Pima County Ecological Monitoring Program: Progress to Date and Future Development

STAT Committee Meeting
Dec 14th, 2006

Summary of Workshops

Expert Workshops. We hosted six technical workshops from September-November: Ecosystem Pattern, Vegetation Structure and Composition, Water and Riparian Resources, Mammals, Birds, and Reptiles and Amphibians. Workshop participants are leading regional scientists from the respective disciplines and represented the University of Arizona, state and federal agencies, non-profit organizations, and consultants (Table 1). Each workshop began by reviewing a list of parameters from an earlier monitoring effort and workshop participants refined that list based on the goals and criteria of the Pima County Ecological Monitoring Program (PCEMP). Each participants was then given the opportunity to score each parameter and provide a brief written narrative for seven criteria related to ecological relevance, response variability, and feasibility of implementation. After each workshop we summarized group discussions and participant scores and narrative (see Table 2 for final list of parameters and Appendix A for example of narrative responses).

Manager's Workshop. Subject-matter experts were essential for providing technical input based on the above-mentioned criteria, but missing from that exercise was an evaluation of the utility of these parameters for managers. For this input we hosted a one-day manager's workshop, which was attended by natural resource managers from throughout the region (Table 1). First we presented the list of parameters from the expert workshops, but did not tell the managers which parameters were most favored by the expert workgroups. We then asked the managers to rank the top parameters (five from the Landscape Pattern, Vegetation, and Water workshops and five from the Vertebrate workgroups) based on their ability to inform a wide range of management actions throughout the County.

Future Development and Timeline

The list of parameters suggested by the experts and managers will be incorporated into Phase I of the monitoring plan, which will be submitted in draft form to Pima County by approximately January 24 (Table 3). We anticipate the final report will be completed in early March, after which it will be sent out for review by a group of national and international monitoring experts. Phase II of the plan's development will begin in the late spring/early summer of 2007 and will involve more detailed evaluations of cost, scale, and efficiency (e.g., collaboration) for each parameter.

We are also in the process of writing a Section 6 grant application to the U.S. Fish and Wildlife Service to support the development of the monitoring plan (Table 3). We wrote a similar proposal to the Wildlife Conservation Society, but we recently learned that did not receive funding.

Table 1. List of workshop participants to inform the parameter selection process for the Pima County Ecological Monitoring Program. Workshops: Birds (BRD), Landscape Pattern (LP), Mammals (MAM), Manager's (MGR), Amphibians and Reptiles (A&R), Vegetation (VEG), and Water (WTR),

