NOAA Coral Reef Conservation Program Ecosystem Science Evaluation

National Coral Reef Monitoring Program

Topical Area: Foundational Efforts
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National Coral Reef Monitoring Program

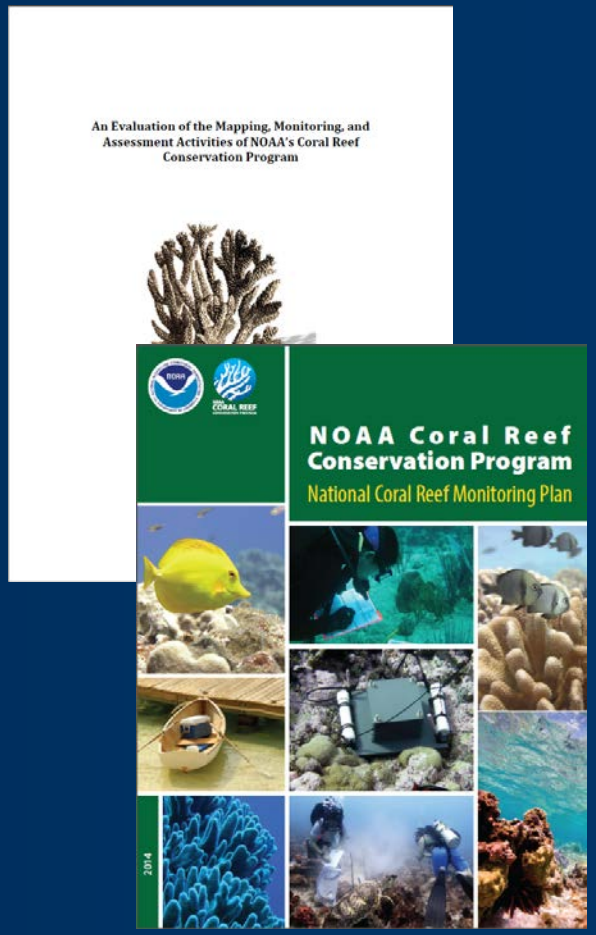
Background

NCRMP formed as a result of strategic planning efforts – brought together monitoring efforts under one umbrella

Filled gaps:

- Lack of standardized methods and objectives
- Integrated ecosystem approach
- Ability to report to Congress/NOAA leadership/public

2013 was first implementation year – currently in fourth field season (many efforts have been ongoing in similar forms since early 2000s)



Funding Support

$4.5M CRCP investment, with $350K support from NOAA Ocean Acidification Program (OAP) through climate partnership

NCRMP Theme	Funding
Biological	$2.6M
Climate	$1.5M (+ $350K OAP)
Socioeconomic	$400K

Goals

1. **Collect scientifically sound, geographically comprehensive data** (biological, climate, and socioeconomic) in the U.S. coral reef areas

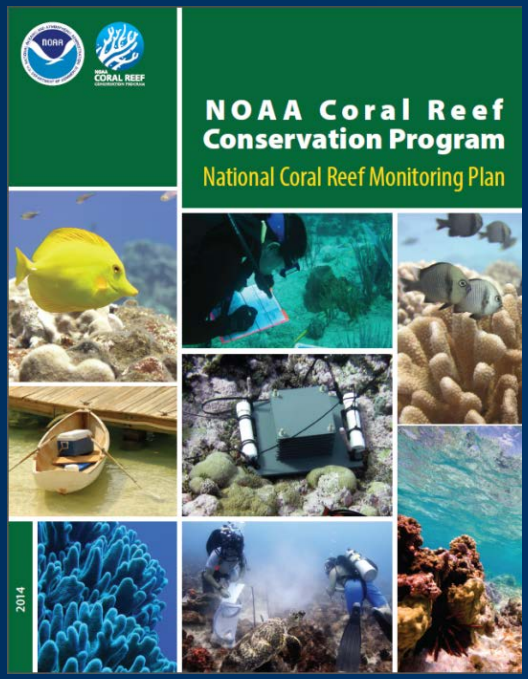
2. **Develop consistent and comparable methods and standard operating protocols**

3. **Deliver data, data products, and tools** to the coral reef conservation community

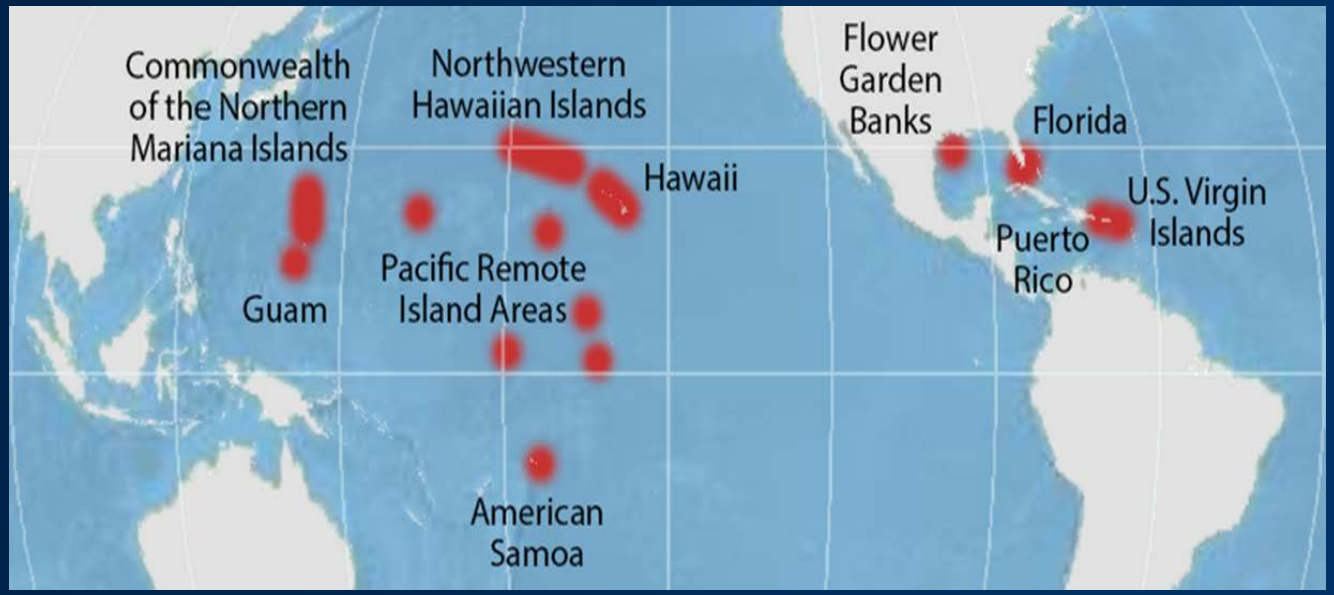
4. **Provide periodic assessments** of the status and trends of the nation's coral reef ecosystems

