

NOAA Coral Reef Conservation Program Ecosystem Science Evaluation

Topical Area: Fish Population Demographics

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Topic Overview

- Status and trends of coral reef fish populations
- Assessment/understanding of fishing effects
- MPA planning and assessment

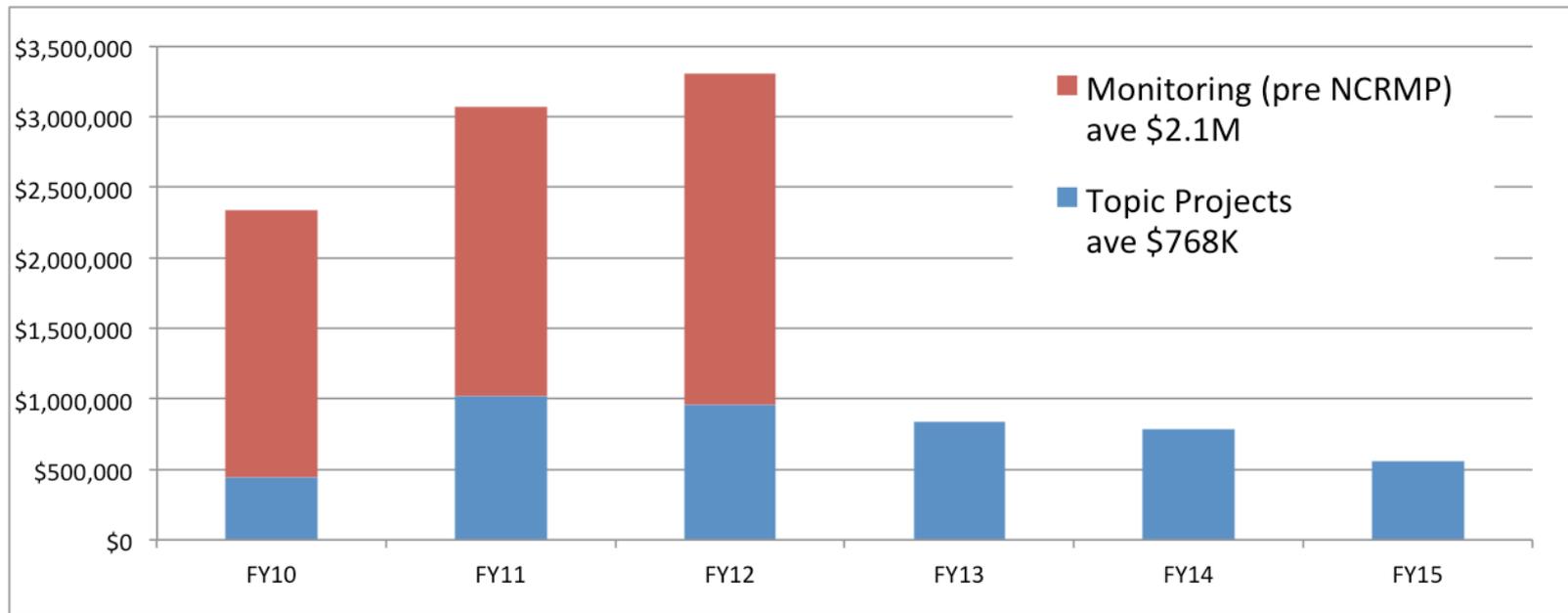
Accomplished by

- Surveys: long-term monitoring (**National Coral Reef Monitoring Plan**) & project-based
- Analysis of NCRMP and other data
- Habitat mapping and assessment

Geographic scope: crosses all US coral reef jurisdictions



Funding Support



Leveraging

- NOAA ship time (70+ days/yr for Pacific)
- Monitoring & project partnerships: Federal & Jurisdictional Agencies, Universities
- NMFS-funded reef fish surveys in Pacific.
- Habitat maps from NOAA Biogeography and PIFSC-CREP mapping group
- Other NCRMP data, e.g. oceanographic and environmental data
- Historical and longer-term data sets



Status & Trends

Standardized NCRMP visual surveys

- #, size and species of coral reef fishes
 - ➔ biomass, abundance, size distribution
- Paired habitat data & geo-referenced
- Habitat and bathymetric maps are critical

