Drought and fire in Hawaii and the US Affiliated Pacific Islands

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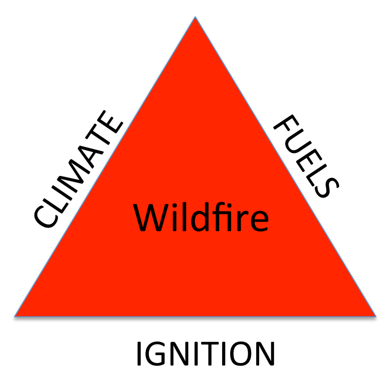
Telling a Story – Resource management introduction

WHAT IS WILDFIRE:

Wildfire (wildland fire) is any unwanted, unplanned, damaging fire burning forest, shrubland or grassland vegetation.



Telling a Story – Resource management impacts

Forests

Telling a Story – Resource management impacts

Rangelands

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Agriculture

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Watersheds, Nearshore Fisheries & Coral Reefs

Telling a Story – Resource management impacts

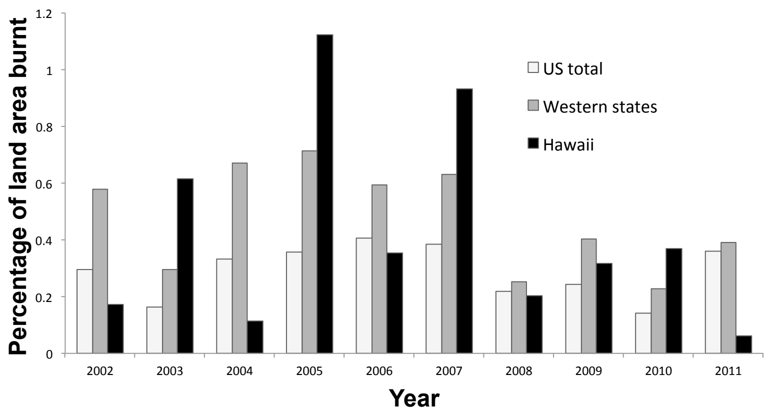
Cultural Resources

Kaala Farms – kaala.org

Telling a Story – Resource management impacts

Communities at the Wildland-Urban Interface

The national context:



Clay Trauernicht *et al.* (2015)

***Telling a Story* – Resource management statement**

THREAT: Fire in Hawaii and the US API is a novel threat and essentially entirely human caused.

GOAL: Reduce or eliminate wildfire from the region.

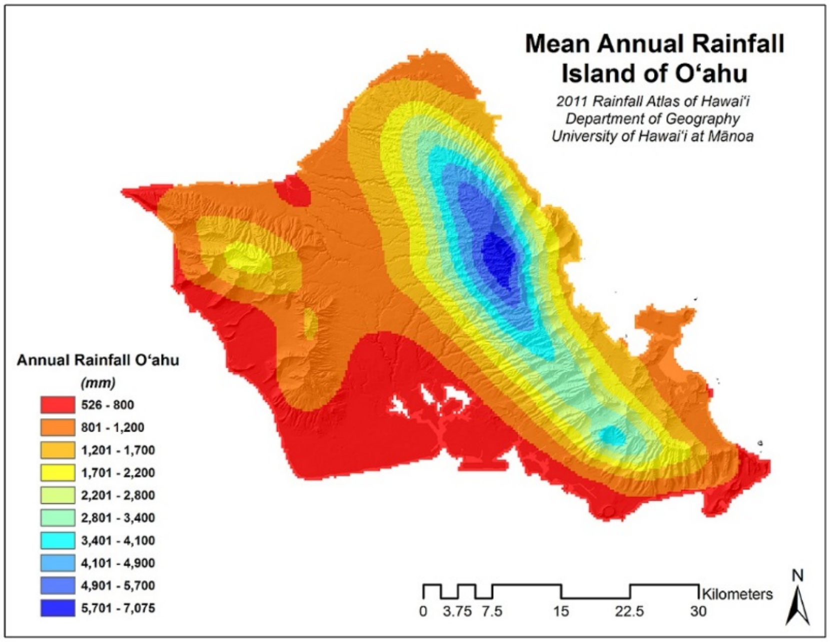
ACTIONS:
Fire prevention via public outreach, pre-fire suppression planning, fuels reduction and management, green-break/green-strip, ecosystem restoration, fire suppression, post-suppression rehabilitation and restoration, policy development and legislation, coordinating effectively across ownerships, mutual assistance agreements.

