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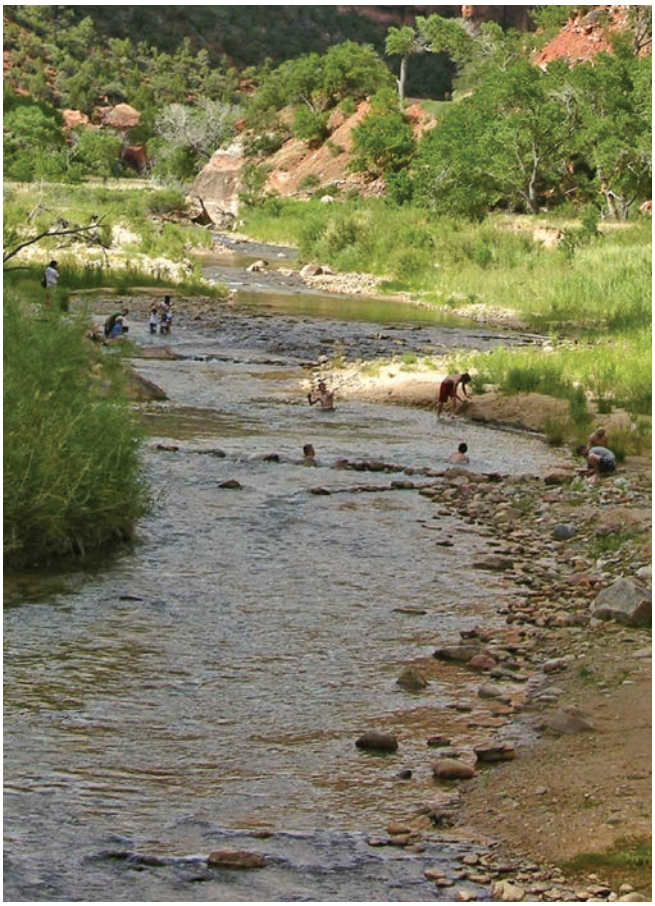
Natural Resource Stewardship and Science

Screening for Contaminants of Emerging Concern in the Northern Colorado Plateau Network, 2014

Natural Resource Report NPS/NCPN/NRR—2015/1040



ON THE COVER

Water sampling (left) and water play (right) at the Grotto, Zion National Park. NPS photo.

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September 2015

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Weissinger, R. 2015. Screening for contaminants of emerging concern in the Northern Colorado Plateau Network, 2014. Natural Resource Report NPS/NCPN/NRR—2015/1040. National Park Service, Fort Collins, Colorado.

NPS 960/129912, September 2015

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Executive Summary

In 2014, as part of an ongoing screening program for contaminants of emerging concern (CECs) in conjunction with the Environmental Protection Agency (EPA) Region 8, surface waters at 16 locations in and near seven national park units of the Northern Colorado Plateau Network (NCPN) were sampled two times for pesticides and pesticide degradation products, pharmaceuticals and personal care products, and wastewater indicators. Overall, detection frequencies and concentrations were low, and detections were more frequent in spring (April and May) samples than in fall (September and October) samples.

The Colorado River at the Potash boat ramp, just upstream of Canyonlands National Park, had the most analytes detected and continued to show chronic contamination by caffeine, the pesticide 2,4-D, and prescription drugs (gabapentin, lamotrigine, metformin, and sulfamethoxazole). Middle Cave Lake, at Timpanogos Cave National Monument, continued to show chronic contamination by the insect repellent, DEET. Two springs and an intermittent stream at Arches National Park showed surprisingly high numbers and concentrations of analytes relative to the other 15 NCPN sites sampled in 2014.

This is an interim report. Sampling will continue in 2015, with the continuation of surface-water sampling and bed-sediment sampling in coordination with the U.S. Geological Survey (USGS). A final report is expected upon completion of the USGS project in 2017.

Acknowledgements

Many thanks to Kristen Keteles (Environmental Protection Agency [EPA] Region 8); Colleen Flanagan (National Park Service [NPS] Air Resources Division), and Pete Penoyer (NPS Water Resources Division), for coordinating support for this project. Ken Dahlin, EPA Region 8 laboratory manager, provided invaluable expertise in analyzing samples and interpreting quality assurance results. Andy Armstrong (Timpanogos Cave National Monument), Mary Moran (Canyonlands National Park) and Tamara Naumann (Dinosaur National Monument) assisted with field logistics. Paul Bradley and Bill Battaglin (U.S. Geological Survey) collected samples. Kerensa King (NPS), Dusty Perkins (NPS Northern Colorado Plateau Network), and Bill Battaglin improved this report with their thoughtful reviews.