'Wide-but-thin' approach

Highly representative of region & island

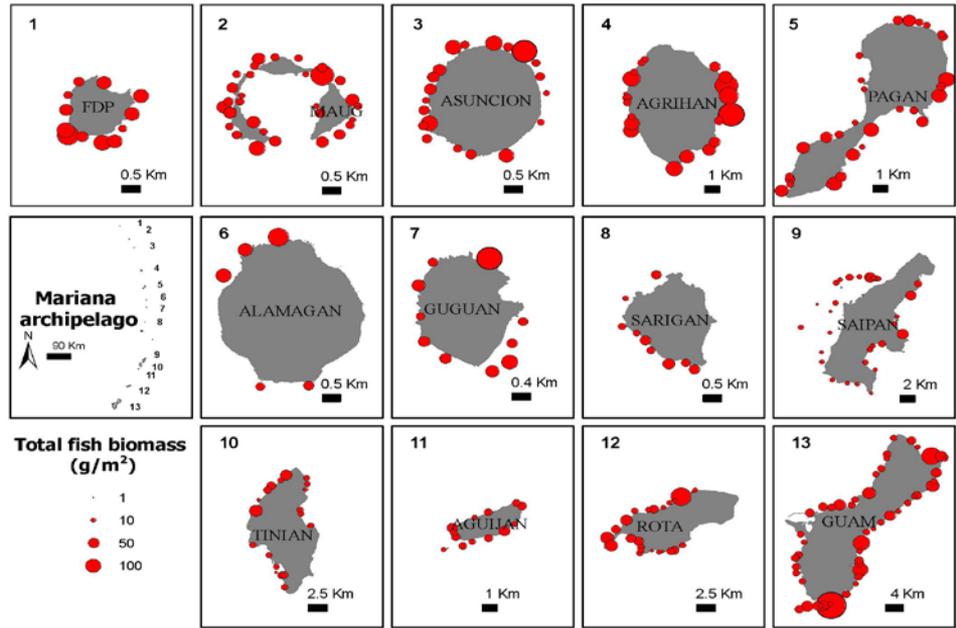
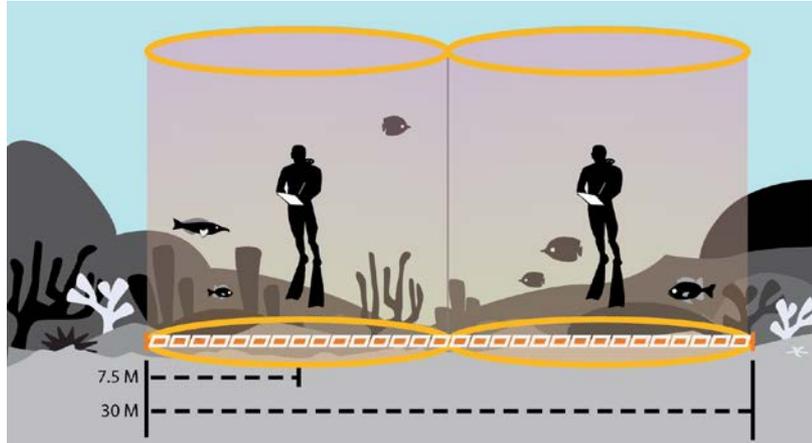
- broad-scale comparisons
- stock and population assessments

But .. limited sampling density at small-scale

Partnerships & Partner Cruises

- Florida: National Park Service, National Marine Sanctuaries, Fish and Wildlife Commission
- Pacific: Papahānaumokuākea Marine National Monument (NWHI). NMFS 'Reef Fish' cruises (MHI, American Samoa)
- Partners/collaborators adopting NCRMP methods