5. **Develop and maintain strong partnerships** with federal, state/territory, and academic partners

6. **Provide context** for interpreting localized monitoring



Overview



- Six NOAA teams implement NCRMP biological, climate and socioeconomic data collection across 10 priority locations
- Biological cycle: 3 years in Pacific, 2 years in Atlantic
- Socioeconomic cycle: 5 years (7 inhabited jurisdictions)

Overview

Focus on four monitoring themes:

- Benthic community structure
- Fish community structure
- Climate impacts
- Socioeconomic condition

Monitoring Themes	Tier 1 (Critical) Indicators
Biological	
• **Coral and Benthos**	• Coral abundance and size structure • Coral condition (bleaching and disease incidence, mortality) • Benthic percent cover • Benthic key species • Rugosity
• **Reef Fish**	• Fish abundance and size structure • Fish diversity • Fish key species
Climate	
• **Thermal Stress**	• Temperature/thermal stress • Vertical thermal structure
• **Ocean Acidification**	• Carbonate chemistry
• **Ecological Impacts***	• Coral growth rate* • Bioerosion rate* • Community structure* (cryptofauna diversity)
Socioeconomics	• Knowledge, attitudes, and perceptions of coral reefs and management strategies • Participation in coral reef activities • Population changes and distribution • Economic dependence on coral reefs

Stratified random sampling design

Strata:

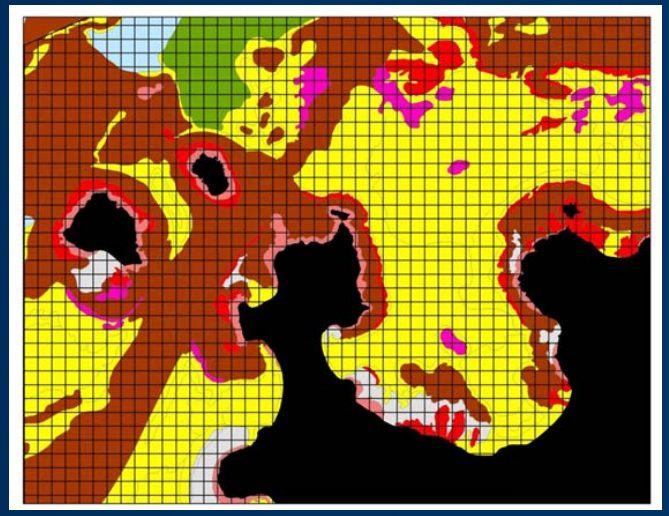
- Region (can include management zones)
- Habitat type
- Depth zones

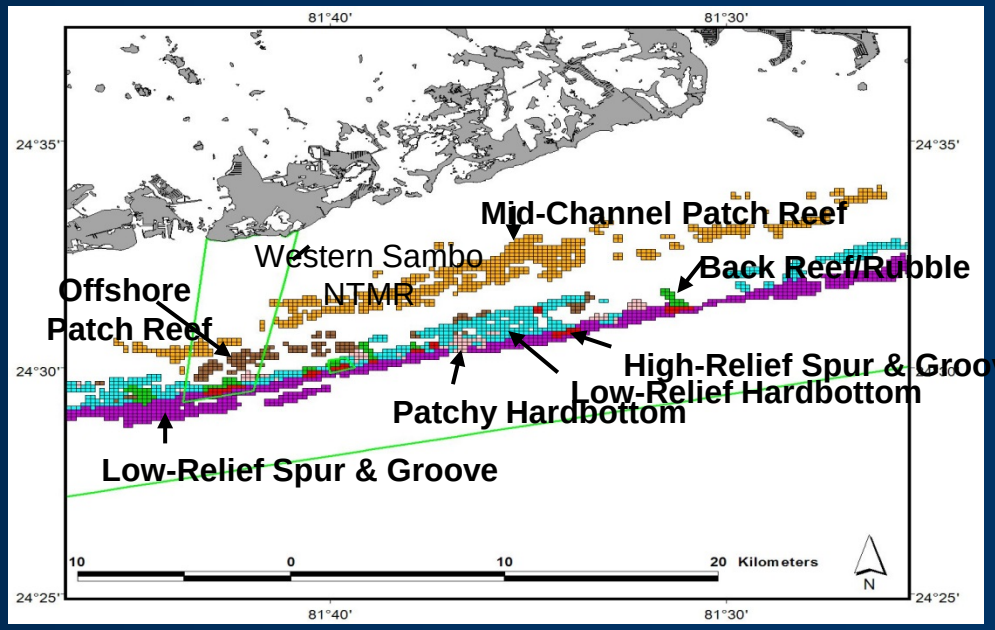
  * 0-30 m hard bottom areas

- Site allocation is statistically driven and iterative process – better maps will improve precision and optimize sampling

- Island/region, sub-region and strata scale, rather than providing site specific information – 'wide but thin'

- Distinct from permanent site-based monitoring approach





Sample Grid at 100 x 100 m

Benthic and fish data

Benthic Transects

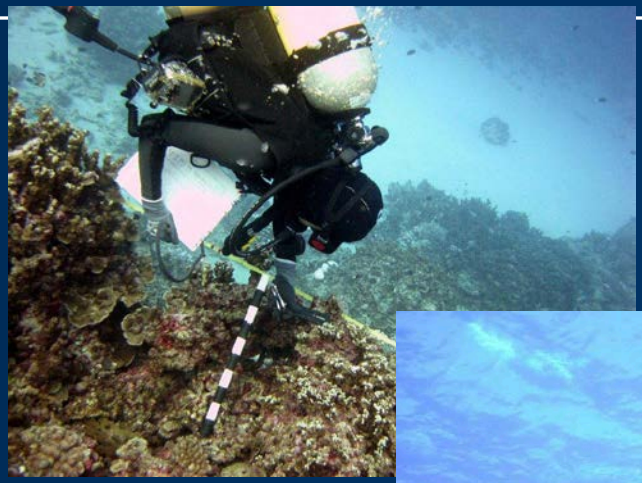
- Demographic metrics: Adult (and juvenile) abundance & size, species/genus, partial mortality, condition, rugosity
- Benthic cover: Photo-quadrats (Pacific), Line-point intercept (Atlantic)
- Benthic key species (Atlantic)