Telling a Story – Resource management needs

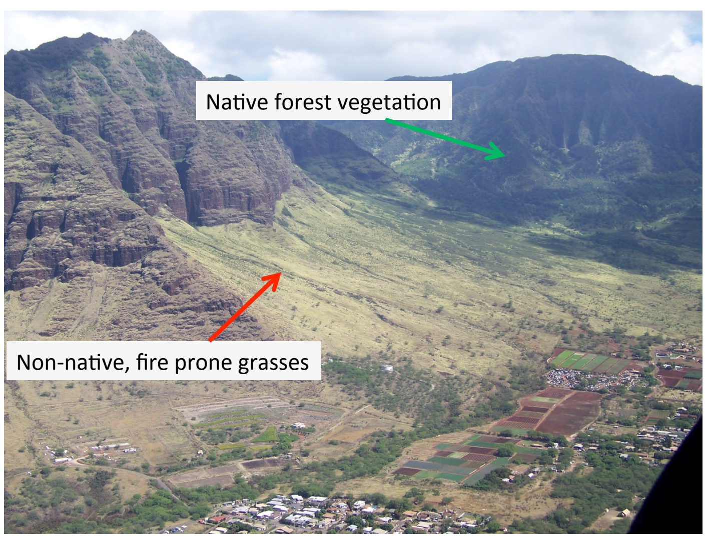
IMPROVEMENTS NEEDED:
- Pre-fire planning and risk mitigation
- Outreach, education & preparedness
- Fuels treatment options
- Tools for fire responders
- Accurate fire danger rating system
- Regionally relevant validated fire modeling
- Prescriptions and funds for post-fire response, including erosion control
- Pre-fire Restoration
- Policy changes
- Wildland fire program dedicated only to this issue

Telling a Story – Resource management questions

ECOLGICAL CHANGE:
Hawaii's forests are classified by elevation and moisture regime. There are three classified moisture regimes: Dry (< 1,200 mm annual rainfall), Mesic (1,200-2,500 mm), and Wet (> 2,500 mm).
- What are short-term versus long-term changes going to look like?
- At what point will climate change cause an irreversible shift in these moisture regimes?
- How will this shift in moisture regimes alter local fire dynamics?



Changes in vegetation



Telling a Story – Resource management questions

OUR QUESTIONS:

- How will fire danger change into the future?
- Which areas of Hawaii and the USAPI will experience a climate driven increase in fire danger?
- How will fire weather parameters change?
- How will intensity of severe events change?
- How will length of multi-year dry periods change?
- How will baseline multi-decadal climate change?

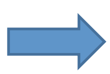
Telling a Story – Resource management responses

RESPONSES TO DROUGHT:

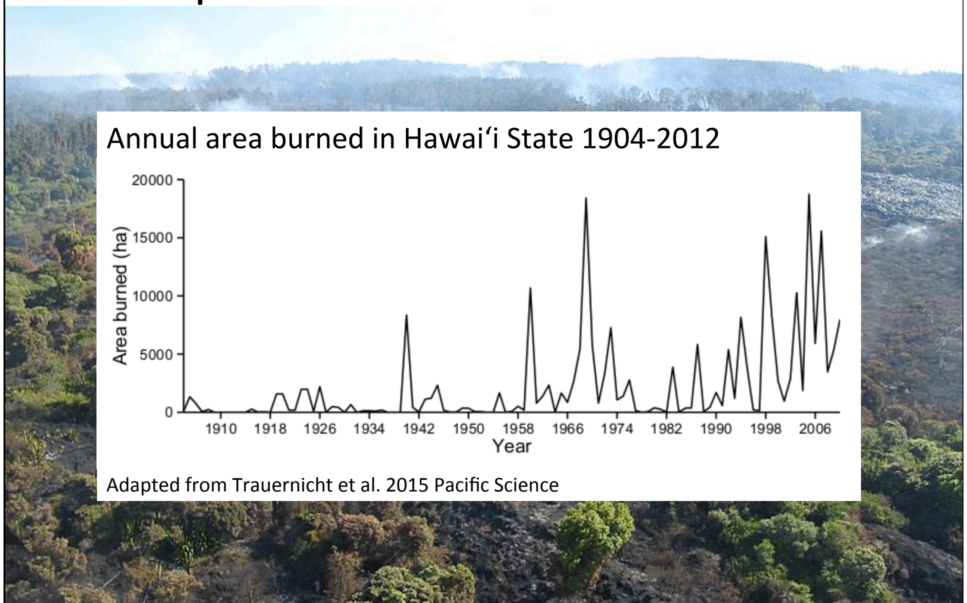
- Short-term allocation of resources to address severe, episodic but short-lived drought events (e.g., El nino), with emphasis on public outreach and prevention.
- Longer-term resource commitments to longer-lived, multi-year, but less severe dry periods (e.g., climate variability), with emphasis on shorter-term increases in fire suppression capacity.
- Long-term changes in baseline climate conditions (e.g., climate-driven biome change), with emphasis on long-term investments in fire suppression, containment, fuels reduction, and restoration.

Telling a Story – Resource management responses

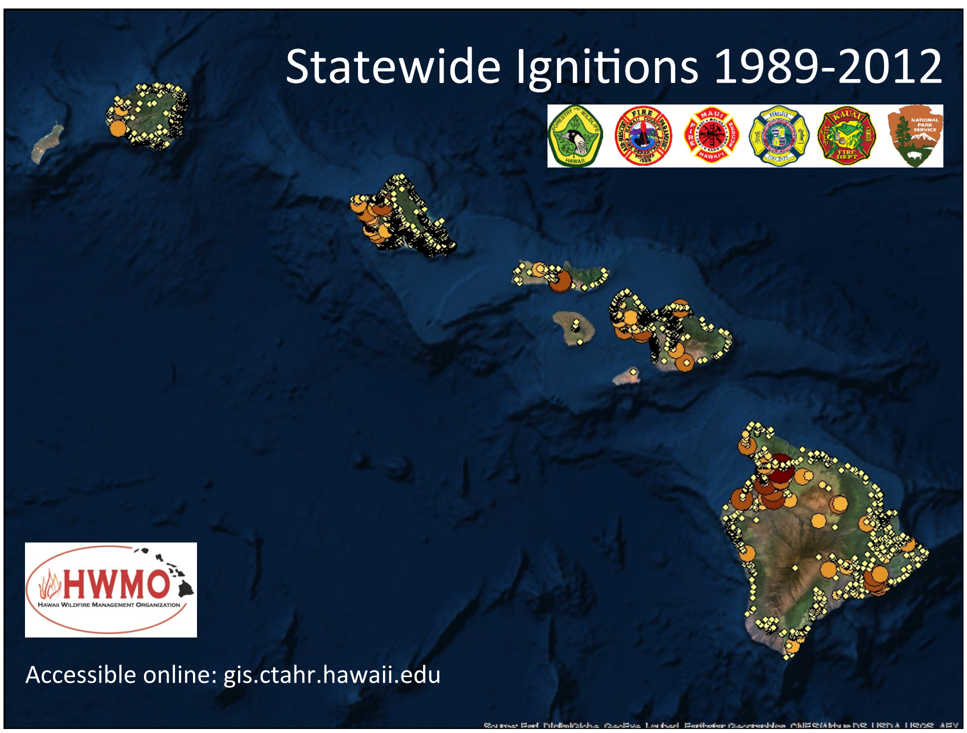
RESPONSES TO DROUGHT:
Where will restoration of forest ecosystems be possible and where will it be a lost cause?



