WHY MONITOR?

Atkinson et al. 2004. Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans

- Compliance – track implementation
- Effectiveness – success in meeting biological objectives
  - Species status & trends
  - Track threats
  - Effects of management
- Targeted studies – ↑ knowledge of ecological systems & mgmt techniques

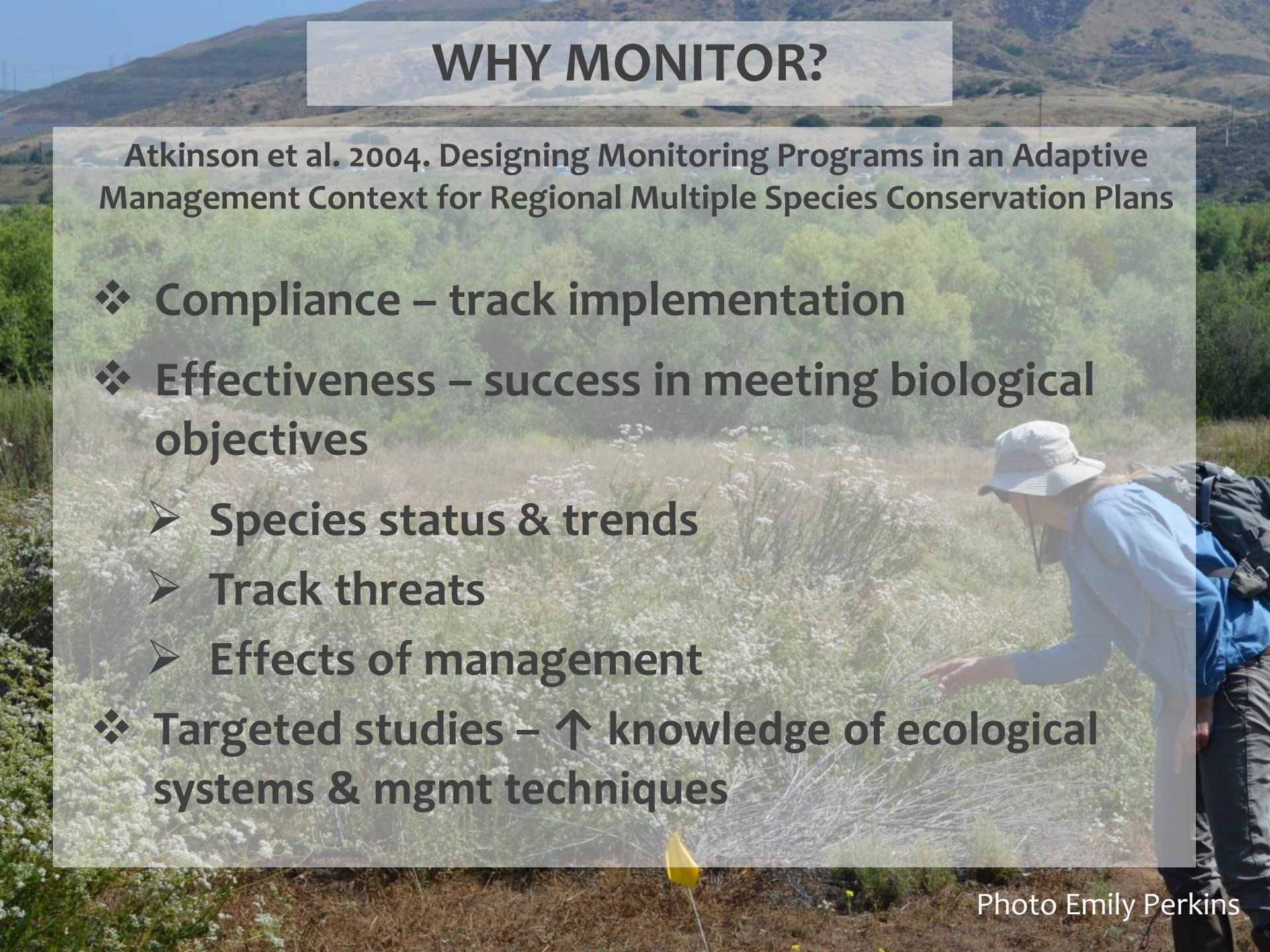


Photo Emily Perkins

ADAPTIVE MANAGEMENT APPROACH

Results from monitoring, targeted studies & applying management in experimental context → inform management decisions to improve effectiveness over time