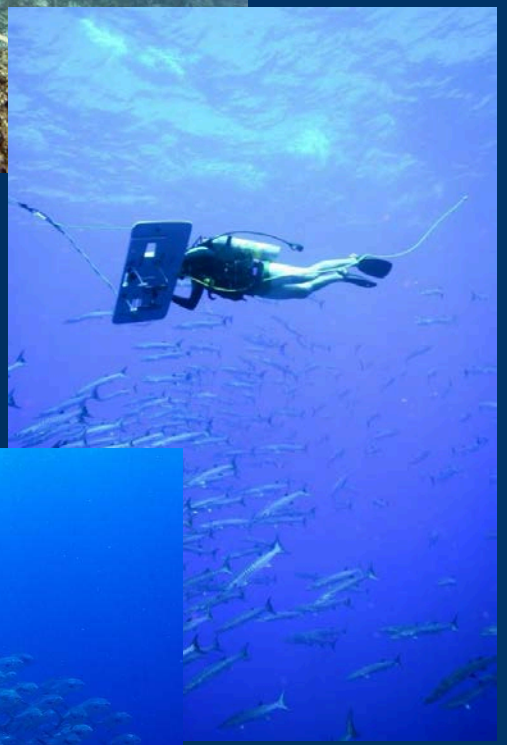
Fish Stationary Point Counts

- Fish abundance, size, species

Towed-diver (Pacific)

- Key benthic and fish species





Key contributions – Benthic data

- Benthic community structure and coral populations data across multiple spatial scales provides the essential foundation of data to support applied management and other projects:
  - Spatial & MPA planning and assessment
  - Spatial predictive models -> coral species habitat utilization
    - Prioritize potential coral restoration areas
  - Reef resilience assessments
  - ESA corals: 1) Spatial predictive models
    2) larval connectivity model
    3) population assessments
  - Evaluation of the effects of bleaching events and disease outbreaks
  - Identify areas for research projects

~24 strata (4 MPAs)

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Key contributions – Fish data

- Island-wide estimates of fish species richness, abundance and size provide biogeographic patterns -> spatial & MPA planning and assessment
- Fishery-independent size structured data useful for fisheries management needs – direct link to Regional Fishery Management Councils
- ESA reviews
- Highly leveraged partnerships – partners benefit from a monitoring program that is larger than their jurisdiction
- Broader conservation and management science
  - Data spans wide gradients of human impact, oceanography and management
  - Understanding of what “natural” coral reef fish assemblages are like and how they vary – essential for understanding human impacts and setting management targets

Climate data

Tiered climate approach to characterizing OA and thermal impacts across spatial and temporal scales

Class III: MApCO_2 buoys (PR, FL, HI, *AS)

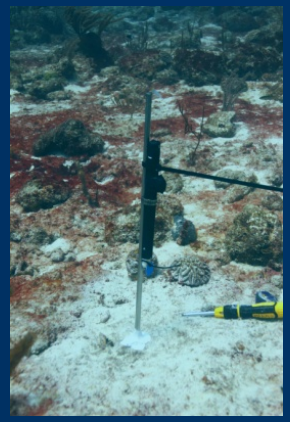
Class II: Diurnal subsurface carbonate chemistry

Class I : Vertical thermal structure

Class 0: Discrete carbonate chemistry water sampling

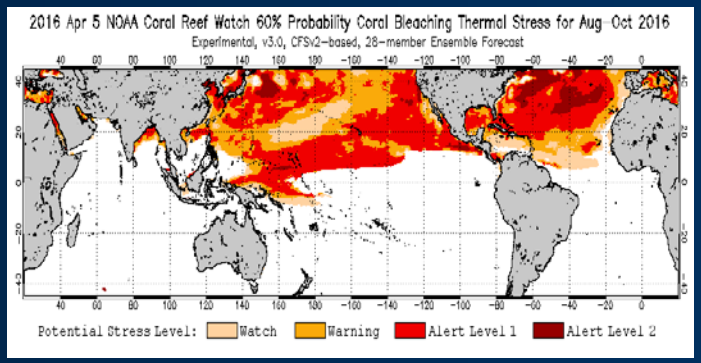
Ecological impacts: coral growth & calcification, bioerosion, community structure (Class II & III)

Cheeca Rocks MApCO_2



Class I
Lang Bank, St Croix

Satellite-derived SST:



Class I sites on Florida Reef Tract

Key contributions – Climate data

- Tracking exposure and response to global climate drivers:
  - Exposure: tracking reef exposure to warming and ocean acidification *in-situ*
  - Response: Tracking realized carbonate accretion/erosion, benthic shifts, and biodiversity impacts
- These datasets allow a firm foundation for modeling both vulnerability and future reef states
- Satellite data provides managers current reef environmental conditions to quickly identify areas at risk

Overview – Socioeconomic data

Primary data collection

- Resident surveys take place in each jurisdiction
- One set of core questions as well as selected jurisdictional specific questions relevant to local management needs

