high occupancy rate of nest boxes in the upper Pajarito watershed as well as the lack of differences in other reproductive measures, gender ratios, and eggshell thicknesses in the Pajarito watershed compared with other watersheds or reference locations (Figure 4 and Table 6).

In conclusion, further characterization of cavity-nesting birds and their food for metals and PCBs in the Pajarito watershed reaches is not warranted based on the exposure evaluation calculated using nest box insects collected from 2009 to 2012 (Table 5). The total PCB concentration for insects from the reach with the highest concentrations in sediment, AW-1, was 0.00527 mg/kg, which is comparable with the two reference sites (reach PA-0 and upstream of reach TWN-1W) as well as other Pajarito reaches. This concentration of PCBs does not indicate potential risks to the avian ground invertevore population in the Pajarito watershed.

REFERENCES

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the New Mexico Environment Department Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

Colestock, K.L., 2007. "Landscape Scale Assessment of Contaminant Effects on Cavity-Nesting Birds," master's thesis for a Master of Science in Ecology, Utah State University, Logan, Utah. (Colestock 2007, 102994)

Colestock, K.L., and J.M. Fair, 2005. "Avian Individual and Population Health on Los Alamos National Laboratory 2005: Foraging Effects and Egg Contaminant Residues," Los Alamos National Laboratory document LA-UR-05-7272, Los Alamos, New Mexico. (Colestock and Fair 2005, 093691)

Fair, J.M., and K. Colestock, 2003. "Avian Individual and Population Health on Los Alamos National Laboratory 2003: Large-Scale Piñon Pine Tree Mortality Impacts and Egg Contaminant Residues," Los Alamos National Laboratory document LA-UR-04-1625, Los Alamos, New Mexico. (Fair and Colestock 2003, 098046)

Fair, J.M., and O.B. Myers, 2002. "Early Reproductive Success of Western Bluebirds and Ash-Throated Flycatchers: A Landscape-Contaminant Perspective," *Environmental Pollution,* Vol. 118, pp. 321-330. (Fair and Myers 2002, 082655)

Fair, J.M., R.T. Ryti, M.D. Jankowski, and S.L. Reneau, August 10, 2009. "Sex Ratio and Contaminant Impacts on Reproduction: Adaptive and Environmental Constraints," Los Alamos National Laboratory document LA-UR-09-05092, Los Alamos, New Mexico. (Fair et al. 2009, 106686)

Fair, J.M., and T. Sommer, 2002. "Avian Individual and Population Health on Los Alamos National Laboratory 2002: Drought Conditions, Fire Effects, and Ecological Screening Levels," Los Alamos National Laboratory document LA-UR-04-1624, Los Alamos, New Mexico. (Fair and Sommer 2002, 098047)

LANL (Los Alamos National Laboratory), November 2003. "Ecorisk Database (Release 2.0)," on CD, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2003, 080117)

LANL (Los Alamos National Laboratory), August 2009. "Pajarito Canyon Investigation Report, Revision 1," Los Alamos National Laboratory document LA-UR-09-4670, Los Alamos, New Mexico. (LANL 2009, 106939)

LANL (Los Alamos National Laboratory), December 2009. "Nest Box Monitoring Plan for the Upper Pajarito Canyon Watershed," Los Alamos National Laboratory document LA-UR-09-8073, Los Alamos, New Mexico. (LANL 2009, 108170)

LANL (Los Alamos National Laboratory), November 2010. "Nest Box Monitoring Report for the Upper Pajarito Canyon Watershed, Revision 1," Los Alamos National Laboratory document LA-UR-10-7429, Los Alamos, New Mexico. (LANL 2010, 111221)

LANL (Los Alamos National Laboratory), August 15, 2011. "Request for Extension for the Submittal of Nest Box Monitoring Report for the Upper Pajarito Canyon Watershed," Los Alamos National Laboratory letter (EP2011-0275) to J.E. Kieling (NMED HRMB) from M.J. Graham (LANL) and G.J. Rael (DOE-LASO), Los Alamos, New Mexico. (LANL 2011, 205234)

