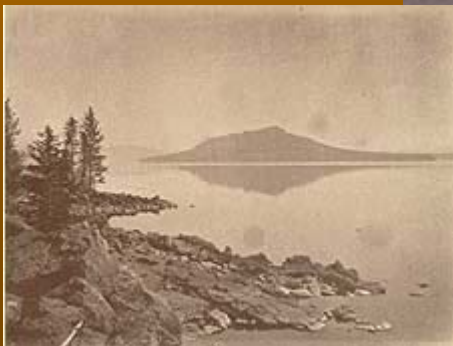
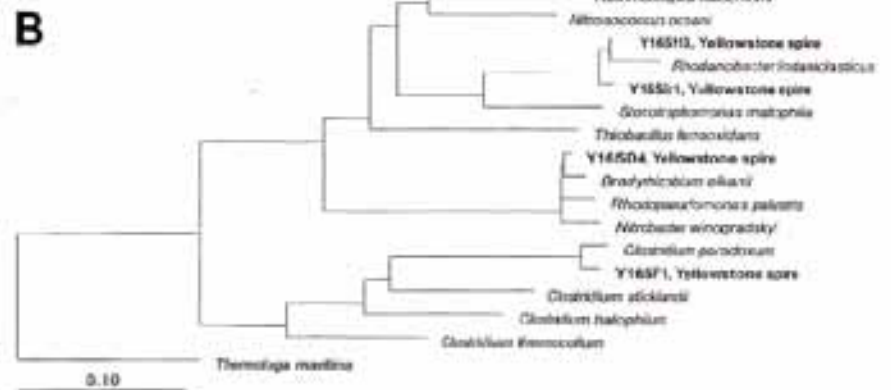
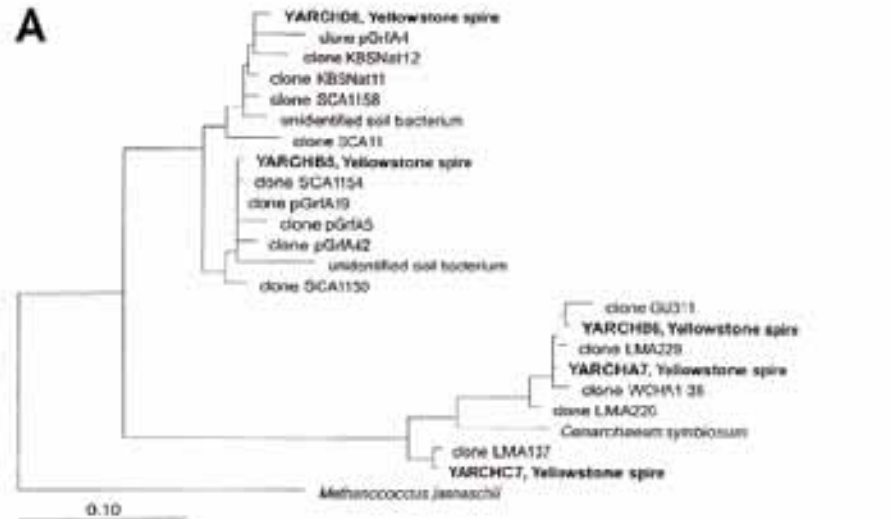