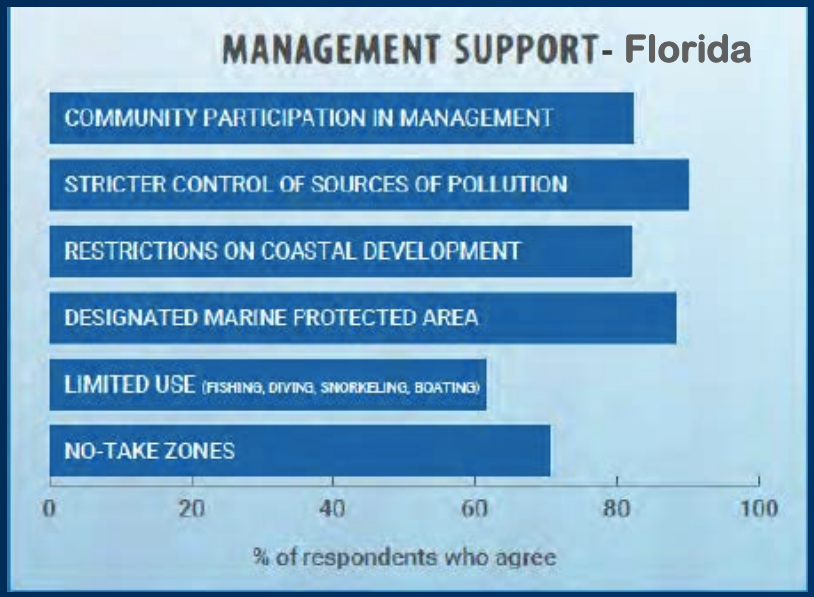
Secondary data collection

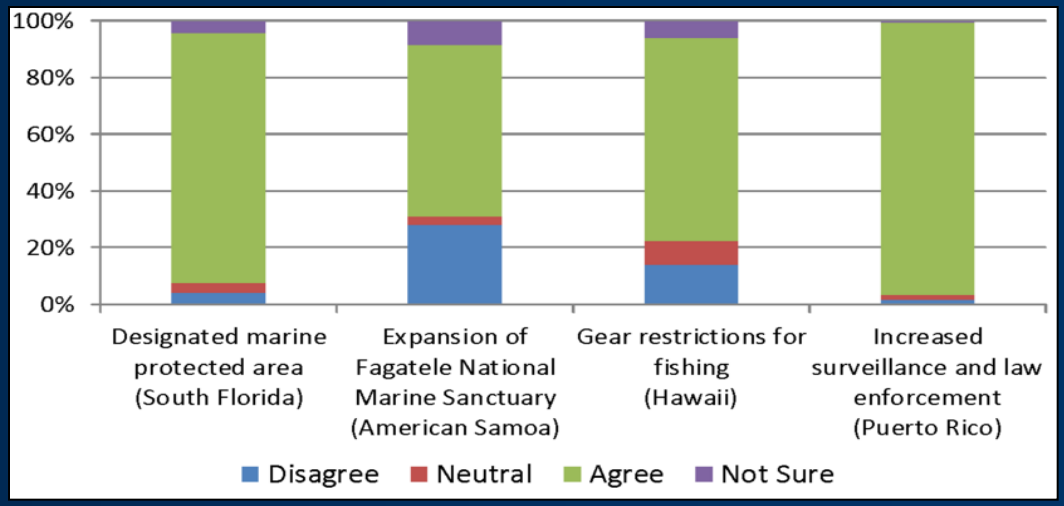
- Focused on indicators such as population change, economic impacts and community well-being
- Relies on public sources like US Census Bureau, jurisdiction governments, federal agencies

- Participation in reef activities
- Perceived resource condition
- Attitudes towards coral reef management strategies and enforcement
- Awareness and knowledge of coral reefs
- Human population changes near coral reefs
- Economic impact of coral reef fishing to jurisdiction
- Economic impact of dive/snorkel tourism to jurisdiction
- Community well-being
- Cultural importance of reefs
- Participation in behaviors that may improve coral reef health
- Physical infrastructure
- Awareness of coral reef rules and regulations
- Governance

Key contributions – Socioeconomic data

- Data collected from representative sample of the entire population (rather than special interest groups)
- Findings to date show that support for management measures is relatively high
- Provides data that decision-makers care about (e.g. what the public thinks)





Key contributions and strengths

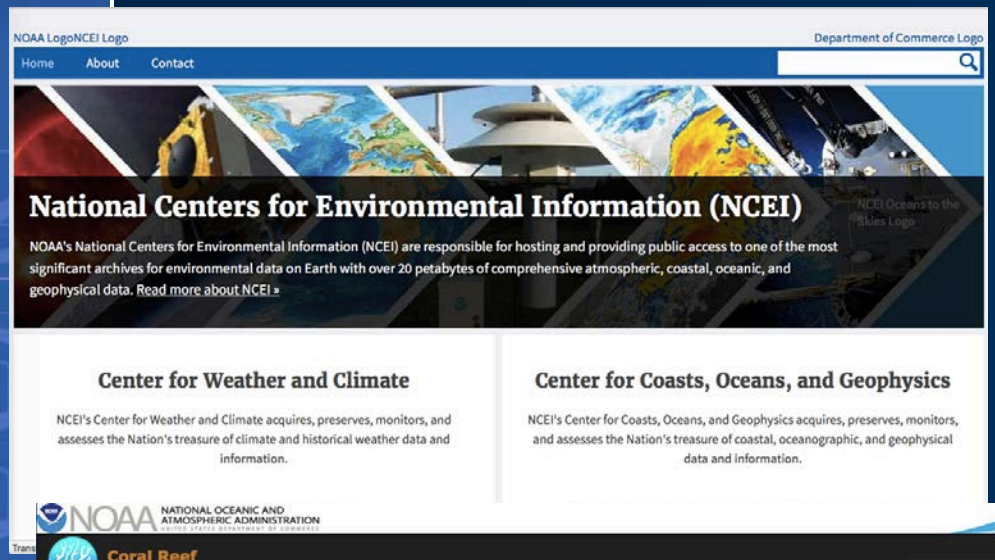
Geographically comprehensive, long-term characterization of U.S. coral reef benthic, fish, climate and socioeconomic conditions

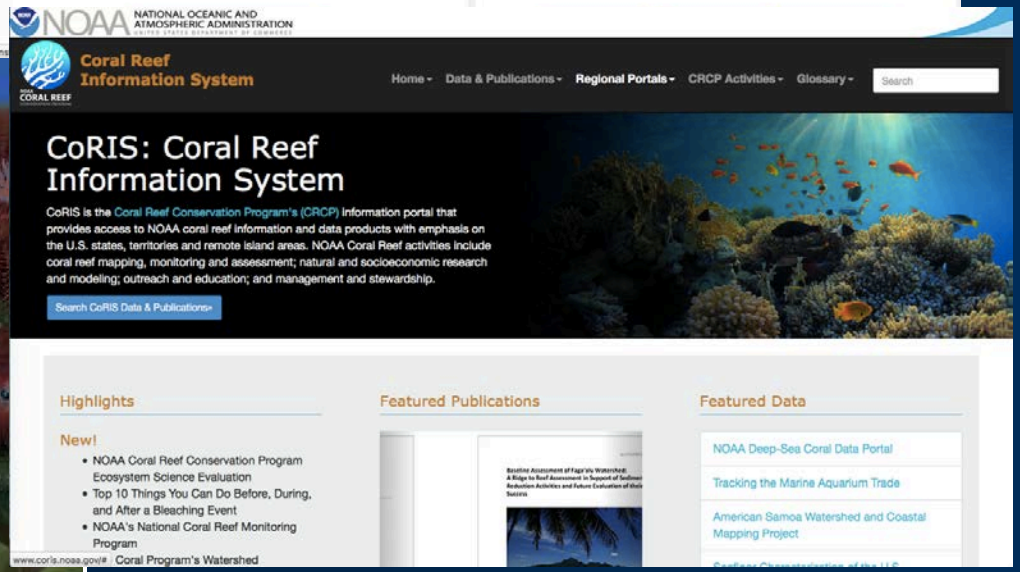
- Data supports ecosystem approach to management planning and assessment
- Provides context for site-based management and data
- Advances fundamental understanding within and across themes
- Provides ability to report to Congress/NOAA leadership/public