LANL (Los Alamos National Laboratory), October 2012. "Ecorisk Database (Release 3.1)," on CD, LA-UR-12-24548, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2012, 226667)

LANL (Los Alamos National Laboratory), November 2012. "Screening-Level Ecological Risk Assessment Methods, Revision 3," Los Alamos National Laboratory document LA-UR-12-24152, Los Alamos, New Mexico. (LANL 2012, 226715)

NMED (New Mexico Environment Department), February 12, 2010. "Notice of Approval, Nest Box Monitoring Plan for the Upper Pajarito Canyon Watershed," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2010, 109015)

NMED (New Mexico Environment Department), January 14, 2011. "Notice of Approval with Modifications, Nest Box Monitoring Report, Revision 1, for the Upper Pajarito Canyon Watershed," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 111683)

NMED (New Mexico Environment Department), August 19, 2011. "Approval of Time Extension Request, Upper Pajarito Canyon Watershed Nest Box Monitoring Report," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 205984)

Van den Berg, M., L. Birnbaum, A.T.C. Bosveld, B. Brunström, P. Cook, M. Feeley, J.P. Giesy, A. Hanberg, R. Hasegawa, S.W. Kennedy, T. Kubiak, J.C. Larsen, F.X.R. van Leeuwen, A.K.D. Liem, C. Nolt, R.E. Peterson, L. Poellinger, S. Safe, D. Schrenk, D. Tillit, M. Tysklind, M. Younes, F. Wærn, and T. Zacharewski, December 1998. "Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife," *Environmental Health Perspectives,* Vol. 106, No. 12, pp. 775–792. (Van den Berg et al. 1998, 106987)