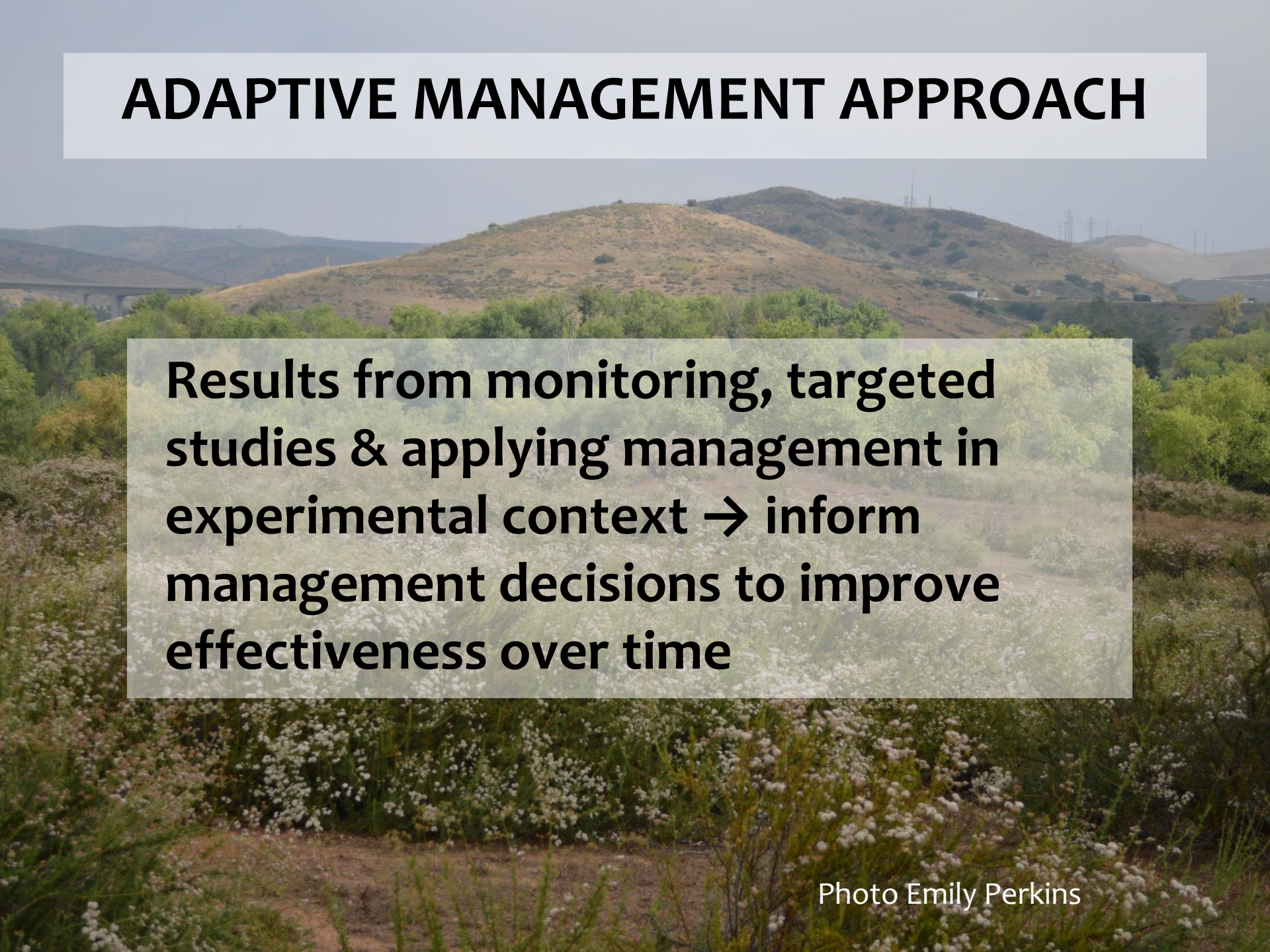
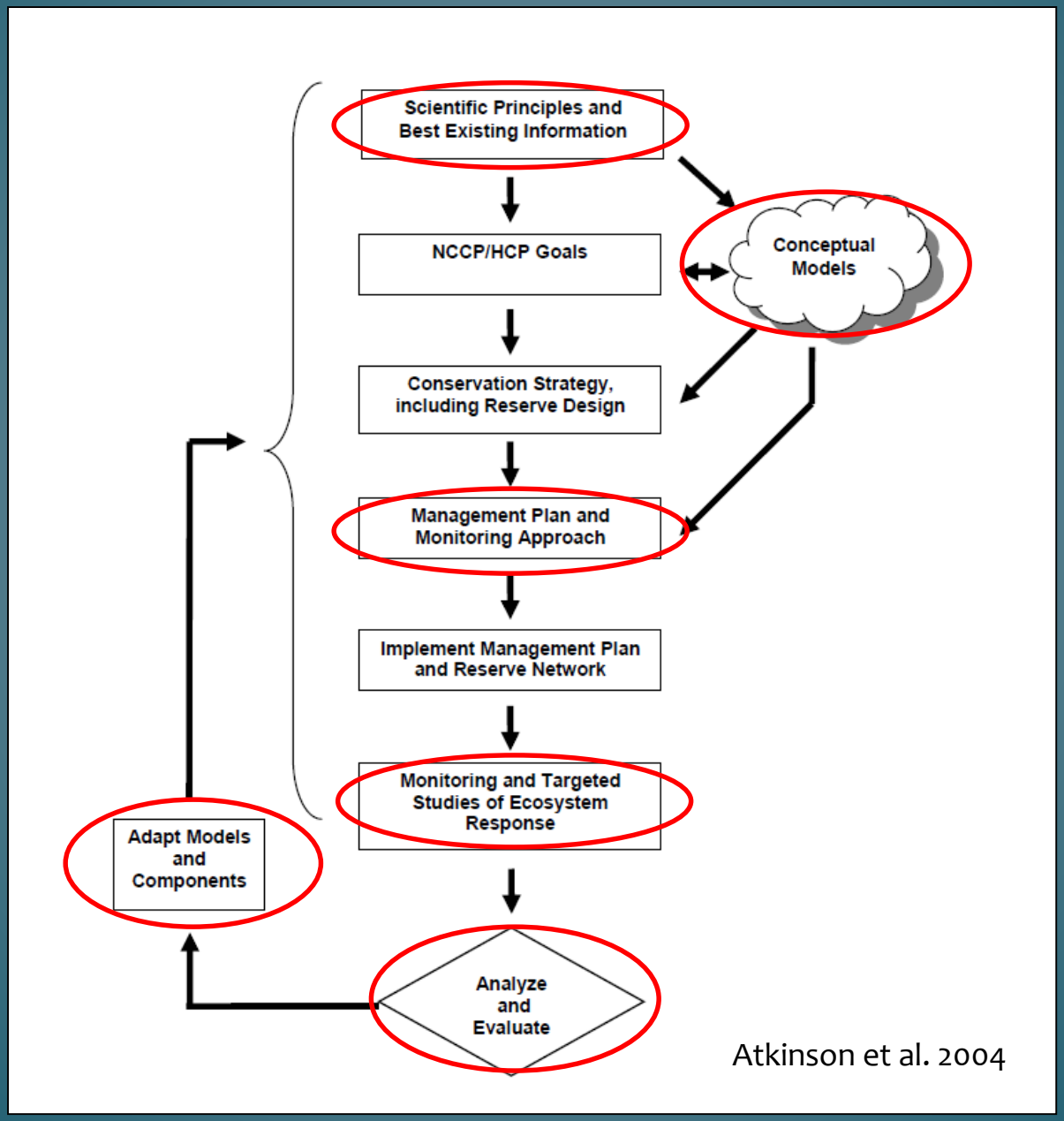


Photo Emily Perkins

NCCP/HCP ADAPTIVE MGMT FEEDBACK LOOP



Atkinson et al. 2004

Examples of What we Have Learned from Pre-MSP Monitoring

Photo Dave Hogan

WHAT HAVE WE LEARNED?