1 Introduction

The Northern Colorado Plateau Network (NCPN) provides long-term monitoring and other natural-resource data to 16 National Park Service (NPS) units throughout Utah, western Colorado, southern Wyoming, and northern Arizona. In 2010, in cooperation with the Environmental Protection Agency (EPA) Region 8, the NCPN began screening selected surface waters at a subset of parks for pesticides, pesticide degradation products, and wastewater indicators.

After a sampling hiatus in 2011, pharmaceuticals and personal care products (PPCPs) were added to the analytical suite in 2012. All of these groups of analytes, collectively known as contaminants of emerging concern (CECs), have been detected in a variety of NCPN waters from 2010 to 2013 (Weissinger et al. 2013; Weissinger 2014). CECs are trace organic compounds that are not commonly tested for during routine water quality monitoring but may have adverse effects on aquatic and terrestrial life at very low (parts per billion) concentrations (Battaglin and Kolok 2014).

In 2014, the U.S. Geological Survey (USGS) expanded the project to include hormones in water and sediment and CECs in sediment to track the source, movement, and fate of CECs in aquatic environments. This is an interim report on results of surface-water samples processed through the EPA Region 8 laboratory in 2014. For more details on the background of this project, see Weissinger and others (2013) and Weissinger (2014). A report integrating surface-water and sediment data is expected at the conclusion of the USGS project in 2017.

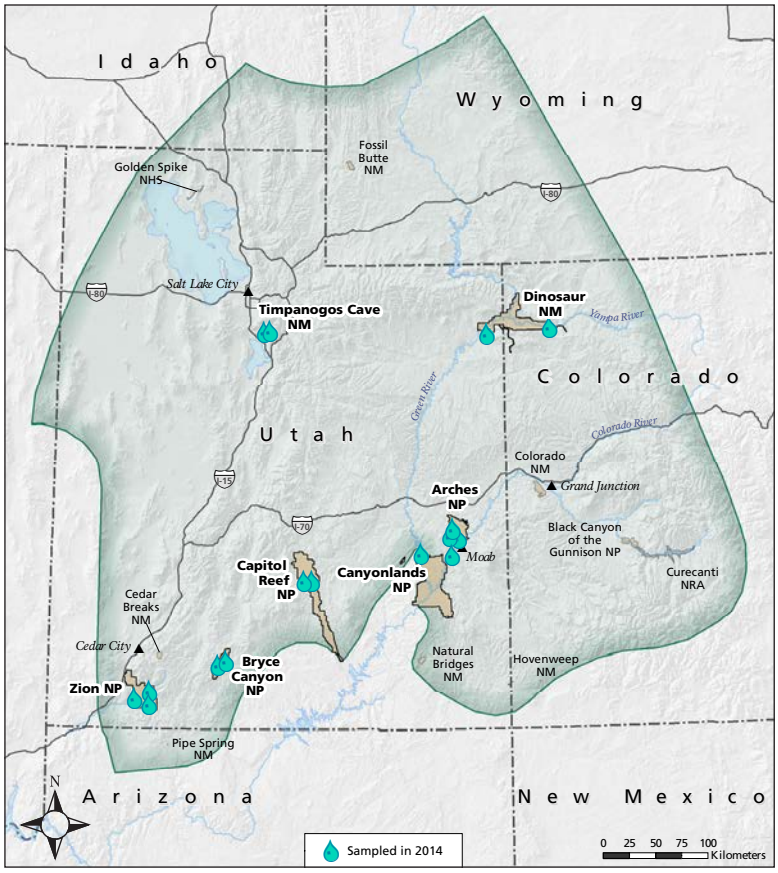

Figure 1-1. Northern Colorado Plateau Network parks and sampling locations for contaminants of emerging concern in 2014.