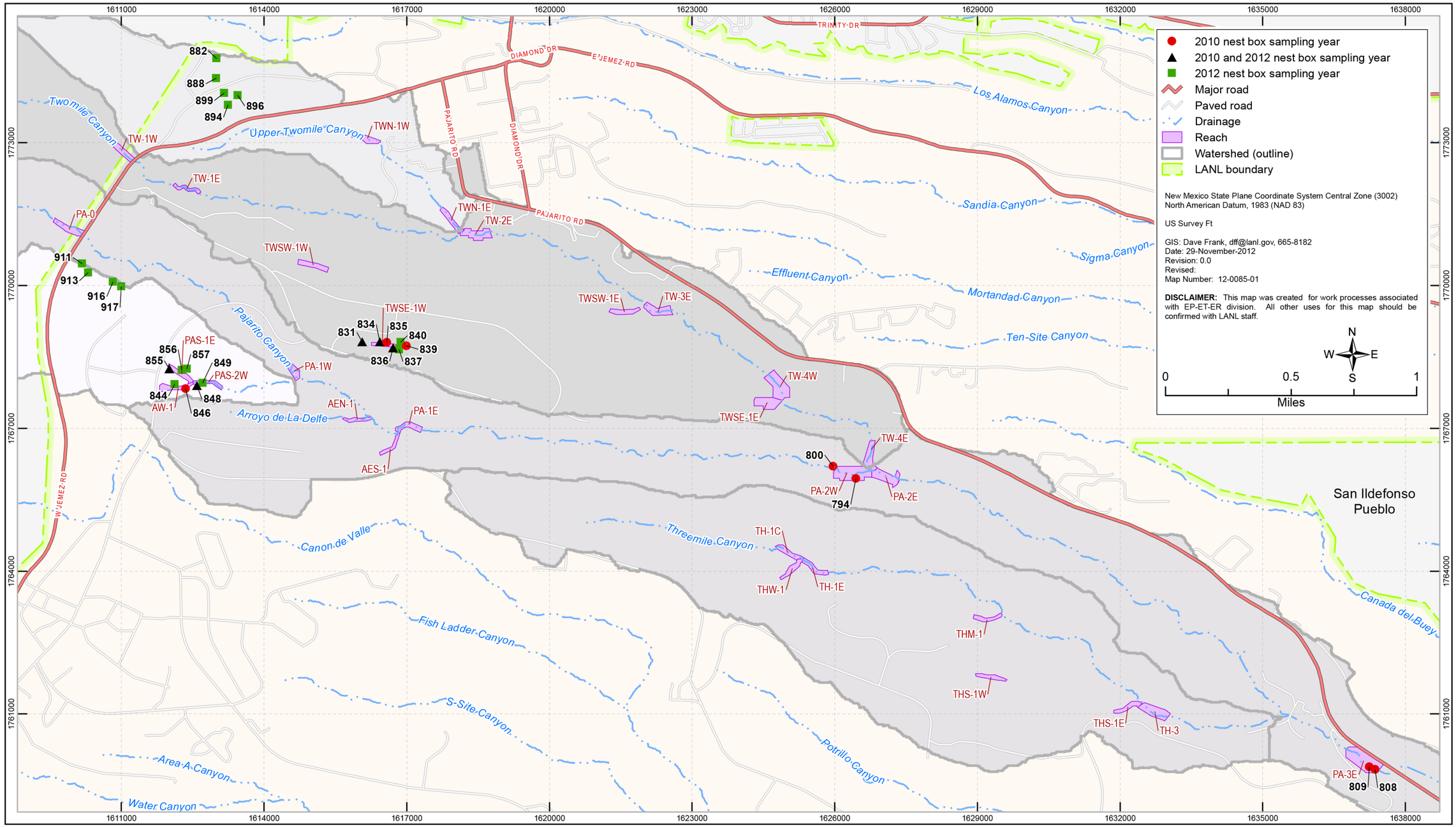
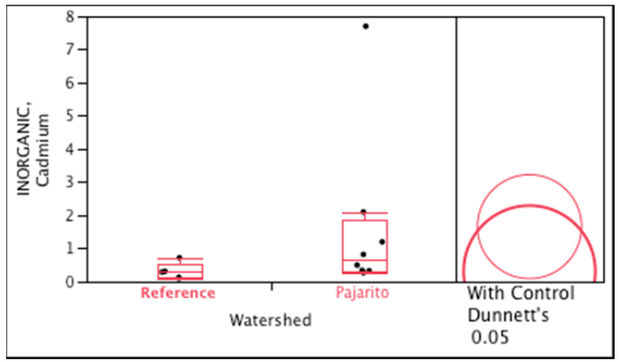
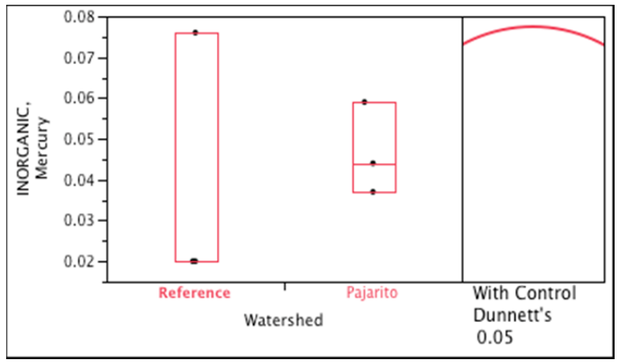
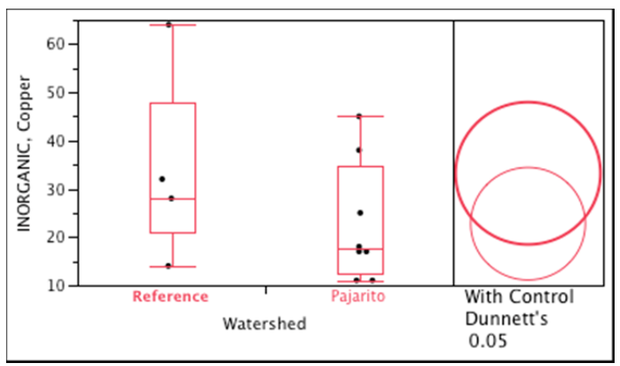


Figure 1 Map showing nest box locations for 2010 and 2012 reports

(a)


(c)


(b)


