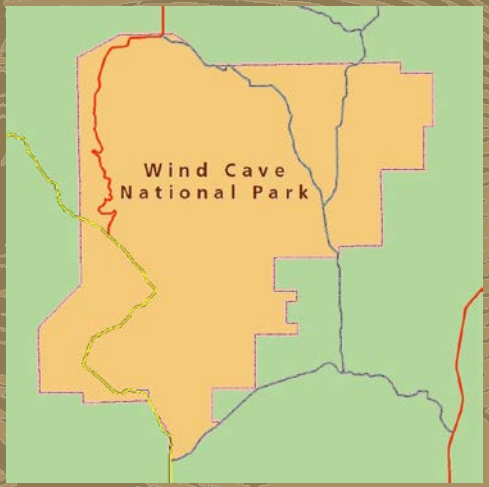
Condition assessment of streambanks and streamside vegetation on perennial streams in Wind Cave National Park 2009 - 2012



Prepared by:
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March 7, 2013

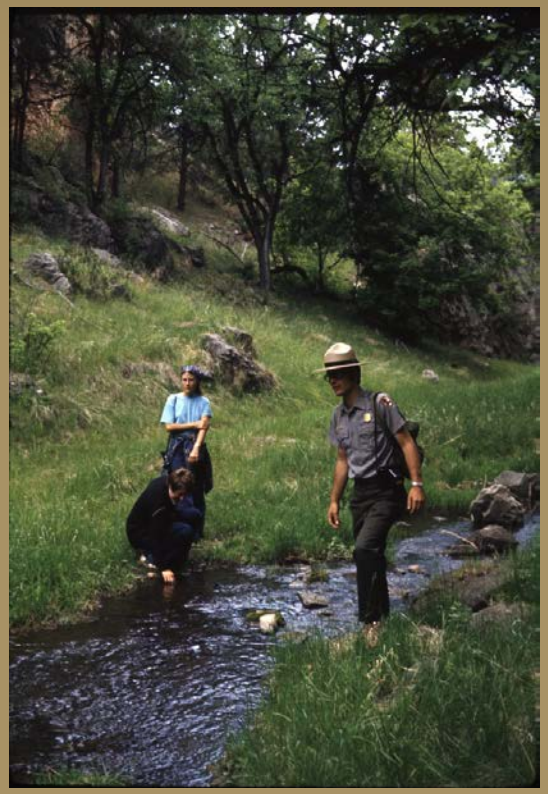
(all photographs by NPS unless noted)

Wind Cave National Park

- 33,851 acres in the southern Black Hills
- mosaic of ponderosa pine forest (30%) and mixed-grass prairie (60%)
- riparian communities: less than 1%