Long-Term Monitoring



Total fish biomass across the Mariana Archipelago from the 2011 CRED surveys

Status & Trends

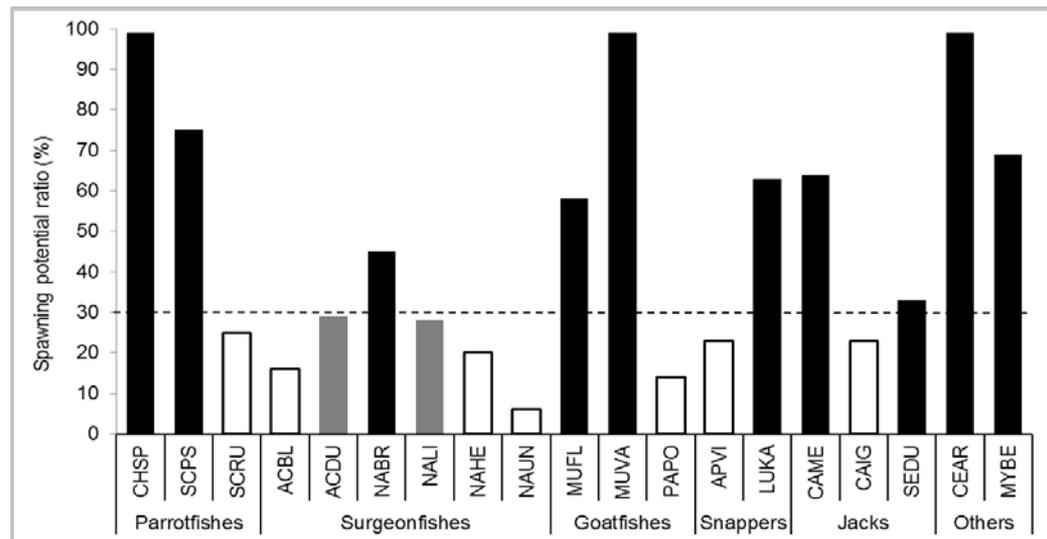
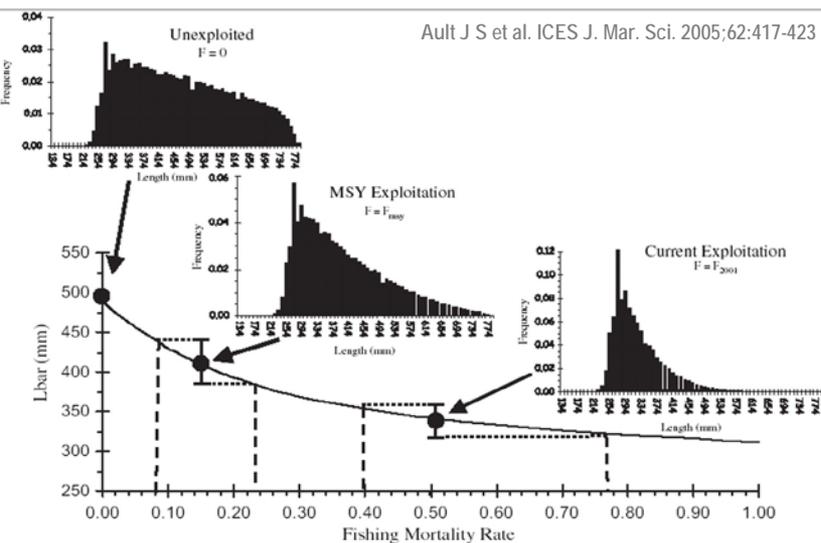
Dissemination & Outcomes

- Data portals & data requests (~50/yr PIFSC) & presentations & data summaries to management agencies
- Routine data reports & synthesized monitoring reports & booklets
 - Pacific data supported establishment of Pacific Marine Monuments and development of management plans
 - Supplementary reporting or surveys at request of AS Sanctuaries and NOAA Pacific Islands Regional Office
- other reports: PMNM status report, Western Pacific Fisheries Council Ecosystem reports, Global Coral Reef Monitoring Network Overview & Synthesis
- Endangered Species Act Reviews
 - Humphead Wrasse, Bumphead Parrotfish, Damselfish, Nassau Grouper
- Other applications
 - Monk seal modeling; Impacts of reef fish consumption by Monk seals
 - Atlantis modeling of Guam reefs; reconstruction of Guam fishery trends
 - NOAA Biogeographic Assessments
 - Evaluation of current & potential MPAs (e.g. Biscayne Bay Management Plan 2015; Dry Tortugas)
 - Document invasive lionfish
- Fishery assessments to support federal (Magnuson-Stevens) and local management



Reef fish assessments required by revised Magnuson Stevens Act

- Reef fish population estimates by family & island used by Western Pacific Council in process to generate Annual Catch Limits for Pacific Jurisdictions
- Preferred approach: length-based modeling



- Fish size distributions provide information on exploitation rate & fishery sustainability
- Fishery-independent visual survey data overcome many problems with coral reef fishery catch data and extends # of species that can be assessed
- # species assessed: Florida (35 species), Puerto Rico (25), Hawaii (19)