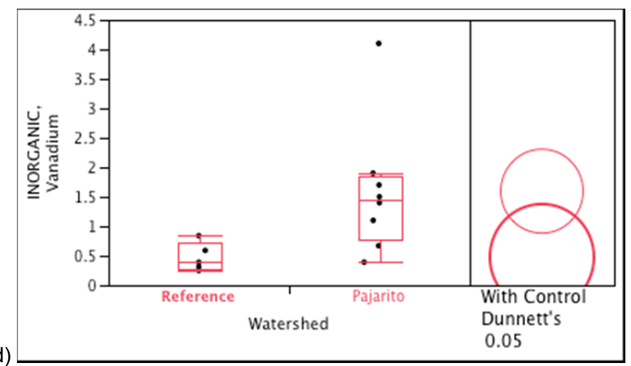
(d)


Figure 2 Concentrations of metal COPECs in nest box insects compared with reference locations: (a) cadmium, (b) copper, (c) mercury, and (d) vanadium

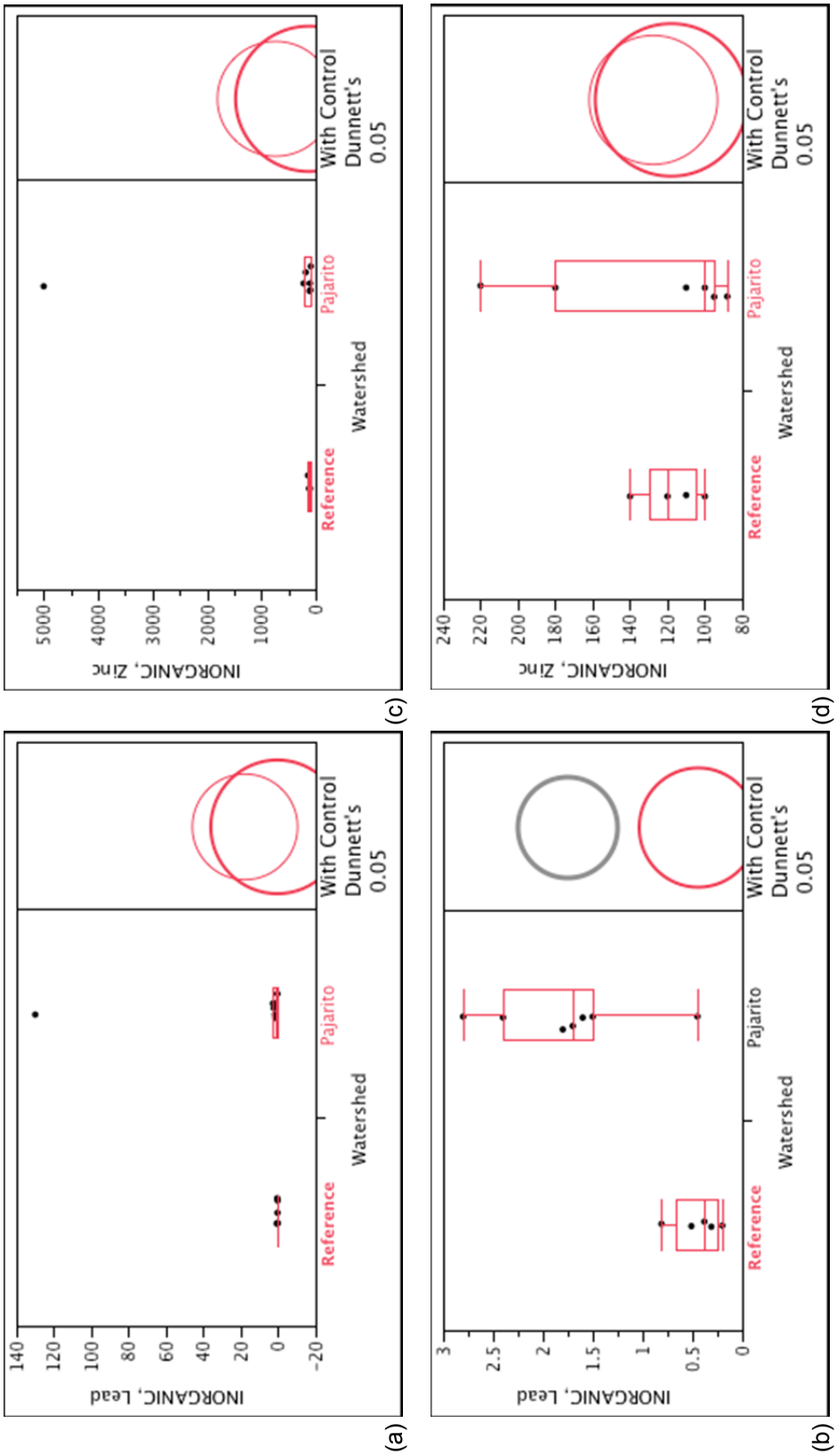


Figure 3 Concentrations of metal COPECs in nest box insects with and without reach AW-1 outlier concentration compared to reference locations: (a) lead, all data; (b) lead without reach AW-1 outlier; (c) zinc, all data; and (d) zinc without reach AW-1 outlier

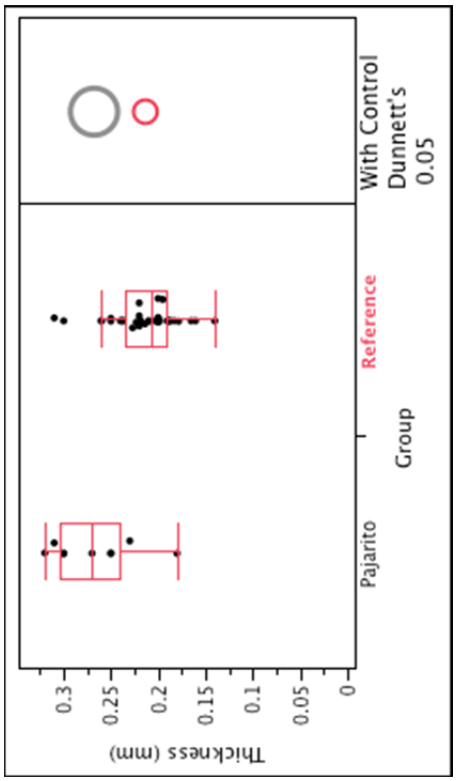


Figure 4 Comparison of western bluebird eggshell thickness in Pajarito Canyon with reference locations

Table 1
Nest Box Insect Samples Collected and Analyses Performed

Collection Year (Analysis Year)	Area	Sample ID	Location ID	EPA 6010A Metals and EPA 7471 Mercury	PCBs EPA 8082	PCBs EPA 1668A	Nest Box Numbers	Sample Weight (g)	Average Sample Weight per Box (g)