1.1 Sampling locations and dates

In 2014, sixteen locations were selected for sampling in and near seven national park units: Arches National Park (NP), Bryce Canyon NP, Canyonlands NP, Capitol Reef NP, Dinosaur NM, Timpanogos Cave NM, and Zion NP. Sites were selected in conjunction with park managers and USGS cooperators based on previous detections of CECs (Weissinger et al. 2013; Weissinger 2014) and the presence of potential CEC sources (e.g., park toilets, direct visitor contact, park orchards). Sample locations included diverse water types and settings, from remote springs to cave pools to large, inter-regional rivers (Figure 1-1; Table 1-1). Samples were targeted to occur during spring (April and May) and fall (September and October) at each location.

Table 1-1. Locations sampled for contaminants of emerging concern in NCPN park units, 2014.

Site name	Type	Latitude	Longitude	Sampling month			
				Apr	May	Sep	Oct
Arches NP							
Lower Courthouse Wash 0.5 mile above Colorado River	intermittent stream	38.686	-109.653	X		X	
Sleepy Hollow Spring	spring	38.673	-109.640	X		X	
Upper Courthouse Wash at NPS boundary	spring	38.688	-109.655	X		X	
Bryce Canyon NP							
Sheep Creek at NPS boundary	perennial stream	37.571	-112.201		X	X	
Yellow Creek at NPS boundary	perennial stream	37.574	-112.141		X	X	
Canyonlands NP							
Colorado River at Potash boat ramp	inter-regional river	38.505	-109.660		X	X	
Green River at Mineral Bottom	inter-regional river	38.521	-109.999		X	X	
Capitol Reef NP							
Fremont River at Hickman Bridge Trailhead	regional river	38.288	-111.235	X		X	
Sulphur Creek above confluence with Fremont River	perennial stream	38.287	-111.246	X		X	
Dinosaur NM							
Yampa River at Deerlodge Park, CO	inter-regional river	40.451	-108.525		X		X
Green River near Jensen, UT	inter-regional river	40.409	-109.235		X		X
Timpanogos Cave NM							
Middle Cave Lake at bridge	cave pool	40.437	-111.711	X		X	
Hansen Cave Spring	cave pool	40.437	111.710	X		X	
Zion NP							
The Grotto	spring	37.258	-112.947	X		X	
North Fork Virgin River at Temple of Sinawava	regional river	37.284	-112.947	X		X	
North Creek at planned gage	perennial stream	37.261	-113.106	X		X	

2 Methods

2.1 Sampling

Sample bottles and coolers were provided by the EPA Region 8 laboratory. A clean pair of gloves was used for each sample. For each sample collected, the bottle was dipped and rinsed in source water twice, followed by the collection of grab samples of the source water. The exterior of the sample bottle was dried off and then each sample bottle was labeled, bagged, and immediately placed on ice. Samples were packed in ice and shipped overnight or delivered to the EPA laboratory as soon as possible after sampling, with a maximum holding time of five days to allow for sample processing at the laboratory prior to the seven-day holding limit.

The laboratory methods used for sample analyses are shown in Table 2-1. Pesticide and PPCP samples were filtered and the dissolved fraction analyzed. Wastewater samples were not filtered; instead, the total sample was analyzed. Water samples were analyzed for 72 pesticides and pesticide degradation products, 140 PPCPs, and 53 wastewater indicator compounds. A table of all analytes and the laboratory reporting limit (the lowest concentration reported, usually 2–10× the method detection limit) for each is provided in Appendix A. Results that fell between the method detection and laboratory reporting limits are not available for analysis.

Pesticide and PPCP samples collected at Arches and Capitol Reef NPs in April, and at all locations in May, were analyzed outside of their designated holding times and temperatures due to processing limitations at the laboratory. Microbial degradation of pesticides and PPCPs can lead to lower concentrations reported for samples that exceed holding times. These data are presented as estimated, with a J-flag.

2.2 Quality assurance

2.2.1 Field blanks

Field-blank samples are processed in the same manner and using the same equipment as the environmental samples. Pesticide-grade organic water for the field-blank samples was provided by the USGS. The purpose of a field blank is to determine whether contamination is being introduced during sample collection and handling. Field blanks are evaluated with the benchmark of no detection for every analyte.

According to procedures developed for previous years' data (Weissinger et al. 2013), if a field blank has a detected level of an analyte, then the field blank is compared to the environmental samples. Any environmental sample detections within 2× the amount of the field-blank detection are considered to be contaminated and are not reported. An environmental detection more than 5× the amount of the field-blank detection is considered robust to contamination and is retained. An environmental detection between 2 and 5× the field-blank detection is reported as detected without an estimated value.