Rare plants –1999-2009, 24 sp:

- Unable to reliably determine total popn size or trends (McEachern et al. 2010)
- Develop adaptive mgmt approach → measure popn (index) & habitat conditions over time, standardize protocols & share databases to address mgmt needs (McEachern et al. 2007, 2010)

Photo John Martin

WHAT HAVE WE LEARNED?

SW Pond Turtle @ Sycuan Peak ER (Brown et al. 2012, 2015):

- 2005 38 ad, no juv - Threat = nonnative aquatic animals
- Removed 5 spp, harvested eggs & captive reared turtles → reintroduction
- Removal of invasives → natural recruitment, popn doubled & 10 head-started turtles survived

WHAT HAVE WE LEARNED?

California gnatcatcher:

- **2002 occupancy = 26%, varied by modeled habitat quality** (Winchell & Doherty 2006)
- **Extinction constant, but colonization > in higher quality habitat at lower elevations** (Winchell & Doherty 2014)
- **Postfire recovery slow** (Winchell & Doherty 2014)
- **Efficacy of area searches > than point counts** (Miller & Winchell 2016)

Photo Alexander Houston

WHAT HAVE WE LEARNED?

Mountain Lions in so CA:

- **High human-caused mortality, annual survival = 56%** (Vickers et al. 2015):
  - **Need to manage vehicle collisions, depredation permits, shooting**
- **Development & I-15 barrier to movement** (Ernst et al. 2014):
  - **Santa Ana Mtns – very low genetic diversity, Ne = 5.1**
  - **San Diego Co - Ne = 24.3**

Photo Winston Vickers

WHAT HAVE WE LEARNED?

CSS, chaparral & grassland vegetation (Deutschman & Strahm 2009, Strahm 2012)**:**

- Determined efficacy of methods & sources of variability → sites, plots, methods & teams
- Initiated conceptual models, questions & objectives
- Power analyses → sample sizes to detect specified change in vegetation/species cover

Photo Emily Perkins

WHAT HAVE WE LEARNED?

Index of Biological Integrity (Diffendorfer et al. 2007)**:**

- IBI for CSS – measure biodiversity along disturbance gradient
- Sampled ants, herps, birds, small mammals & veg
- Gradient of disturbance = % NNG cover
- No single taxon, sp, or community measure = good indicator
- Turnover in spp along gradient
- Multi-taxa IBI > sensitivity than % NNG cover & can decompose

Photo Patricia Gordon-Reedy

OTHER PRE-2013 MSP REGIONAL MONITORING PROJECTS

Species:

Dehesa nolina mapping
Tecate cypress mapping
Torrey pines mapping/age
Hermes copper
Thorne's hairstreak
Quino checkerspot
Wandering skipper
Arroyo toad
Herpetofauna
Cactus wren
Western burrowing owl
American badger
Bats

Vegetation

CSS & chaparral remote sensing
Vegetation classification & map

Threats

Aquatic invasive species
Connectivity studies
Enforcement study
Feral pigs
Invasive plants & mgmt studies
Postfire studies

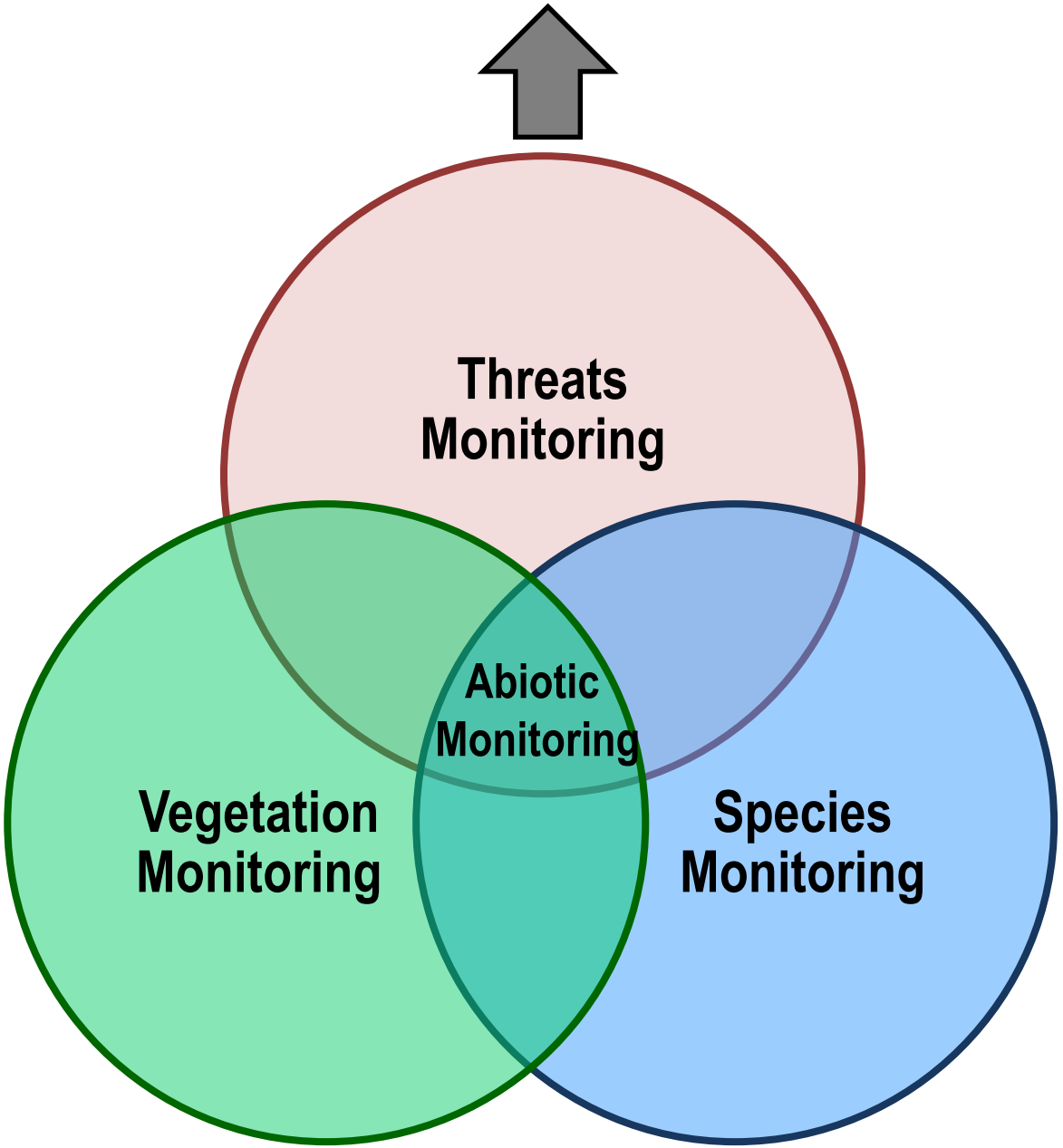
2016 Regional Monitoring Approach for Western San Diego County