2009 (2010)	Reach AW-1	CAPA-10-15045	PA-611896	X	—*	—	843, 844, 845, 847, 848	2.25	0.45
	Reach PAS-1E	CAPA-10-15046	PA-611897	X	—	—	850, 852, 854, 855, 856, 857	2.50	0.42
	Reach TWSE-1W	CATW-10-15049	TW-611900	X	X	X	831, 832, 833, 834, 835, 836, 837, 839, 840, 841	7.92	0.79
	TA-14 mesa–Reference	CAPA-10-15048	PA-611899	X	—	—	823, 826, 827, 830	2.20	0.55
2010 to 2012 (2012)	Reach TWSE-1W	CAPA-13-24796	Pajarito Canyon	—	—	X	840, 836, 834, 831, 837	2.75	0.55
	Reach PA-0–Reference	CAPA-13-24797	Pajarito Canyon	—	—	X	911, 913, 916, 917	1.99	0.50
	Upstream reach TWN-1W–Reference	CAPA-13-24798	Pajarito Canyon	—	—	X	882, 888, 894, 896, 899	4.18	0.84
	Reach PAS-1E	CAPA-13-24799	Pajarito Canyon	—	—	X	855, 856, 857	2.36	0.79
	Reach AW-1	CAPA-13-24800	Pajarito Canyon	—	—	X	844, 848, 849	3.37	1.12

*— = No analyses performed.