Table 2-1. Analysis methods and sample requirements for the EPA Region 8 laboratory.

Analyte groups	Analytical method	Sample volume	Container size and type	Preservation	Maximum holding time
Pesticides and pesticide degradation products	Liquid Chromatography–Mass Spectrometry. EPA Method 8321A, EPA R8 Laboratory SOP ORGM-550 (2013a)	40 ml	Sterile 40-ml amber glass volatile organic analysis (VOA) vials	Ice to 2–6°C	7 days
PPCPs	Liquid Chromatography–Mass Spectrometry. EPA Method 1694 EPA R8 Laboratory SOP ORGM-001 (2013b)	40 ml	Sterile 40-ml amber glass VOA vials	Ice to 2–6°C	7 days
Wastewater indicator compounds	Gas Chromatography–Mass Spectrometry. EPA R8 Laboratory SOP ORGM-006 (2011)	250 ml	Sterile 250-ml amber glass vials	Ice to 2–6°C	7 days to extraction

Field blanks were submitted for 4 of 32 (12.5%) sampling visits for pesticides, PPCPs, and wastewater-indicator samples. Each individual who regularly collected samples submitted at least one set of field blanks. Field blanks for pesticides, PPCPs, and wastewater indicators submitted on April 14, 2014 met the quality assurance/quality control (QA/QC) goal of having no detections.

Field blanks submitted on May 6, September 25, and October 14, 2014, had at least one analyte detected (Table 2-2). In two cases, bisphenol A on May 6 and acetophenone on October 14, the analytes were also detected in laboratory blanks or recovered from spiked laboratory samples in similar or greater concentrations than in field-blank samples. Associated environmental samples were not reported.

For most other field-blank detections, there were no associated analyte detections in the environmental samples. The Green River near Jensen, UT (Dinosaur NM) environmental sample from October 14 had gabapentin and metformin results within 2× the level detected in the field blank. The environmental sample detections were not reported.

2.2.2 Replicate samples

Replicate samples are collected concurrently with environmental samples and processed in the same lab. The purpose of a replicate is to determine the variability introduced from collection, processing, shipping, and laboratory handling. Replicate samples are evaluated with the benchmark that all detected analytes are within 30% relative percent difference (RPD) of those detected in the environmental sample. RPD is calculated as the percent difference between the detected amounts, divided by the average of the amounts: (A-B)/((A+B)/2)*100.

A non-detected analyte in the environmental sample should also be non-detected in the replicate sample. If an analyte is detected in one sample, but not the other, then the detected result should be within 30% of the reporting limit. When original samples and their replicates are entirely composed of non-detects, it is assumed that the analyses are falling within the desired precision.

Replicate samples were submitted for 1 of 32 (3%) sampling visits for pesticides, PPCPs, and wastewater indicators, for a total of 265 comparisons. In 262 of those comparisons (99%), both the environmental and the replicate samples were non-detects and were assumed to meet precision goals.

Analytes detected in both the environmental and the replicate samples met the precision goal (2 comparisons). Bisphenol A was detected in one replicate sample but not in the associated environmental sample, with an RPD of >30% for these two samples. Bisphenol A results for these samples were reported with a note indicating the RPD was higher than the desired range.

2.2.3 Laboratory measures

Laboratory QA/QC measures include laboratory (1) blanks that test for contamina-

Table 2-2. Analytes detected in field blanks submitted in 2014.

Date	Analyte	Result (ng/L)	Reporting limit (ng/L)	Comment
5/6/2014	bisphenol A	112[J]	50.0	Lab blank contamination; two environmental detections not reported
5/6/2014	phenanthrene	58.3	50.0	No environmental detections
5/6/2014	triphenyl phosphate	82.1	50.0	No environmental detections
9/25/2014	acetophenone	57.3	50.0	No environmental detections
10/14/2014	acetophenone	57.6[J]	50.0	High lab spike recovery; no environmental detections
10/14/2014	gabapentin	49.5	10.0	One environmental detection not reported
10/14/2014	metformin	20.2	10.0	One environmental detection not reported
10/14/2014	thiamethoxam	24.1	20.0	No environmental detections

tion during the analysis process, (2) spikes in which an analyte of known concentration is analyzed, and the percent recovery of the known amount is recorded[1], and (3) replicates that test for precision. For all analytes, laboratory blanks are evaluated with the benchmark of no detection. For matrix spikes and duplicates, the acceptance criteria are +/- 40% for pesticides and pesticide degradation products and +/-30% for wastewater indicators. Matrix spike and duplicate acceptance criteria for PPCPs are variable by analyte, but are generally +/-50% or greater. Analytes may be flagged for any single or combination of reasons.