Photo Chris Brown

DEVELOPING THE 2016 MSP MONITORING ELEMENT

- Builds upon what we have learned from monitoring prior to the 2013 MSP
- Expands upon 2013 MSP - 91 monitoring objectives: 81 species, 6 veg & 4 threats
- 2016 MSP includes the completed monitoring element for 2017-2021

Regional Preserve System Monitoring



Regional Preserve System Monitoring Questions

What is the ecological integrity of the MSPA preserve system, is it changing over time & why?

(Meta-analysis of datasets in MSP Web Portal)

Ecological integrity –

The ability of an ecological system to support & maintain a community of organisms that has species composition, diversity & functional organization comparable to those of natural habitats within a region

Karr & Dudley 1981, Parrish et al. 2003

Regional Preserve System Monitoring Questions

What is the ecological integrity of the MSPA preserve system, is it changing over time & why?
(Meta-analysis of datasets in MSP Web Portal)

Two levels of evaluation:

- **Simple metrics relevant to public & decision makers**
- **More biologically detailed metrics to determine if meeting management objectives & to inform management decisions**

Regional Preserve System Monitoring Questions

What is the ecological integrity of the MSPA preserve system, is it changing over time & why?

(Meta-analysis of datasets in MSP Web Portal)

Threats Monitoring Questions

- What are the types & levels of threats in the MSPA preserve system, are they changing over time & why?
- What are BMPs for managing threats?
- Is management effective at reducing threats?

Abiotic Questions

- Are abiotic elements in the MSPA changing over time & why?

MSP Vegetation Monitoring Questions

- What is the distribution, composition, structure & integrity of vegetation communities in the MSPA & are these changing over time?
- What threats & abiotic factors are associated with changes in vegetation community attributes?
- What are BMPs for managing threats?
- Is management effective at reducing threats & enhancing vegetation communities?

MSP Species Monitoring Questions

- What is the distribution & status of MSP species in the MSPA & are they changing over time?
- What threat, habitat & abiotic characteristics are associated with changes in MSP species distribution & status?
- Research oriented questions (e.g., connectivity & genetic diversity, demographics) to address critical uncertainties important for management.
- What are BMPs for managing threats & enhancing species' populations?
- Is management effective at reducing threats & enhancing species populations?

Regional Preserve System Monitoring Objectives

Meta-analysis of datasets in MSP Web Portal every 3 years to evaluate integrity metrics

Threats Monitoring Obj

- Fire: multiple obj
- Altered hydrology – plan
- Climate change – modeling & weather/soil stations
- Human use of preserves – Support CSU & NCC studies
- Invasive plants – ISP & EDRR
- Invasive animals – plan & monitoring, feral pig erad, BHCO, SHB
- Loss of connectivity – multiple monitoring obj
- Loss of ecological integrity– oak & rip bird surveys, pollinator plan
- Pesticides – plan

MSP Vegetation Monitoring Obj

Vegetation Communities:

- CSS, chaparral & grassland – remote, plan & monitor
- Oak wdld – remote, plan & monitor
- Riparian – remote, plan & monitor
- Salt marsh – plan
- Torrey pine forest – remote
- Tecate cypress forest – remote
- Vernal pool – monitor

VF Species:

- CA gnatcatcher – regional & fire
- CSS rare plants IMG 4 sp
- Blaineville's horned lizard – plan & monitor
- Black-tailed jackrabbit – plan & monitor
- Vernal Pool - monitor
- Engelmann oak wdld – remote, plan & monitor

MSP SL, SO & SS Species Monitoring Obj

- **Rare Plants:**
  - IMG 30 sp
  - Baseline survey 11 sp
  - Genetics 6 sp
  - Mgmt effect 24 sp
  - Research 6 sp
  - Rare Plant Postfire Res 3 sp
  - VP SL plants – monitor 2 sp
- **Animals:**
  - Fairy shrimp – monitor Butterflies - monitor 3 sp
  - Amphibian – monitor 1 sp
  - Reptiles – monitor 1 sp
  - Birds – monitor 9 sp
  - Mammals – monitor 6 sp