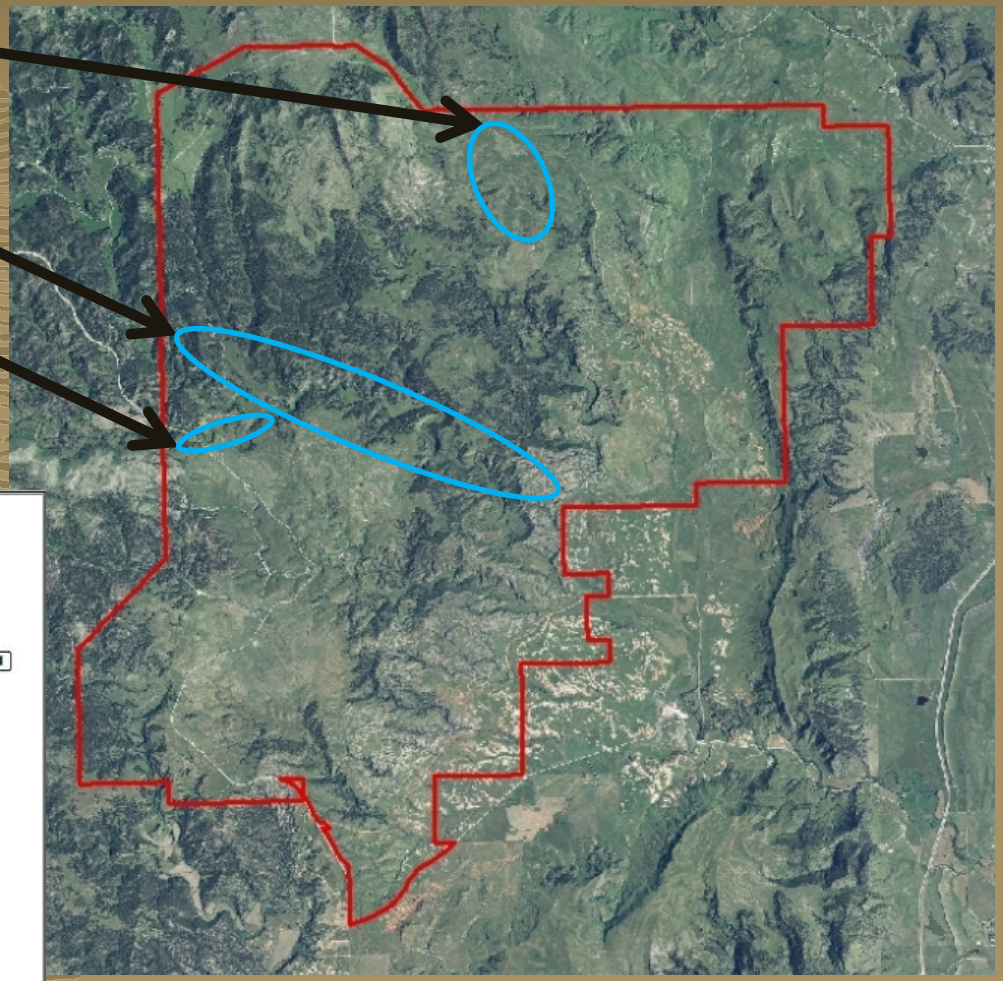
Streams/riparian vegetation provide ecological services including:

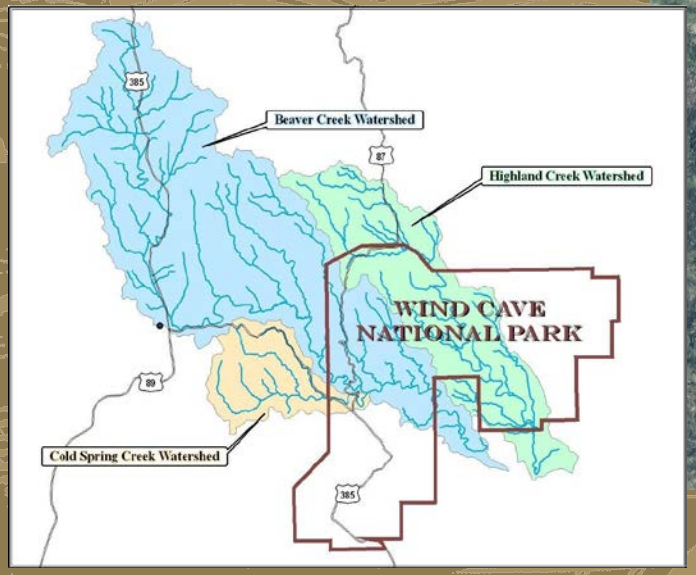
- forage and browse production
- wildlife use
- species richness (plant and animal)
- compositional, structural, and functional diversity
- watershed health
- hydrologic function
- visitor opportunities for education and enjoyment



Three perennial streams

- Highland Creek (ca 2000 m)
- Beaver Creek (ca 5400 m)
- Cold Spring Creek (ca 3500 m)





Previous assessments of condition

Physical context:

- 2012 Water Resources of WICA (Ohms 2012)
- 2011 WICA Natural Resource Condition Assessment (Comp et al. 2011)

"Surface and groundwater resources in WICA are well documented and have been studied extensively."

Vegetation context:

- 1999 Black Hills Community Inventory (Marriott et al. 1999)

WICA designated exemplary site (outstanding size, outstanding landscape context [including little fragmentation], diverse set of community types, and high quality occurrences)

- 9 rare plant communities (of 22 total) – including Western Great Plains Streamside Vegetation (NatureServe rank G3 – Vulnerable)
- data produced: 2 riparian plots in WICA

Primary concern: status of streambanks and streamside vegetation and ability to provide wide range of ecological services

Another vegetation concern:
how do **persistent** (common, abundant, resilient) riparian plant species contribute to riparian flora compared to **sensitive** (uncommon, sparse, vulnerable) riparian plant species?