Fishing Effects

Stock Assessment Outcomes

SEDAR (Gulf of Mexico Fishery Council)

Hogfish (2012), Red Grouper (2013, 2015), Goliath grouper (2014), Yellowtail Snapper (2010)
previously Black grouper, Mutton snapper

Hogfish declared 'overfished' & recreational fishery closed (Aug 2015)

WPSAR (Western Pacific Stock Assessment Review)

September 2016 (19 species MHI)

approach passed Center for Independent Experts Review 2015
future timeline: Guam & CNMI (2017); American Samoa (2018)

PIFSC NMFS support for 'Reef Fish Survey Cruises' (2102, 2014, 2105)

Local Management

Florida: Hogfish Bag & Size Limits & Spawning Area Closures in development

Hawaii: 2014 Maui Size and Bag Limits



Hogfish image: Albert Kok at nl Wikipedia



Fishing Effects

Statistical models developed to

Estimate natural 'pristine' state based on habitat and environment

Compare current state against 'pristine' biomass to estimate depletion

Completed for US Pacific Reef fishes & sharks

Dissemination & Outcomes

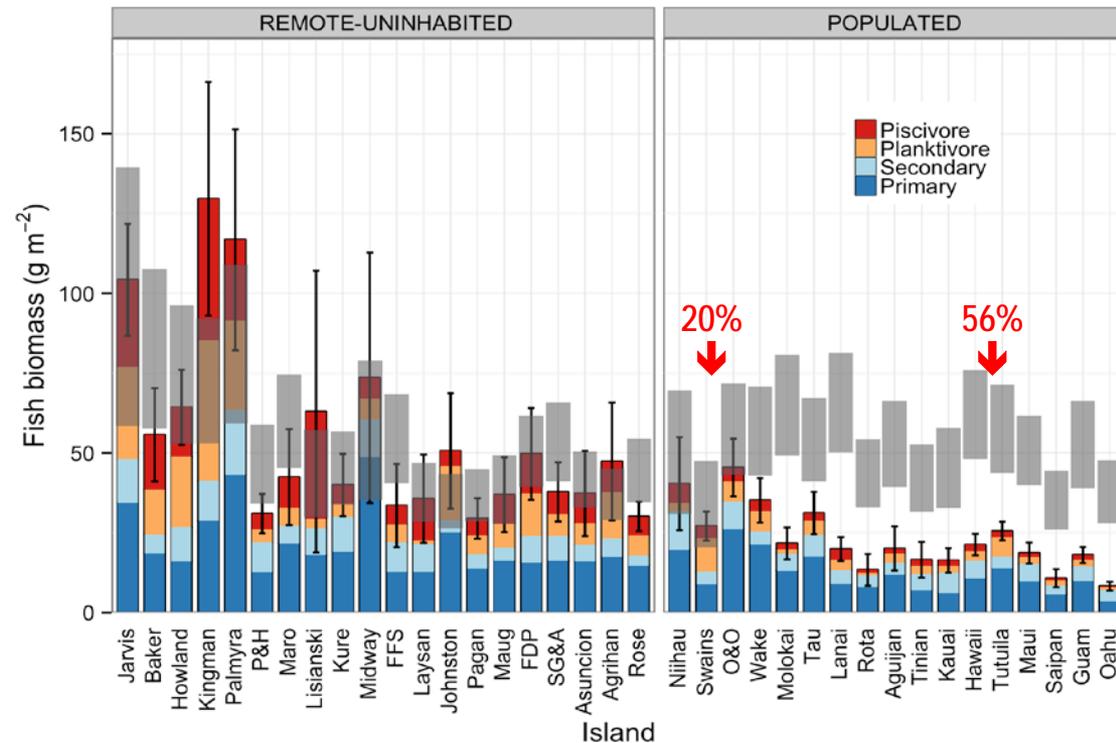
Scientific papers: 2 as direct outcomes; other global assessment heavily reliant on NCRMP data

Used as basis of scoring for NCRMP Report Card

Understanding what is natural and how that varies is critical step to understanding human impact, setting management targets, and identifying effective or ineffective management.