EXAMPLE - 2016 MONITORING OBJ & TIMELINE

Scientific Name	Common Name	Mgmt Category	Type of Fire Obj	Obj Type	Obj Code	IMP Obj Type	2017	2018	2019	2020	2021	Description
Branchinecta sandiegoe	San Diego fairy shrimp	SL		MON	CYST			X	X	X	X	Quantitative cyst sampling - Local
Streptocephalus wooton	Riverside fairy shrimp	SL		MON	CYST			X	X	X	X	Quantitative cyst sampling - Local
Euphydryas eitha quino	Guino checkerspot	SL		MON	SUR		X	X	X	X	X	Metapopn assessment - survey for larvae, adults and map Plantago erecta.
Euphydryas eitha quino	Guino checkerspot	SL		MON	MODL		X	X	X			Develop habitat suitability models for QCB & host plants under current & future climate scenarios. Conduct metapopn modeling to inform mgmt.
Euphydryas eitha quino	Guino checkerspot	SL		MON	IMP	MGT			X	X	X	Monitor implementention and effectivenss of high priority management plan actions in So Co
Euphydryas eitha quino	Guino checkerspot	SL	POST	MON	PFMGT		X	X	X	X	X	Document recovery of QCB habitat and butterflies and effectiveness of management actions for first 3 years after fire.
Eyphyes harbisoni	Harbison's dun skipper	SL		MON	SUR		X					Host plant, larval & adult surveys
Eyphyes harbisoni	Harbison's dun skipper	SL		MON	GEN		X					Pop genetics & connectivity between popns
Eyphyes harbisoni	Harbison's dun skipper	SL		MON	RES		X					Marking study to determine connectivity within watersheds
Eyphyes harbisoni	Harbison's dun skipper	SL		MON	IMP	MGT		X	X	X	X	Monitor implementention and effectivenss of high priority management plan actions
Eyphyes harbisoni	Harbison's dun skipper	SL	PRE	MON	IMP	FMGT	X	X	X	X	X	Monitor response of Harbison's dun skipper & habitat to pre-fire dead tree removal and other fire risk reduction measures
Lycaena hermes	Hermes copper	SL		MON	SUR		X					Adult butterfly surveys
Lycaena hermes	Hermes copper	SL		MON	IMP	MGT		X	X	X	X	Implement high priority actions from IP
Lycaena hermes	Hermes copper	SL	PRE	MON	IMP	FMGT			X	X	X	Monitor implementation of high priority fire mgmt plan actions
Gila orcuttii	Arroyo chub	SL										No objectives planned for 2017-2021
Anaxyrus californicus	Arroyo toad	SO		MON	ISV			X	X			Need to complete surveys during rainy year (as 2014-16 were drought years)
Anaxyrus californicus	Arroyo toad	SO		MON	GEN			X	X	X		Complete genetic study - need more tissure samples & analysis
Anaxyrus californicus	Arroyo toad	SO		MON	IMG		X	X	X	X	X	Inspect & manage monitoring
Anaxyrus californicus	Arroyo toad	SO		MON	IMP	MGT		X	X	X	X	Monitor implementation and effectiveness of high priority management plan actions
Emys marmorata pallida	Southwestern pond turtle	SL		MON	IMP	MGT		X	X	X	X	Monitor implementation & effectiveness of high priority management plan actions
Emys marmorata pallida	Southwestern pond turtle	SL		MON	TRAN		X	X	X	X	X	Monitor translocation success.

Regional Preserve System Monitoring Metrics

Threats Data

- **Fire Regime** (GIS/field - fire hist & risk)
- **Hydrology** (GIS/field - % watershed dev, water flows, groundwater depletion)
- **Climate Change** (GIS/field - models, weather data)
- **Herbivory/Predation** (field – predators)
- **Human Use of Preserves** (GIS/field – trail mapping, modeled & measured use)
- **Invasive Plant & Animal Species** (GIS/field - distrib, abundance, models, research, BMPs)
- **Loss of Connectivity** (GIS/field – land use, Cons Lands, roads, fragmentation, studies)
- **Loss of Ecological Integrity** (GIS/field – biodiversity, integrity classification)
- **Parasitism/Disease** (GIS/field – modeled risk, distrib, research)
- **Pesticides/ Rodenticides/Herbicides** (field – mapping treated areas, research)
- **Urban Development** (GIS/field – land use, N deposition, artificial lighting, fragmentation & edge metrics, Argentine ant)

MSP Species Data

- **Distribution** (GIS/field – modeled, surveys)
- **Population Abundance & Dynamics** (field)
- **Habitat & Threat Associations** (GIS/field – vegetation, abiotic elements, threats)
- **Effectiveness of Management** (field)
- **Targeted Studies** (field – genetics, demography, foraging, ecology)

MSP Vegetation Data

- **Distribution** (GIS/field –mapping, NDVI, change detection, preserve mapping)
- **Composition, Structure, Integrity** (GIS/field – remote, measurements)
- **Habitat & Threat Associations** (GIS/field – abiotic elements, threats)
- **Effectiveness of Management** (field)
- **Targeted Studies** (field – mortality, recruitment)