Retrospective look at Wildfire in Hawaii



hvo.wr.usgs.gov



Fire Weather Changes

Andrew Pierce *et al.* (In Prep)

Daily High Temperature Patterns

Temperature	1950s Frequency	2000s Frequency	%Change in Frequency
20	0	0	------
21	1	0	-100%
22	10	1	-90%
23	12	6	-50%
24	101	51	-50%
25	268	67	-75%
26	626	314	-50%
27	822	581	-29%
28	410	640	56%
29	888	531	-40%
30	445	358	-20%
			1133%
			3788%
			Unprecedented
34	0	0	------

Number of days with High Temperatures at or above 31C:
1950s: 69 days or 2.3 months
2000s: 1104 days or **3 years**

Fire Weather Changes

Andrew Pierce *et al.* (In Prep)

Daily Minimum RH Patterns

Minimum RH	1950s Frequency	2000s Frequency	% Change in Frequency
<=25	0	0	
<=30	0	1	Unprecedented
<=35	11	9	-18%
<=40	45	205	356%
<=45	331	790	139%
<=50	1155	966	-16%
<=55	1133	711	-37%
<=60	651	497	-24%
<=65	169	250	48%
<=70	95	142	49%
<=75	32	58	81%
<=80	18	17	-6%
<=85	12	6	-50%
<=90	0	1	Unprecedented
<=95	0	0	
<=100	0	0	

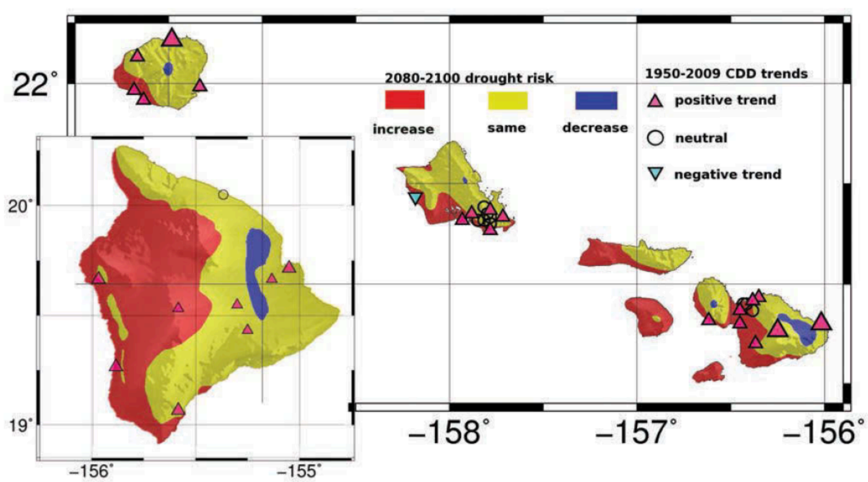
Fire Weather Changes

Andrew Pierce *et al.* (In Prep)

90th Percentile Fuel Moisture and Fire Weather			
	1950s	2000s	%Change
<0.6 cm diameter fuels	8.1	7.6	-6%
0.6 - 2.5 cm diameter fuels	9.4	8.6	-9%
2.5-7.6 cm diameter fuels	14.4	12.5	-13%
Live Herbaceous fuels	86.3	80.6	-7%
Live Woody fuels	116.8	99.7	-15%
Wind Speed (km/h)	41.8	42.2	1%