- Understudied WICA riparian flora (WICA herbarium, SD Natural Heritage Database)
- Apparently low current WICA riparian vegetation diversity (WICA botanist)

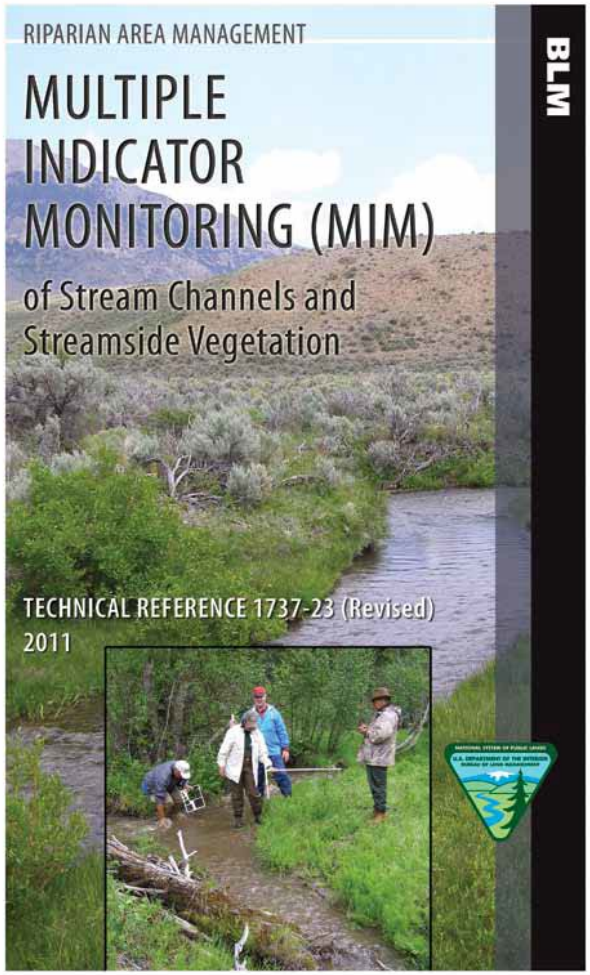
Photo by Eugene Reimer 2011

Sensitive species may:
- require **refugia** (variability in topography, geomorphology, hydrology, etc.) to get through periods of high intensity/frequency disturbance
- experience bottlenecks where diversity is lost

Protocol selected:
Multiple Indicator Monitoring (MIM) of Streambanks and Streamside Vegetation

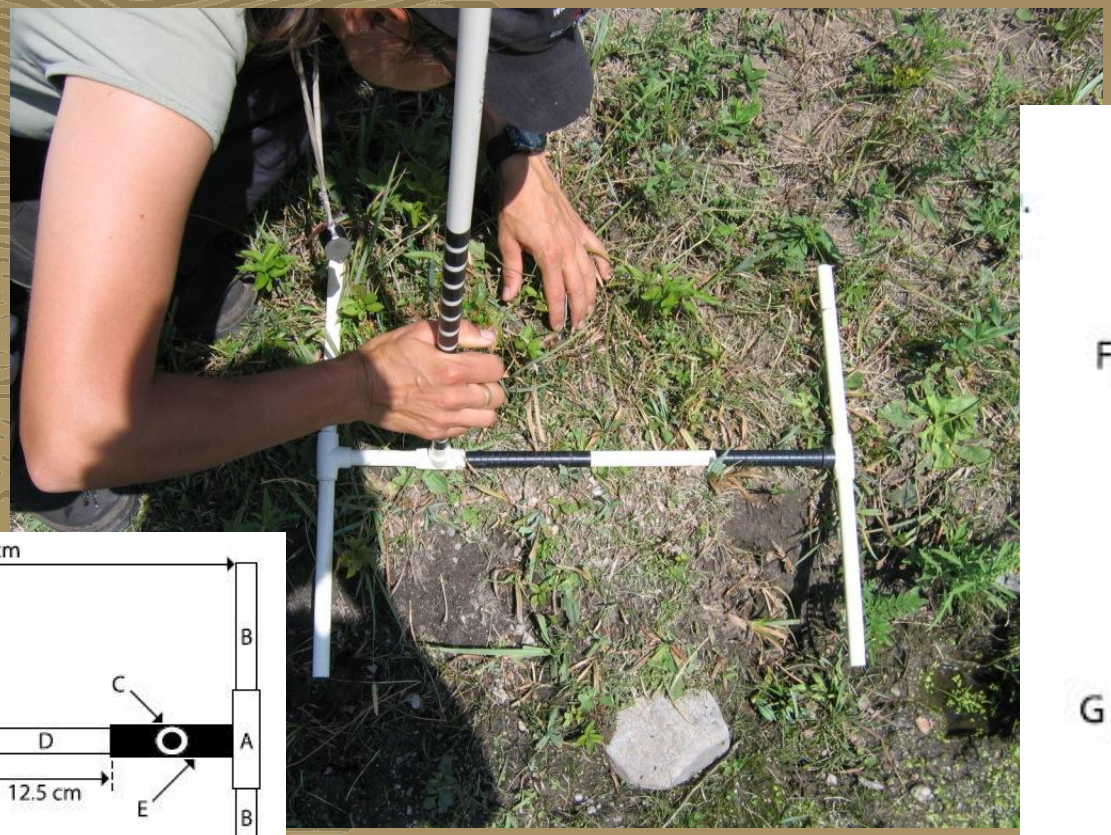
- Designed to be objective, efficient, and effective for monitoring streambanks, stream channels, and streamside/riparian vegetation
- Developed and tested for 7 years on relatively low gradient (<4%) , perennial, snow-melt-dominated and spring-fed streams in the western US