Nine of 63 detected analytes were flagged for analytical reasons. Of those, four were analyzed in the same batch as a contaminated laboratory blank. For these analytes, the detected amount was compared to the amount reported for the laboratory blank. All four of the detected amounts in the environmental samples were within 2× the amount reported for the blank, and the data were not reported.

In five cases, analytes were flagged as having less than 60–70% recovery of a spike. The data were reported as estimated, with a J-flag.

[1]For example, if 50 ng/L of caffeine was added to a sample and the analyzed result said 52.3 ng/L, then the "percent recovery" would be 104.6%.

3 Results

All data for this project are publicly accessible through the EPA Storage and Retrieval database, available at http://www.epa.gov/storet/. To access the data, select Organization Name: 11NPSWRD_WQX and Project Name: NPS_3P EPA/NPS Emerging Contaminants Program (3P).

3.1 Overall patterns

There were 16 sample sites visited in both spring and fall 2014, for a total of 32 sample visits. Of those 32 sample visits, no analytes were detected at 7 (22%) visits, only one analyte was detected at 13 (41%) visits, and two or more analytes were detected at 12 (38%) visits. Seventeen target analytes were detected throughout the course of this study, including 4 (of 72) pesticides, 6 (of 140) PPCPs, and 7 (of 53) wastewater indicators. As observed, the majority of analytes were not detected during any visit. Due to the large number of target analytes, only the detected analytes are presented in this report. For a full schedule of analytes and their reporting limits, see Appendix A.

3.1.1 Detection frequency

Overall, detection frequencies were low (Table 3-1; Figure 3-1). Only one wastewater indicator, tri(dichloroisopropyl) phosphate, was detected at more than one-third (34.4%) of site visits (n=32). Three analytes were detected at more than one-third of sampling locations (n=16): tri(dichloroisopropyl) phosphate; the wastewater indicator, bisphenol A; and the personal care product, DEET. In comparison, of 144 samples from 20 predominantly urban sites in Colorado submitted to the EPA Region 8 laboratory in 2014, 5 pesticides, 41 PPCPS, and 5 wastewater indicators were detected in more than one-third of the samples (K. Dahlin, unpublished data).

3.1.2 Site frequency

Of the 16 sites sampled, six sites had only one analyte detected over the course of both site visits, while 10 had two or more analytes detected. Sampling locations with the most detections were observed to cluster at Arches and Canyonlands national parks (Table 3-2). Interestingly, while two inter-regional rivers (the Colorado and Green rivers near Canyonlands NP), had relatively frequent detections, the remaining sites with the most frequent detections were more local waters, including springs, an intermittent stream, and a cave pool.

3.1.3 Seasonal timing

In most cases, analyte detections were more common during spring sampling (April and May) than fall sampling (September and October) (Figure 3-2).

Table 3-1. Most commonly detected analytes collected from 16 sample sites and 32 samples in seven national park units in 2014.

Analyte	Type	Samples in which analytes detected (of 32)		Sites where analytes detected (of 16)	
		Number	Percent	Number	Percent
tri(dichloroisopropyl) phosphate	WWI	11	34.4%	11	68.8%
bisphenol A	WWI	9	28.1%	8	50.0%
DEET	PPCP	7	21.9%	6	37.5%
gabapentin	PPCP	4	12.5%	2	12.5%
2,4-D	Pest	3	9.4%	2	12.5%
caffeine	PPCP	3	9.4%	2	12.5%
camphor	WWI	3	9.4%	2	12.5%
metformin	PPCP	3	9.4%	2	12.5%

Pest = pesticide or pesticide degradation product, PPCP = pharmaceutical or personal care product, WWI = wastewater indicator.