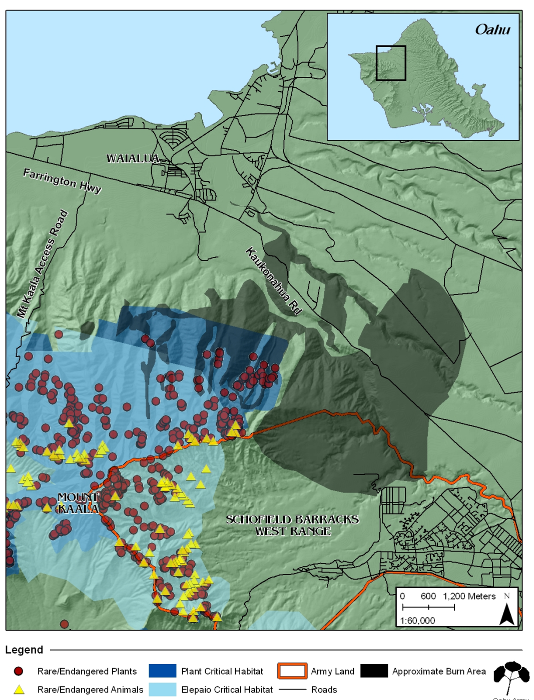
Drier fuels under similar wind conditions

Hawaii Drought Projections



Giambelluca, T.W. *et al.* 2012 PIRCA Report.

2007 Waialua Fire



Telling a Story – Resource management scale

SPATIAL SCALES FOR MANAGEMENT:

Primarily leeward and mesic shoulder areas of larger Hawaiian islands, and entire Island areas for smaller Hawaiian Islands like Lanai.

Under drier and warmer conditions, especially during severe El Nino conditions, entire islands of Hawaii and USAPI, with a focus on savanna areas of USAPI in nearly all years.

Telling a Story – Resource management scale

TEMPORAL SCALES FOR MANAGEMENT:

Planning for fire management (Statewide Fire Management Planning, ICS, FMPs) usually occurs in 3 to 5 year blocks, usually focused on identifying and or supporting: equipment purchasing; staffing and infrastructure needs; and training needs.

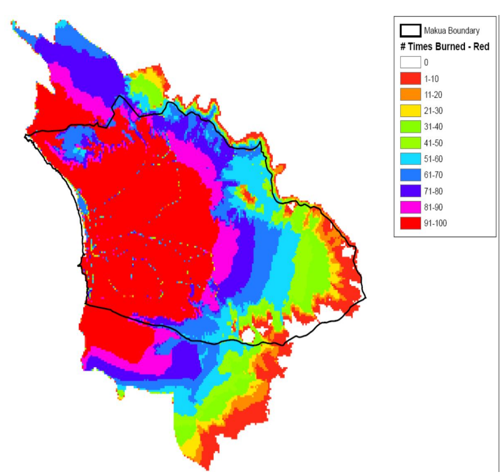
Ideally, there are two meetings a year (pre-fire and post-fire season) to address fire-related management activities including: fire / ignition prevention; fire mitigation (for example managed fuel breaks, fuel reduction treatments, restoration to break grass fire cycle); pre-suppression implementation; training and planning; post-fire review including assessing past fires within a scenario framework.

Telling a Story – Resource management data

Fire Modelling

Ellsworth et al (2010) found:

- A positive linear relationship existed between volumetric soil moisture (%) and live, standing dead, and litter fuel moisture (P<0.01).
- Cumulative rainfall was also positively and linearly correlated with live fuel moisture (P<0.01).
- Correlation of fuel moisture with readily measured variables such as soil moisture and weather variables provides an opportunity to improve fire modeling in Hawaii.



Telling a Story – Resource management data

VARIABLES OF INTEREST:

Relative Humidity, avg and max air temperature, rainfall amount & distribution, wind speed & direction, soil moisture.

Ideally, fuel moisture, current and future thresholds of 80th, 90th, and 97th percentile fire weather conditions and information on changes to energy release and burning indexes.