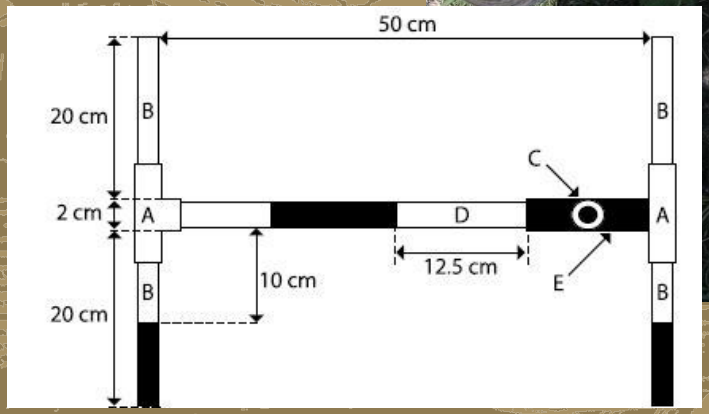
Available on www at:
http://www.blm.gov/ntsc/library/pdf/MIM.pdf

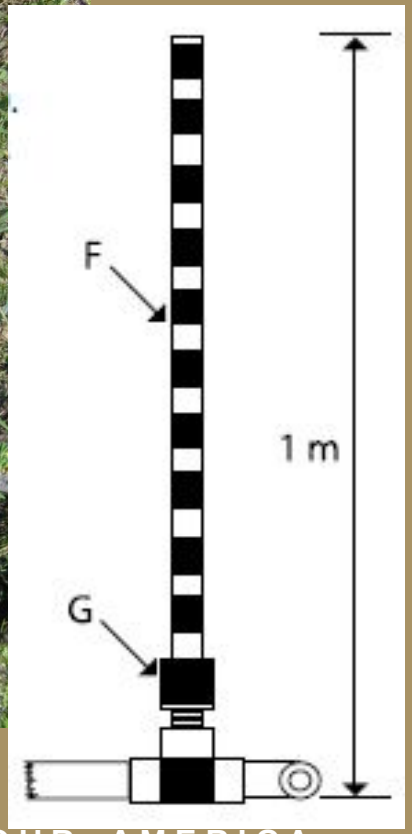


Greenline is the reference point for collecting most MIM data

Greenline (Winward 2000) = the first perennial vegetation that forms a lineal grouping of community types on or near the water's edge (any combination of perennial herbaceous vegetation, shrub/tree seedlings, embedded rock, anchored wood – provided there are no patches of bare ground, litter, or nonvascular plants greater than 10 x 10 cm)







Three short-term indicators:

Indicator	Description
Stubble height	Heights of plants after grazing (key dominant species and all key species)
Streambank alteration	Percent of linear length of streambank altered by herbivores in current grazing season
Woody species use	Percent of current year's leaders on woody plants that are browsed

Seven long-term indicators:

Indicator	Description
Greenline composition	Percent cover of dominant and subdominant plant species, embedded rock, and anchored wood
Streambank cover	Percent of linear length of streambank with vegetation cover
Streambank stability	Percent of linear length of streambank that is stable
Greenline-to-greenline width (GGW)	Average non-vegetated distance between greenlines on each side of the stream
Woody species age class	Estimate of age classes of woody species
Woody species height class	Estimate of woody plant heights adjacent to stream by class
Substrate	Percent substrate classes (including percent fines)

Three long-term metrics:

Metric	Description	Rating values	
Wetland rating	Presence of wetland plant species - wetland species are more functional in wetlands than upland species	0-15 16-40 41-60 61-85 85+	Very poor Poor Fair Good Very good
Windward greenline stability rating	Ability of greenline vegetation, anchored rock, and anchored wood to resist erosion	0-2 3-4 5-6 7-8 9-10	Very low Low Mid High Very high
Greenline ecological status rating	Ecological status based on successional stage of plant species on the greenline, substrate, stream gradient, and presence/absence of woody vegetation	0-15 16-40 41-60 61-85 85+	Very early Early Mid Late Potential natural community

Locations of WICA MIM transects

Designated monitoring area (DMA) - where all monitoring takes place

Starting hypotheses for DMAs:

Beaver Creek Exclosure – least intensive use by wildlife
Beaver Creek 1 – intensive and consistent use by wildlife
Beaver Creek 2 – accessible to wildlife but not intensively/consistently used; nearby to Beaver Creek 1
Beaver Creek 3 – accessible to wildlife but not intensively/consistently used; distant from Beaver Creek 1 and west of Hwy 87 high bridge

Highland Creek Exclosure – least intensive use by wildlife
Highland Creek 1 – accessible to wildlife but not intensively used
Highland Creek 2 – intensive and consistent use by wildlife

Cold Spring Exclosure – least intensive use by wildlife
Cold Spring 1 – intensive and consistent use by wildlife

Stream	MIM Transect	DMA type	Transect length/ # plots	Dates monitored:		
Beaver Creek				**2009**	**2010**	**2012**
	Beaver Creek Exclosure	Reference	100m/ 70 plots	-----	Sept 29	Sept 10
	Beaver Creek 1	Representative	110m/ 80 plots	Aug 13	-----	Aug 29
	Beaver Creek 2	Representative	110m/ 80 plots	Aug 13	-----	Aug 29
	Beaver Creek 3	Representative	110 m/ 80 plots	-----	Aug 12&17	Sept 12
Highland Creek						
	Highland Creek Exclosure	Reference	60 m/ 40 plots	-----	Sept 9	Sept 12
	Highland Creek 1	Representative	110m/ 80 plots	Aug 14	-----	Aug 30
	Highland Creek 2	Representative	110m/ 80 plots	Aug 20	-----	Aug 30
Cold Spring Creek						
	Cold Spring Exclosure	Reference	90m/ 62 plots	-----	Sept 8	Aug 30: dry-no data
	Cold Spring 1	Representative	110m/ 80 plots	-----	Aug 26	Aug 30: dry-no data

I. MIM data collected and analyzed <u>for each transect</u>

II. MIM data compared <u>for all transects on a given stream over time</u>

III. MIM transect data extrapolated to assess <u>overall stream condition and</u> ek a

I. Sample data set – Beaver Creek 1

(values +/- 95% confidence interval)