Table 2
Comparison of Metal Concentrations in Insects

COPEC	Reach AW-1 2009 Concentration (mg/kg)	Reach AW-1 2007 Concentration (mg/kg)	2009 Concentration Range (mg/kg)	2007 Concentration Range, Excluding AW-1 (mg/kg)	2005 Concentration Range[a] (mg/kg)
Cadmium	2.1	7.7	0.29–2.1	0.27–1.2	0.015–0.72
Copper	11	38	11–17	11–45	0.85–93
Lead	2.8	130	0.81–2.8	0.45–1.7	0.024–1.8
Mercury	0.044	—[b]	0.037–0.076	—	—
Vanadium	0.67	4.1	0.59–1.9	0.39–1.5	0.24–3.6
Zinc	95	5000	95–120	88–220	8.6–210

[a] Colestock 2007, 102994.

[b] — = No data.

Table 3
Total PCB Congener and Dioxin Equivalent Concentrations in Insects

Sample ID	Reach	Total PCBs (mg/kg)	TCDD-Equivalent Concentration (mg/kg)
CAPA-13-24796	TWSE-1W	0.0203	2.2E-08
CAPA-13-24797	PA-0	0.00421	5.7E-09
CAPA-13-24798	Upstream TWN-1W	0.00819	4.8E-09
CAPA-13-24799	PAS-1E	0.00406	6.7E-09
CAPA-13-24800	AW-1	0.00527	6.4E-09

Table 4
Bird TCDD TEFs

PCB Congener	TEF[a]
PCB-77	0.05
PCB-81	0.1
PCB-105	0.0001
PCB-114	0.0001
PCB-118	0.00001
PCB-123	0.00001
PCB-126	0.1
PCB-156/157[b]	0.0001
PCB-167	0.00001
PCB-169	0.001
PCB-189	0.00001

[a] TEF values are from Van den Berg et al. (1998, 106987).

[b] Coeluting congeners; they have the same TEF.

Table 5
Exposure Evaluation for the Robin Based on the Insect Pathway

COPEC	Analysis Year	Reach	Sample Result (mg/kg)	NOAEL HQ	LOAEL HQ
Cadmium	2007	AW-1	7.7	8.0	0.8
		PAS-1E	1.2	1.2	0.1
		PA-3E	0.82	0.8	0.1
		TWSE-1W	0.33	0.3	<0.1
		PA-2W	0.27	0.3	<0.1
	2010	AW-1	2.1	2.2	0.2
		PAS-1E	0.5	0.5	<0.1
		TWSE-1W	0.34	0.4	<0.1
		TA-14 mesa	0.29	0.3	<0.1
Copper	2007	PA-3E	45	16.9	5.7
		AW-1	38	14.3	4.8
		PA-2W	25	8.4	3.1
		TWSE-1W	18	6.8	2.3
		PAS-1E	11	4.1	1.4
	2010	PAS-1E	17	6.4	2.1
		TWSE-1W	17	6.4	2.1
		TA-14 mesa	14	5.3	1.8
		AW-1	11	4.1	1.4
Lead	2007	AW-1	130	121	61
		PAS-1E	1.7	1.6	0.8
		TWSE-1W	1.6	1.5	0.7
		PA-3E	1.5	1.4	0.7
		PA-2W	0.45	0.4	0.2
	2010	AW-1	2.8	2.6	1.3
		PAS-1E	2.4	2.2	1.1
		TWSE-1W	1.8	1.7	0.8
		TA-14 mesa	0.81	0.8	0.4
Mercury	2010	TA-14 mesa	0.076	6.1	0.6
		TWSE-1W	0.059	4.7	0.5
		AW-1	0.044	3.5	0.4
		PAS-1E	0.037	3.0	0.3

Table 5 (continued)