Participant	Workshop(s)	Affiliation
Archer, Steve	LP	University of Arizona, School of Natural Resources
Baldwin, Kerry	MGR	Pima County, Natural Resources Parks and Recreation Department
Barrett, Sherry	MGR	U.S. Fish and Wildlife Service, Ecological Services Office
Birkenfield, Scott	MGR	Bureau of Land Management, Tucson Field Office
Bodner, Gita	VEG	The Nature Conservancy, Arizona
Briggs, Mark	WTR	Private consultant
Canfield, Evan	WTR	Pima County, Regional Flood Control District
Changkakoti, Ben	WTR	Pima County, Development Services
Christelman, Jennifer	MGR	Town of Marana, Planning Department
Cordy, Gail	WTR	U.S. Geological Service, Arizona Water Science Center
Corman, Troy	BRD	Arizona Game and Fish Department, Research Branch
Crawford, Cathy	MGR	Arizona Game and Fish Department, Habitat Branch
de Souza, Locana	MGR	Arizona Game and Fish Department/ Pima County Natural Resources Parks and Recreation Department
Dickerson, Dennis	WTR	Pima Association of Governments, Environmental Planning Department
Duncan, Doug	MAM	U.S. Fish and Wildlife Service, Ecological Services Office
Flesch, Aaron	BRD	University of Arizona, School of Natural Resources
Fonseca, Julia	WTR	Pima County, Regional Flood Control District
Guertin, Phillip	LP	University of Arizona, School of Natural Resources
Hare, Trevor	A&R, MGR	Coalition for Sonoran Desert Protection
Holm, Peter	A&R, VEG	Organ Pipe Cactus National Monument, Ecological Monitoring Program
Ingraldi, Mike	MGR	Arizona Game and Fish Department, Research Branch
Kennedy, Kathleen	MGR	Town of Marana, Planning Department
Kirkpatrick, Chris	BRD	University of Arizona, School of Natural Resources
Koprowski, John	MAM	University of Arizona, School of Natural Resources
Krausman, Paul	MAM	University of Arizona, School of Natural Resources
Litt, Andrea	MAM	University of Arizona, School of Natural Resources
Lowery, Shawn	MGR	Arizona Game and Fish Department, Research Branch
Mack, Chris	LP	Town of Marana, GIS Department
Mannan, Bill	BRD	University of Arizona, School of Natural Resources
McCaffrey, Rachel	BRD	University of Arizona, School of Natural Resources
McPherson, Guy	VEG	University of Arizona School of Natural Resources
Parra Salazar, Iván	LP	University of Arizona, School of Natural Resources/ Office of Arid Land Studies
Pavolitas, Tony	MAM, VEG	Organ Pipe Cactus National Monument, Ecological Monitoring Program
Payan, Rafael	MGR	Pima County, Natural Resources Parks and Recreation Department
Phillips, Ann	MGR	City of Tucson, Office of Conservation and Sustainable Development
Povilitis, Tony	MAM	Organ Pipe Cactus National Monument, Ecological Monitoring Program
Regan, John	LP	Pima County, Public Works Department, GIS Services
Richardson, Scott	MGR	U.S. Fish and Wildlife Service, Ecological Services Office
Rosen, Phil	A&R	University of Arizona, Ecology and Evolutionary Biology Department
Ruther, Sherry	MGR	Pima County, Development Services Department
Ruyle, George	MGR	University of Arizona, School of Natural Resources
Schwalbe, Cecil	A&R	U.S. Geological Service, Sonoran Desert Research Station
Shaw, Bill	MAM	University of Arizona, School of Natural Resources
Sidner, Ronnie	MAM	University of Arizona/Independent contractor
Simms, Jeff	MGR	Bureau of Land Management, Tucson Field Office
Simms, Karen	MGR	Bureau of Land Management, Tucson Field Office
Steidl, Bob	BRD	University of Arizona, School of Natural Resources
Sullivan, John	MGR	Pima County, Natural Resources Parks and Recreation Department
Swann, Don	A&R	Saguaro National Park
Tersey, Darrell	MGR	Bureau of Land Management, Tucson Field Office
Thomas, Kathryn	VEG	U.S. Geological Service, Sonoran Desert Research Station
Turner, Dale	A&R, VEG	The Nature Conservancy, Arizona
van Leeuwen, Wim	LP	University of Arizona, Office of Arid Land Studies
van Pelt, Bill	MAM	Arizona Game and Fish Department, Habitat Branch
Walker, David	WTR	University of Arizona, School of Natural Resources/Department of Soil, Water, and Environmental Quality
Windes, John	MGR	Arizona Game and Fish Department, Habitat Branch
Wissler, Craig	LP	University of Arizona, School of Natural Resources
Youberg, Ann	WTR	Arizona Geological Survey

Table 2. List of parameters that were suggested for inclusion into the Pima County Ecological Monitoring Program. Participants in the subject-matter workshops (Landscape Pattern, Vegetation, Water, Birds, Reptiles and Amphibians, and Mammals) chose the initial group of parameters and participants in the Manager's workshop ranked the top 5 for Landscape Pattern, Vegetation, and Water and the top 5 for all vertebrates combined. NS = not scored