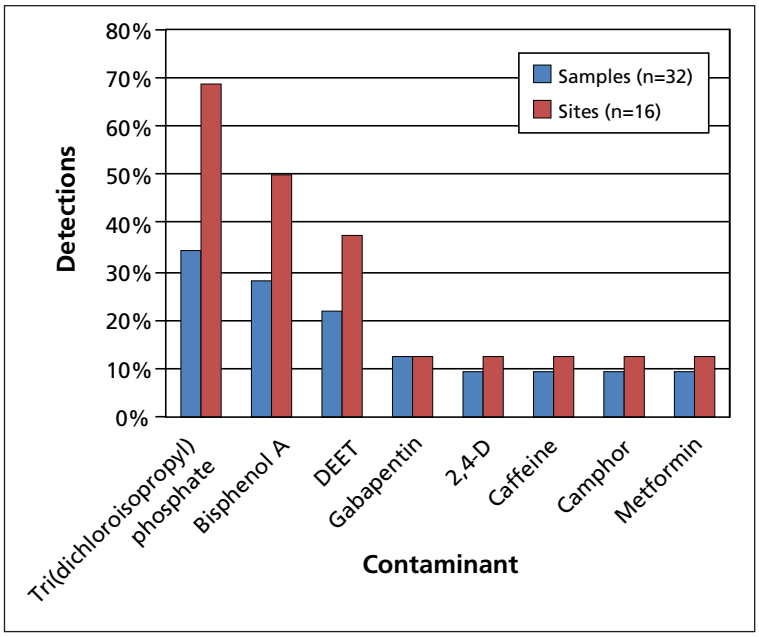

Figure 3-1. Frequency of analytes detected out of 32 samples and 16 sampling sites in 2014.

Table 3-2. Sampling locations with the most analyte detections and target analytes detected (two samples per site) from April to October 2014.

Park	Sampling location	Type	Detections	Target analytes
Canyonlands NP	Colorado River at Potash boat ramp	inter-regional river	12	7
Arches NP	Sleepy Hollow Spring	spring	8	7
Arches NP	Upper Courthouse Wash at NPS boundary	spring	6	5
Canyonlands NP	Green River at Mineral Bottom	inter-regional river	5	4
Timpanogos Cave NM	Middle Cave Lake at bridge	cave pool	5	4
Arches NP	Lower Courthouse Wash 0.5 mile above Colorado River	intermittent stream	4	3

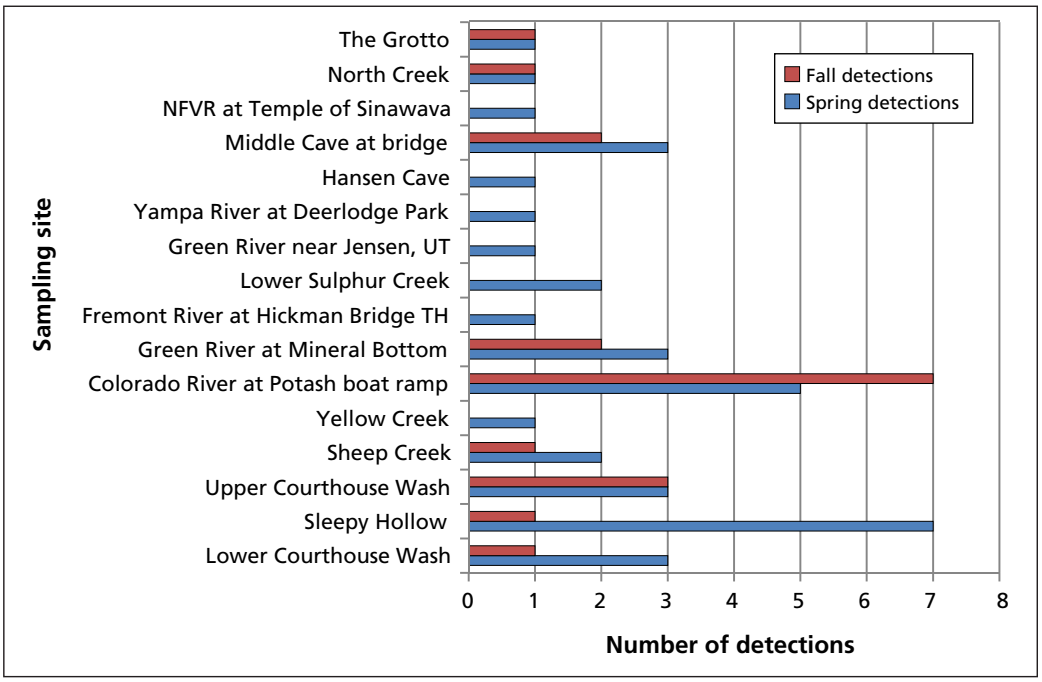

Figure 3-2. Number of analytes detected by site for spring (April and May) vs. fall (September and October) sampling.