Approach will be basis for collaborative assessment of MHI reef areas (NOAA, DAR, NGOs, Univ Hawaii)

'Pristine' states & depletion



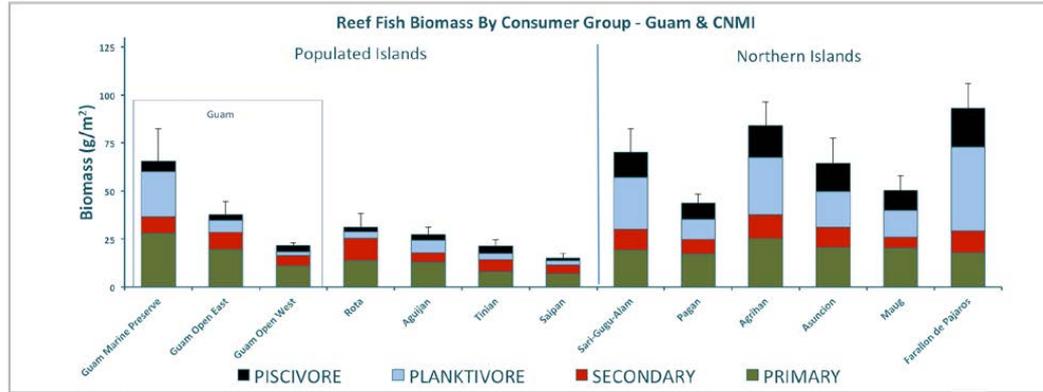
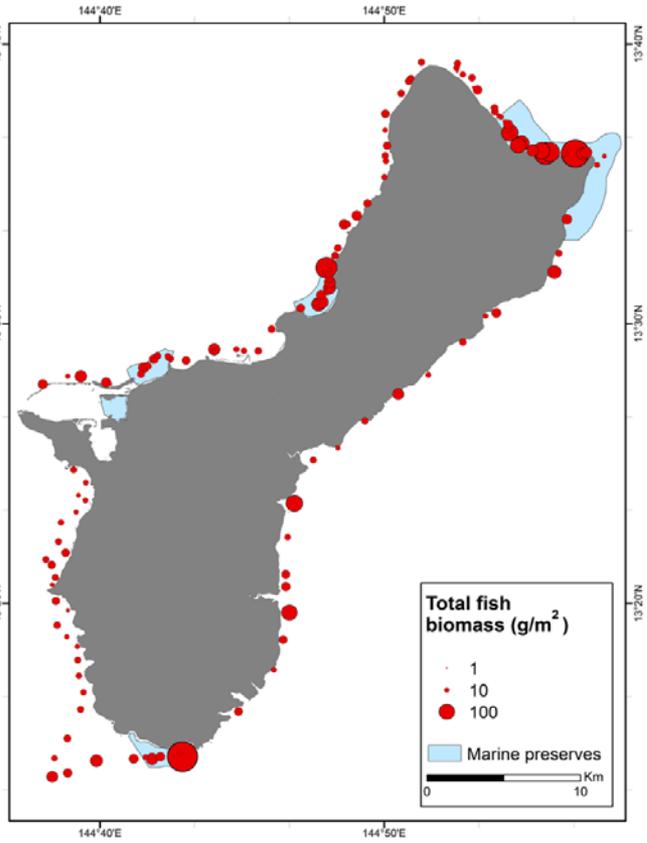
MPA Assessment

Guam Marine Preserves

Supplementary surveys to assess Guam Marine Preserves (est 1997)

- 52 NCRMP + 81 supplementary sites
- 2.4 * fish biomass in MPs compared to open areas
- Higher encounter rates for rare/ targeted species
- No systematic differences in habitat quality