# Integration of Science into Park Management: Yellowstone Case Studies

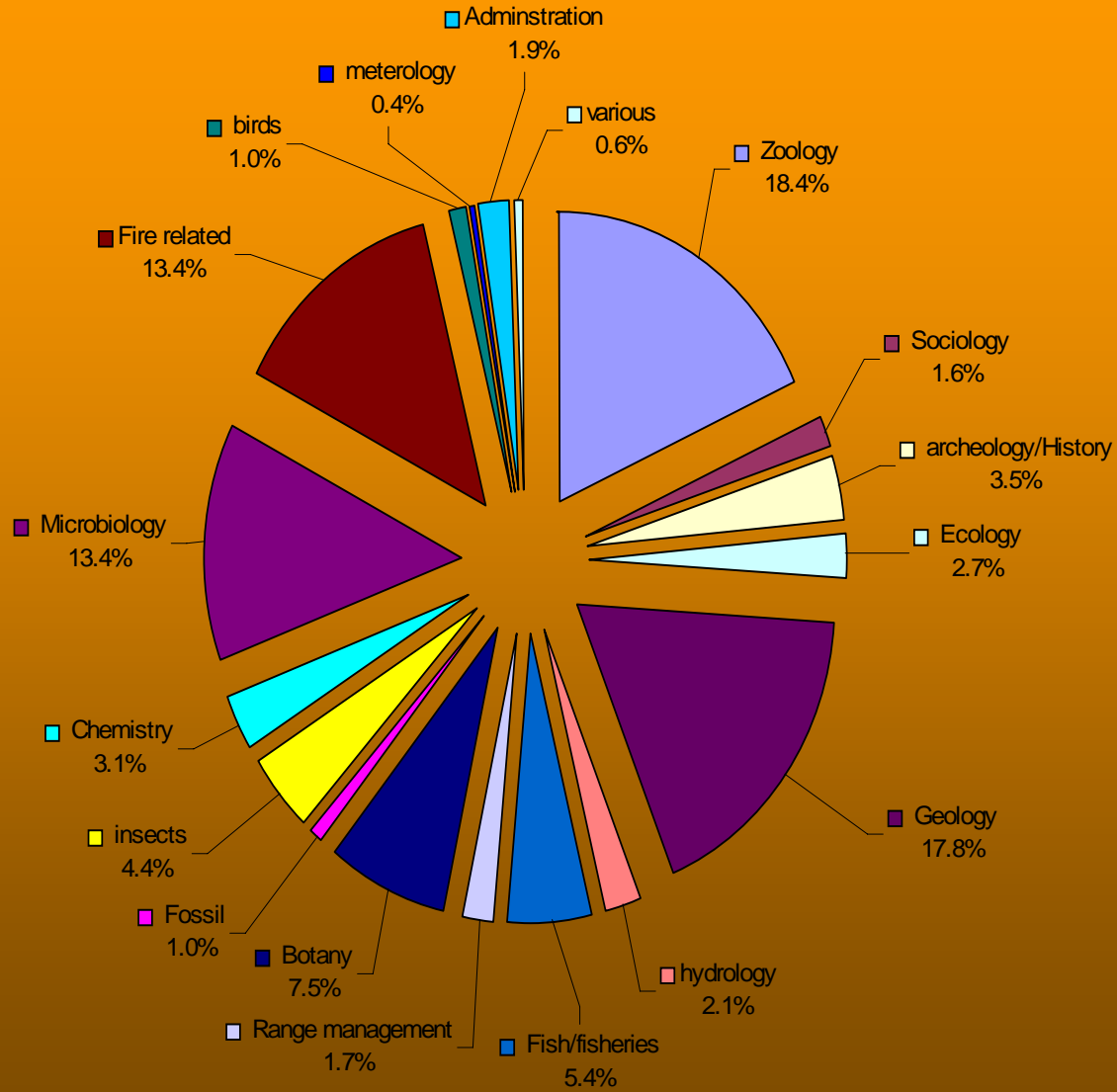






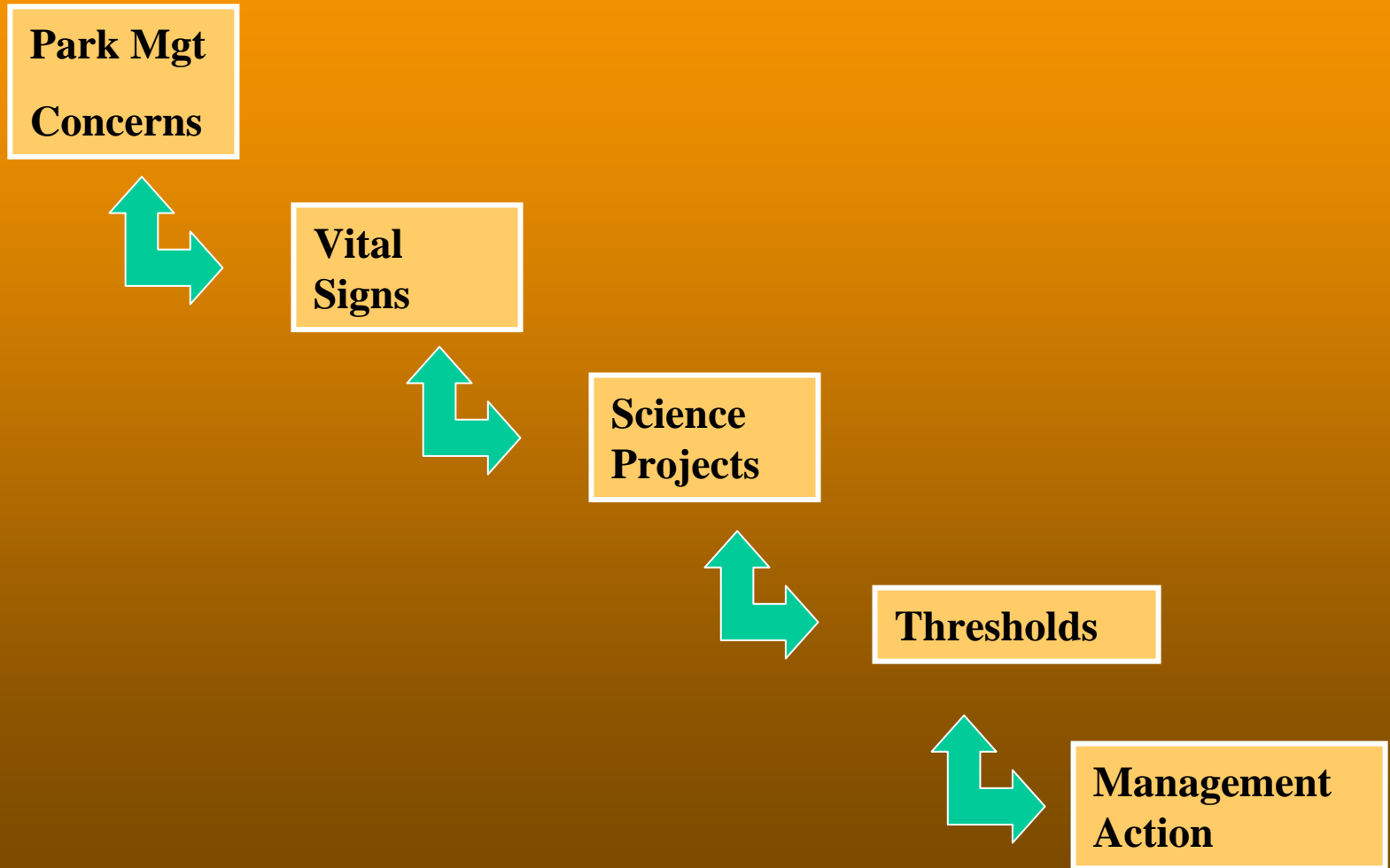
Reconstructed phylogenetic tree based on 16S rRNA sequences that were retrieved from a spire of Yellowstone National Park. **A**, Relationships of archaeal clones. **B**, Relationships of bacterial clones. Bars indicate 10% estimated sequence divergence.