Trends data that show how these measures change under future fire weather conditions.

Spatial information on which landscapes / islands will be most susceptible to future changes in fire weather.

Telling a Story – Data for resource management

HOW IS CLIMATE INFORMATION INCORPORATED INTO MANAGEMENT?

More focused on fire weather and fire danger rating systems, which to date have been of marginal value. Improved characterization of forest type – biome type, especially how vegetation type might change in the future.

IN TERMS OF BASELINE CONDITIONS, HOW IS "NORMAL" DEFINED?

Mean annual rainfall, mean monthly temperatures, maximum daytime temperatures, mean and max winds speeds, average fuel moisture and greening events, fuel loads.

HOW DOES MANAGEMENT DIFFER UNDER AVERAGE & EXTREME CONDITIONS?

Average temperature, RH, wind and rainfall conditions versus dry, hot, windy ESPECIALLY following a prolonged wet period (high fuels).

HOW WILL CLIMATE CHANGE ALTER THE GAME FOR HOW YOU MANAGE?

Increase periodicity of rainfall events; more droughts; increased temperatures, especially maximum air temps; altered wind patterns; reduced soil and fuel moisture; higher plant mortality rates.

Telling a Story – Other resource management needs

OTHER CONCERNS OR QUESTIONS:

- How will future climate affect the spread of fire-prone invasive species?
- How will restoration for fire affected landscapes be impacted by future climates (more difficult to restore to closed canopy dry and mesic forest, for example)?
- How do we affect policy changes that prevent fire prone invasions, improve HFD access to private lands, increase money for fire related management, and enhance coordination across ownerships?

Telling a Story – Other resource management needs

OTHER CONCERNS OR QUESTIONS:

We are about to enter into a huge El Nino event.

- How are we addressing this event at a multi-agency level?
- Can we come together across agencies and entities to plan for this event?

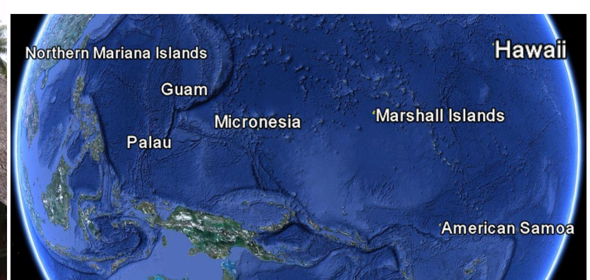
Telling a Story – Resource management lessons

LESSONS LEARNED:

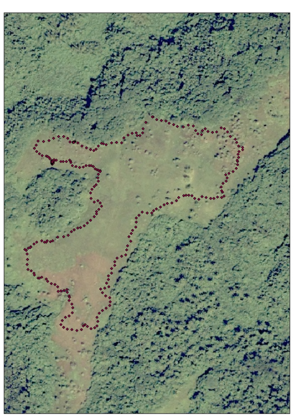
Community Wildfire Protection Plans

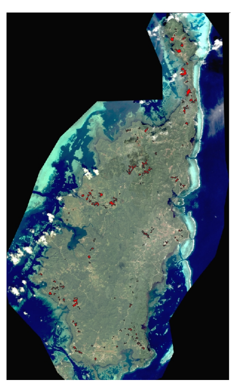
Telling a Story – Resource management lessons

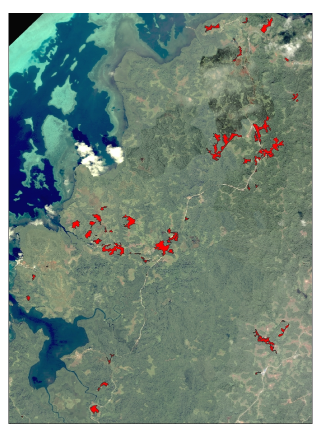
LESSONS LEARNED:
Things get more complicated in the
US Affiliated Pacific



Grassland and savannah systems in US API are anthropogenic via human caused fires, are tightly linked with fire, are slow to recover and cause erosion and biodiversity loss.