Reference = Beaver Crk Excl. 2012

Metric	2009	2012	Reference	Condition
Mean stubble height (all key species)	4.2 ± 0.96 in	3.0 ± 0.96 in	16.2 ± 1.5 in	High grazing not supporting long-term plant health
Dominant key species – stubble height	Nebraska sedge 3.87 ± 1.0 in	Nebraska sedge 2.66 ± 0.0 in	Nebraska sedge* 22.16 ± 2 in	High grazing not supporting long-term persistence of key species
Plant diversity index	12.61	13.16	13.26	Mid-range among Beaver Creek transects
Hydric species (%plots)	56.5 ± 6.2%	51.5 ± 6.2%	36.8 ± 6.2%	Mid-range among Beaver Creek transects
Woody composition	2 ± 5.9%	1 ± 5.9%	10 ± 5.9%	Very low contribution of woody species
Covered banks	4 ± 5%	3 ± 5%	100 ± 5%	High grazing/disturbances contributing to low streambank cover
Stable banks	0 ± 5%	0 ± 5%	87 ± 5%	High trampling/disturbances contributing to low streambank stability
Bank alteration	82%±6	92%±6	6 ± 6%	High trampling resulting in high streambank alteration
Mean GGW	5.43 ± .38 m	4.85 ± .35 m	2.44 ± .3 m	Mid-range for all Beaver Creek transects
Substrate	Not measured – observation of fine sediment of 1 to 24 inches throughout transect	Not measured – observation of fine sediment of 1 to 24 inches throughout transect	68 ± 11.6% fines**	High fine sediment load contributing to high risk for aquatic habitat
Wetland rating	63 ± 4.9 - Good	65 ± 4.5 - Good	54 ± 4.9 - Fair	Average contribution by wetland species
Winward greenline stability rating	4.06 ± .16 - Mid	3.88 ± .16 - Low	3.20 ± .16 - Low	Low-mid resistance to erosion
Greenline ecological status rating	13 ± 5.75 – Very early	10 ± 5.75 – Very early	7 ± 5 – Very early	Very early ecological condition is not resilient

II. MIM data analyzed <u>for all transects on a given stream</u>

Indicator of Condition	Stream Transect	Condition Status/Change	MIM Protocol Parameters Evaluated	Reference Condition
Streamside vegetation	Beaver Creek Exclosure		Mean stubble height of all species; Mean stubble height of dominant species; Mean greenline-to-greenline width; Plant diversity index; Percent hydric species; Woody composition	Beaver Creek Exclosure
	Beaver Creek-1			
	Beaver Creek-2			
	Beaver Creek-3			
Streambank stability	Beaver Creek Exclosure		Percent bank alteration; Percent covered banks; Percent stable banks; Mean greenline-to-greenline width	Beaver Creek Exclosure
	Beaver Creek-1			
	Beaver Creek-2			
	Beaver Creek-3			
Ecological condition	Beaver Creek Exclosure		Wetland rating; Winward greenline stability rating; Greenline ecological status rating	Beaver Creek Exclosure
	Beaver Creek-1			
	Beaver Creek-2			
	Beaver Creek-3			

III. MIM transect data extrapolated to assess overall stream condition and change on Beaver Creek

Extrapolation based on full-stream field reconnaissance by WICA botanist

Stream segment	Length	Approximate percent of stream	Most representative MIM transect
Segment: West boundary to Hwy 87 High Bridge	2300 meters	43%	Beaver Creek 3
Segment: Hwy 87 High Bridge to Beaver Creek Exclosure	1200 meters	23%	Beaver Creek 2
Segment: Beaver Creek exclosure	100 meters	.02%	Beaver Creek Exclosure
Segment: Exclosure to Beaver Creek 2 transect	600 meters	11%	Beaver Creek 1
Segment: Beaver Creek 2 transect to sink	1200 meters	23%	Beaver Creek 2

Expectation was transects would have different ratings; individual transect characteristics were discovered and some short-term indicators changed from 2009 – 2012 .
However, all Beaver Creek transects rated the same:
ecologically poor condition, no change from 2009 to 2012.
Conclusion: 100% of Beaver Creek is in ecologically poor condition

III. MIM transect data extrapolated to assess overall stream condition and change on Highland Creek

Extrapolation was based on full-stream field reconnaissance by WICA botanist

Stream segment	Length	Approximate percent of stream	Most representative MIM transect
Segment: North/CSP boundary to Highland Creek Exclosure	500 meters	25%	Highland Creek 2
Segment: Highland Creek Exclosure	80 meters	.04%	Highland Creek Exclosure
Segment: Bison corrals	500 meters	25%	NA
Segment: south boundary of bison corrals to sink	1000 meters	50%	Highland Creek 1

Expectation was that transects would have different ratings; individual transect characteristics were discovered and some short-term indicators changed from 2009 – 2012.
However, all Highland Creek transects rated the same:
ecologically poor condition, no change from 2009 to 2012
Conclusion: 100% of Highland Creek is in ecologically poor condition