Category 1	Category 2	Parameter(s)	Description (if needed)	Workshop Rank	
				Subject-matter	Manager's
Landscape Pattern	Land cover type	Area and distribution of type, roads, and connectivity, isolation, etc.	Natural, urban, agriculture, mining, roads.	1	1
	Land Use	Area and distribution	Both current and potential future use of land.	1	5
	Upland Vegetation Formation[a]	Area and distribution	Physical structure of vegetation communities.	2	5
	Greenness Index	NDVI, floristics, phenology,	Measure of chlorophyll in plants.	3	
	Fire	Frequency, size, severity		NS	
Vegetation	Perennial species: mesoriparian	Distribution, area, recruitment, and condition		1	3
	Perennial species: semi-desert grasslands	Community composition, relative abundance, frequency, distribution, recruitment		1	4
	Perennial species: Sonoran Desert uplands	Community composition, relative abundance, frequency, distribution, recruitment		1	
	Exotic, invasive species	Distribution, area, frequency, relative abundance	May include some species covered under various perennial-species categories.	1	4
	Vegetation Formation[a]	Area and distribution	See Landscape Pattern	2	5
Water	Geomorphology	Channel cross section, longitudinal profile, pebble count	Expression of watershed health, floodplain function, surface water availability, and riparian vegetation.	5	
		Planform analysis and floodplain change, riparian buffer	How a river moves in relation to floodplain.		
	Water Quality	Field parameters- (e.g., temperature, turbidity, pH, etc.)	Most basic characteristics of water quality.	1	
		Nutrient loading (e.g., ammonia, nitrite, nitrate)	A good indicator of aquatic health.	3	
		Priority pollutant metals (e.g., Sb, Cd) and carcinogens.	Toxic metals resulting from human land uses.		
		Algal blooms	Indicator of nutrient loading.		
	Water Quantity	Streamflow extent and/or persistence of flow	Number of km of surface water; especially during dry periods.		5
		Streamflow discharge- natural streams and springs	Amount of water in streams and springs	4	5
		Ephemeral pools- volume and persistence (availability)	Amount and timing of water availability for wildlife and plants.		
	Groundwater	Depth/gradient to shallow groundwater	Gradient is an early warning indicator of changes of depth.	2	
	Macroinvertebrates	Community structure	Generally defined as insects that can be seen with the naked eye. Community structure is often used as a measure of water quality and overall stream health.		
Other	Disturbance[b]	e.g., insect and pathogen outbreaks, floods, toxic spills, etc.	Distribution and characterization of disturbance events		
Vertebrates					
Fishes	All Species	Occupancy, abundance	Native and non-native	[c]	1
Amphibians and Reptiles	Frogs	Occupancy, abundance	Leopard frogs, bullfrogs	1	3
	Toads and spadefoots	Occupancy, abundance		3	

Category 1	Category 2	Parameter(s)	Description (if needed)	Workshop Rank	
				Subject-matter	Manager's
Amphibians and Reptiles cont.	Nocturnal reptiles	Occupancy, abundance	Primarily snakes	2	
	Diurnal lizards and snakes	Occupancy, abundance	Whiptail lizards and common snakes	4	
	Mexican garter snake	Occupancy, abundance		NS	
	Box turtle	Occupancy, abundance		NS	
	Desert tortoise	Occupancy, abundance		NS	
Mammals	Predators	Occupancy, abundance	Bear, cats, skunks, fox, coyote, raccoon, badger, coati, ringtail	1	2
	Bats	Occupancy, abundance		2	5
	Small mammals	Occupancy, abundance	Rodents, squirrels, lagomorphs	3	
		Diversity, evenness, species composition		4	
Birds	Songbirds: breeding season	Occupancy, abundance	Including allies like cuckoos	2	4
	Songbirds: non-breeding season	Occupancy, abundance			
	Diurnal raptors: breeding season	Occupancy, abundance	Hawks, falcons, golden eagle	5	
	Diurnal raptors: non-breeding season	Occupancy, abundance			
	Nocturnal raptors and nightjars: breeding season only	Occupancy, abundance	Most owls and nightjars	4	
	Hummingbirds	Occupancy, abundance			
	Ducks and waders	Occupancy, abundance	Ducks, grebes, shorebirds, etc.		
	Songbirds	Productivity	Number of young	2	
	Diurnal raptors	Productivity	Number of young	1	
	Nocturnal raptors and nightjars	Productivity	Number of young		
	Diurnal raptors	Breeding status	Binary; whether they bred or not	3	

[a] Vegetation formation was scored by both the landscape pattern and vegetation workshops. The landscape pattern participants chose to focus on upland communities whereas the vegetation group did not make a distinction between upland and riparian. The manager's workshop participants were asked to rank only "upland" vegetation formation.
[b] Only the manager's workshop was asked to rank disturbance but participants in all meetings expressed interest in collecting this information.
[c] No expert workgroup for fishes.

Table 3. Proposed timeline for Section 6 grant application and for completing the Phase I monitoring plan.

Proposed Date	Section 6 Grant	Phase I plan
Jan 2	Draft grant to AZG&F	
Feb 7	Grant submitted by AZG&F	
Jan 24		Draft report to Pima County and RECON
Mar 9		Final Report to Pima County
Mar 15		Report reviewed by External Review Committee (ERC)
April 15		Receive comments back from ERC
Aug 1 (approx.)	Grant award announcement. If we are awarded funding, then $ is available no earlier than October 1	

Appendix A. Example of comments that we received from workshop experts (E).