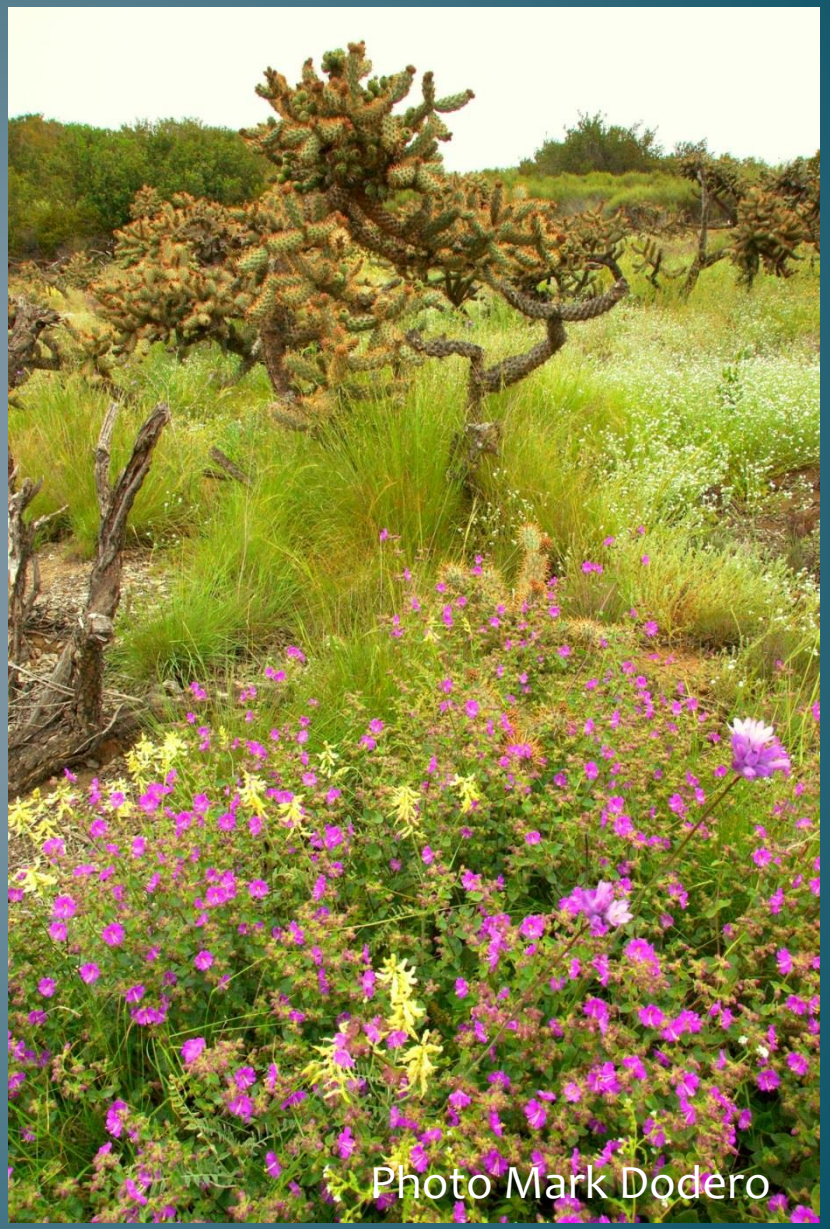
Abiotic Data

- **Climate** (GIS/field - precip, temp)
- **Soils** (GIS/field type, composition, moisture, nutrients)
- **Topography** (GIS - elevation, slope, aspect)
- **Solar Radiation** (GIS)
- **Water Bodies/ Hydrology** (GIS/field – stream reaches & classification, SCCWRP data)


have
a
break!

REGIONAL PRESERVE SYSTEM MONITORING

- GIS data layers & species, veg, threat & abiotic monitoring data → meta-analyses & syntheses
- Detect changes over time → distrib, status & relationships among components
- Results → Metrics to inform status of preserve & develop regional mgmt priorities



REGIONAL PRESERVE SYSTEM MONITORING METRICS

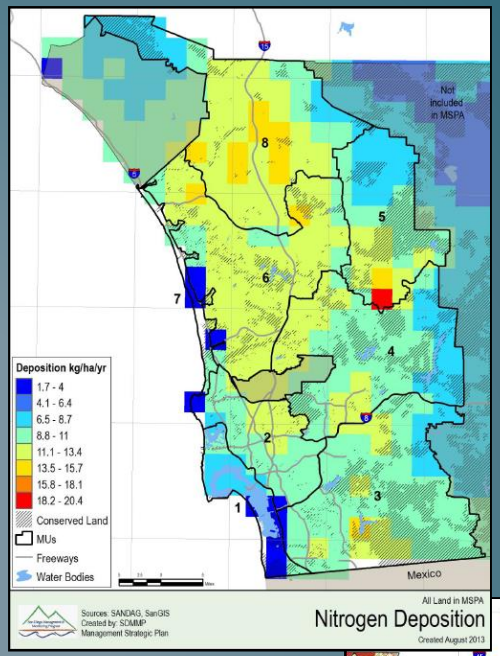
Two Types:

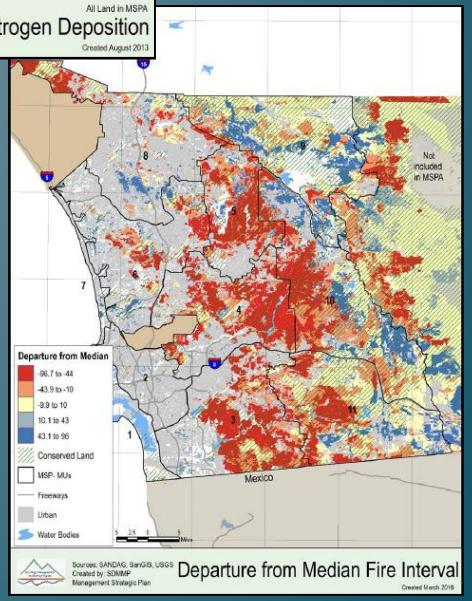
- Simple & relevant for decision makers & public
- Detailed & biologically based for mgmt of species, veg & threats