Conclusions

- WICA perennial streams in ecologically poor condition, not resilient to stresses from climate change, high animal numbers, etc.
- WICA perennial streams are providing primary ecological service of water for wildlife but not able to provide range/depth of others
- Strategic management of WICA surface water management needed to meet ecological needs in the short-term and long-term
- Information about reference conditions/potential is critical to understanding status – maintenance of exclosures warrants high priority

Surprises

- Consistency of ecological conditions on all perennial streams

d – aquatic habitat at risk

- Current lack of stream area describable as light use by wildlife

- Current lack of refugia for sensitive riparian species during periods of high stress (e.g. drought, high animal population numbers)

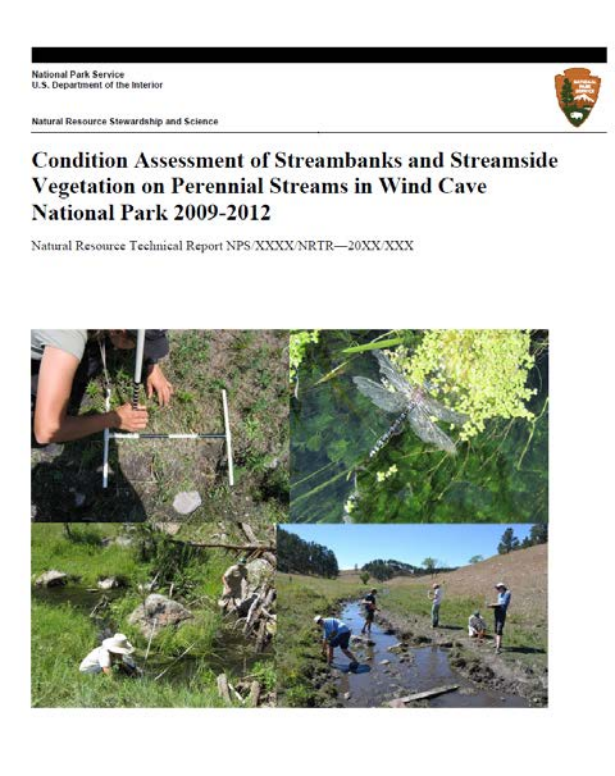
What's next?

- WICA MIM Project published as NPS Natural Resource Technical Report – available in ca 30 days from WICA www website

- Collect subset of MIM data annually on existing WICA transects (stubble height, bank alteration, bank stability) to track impacts from management changes, drought, etc.

- In three years, collect full MIM data set on existing transects to investigate change/trend

- Establish additional WICA transects – on Beaver Creek? on Cold Spring Creek?


National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Condition Assessment of Streambanks and Streamside Vegetation on Perennial Streams in Wind Cave National Park 2009-2012

Natural Resource Technical Report NPS/XXXX/NRTR—20XX/XXX

- Contribute to Black Hills MIM data set with WICA data and gain context from Black Hills MIM data for southern Hills (e.g. Black Hills Citizen MIM Project, Black Hills National Forest)

- Develop WICA surface water management strategy (identify desired conditions, goals, tools, triggers, monitoring) and implement to support resilient streams providing broad range of ecological services into an uncertain climate future

Acknowledgements

- Thanks to data collectors!

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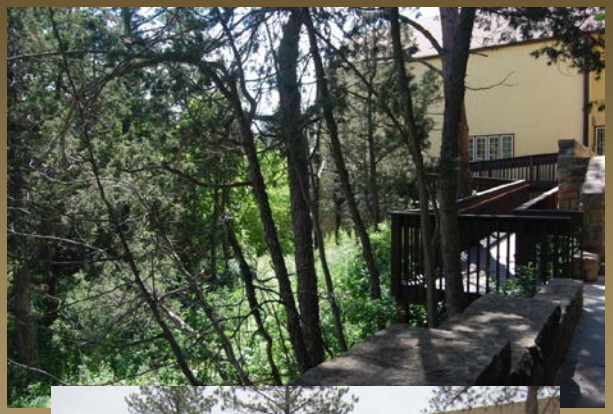
- Thanks to:

Kevin Kovacs – WICA data management
Ervin Cowley, Riparian Management Services LLC (retired BLM) – consultation greatly improved data analysis and positioned WICA to take advantage of MIM protocol updates in the future

Update on Wind Cave Canyon Vegetation Rehabilitation project: stop by and see the changes for yourself!



2012 WICA Canyon project in progress