COPEC	Analysis Year	Reach	Sample Result (mg/kg)	NOAEL HQ	LOAEL HQ
Vanadium	2007	AW-1	4.1	18.1	9.1
		PAS-1E	1.5	6.6	3.3
		TWSE-1W	1.4	6.2	3.1
		PA-3E	1.1	4.9	2.4
		PA-2W	0.39	1.7	0.9
	2010	TWSE-1W	1.9	8.4	4.2
		PAS-1E	1.7	7.5	3.8
		AW-1	0.67	3.0	1.5
		TA-14 mesa	0.59	2.6	1.3
Zinc	2007	AW-1	5000	115	11
		PA-3E	220	5.1	0.5
		PAS-1E	180	4.1	0.4
		PA-2W	100	2.3	0.2
		TWSE-1W	88	2.0	0.2
	2010	TA-14 mesa	120	2.8	0.3
		TWSE-1W	110	2.5	0.3
		PAS-1E	100	2.3	0.2
		AW-1	95	2.2	0.2
PCB congeners (TCDD equivalents)	2012	TWSE-1W	2.2E-08	<0.01	<0.01
		PAS-1E	6.7E-09	<0.01	<0.01
		AW-1	6.4E-09	<0.01	<0.01
		PA-0	5.7E-09	<0.01	<0.01
		Upstream TWN-1W	4.8E-09	<0.01	<0.01

Note: Cells are highlighted if the HQ is >1.

Table 6
Average Western Bluebird
Reproductive Measurements and Elevation by Watershed from 1997–2011

Watershed	Number Original Boxes	Clutch Size	Hatching Success (%)	Fledgling Success (%)	Percent Female	Julian Hatch Date	Elevation (ft)
Ancho Canyon	18	4.7	82.8	34.9	0.43	164	6306
Bayo Canyon	82	4.5	88.0	94.7	0.47	165	6713
Cañada del Buey	29	4.7	90.1	92.0	0.40	154	6954
DP Canyon	12	4.7	95.0	96.7	0.47	160	7040
Los Alamos Canyon	112	4.6	91.2	75.5	0.45	171	6555
Mortandad Canyon	111	4.5	87.3	85.1	0.48	157	6864
Pajarito Canyon	76	4.7	93.6	95.6	0.41	161	7497
Pueblo Canyon	61	4.6	87.3	87.9	0.44	161	6523
Rendija Canyon	50	4.8	91.3	91.8	0.43	161	7194
Sandia Canyon	33	4.4	77.0	65.0	0.35	169	6922
Water Canyon	39	4.3	80.0	91.8	0.62	173	6292

Table 7
Weight of Evidence and Rationale for Avian Ground Invertevores

Line of Evidence	Weight of Evidence Criteria	Result
(1) Nest box study—Compare the measured concentrations of COPECs in insects with the TRV for the robin with the invertevore diet	Medium	Exposure through food to robin was evaluated based on measured COPEC concentrations in nest box insects. Two metals (lead and zinc) had LOAEL HQs >1 in a single reach and collection period. Later recollection of insects could not verify original lead and zinc results. Two other metals (copper and vanadium) had HQs >1 in all reaches, but concentrations were not different from HQs for reference locations. PCB congeners had HQs <1 in all reaches.
(2) Nest box study—Determine nest success rate by bluebirds along a gradient of COPEC concentrations in the Pajarito watershed	Medium (new boxes)	Percent fledged and percent female nestlings were not different between Pajarito watershed reaches or between Pajarito watershed and reference locations, indicating no effect on population (measured as nest success).
(3) Nest box study—Determine eggshell thickness for bluebirds along a gradient of COPEC concentrations in Pajarito watershed	Medium	Egg size (length and weight) and eggshell thickness were not different between Pajarito reaches or between Pajarito and reference locations, indicating no effect on nest success.
(4) Nest box study—Compare COPEC concentrations in eggs within Pajarito watershed and also compare concentrations with “reference” locations	Medium-low	Uncertain; no eggs were sampled in Pajarito reaches
(5) Modeled and measured concentrations in food (earthworm bioaccumulation test)—Determine if exposure concentrations differ within the watershed in relation to sediment concentrations; design used a gradient in COPEC concentrations with the Pajarito watershed and also compared concentrations with “reference” locations	Medium	NOAEL HQs based on PCB Aroclor and metal concentrations in earthworms in 2007 indicated that some COPECs may have potential ecological risk to avian ground invertevores. LOAEL HQs were not calculated.
(6) Comparison of concentrations in sediment samples to ecological screening levels (ESLs)	Low	Screening of sediment data against ESLs identified study design COPECs and the potential for adverse effects on this receptor.

Attachment 1

Polychlorinated Biphenyl Congener Data
(on CD included with this document)