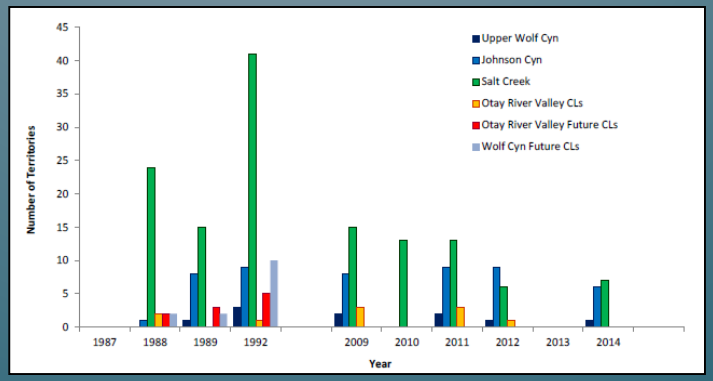
REGIONAL PRESERVE SYSTEM MONITORING

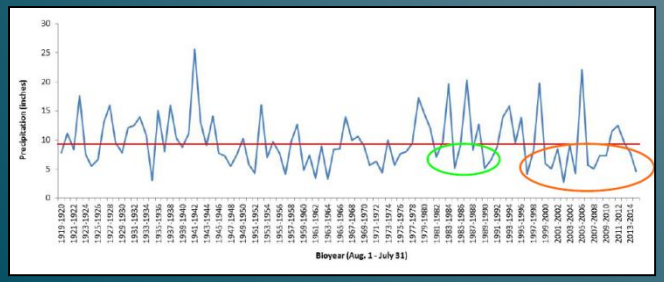
Types of Data Syntheses:

- Office based evaluation & analyses of GIS data layers, predictive models, weather station data, etc
- Field-based monitoring results & analyses – effectiveness & targeted studies









EXAMPLE: CSS & CHAPARRAL SYSTEMS

Overall Obj:

Determine status & ecological integrity of CSS & chaparral systems in MSPA & whether these are changing in response to threats & environmental conditions

Approach is based on synthesizing & analyzing data from species, veg, threat & abiotic monitoring

Photo City of San Diego

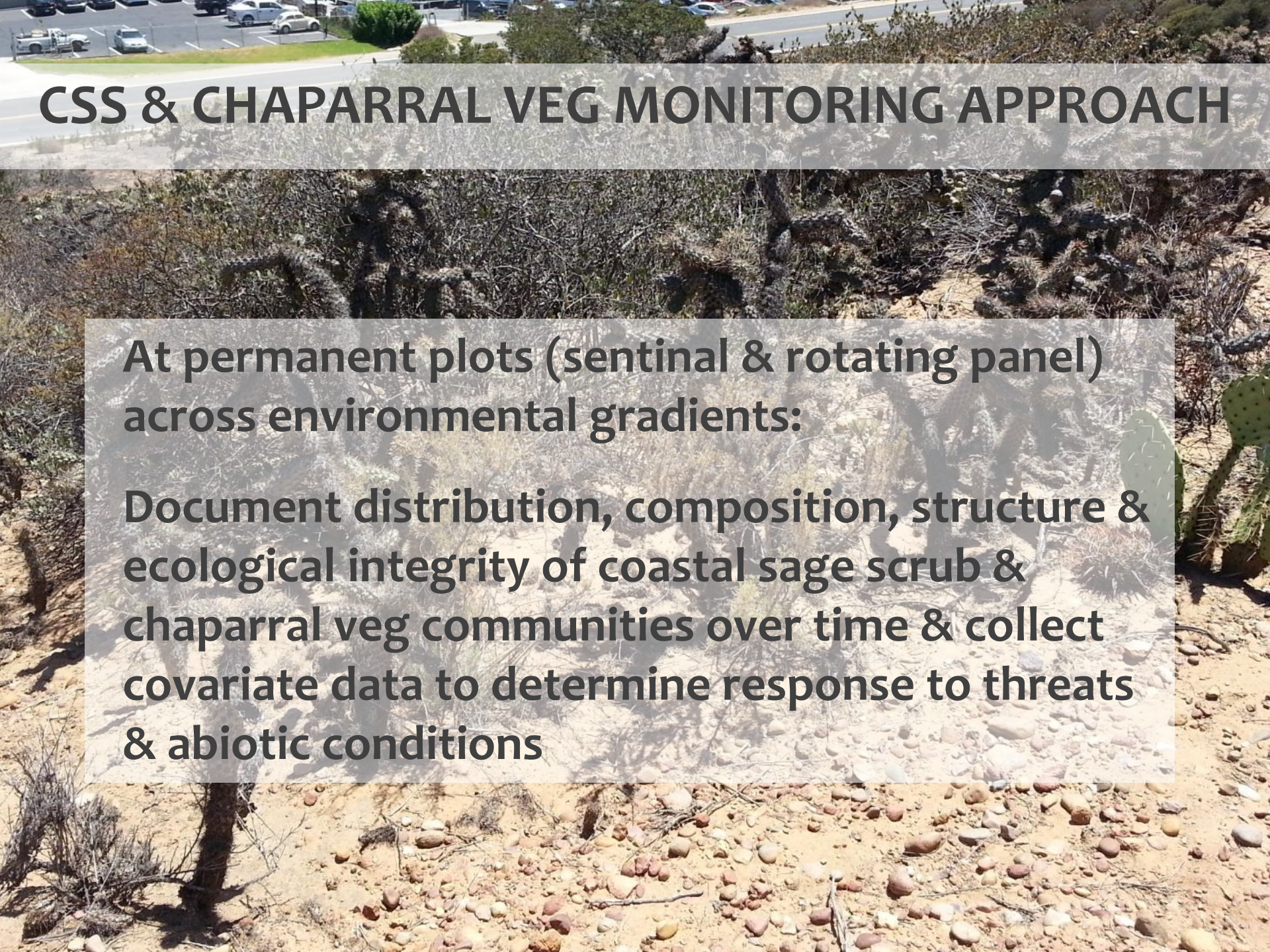
CSS & CHAPARRAL SYSTEMS

Veg Monitoring Component:

- Approach based in part on MCB Camp Pendleton CSS & Chaparral Monitoring Plan (Dawn Lawson, Deborah Bieber & Working Group)
- Conceptual model: primary threats = altered fire regime, invasive plants & climate change (e.g., drought)