Information dissemination

Information dissemination

- **Data**





Data repositories

- Public Access to Research and Results (PARR) requires – documentation, archived and accessible
- NCEI (NOAA) – National Centers for Environmental Information
- CoRIS (NOAA) – Coral Reef Information System

Information dissemination

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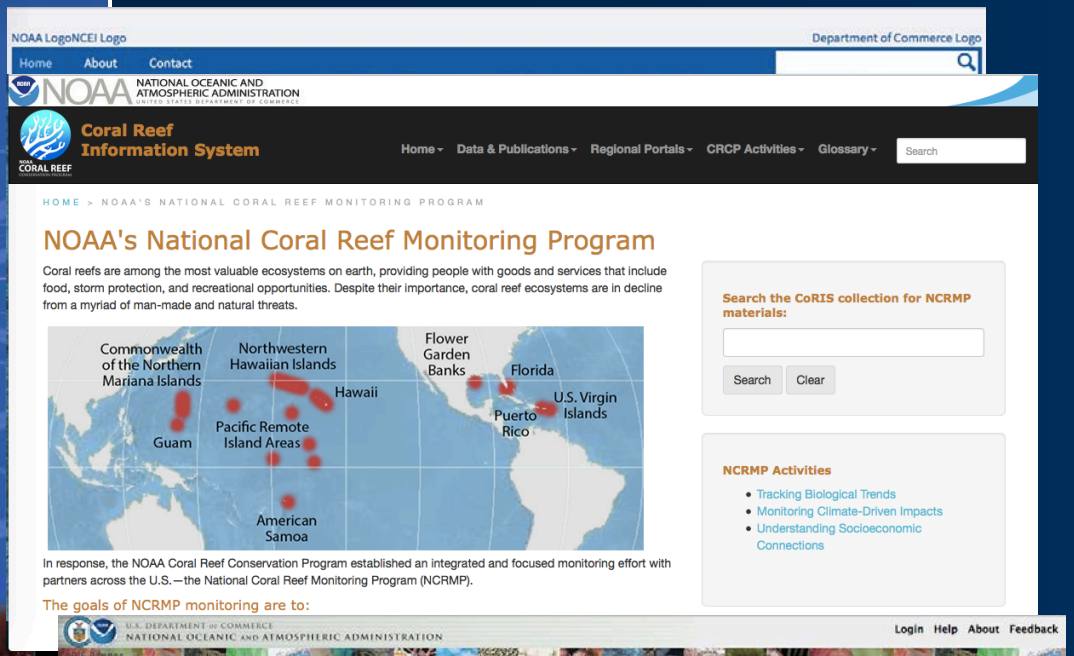