# Scientific Research 1989-1996 Total No. of 1444



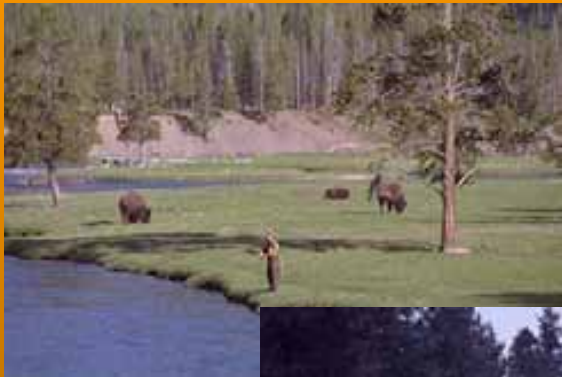
# *General Conceptual Model*

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# Case Studies

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# Dozens of Vital Signs have been identified for the Greater Yellowstone Network

Level 1	Level 2	Vital Signs
Air and Climate	Air Quality	Atmospheric deposition
		Oversnow emissions
		Visibility
Weather	Climate	
Geology and Soils	Geomorphology	Glaciers
		Stream sediment transport
	Subsurface Geologic Processes	Geothermal features
		Geothermal water chemistry
		Seismic activity
	Soil Quality	Soil structure and stability
		Soil biota
Water	Hydrology	Ground water quantity
		Arid seep and spring
		Reservoir and lake elevation
		Streamflow
	Water Quality	Biogeochemical flux
		Chloride flux
		Water chemistry
		Ground water quality
		E.coli (Escherichia coli)
		Algae
		Aquatic invertebrate assemblages
	Water temperature	

Level 1	Level 2	Vital Signs
Biological Integrity	Invasive Species	Invasive plants
		Exotic aquatic assemblages
	Infestations and Disease	Forest insect and disease
		Whitebark pine
		Vertebrate disease
	Focal Species or Communities	Aspen
		Riparian/riverine
		Shrub-steppe
		Insects
		Beaver
		Meso-carnivores
		Amphibians
		Landbirds
		Native aquatic assemblages
		Alpine
		Cushion plant
		Ungulates
At-risk Biota	Birds of concern	
	Large carnivores	
Human use	Visitor and Recreation Use	Backcountry day use
		Backcountry overnight use
		Visitor use
Ecosystem Pattern and Processes	Fire	Fire
	Land Use and Cover	Land use
		Land cover
Soundscape	Soundscapes	

# The network selected 12 Vital Signs to be funded by the I & M program

Level 1	Level 2	Vital Sign
Air and Climate	Air Quality	Atmospheric deposition
		Oversnow emissions
		Visibility
Weather	Climate	
Geology and Soils	Geomorphology	Glaciers
		Stream sediment transport
	Subsurface Geologic Processes	Geothermal features
		Geothermal water chemistry
		Seismic activity
	Soil Quality	Soil structure and stability
		Soil biota
Water	Hydrology	Ground water quantity
		Arid seep and spring
		Reservoir and lake elevation
		Streamflow
	Water Quality	Biogeochemical flux
		Chloride flux
		Water chemistry
		Ground water quality
		E.coli (Escherichia coli)
		Algae
		Aquatic invertebrate assemblages
	Water temperature	

Vital Signs			Vital Sign
Human Use	Visitor and Recreation Use	Ecosystem Pattern and Processes	Invasive plants
			Exotic aquatic assemblages
			Forest insect and disease
			Whitebark pine
			Vertebrate disease
			Aspen
			Riparian/riverine
			Shrub-steppe
			Insects
			Beaver
			Meso-carnivores
			Amphibians
Human Use	Visitor and Recreation Use	Ecosystem Pattern and Processes	Landbirds
			Native aquatic assemblages
			Alpine
			Cushion plant
			Ungulates
			Birds of concern
			Large carnivores
			Backcountry day use
			Backcountry overnight use
			Visitor use
			Fire
			Land use
Land cover			
Soundscapes			



Many other critical Vital Signs are being monitored by other programs

Level 1	Level 2	Vital Sign
Air and Climate	Air Quality	Atmospheric deposition
		Oversnow emissions
Geology	Geology	Geology
		Geology
Water	Water	Bio
		Chloride flux
		Ground water quality
		E.coli (Escherichia coli)
		Algae
		Water temperature

Together they form a more balanced comprehensive monitoring program

- Vital Signs**
- Climate
- Streamflow
- Water chemistry
- Aquatic invertebrate assemblage
- Arid seep and spring
- Structure and stability
- Native plants
- Terrestrial aquatic assemblages
- Bark pine
- Amphibians
- Landbirds
- Land use

Vital Sign
Forest insect and disease

- On-going monitoring**
- Visibility
- Atmospheric deposition
- Geothermal features
- Seismic activity
- Chloride flux
- Water temperature
- Reservoir and lake elevation
- Vertebrate disease
- Ungulates
- Large carnivores
- Birds of concern
- Land cover
- Fire
- Backcountry overnight use
- Soundscape

	At-risk Biot
Human use	Visitor and Recreation U
Ecosystem Pattern and Processes	Fire
	Land Use and Cover
	Soundscape

## *General Observations*

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4. Monitoring tells us something has changed—additional science explains why
5. Thresholds are generally complex

## *General Observations*

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6. Communicating the results of science to managers is the most important thing we do—and we don't do it that well!