NCRMP data provide context & comparison



Dissemination & Outcomes

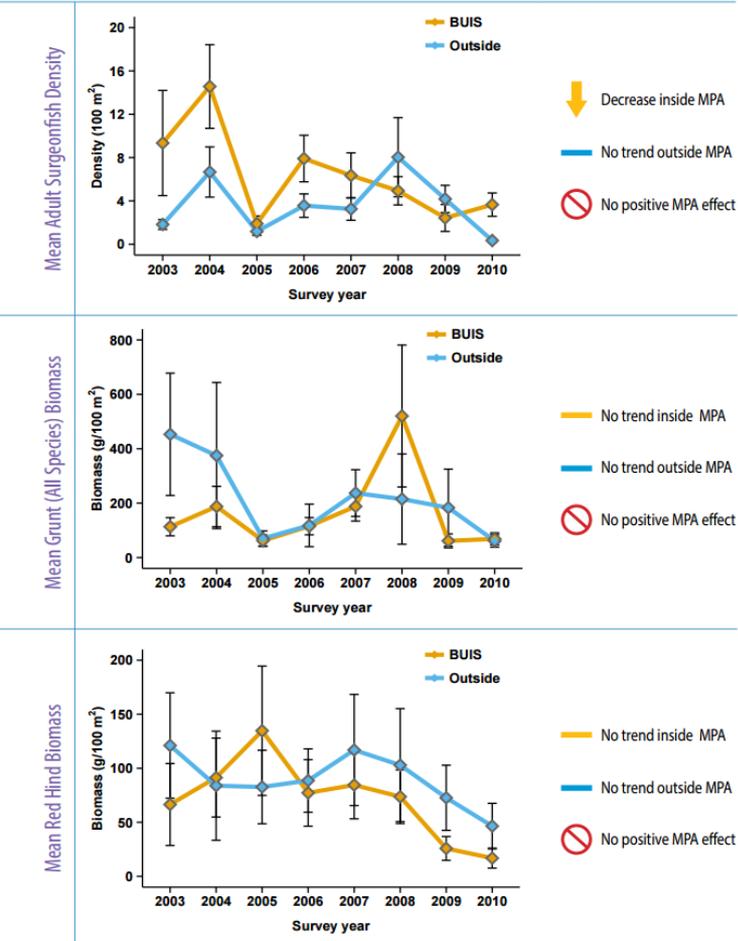
NOAA Tech. Memo. 2012 NOAA-TM-NMFS-PIFSC-33

Similar approaches utilized for AS Community-based MPA (ongoing)

AS Sanctuaries Baseline Report (2015)

Manele Geus (Guam Habitat Blueprint Area, 2014)

Fish Family & Species Metrics



Used existing data to assess resource trends & MPA performance

- No evidence of positive effects of >10 years of protection at 3 USVI MPAs for fish or benthos
- Mgmt. implementation, enforcement, other stressors also quantified

Dissemination & Management Outcomes

- Clarity on management outcomes for 15 fish and 2 benthic indicators
- Partners: Buck Island Reef National Marine Monument, NPS, USGS, University of the VI.
- Tech Memo: MPAs of US Virgin Islands: Ecological Performance Report



Assessing herbivore management in Maui by monitoring fish & benthic assemblages in partnership with Hawaii DAR

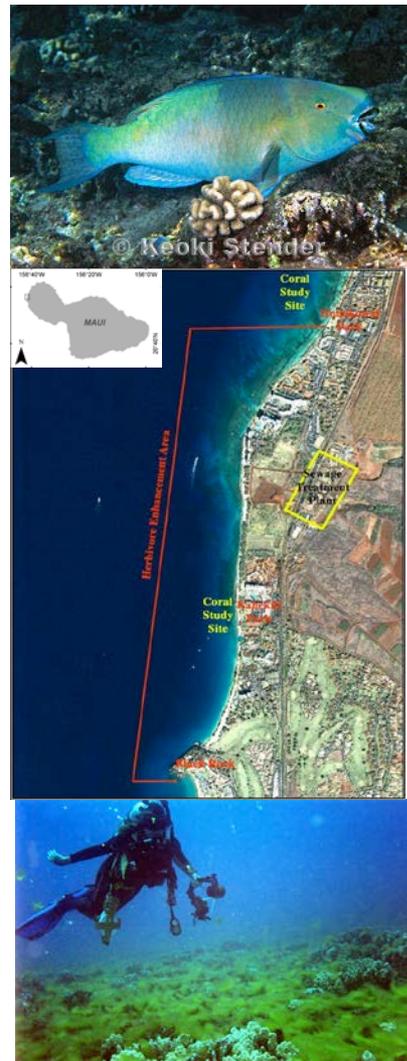
- Project began 2008, CRCP funded NOAA-CREP involvement since 2010
- Clear positive change to herbivore biomass & benthic algae
- Coral decline arrested, some recovery pre-2015 bleaching event

Management Outcomes & Significance

- Supports Continued Implementation of KHFMA
- Results used to support increased protection for parrotfishes in Maui Size and Bag Limits (2014)
- Active consideration of expanding herbivore management as response to recent (and future) bleaching events – HDAR Bleaching Response Working Group