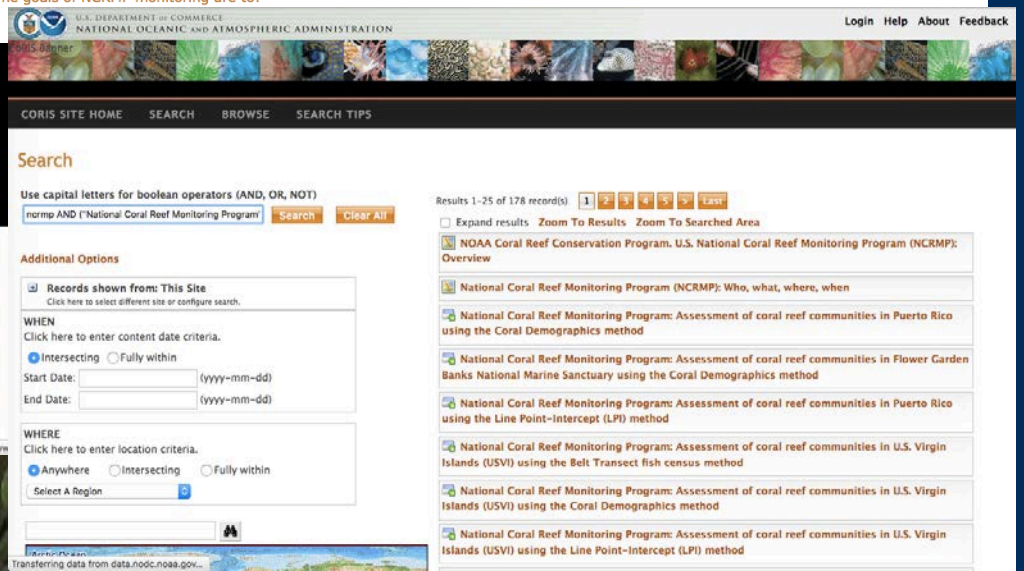

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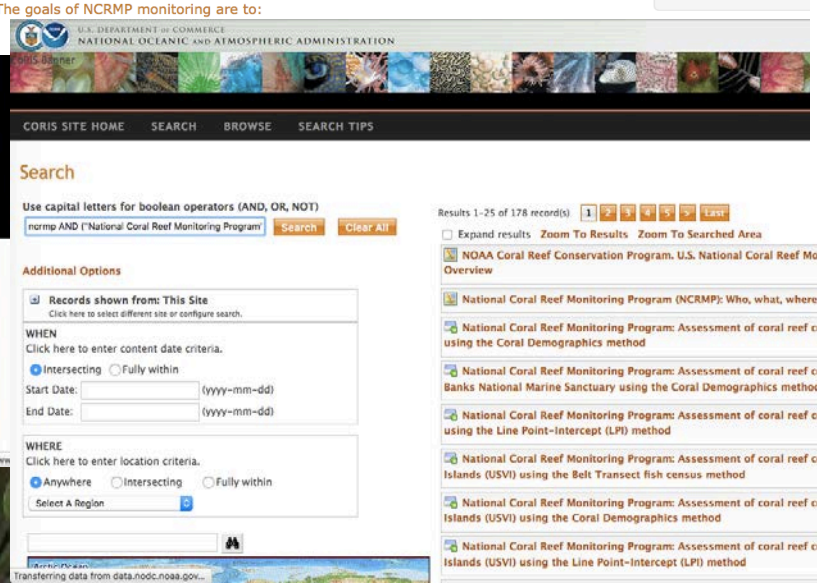
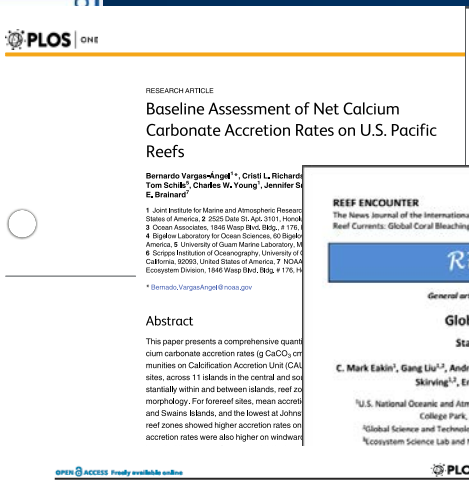
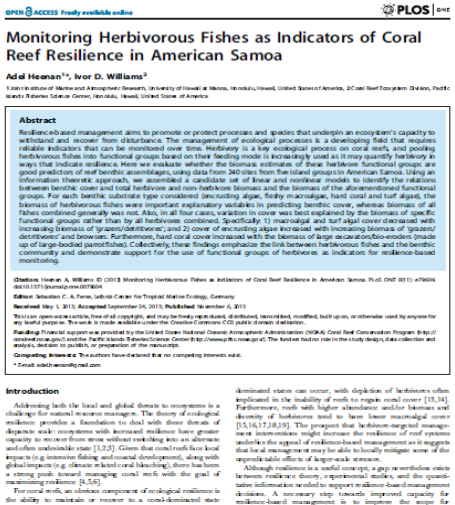
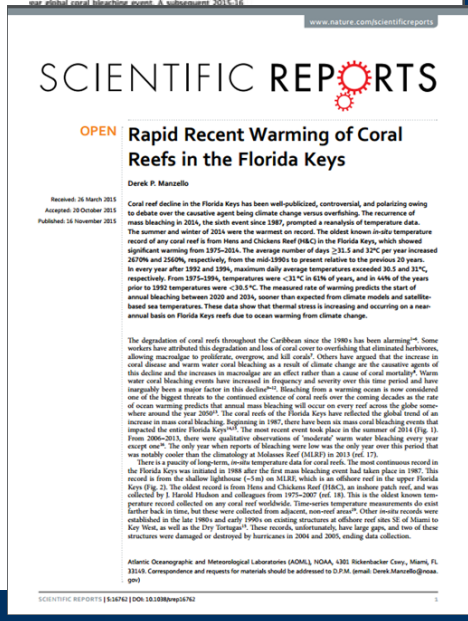
Information dissemination