# *General Observations*

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**Report to  
Management**



**Peer-  
Reviewed  
Manuscript**



**Popular  
Article**



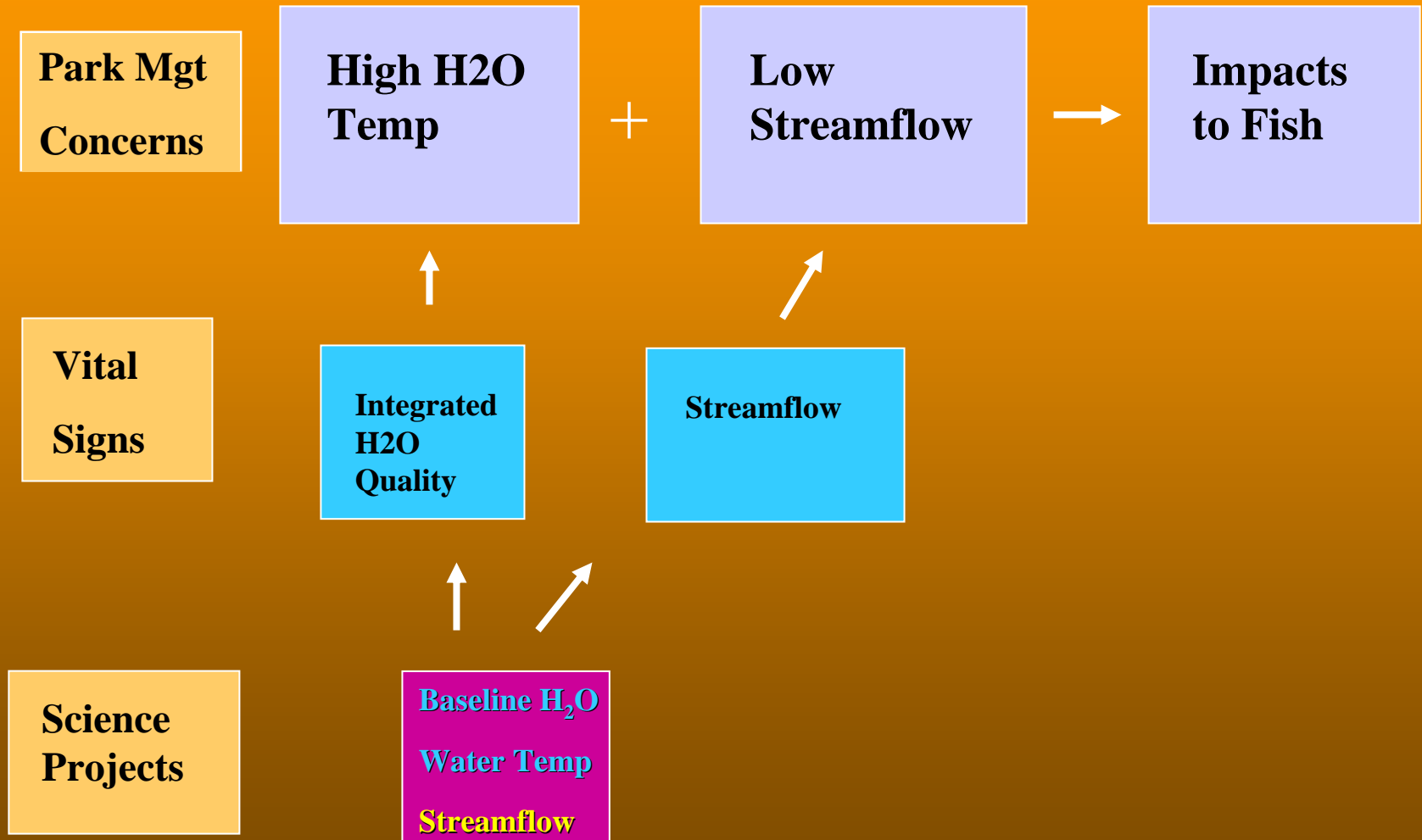
**Soundbite**

# Drought Contingency—Angling

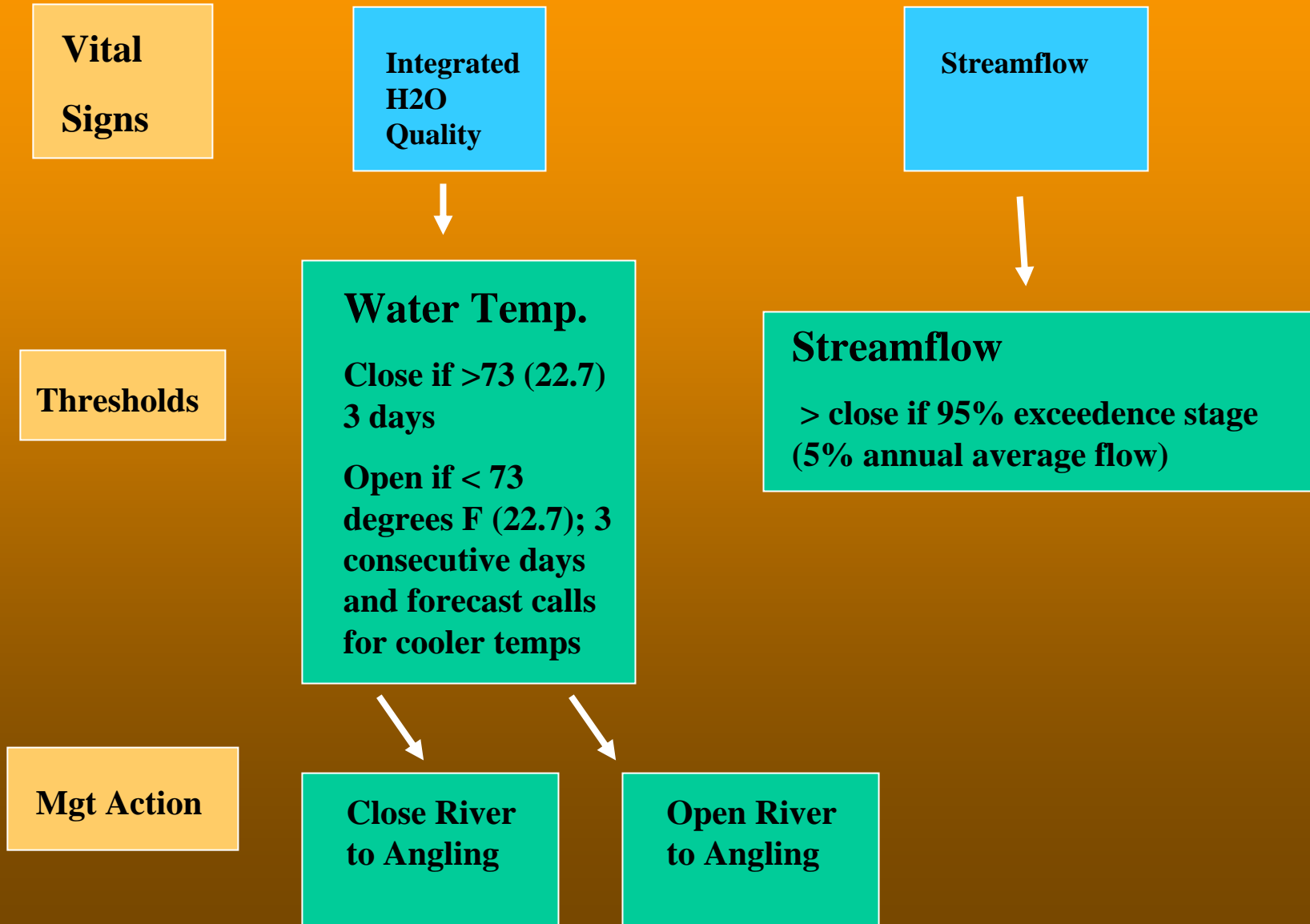
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# Drought Contingency—Angling