Photo Patricia Gordon-Reedy

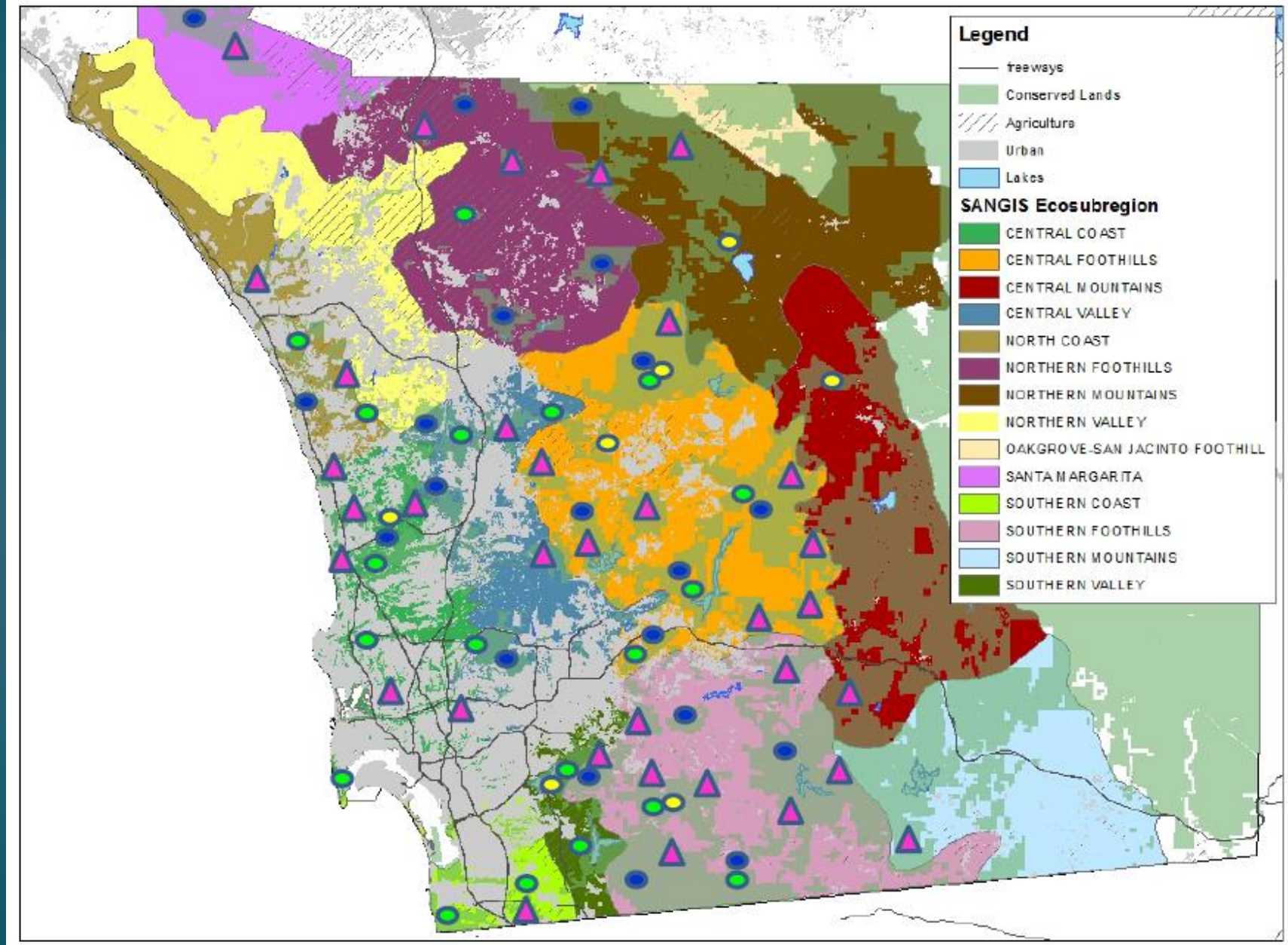
CSS & CHAPARRAL VEG MONITORING APPROACH



At permanent plots (sentinal & rotating panel) across environmental gradients:

Document distribution, composition, structure & ecological integrity of coastal sage scrub & chaparral veg communities over time & collect covariate data to determine response to threats & abiotic conditions

MOCK UP OF ECOREGION STRATIFIED SAMPLE DESIGN



CSS & CHAPARRAL VEG MONITORING APPROACH

Ecological Integrity of Vegetation:

- Integrity classes defined by % cover & density of shrubs, % cover of NNG as determined by range of variation in MSPA
- Model integrity classes across landscape & verify in field

Photo Patricia Gordon-Reedy

CSS & CHAPARRAL MONITORING APPROACH

Add in other components to assess status & integrity of system:

- Abiotic: soil mapping, soil temp & moisture, weather stations
- Species: VF plants & animals, SL, SO & SS as feasible
- Threats:
  - Loss of integrity: biodiversity, key ecological fxns Invasive species
  - Mgmt Actions: Invasive control

Photo John Martin

SPECIES MONITORING INSIGHTS INTO CSS SYSTEM

Ex: CAGN Fire Study obj

- Determine CAGN PAO & recovery from 2003, 2007 & 2014 fires
- Identify relation between CAGN PAO & veg covariates
- Determine recovery of CSS with different fire histories, time since fire, spatial distribution & environmental conditions

2007 Harris Wildfire – Lower Otay Lake; SD Wildfires Education Project

MANAGEMENT EFFECTIVENESS

- 2016 MSP has mgmt plans for sp, veg & threats
- All mgmt plan implementation obj have monitoring objective
- Monitoring part of IMG, BMP, pre- & post-fire mgmt obj

Photo Mark Dodero

CONCLUSION

2016 MSP is adaptive mgmt focused:

- Expands on previous monitoring & lessons learned
- All monitoring designed to inform mgmt of conserved resources
- Syntheses & meta-analyses of many data sources will allow greater understanding of status & integrity of preserve system & individual components


Thank You!!!!