3.2 Park-specific results

3.2.1 Arches National Park

Three sites were sampled in Arches National Park (Table 3-3; tables begin on page 10). Upper Courthouse Wash is a spring that emerges in alluvium at the northern, upstream boundary of the park. It is located just outside the park boundary fence and is frequently visited by cattle and off-highway vehicles. Sleepy Hollow Spring emerges as a hanging garden in a protected alcove and receives infrequent visitation from hikers. Lower Courthouse Wash is in a perennial, spring-fed stretch of an intermittent stream and is accessible by a half-mile hike from a state highway. The numbers of analytes detected at these three sites were some of the highest from sites sampled in 2014 (Table 3-3). In addition, camphor and p-cresol at Sleepy Hollow Spring had the highest concentrations of all analytes reported in 2014. Both of these compounds occur naturally in pine oil, although pines are not common at the site.

3.2.2 Bryce Canyon National Park

Two sites were sampled at Bryce Canyon National Park (Table 3-4). Both sites are located on perennial streams well downstream of backcountry campsites along a hiking trail. The sites are within the fenced park boundary, yet the occasional trespass of cattle occurs when fences are compromised. The numbers and concentrations of analytes detected were low.

3.2.3 Canyonlands National Park

Two sites were sampled near Canyonlands National Park (Table 3-5). Both sites were located at boat ramps with associated campgrounds and pit toilets along major interregional rivers. The Colorado River at the Potash boat ramp previously had consistent detections of 2,4-D, caffeine, DEET, gabapentin, lamotrigine, metformin, Metolachlor ESA, and sulfamethoxazole (Weissinger 2014). Most of these analytes were detected at the Potash boat ramp in 2014, as well. In comparison, the number and concentrations of analytes detected at the Green River at Mineral Bottom site were relatively low.

3.2.4 Capitol Reef National Park

Two sites were sampled at Capitol Reef National Park (Table 3-6). The Fremont River at Hickman Bridge Trailhead site is located at a popular park trailhead with a paved parking lot and pit toilet, and is downstream of additional park infrastructure. The Sulphur Creek site, above the confluence with the Fremont River, is located downstream of park orchards and campgrounds and adjacent to park housing and the park leach field. The number and concentration of analytes detected were low.

3.2.5 Dinosaur National Monument

Two sites were sampled near Dinosaur National Monument (Table 3-7). Both sites were located at boat ramps with associated campgrounds and pit toilets along major inter-regional rivers. The Yampa River at Deerlodge Park has had a high number of detections in the past (Weissinger et al. 2013; Weissinger 2014). The number and concentration of analytes detected at Deerlodge Park in 2014 were low. This was the first year of sampling at the Green River near Jensen, Utah, site.

3.2.6 Timpanogos Cave National Monument

Two cave pool sites were sampled at Timpanogos Cave National Monument (Table 3-8). The Middle Cave Lake at bridge site is located along the cave tour and has water levels that fluctuate rapidly after precipitation events, suggesting rapid connection with the surface. This site previously had consistent detections of DEET and caffeine (Weissinger 2014). DEET was detected on both sample visits in 2014, but caffeine was not detected on either visit. The bisphenol A concentration reported for Middle Cave Lake in April was one of the highest concentrations of all analytes reported for 2014. Hansen Cave Spring is a less-visited site within the cave system that also responds to precipitation. This site had low numbers and concentrations of analytes detected.

3.2.7 Zion National Park

Three sites were sampled at Zion National Park (Table 3-9). The Grotto is a spring that emerges as a hanging garden. The site is also the source for the park's water supply and receives little park visitation. The North Fork Virgin River at Temple of Sinawava site is at one of the most popular attractions in the

park. The sampling location is adjacent to a paved parking lot, several toilets, and a trailhead. During the tourist season, thousands of visitors wade in the river just upstream of the sampling location. North Creek is a perennial stream. Wading in the creek is popular several miles upstream of the sampling location. The number and concentrations of analytes detected at all three sampling locations were low.

Table 3-3. Concentrations (ng/L) detected in sampling locations, Arches National Park.