# Drought Contingency—Angling



# Drought Contingency—Costs

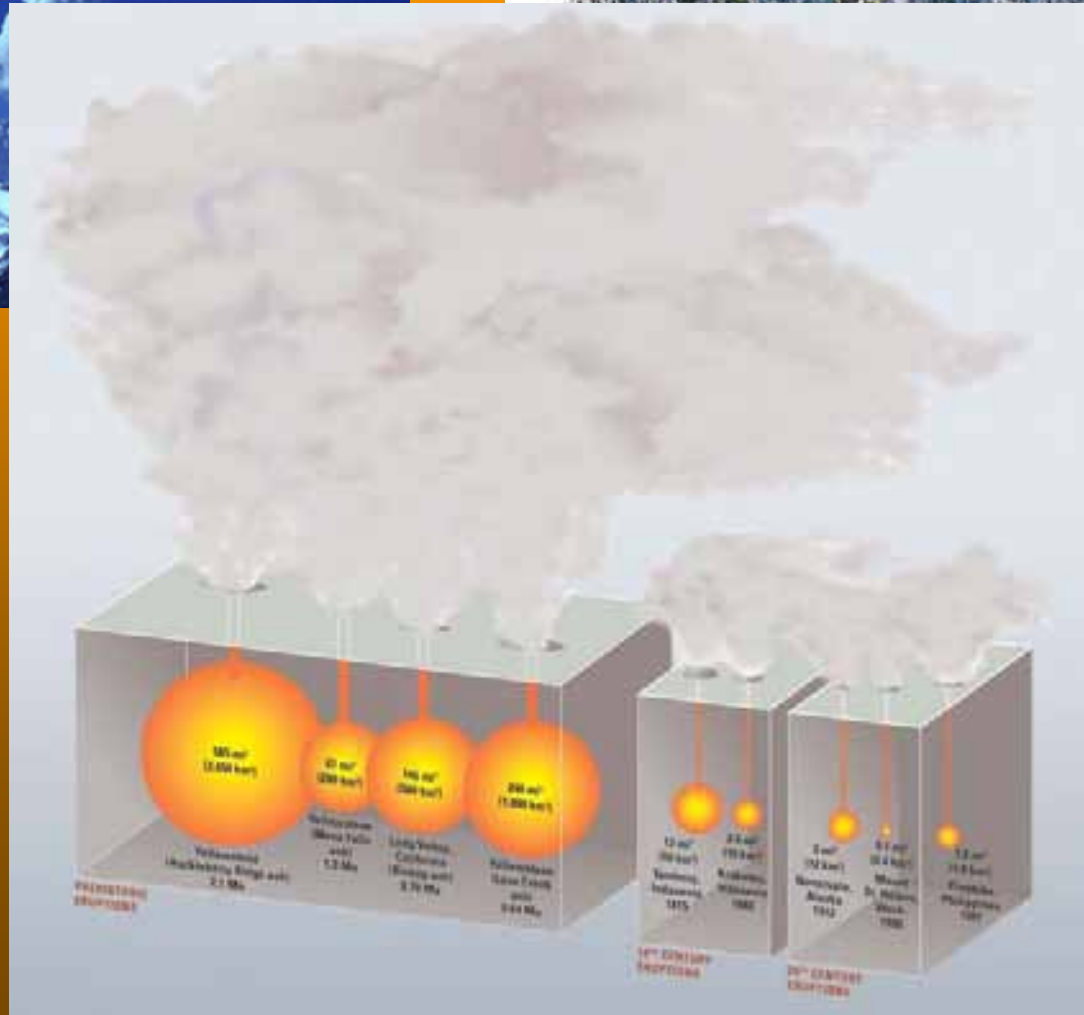
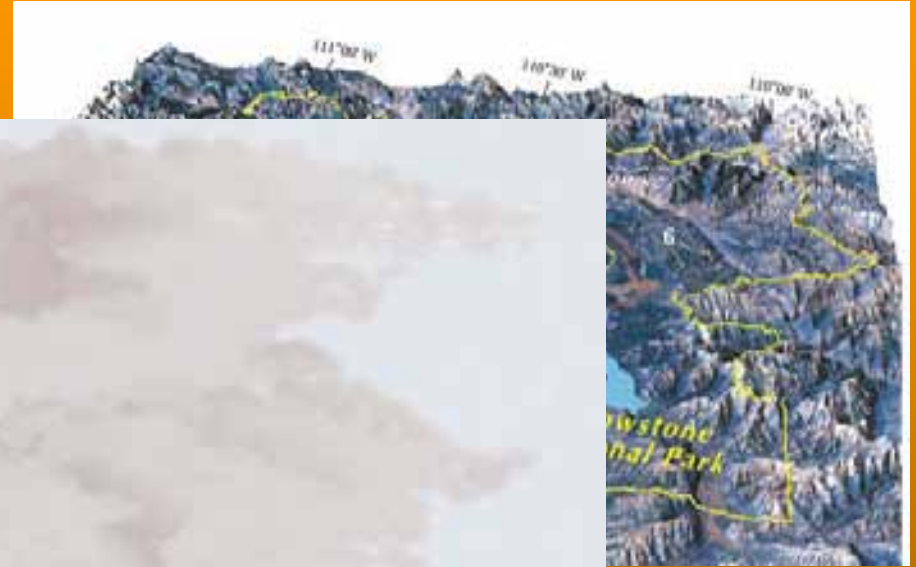
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NPS Costs: Year 1: \$6000; Year  
2: \$16,000