- Data and **peer-reviewed publications**



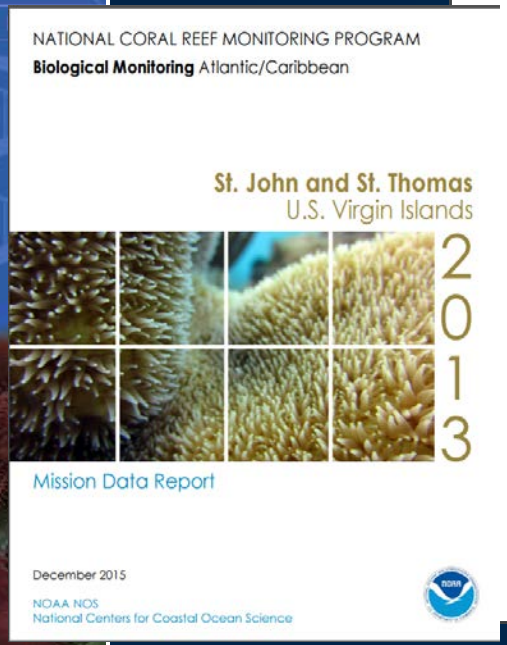


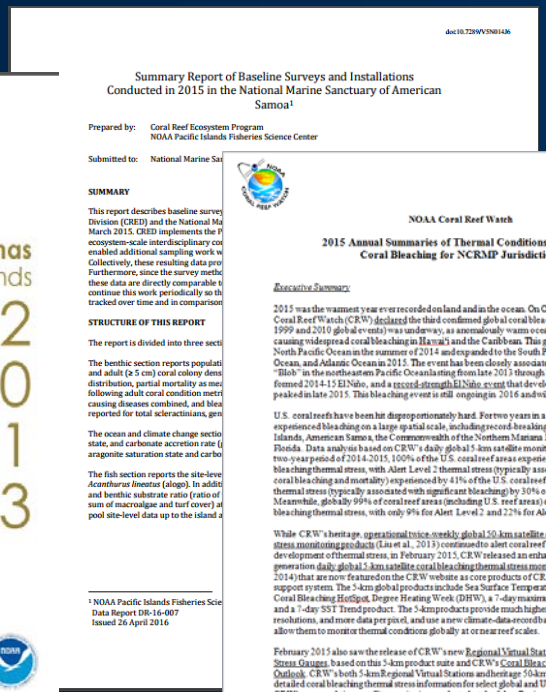


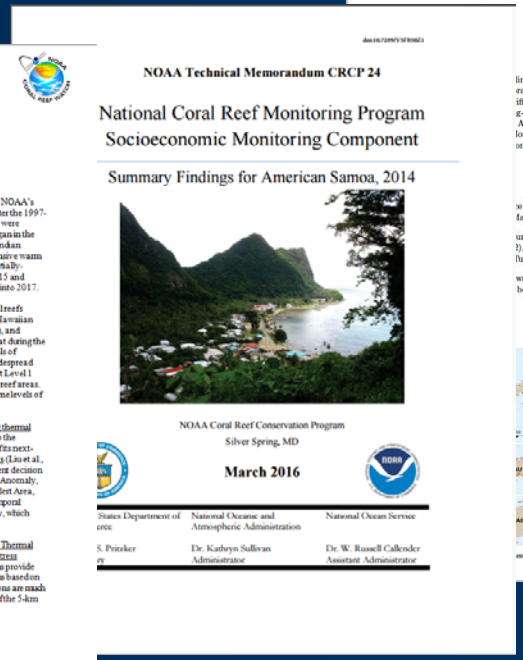


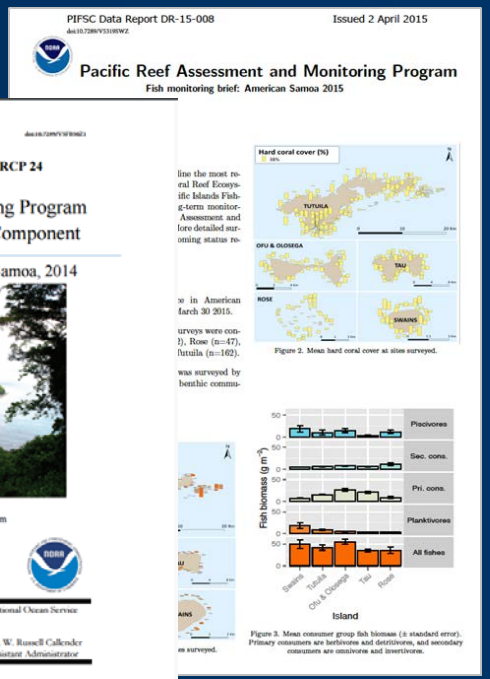
Information dissemination

- Data and peer-reviewed pubs, **technical reports**



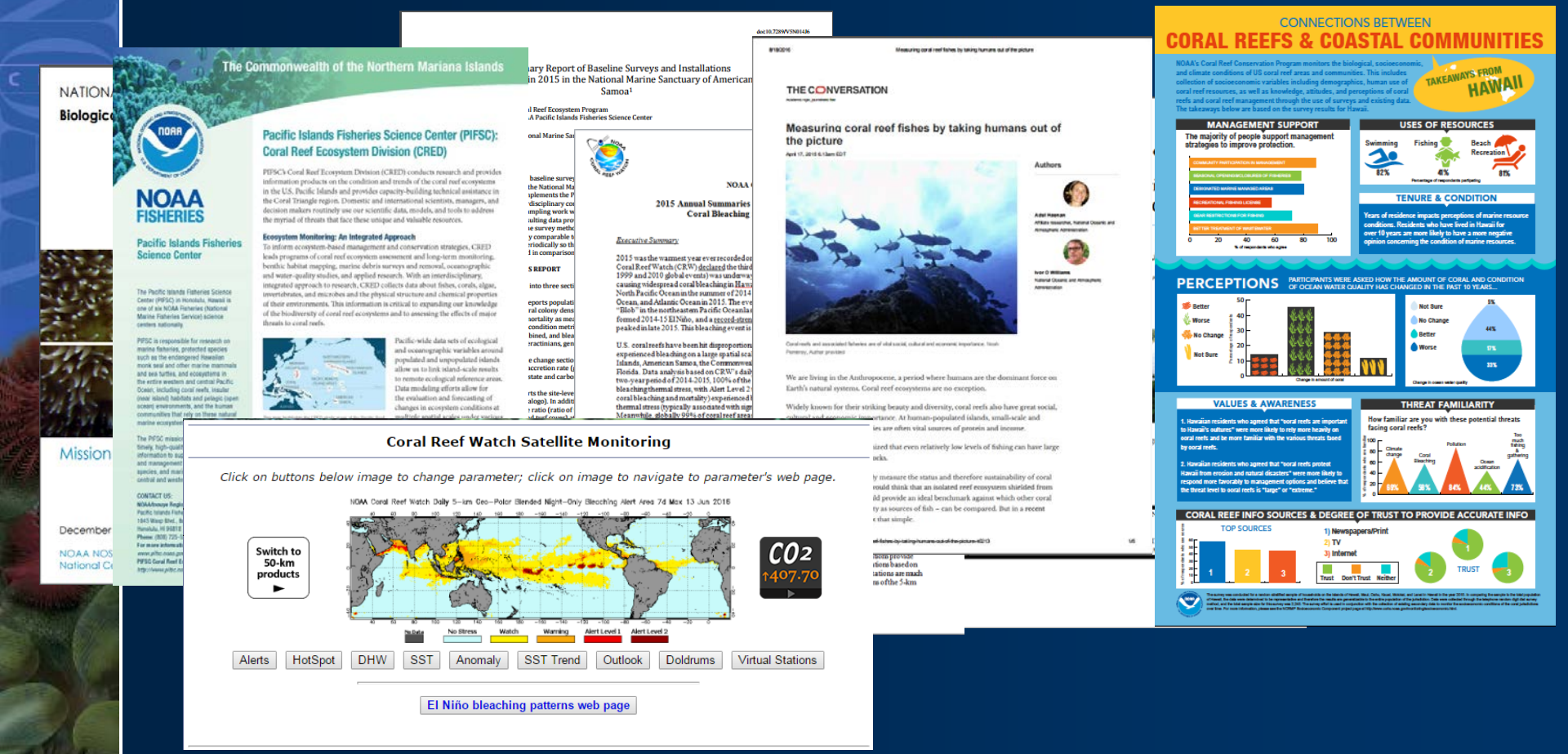






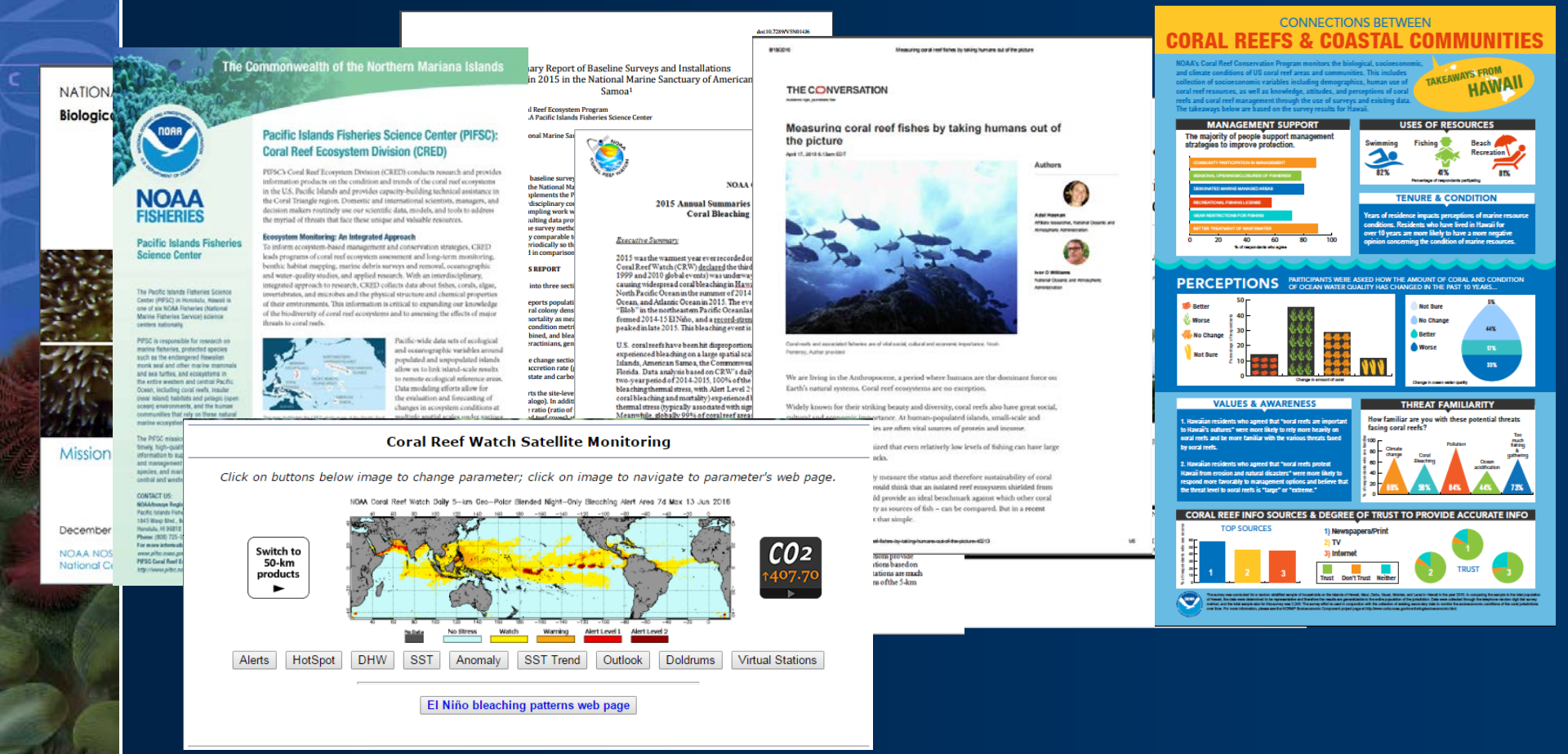
Information dissemination

- Data and peer-reviewed pubs, technical reports, **outreach/education/tools**

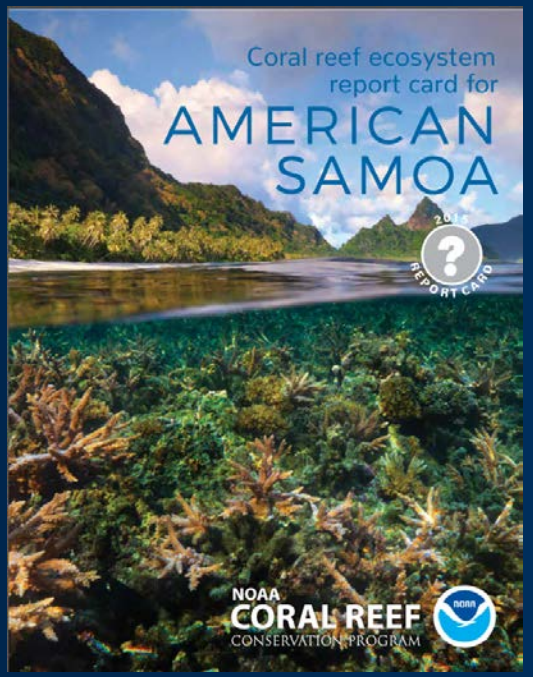


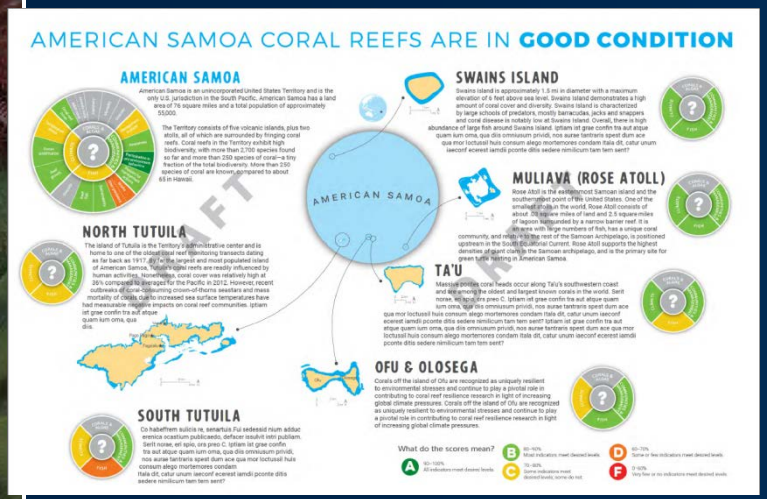
Information dissemination

- Data and peer-reviewed pubs, technical reports, **outreach/education/tools**
- Additionally: conference presentations, presentations to managers, direct relationships, team/region specific web portals, working directly with NCRMP team members



New product: Status and trends report cards





Indicators:

- Benthic
- Fish
- Climate
- Socioeconomic

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New product: Status and trends report cards

Benthic indicators:
- Benthic cover (coral, macroalgae, CCA)
- Key adult populations
- Key juvenile populations
- Partial mortality
- Diversity
- Herbivory

Fish indicators:
- Reef fish biomass
- Sharks and piscivores
- Sustainability
- Diversity

Climate indicators:
- Thermal stress
- Ocean acidification
- Reef material growth

Socio indicators:
- Management in place
- Awareness of coral reefs
- Pro-environmental behavior
- Support for management

Each indicator requires baseline and thresholds for scoring

Challenges

- Site scale monitoring needs– compatibility between national and jurisdictional programs
- Field fatigue – Understaffed, lack of time and/or funding for non-standard analysis and thought
- NOAA ship time and boats – remote locations, few options, long advance planning, unreliable supply
- Level funding does not take into account cost of doing business increases (something has to give)

Future directions

- Better integration across socio and biophysical
- Refine survey design – increase sampling allocation efficiency (need better maps!)
- Plan to compare localized monitoring efforts (e.g. Territorial Coral Reef Monitoring Program (TCRMP)) with NCRMP to assess comparability
- Water quality – gap in ecosystem approach, but not compatible with NCRMP scales (and funding!)
- Continue to refine and target reporting products and data, including data accessibility and visualization