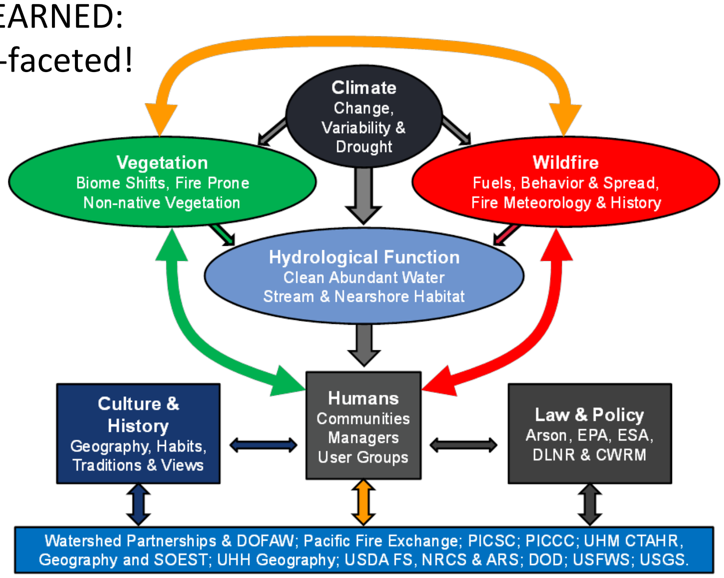


Palau Fire History Results (2012-2013)

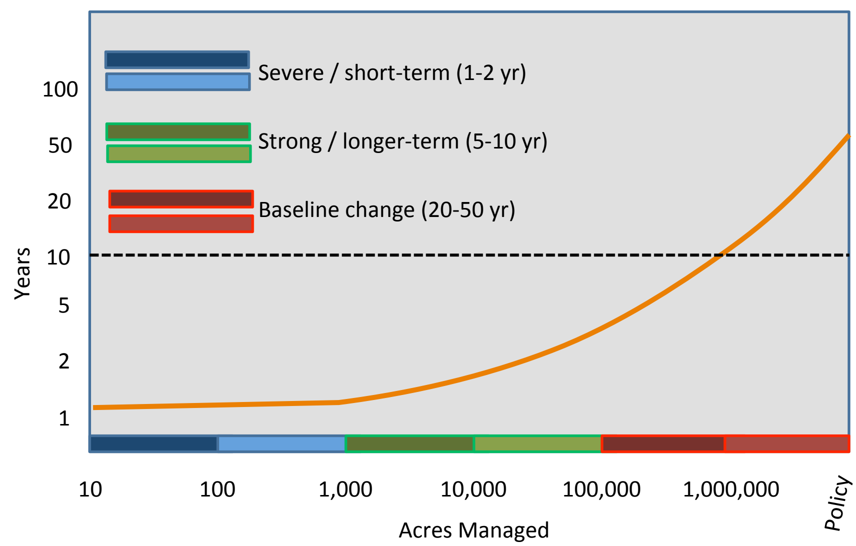
- 1.7% of total non-mangrove area of Babeldaob burned
- 11.7% of non-forest vegetation area burned
- > 180 fires
- ~ 0.4% forest area burned
- Top reasons for burning – arson (36 %) farming (26%), hunters (15%), government (13%), brush piles (6%), unknown. (4%)

Telling a Story **– Resource management lessons**

LESSONS LEARNED:
Fire is multi-faceted!



Telling a Story – Resource management lessons



Telling a Story – Resource management lessons

LESSONS LEARNED:

Integrating accurate climate information into wildfire planning and management will likely have major benefits for the future of the region's biodiversity, human health and safety, hydrological resources, cultural resources, in-stream biota, and nearshore reef and fisheries condition.


Mahalo
Photo by Ashley Shaw