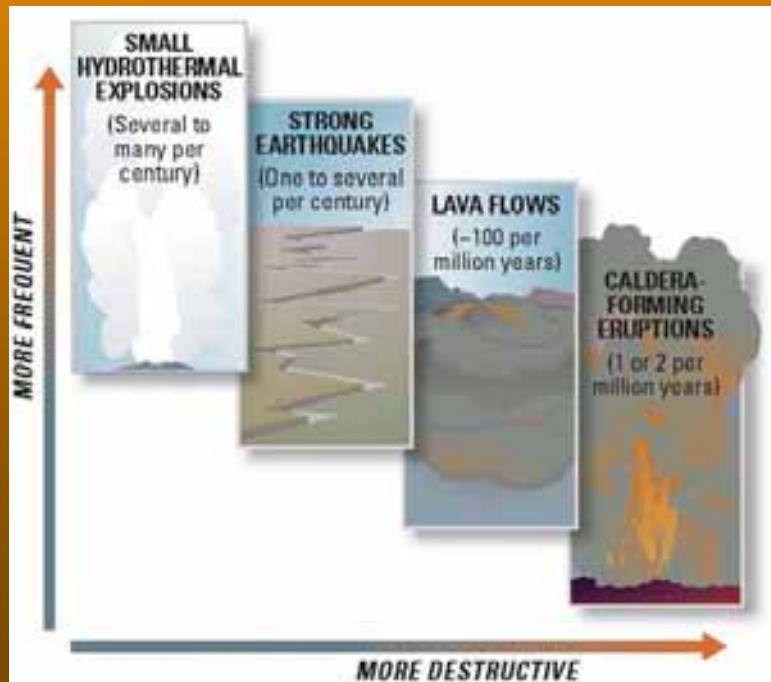
USGS Costs: Year 1: \$0; Year  
2: \$50,000 (install gauging  
station)