Dissemination

- Scientific Paper: Williams et al, 2016, *PLoS ONE* 11(7): e0159100
- DAR Maui & Lanai Monitoring Report 2016
- 2 2-page Interim Monitoring Briefs (2011, 2013)
- West Maui Priority Watershed Status and Trends Report (Maui R2R 2014, 2106)



MPA Assessment PR & USVI Fish Biomass Hotspots

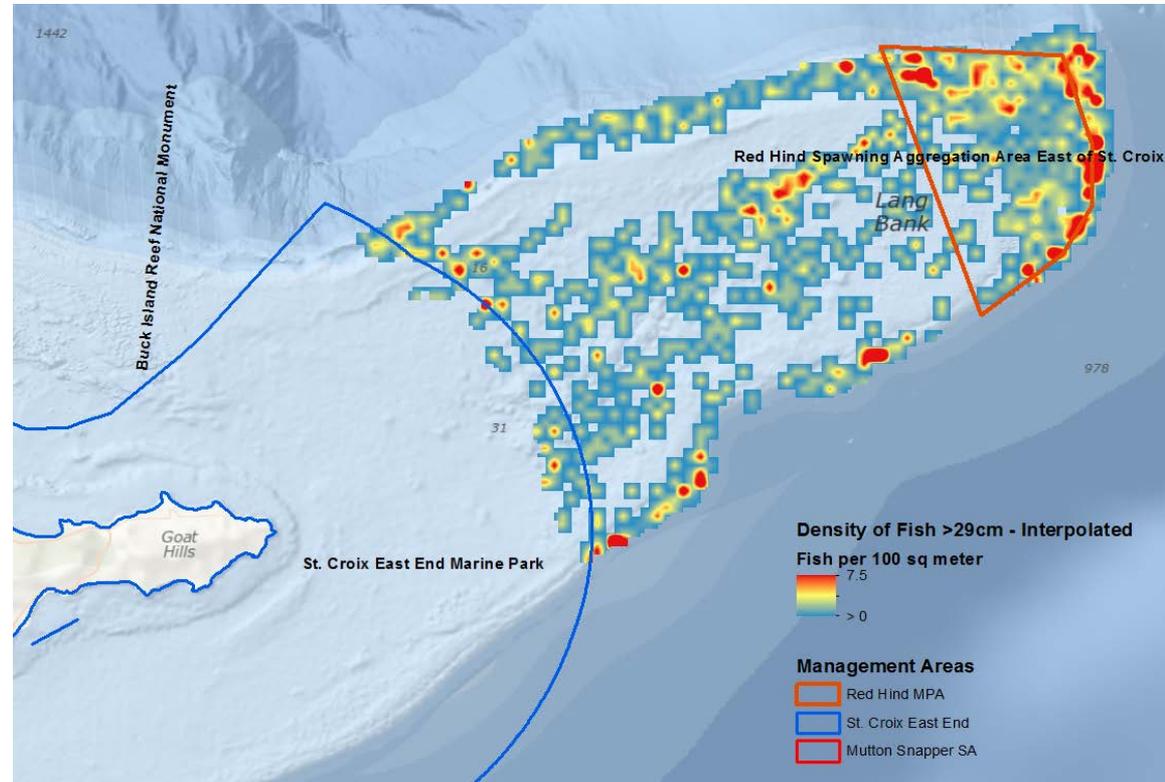
Acoustic mapping of habitat and fish hot spots

Aggregations and hotspots relative to habitat and MPA boundaries @ locations in Puerto Rico and USVI