Group Parameter	Characteristic(s) to which parameter is linked	Criteria						
		Ecological Relevance		Response Variability		Feasibility		
		Changes reflect larger system	Changes quickly	Low Natural Variability	Low Sampling Error	Low Cost	Methods well established	Other Comments
Geomorphology 1) channel cross section 2) longitudinal profile 3) pebble count	Land use, climate, vegetation, bedload	E2: Most useful at the watershed scale; local events may not be important- sediment waves may not indicated larger channel issues. E5: Well established parameters to monitor changes. E4: Affects water availability and vegetation along the stream channel	E2: Especially sediment/influx. E5, E3, E1: Mostly slow change, but can be quick with large disturbance events. E4, E1: Profiles have slower systematic change, but local change is rapid.	E2: Depends on disturbance and rainfall. E5: Trends are generally in one direction (X section increases with increasing contributing area). E1: Can be significant high natural variability (spatial?).	E5: Training is imperative to reduce errors. E3: Methods are well established and this will reduce errors and allow for ease of implementation. E1: Use of a total station using trained personnel is critical.	E2: Use on a limited number of streams and on "event" basis, not annually. E5, E1: Field personnel can sample quickly if well trained. E3: Expensive because of labor. E4: Pebble counts, in particular, are time consuming,	E2, E5: Yes, except for pebble counts. E3: See USGS NAWQA program, also USEPA EMAP program. E4: Frequency of sampling may not be well established. E1: Survey methods well established, but analysis methods, detecting when morphologic change is significant and why it is occurring is not well established.	E2: Function of watershed scale and relevance depends on spatial sampling; suggest beginning sampling at small watersheds-no larger than 1km^2. E5: At each site must do at least 3 cross sections and get an average. Cross sections provide width and depth ratios and area which can be used to monitor aggradation/degradation. Once baseline is established, re-do after 5 yrs or after disturbance.
Groundwater Depth/gradient (shallow groundwater, riparian water table)	Land use, pumping volume, ET, climate,	E2, E5, E4, E1: long-term, large scale indicator- ties directly to vegetation communities. Indirectly to aquatic. E4: Drives the change in extent of baseflow. E1: Water availability, can be directly linked (with some additional monitoring) to human disturbances such as pumping	E5: Very rapid response in parameter, but affects on other ecosystem components will take longer (lag time). E3, E1: Yes, to local pumping.	E2: Should reflect local condition in absence of pumping. E5: High seasonal variability. E4: Change is less variable than streamflow quantity and extent. E1: Depth to shallow groundwater for perennial systems typically does not vary as much as that for ephemeral systems.	E5: Often monitored by dataloggers, which need calibration. E3, E4: Few errors because of standard methods.	E2, E5, E1: Once established, cost is low if only monitoring depth and shallow groundwater. E4: High cost except for dirvepoints, which are susceptible to loss by fire and flood. Low training needs and analytical costs.	E3: Yes. E4: Location and design need a lot of attention (common design problem).	E2: Cheaper without gradient. Ephemeral systems will be more expensive (deeper well rigs) are important for plant response. E5: This is a key parameter for ecosystem health- will be reflected throughout system. (E4) Gradient will be good early warning of impending change. E3: Changes may be very limited in extent. Must have a good understanding of local hydrogeology.

Ecological Monitoring IGA

Parties: Pima County, Pima County Regional Flood Control District, and other State, federal and local land managing agencies; state and local water management agencies; AGFD, non-governmental organizations.

Term: Ten years, renewable for two additional ten year terms.

Purpose: 1) To further the region's ability to detect and quantify changes to select ecosystem components at appropriate spatial and temporal scales to inform adaptive management and 2) to determine if the SDCP biological goal of the maintaining the full spectrum of indigenous plants and animals is being achieved through maintaining ecosystem structure and function.

Specific Provisions:

1) share ecological monitoring data collected by the parties;
2) share equipment or other physical resources for ecological monitoring as deemed appropriate by the parties;
3) conduct joint field monitoring as deemed appropriate by the parties;
4) attend meetings for development and implementation of Pima County Ecological Monitoring Plan;
5) authorize the parties to develop and submit joint proposals to increase the funding available to the region for ecological monitoring;