Analyte	Lower Courthouse Wash		Sleepy Hollow Spring		Upper Courthouse Wash	
	Apr	Sep	Apr	Sep	Apr	Sep*
2,4-D	-	-	-	-	-	20.2, 21.5
3-Methyl Indole	-	-	398	-	-	-
bisphenol A	72.4	-	77.2	-	58.7	103[J][b, c], <50.0
caffeine	-	-	43.6[J][a]	-	-	-
camphor	-	-	1,040	182	-	-
DEET	-	-	-	-	-	37.3, 48.4
methyl salicilate	-	-	253	-	-	-
p-cresol	-	-	5,360[J][b]	-	90.9[J][b]	-
tri(dichloroisopropyl) phosphate	196	-	166	-	367	-
triclopyr	25.4[J][a]	35.5	-	-	-	-

*Replicate samples at Upper Courthouse in September are represented as two numbers for each analyte.
Hyphens represent non-detects.
[a]Exceeded holding time and temperature
[b]Low recovery rate of laboratory matrix spike
[c]RPD >30%

Table 3-4. Concentrations (ng/L) detected at sampling locations, Bryce Canyon National Park.

Analyte	Sheep Creek		Yellow Creek	
	May	Sep	May	Sep
camphor	-	101	-	-
DEET	11.2	-	-	-
tri(dichloroisopropyl) phosphate	116	-	61.4	-

Hyphens represent non-detects.

Table 3-5. Concentrations (ng/L) detected at sampling locations near Canyonlands National Park.

Analyte	Colorado River at Potash		Green River at Mineral Bottom	
	May	Sep	May	Sep
2,4-D	98.0[J][a]	44.0	-	-
bisphenol A	-	65.1[J][b]	-	52.5[J][b]
caffeine	50.2	26.0	-	-
DEET	-	-	19.7	-
gabapentin	54.1	55.8	12.6	21.9
lamotrigine	14.2	15.1	-	-
metformin	42.9	36.9	-	-
sulfamethoxazole	-	12.1	-	-
tri(dichloroisopropyl) phosphate	-	-	50.4	-

Hyphens represent non-detects.

[a]Exceeded holding time and temperature

[b]Low recovery rate of laboratory matrix spike

Table 3-6. Concentrations (ng/L) detected at sampling locations, Capitol Reef National Park.

Analyte	Fremont River		Sulphur Creek	
	Apr	Sep	Apr	Sep
bisphenol A	-	-	72.0	-
tri(dichloroisopropyl) phosphate	168	-	243	-

Hyphens represent non-detects.

Table 3-7. Concentrations (ng/L) detected at sampling locations near Dinosaur National Monument.

Analyte	Green River (Jensen, UT)		Yampa River (Deerlodge Park)	
	May	Oct	May	Oct
metformin	11.7	-	-	-
thiamethoxam	-	-	29.8	-

Hyphens represent non-detects.

Table 3-8. Concentrations (ng/L) detected at sampling locations, Timpanogos Cave National Monument.

Analyte	Middle Cave Lake		Hansen Cave Spring	
	Apr	Sep	Apr	Sep
bisphenol A	607	-	51.5	-
DEET	22.1	35.3	-	-
galaxolide	-	184	-	-
tri(dichloroisopropyl) phosphate	50.1	-	-	-

Hyphens represent non-detects.

Table 3-9. Concentrations (ng/L) detected at sampling locations, Zion National Park.

Analyte	The Grotto		North Fork Virgin River		North Creek	
	Apr	Sep	Apr	Sep	Apr	Sep
DEET	-	12.0	-	-	-	16.1
neburon	-	-	129	-	-	-
tri(dichloroisopropyl) phosphate	149	-	-	-	79.9	-

Hyphens represent non-detects.

4 Future Sampling

Sampling of contaminants of emerging concern in surface waters in conjunction with EPA Region 8 will continue in 2015. In addition, a separately funded project to analyze bed sediments for endocrine-disrupting hormones, initiated with the U.S. Geological Survey in 2014, will continue to be co-sampled in 2015. Co-sampling of surface-water and bed-sediment samples will provide us a more complete understanding of how CECs accumulate and are transported in NCPN aquatic systems. The USGS also is collecting bioassay samples at all sites in 2014 and 2015, and tissue sampling may be conducted at a few sites in 2016, to help determine the bioactivity of the water at these sites. A final report is expected upon completion of the USGS project in 2017.

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NPS 960/129912, September 2015

National Park Service
U.S. Department of the Interior

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