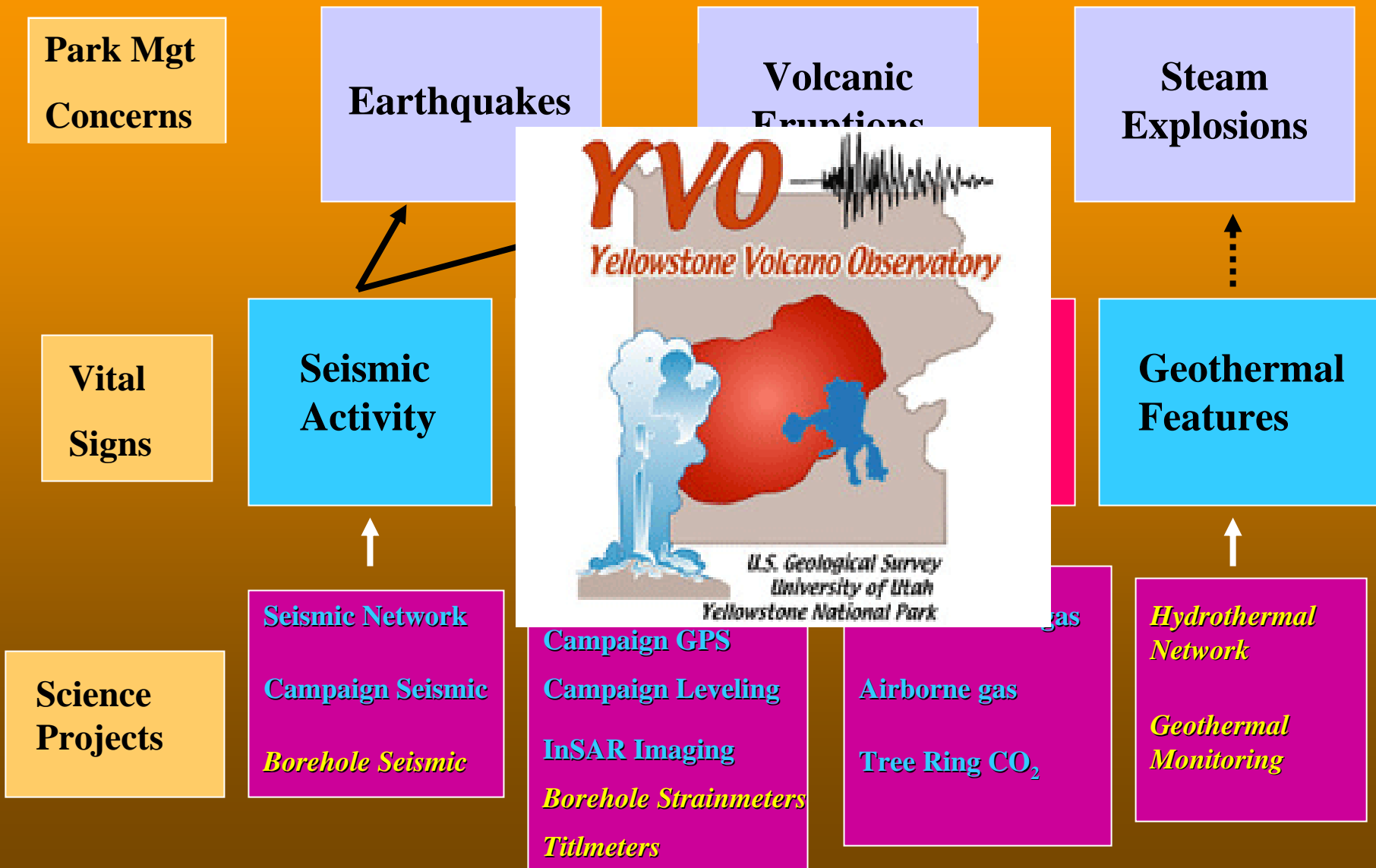
# Volcano Hazards



# Volcano Hazards



# Volcano Hazards

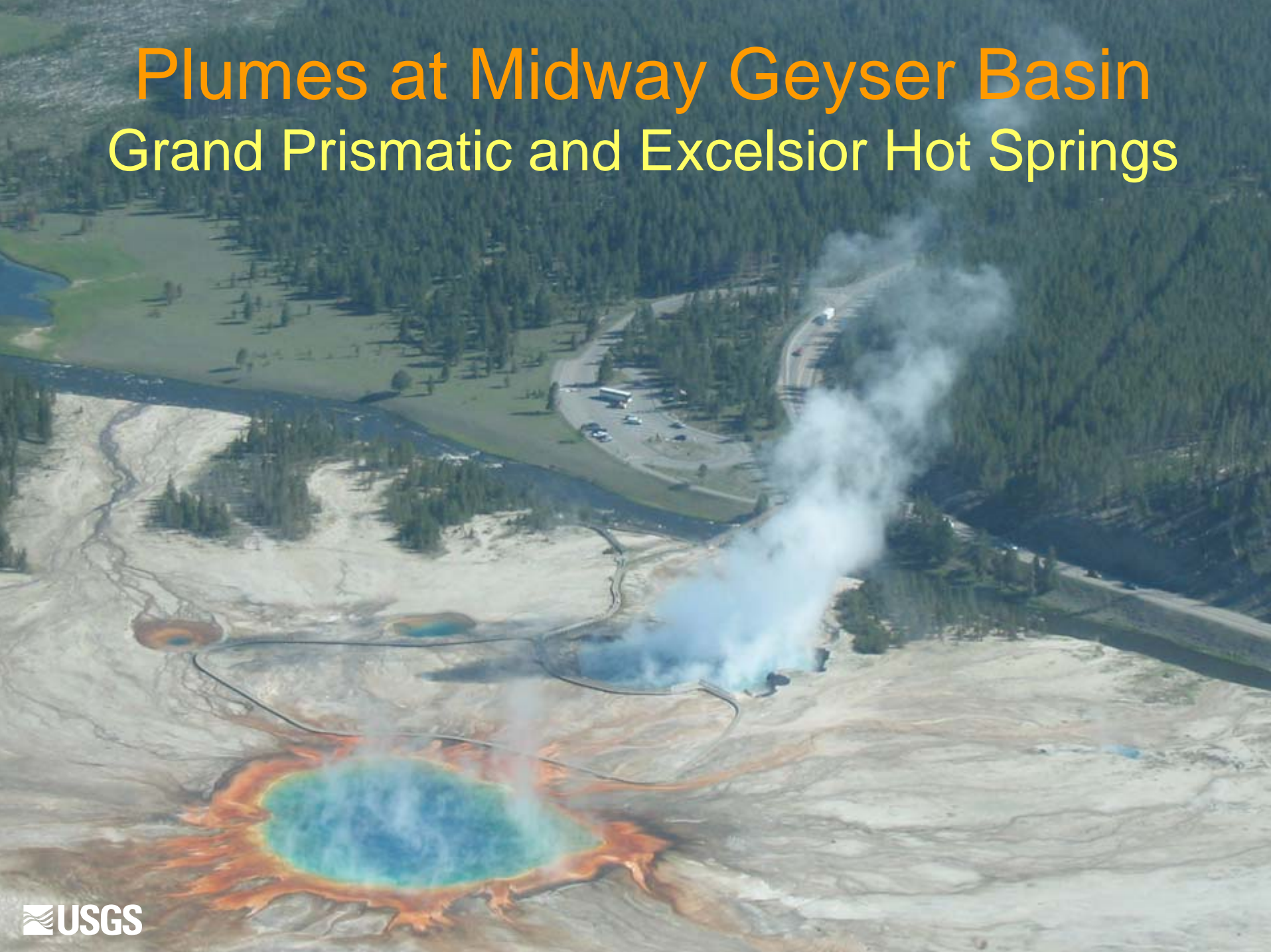


# Volcano Hazards

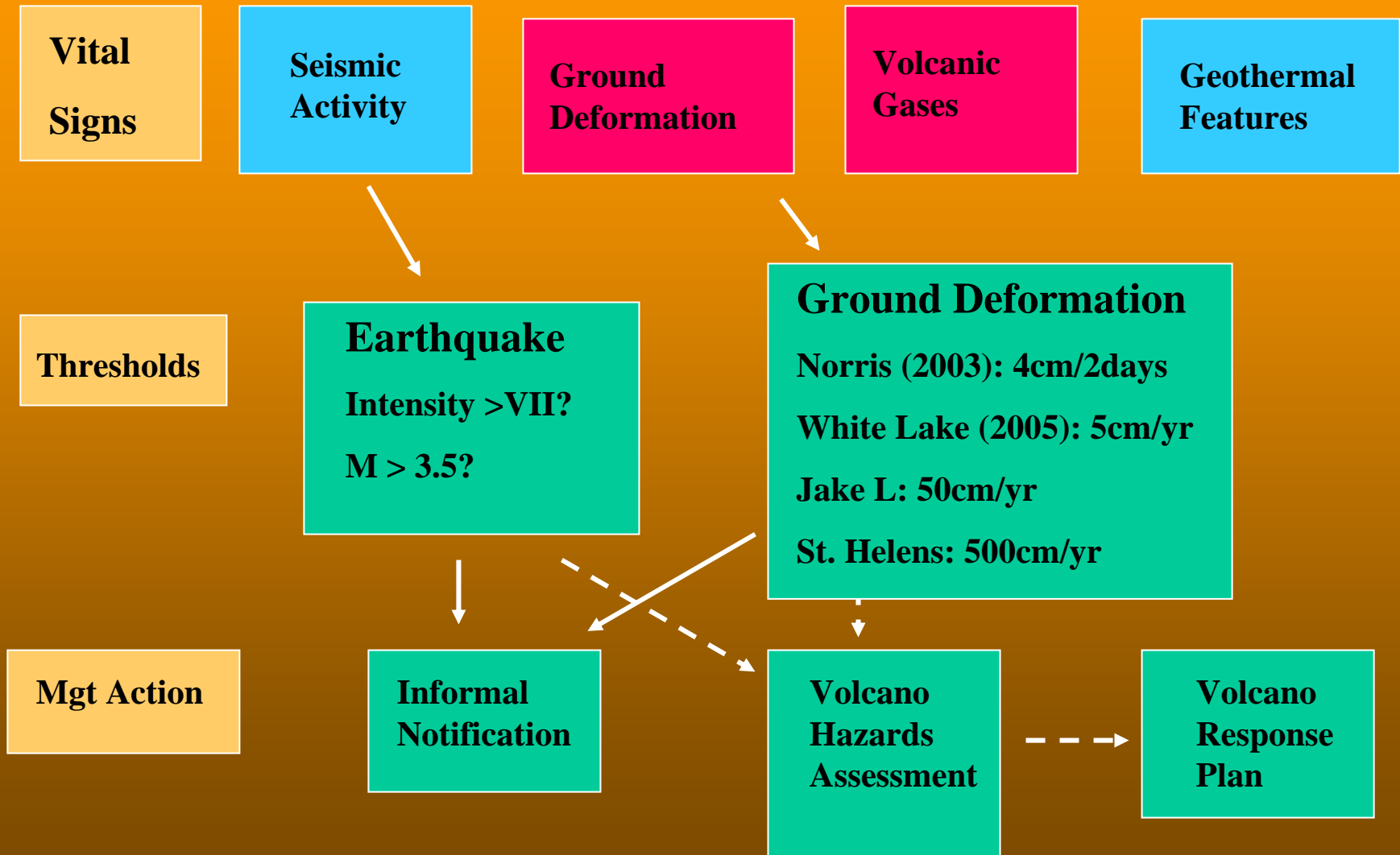
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# Plumes at Midway Geyser Basin Grand Prismatic and Excelsior Hot Springs



# Volcano Hazards



# Volcano Hazards--Funding

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NPS: ~ \$200,000/year

YVO: ~ \$430,000/year

USGS: ~ \$350,000/year

U of U: ~ \$75,000

Total Annual Ops: \$1,055,000

U of U/USGS: \$675,000

Earthscope: \$100K (05); \$400K (07)

Total Investments: \$1,175,000

# Winter Use

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**Winter Use  
Plan 1990**

**Winter Use  
Assessment  
1999**

**Final EIS  
2000**

**Final SEIS  
2003**

**Temp  
Winter Use  
EA 2004**

**Final, Final  
SEIS *OR*  
Final  
SSEIS 2007**



# Winter Use

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# Winter Use



# Winter Use

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# Winter Use

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**Vital  
Signs**

**Integrated  
H2O  
Quality**

**OSV  
Emissions**

**Effects to  
Wildlife**

**Soundscapes**

**Visitor  
Use**

**Employee  
Exposure**

**Thresholds**

**Air Quality**

**Developed: 8/3/3**

**Roads: 1/1/6**

**NAAQS: 35/9/65**

**Soundscapes**

**dB human noise <70dB(A)**

**Ave sound level <45dB(A)**

**Audibility <50%**

**Mgt  
Actions**

**BAT**

**Limit OSV  
numbers**

**Time  
Entries**

**Require  
Guides**

# Winter Use-Funding

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NPS BASE: \$422,000/yr

NPS SOFT: >\$1,000,000

NASA: \$300,000

# Conclusion

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