Partnerships with Navy Oceanographic Office and Caribbean Fishery Council

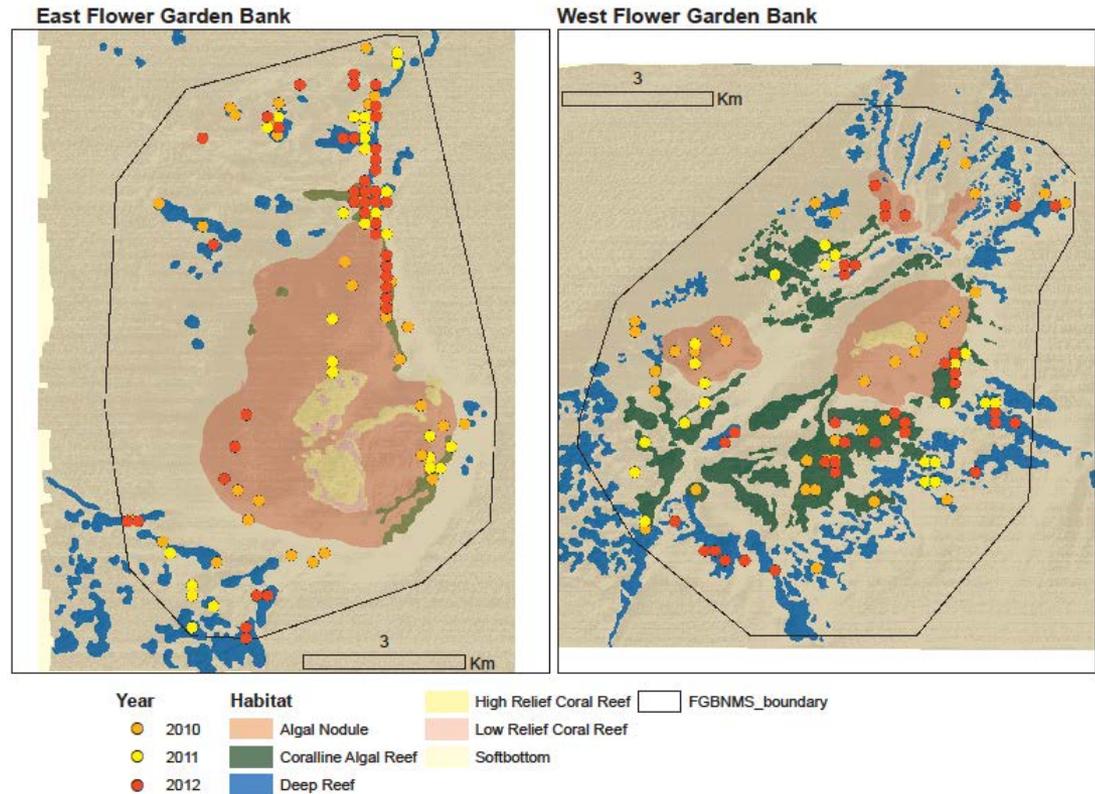
Dissemination and Outcomes

- Peer-reviewed Papers, Online GIS portal
- Approach suitable for assessing fish assemblages over large areas and in deeper water than can be surveyed by divers
- Data used by Caribbean Fishery Management Council and University of Virgin Islands to focus further research on critical management units



Comprehensive baseline resource assessment to

- Assess existing management
- Support potential establishment of full closure 'research' area
- Provide template for future monitoring by Sanctuary staff



Dissemination and Outcomes

- NOAA Tech Memo and GIS layers (<https://coastalscience.noaa.gov/projects/detail?key=44>)
- Current review of proposed expansion of Flower Garden Bank Sanctuary means other management actions on hold



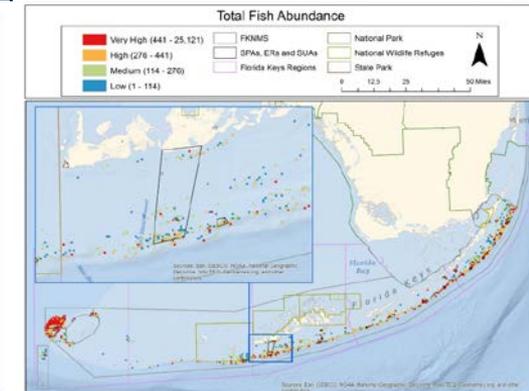
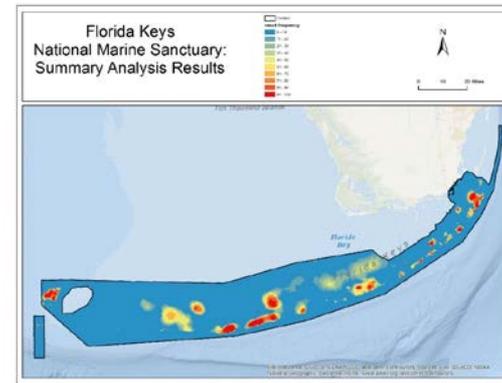
MPA/Spatial Planning Florida Biogeographic Assessment

Map marine resources & human uses

Fish & habitat (NCRMP), key oceanographic features, socioeconomic assessment, key threats

Map-based synthesis of relevant regulations & jurisdiction

Partnerships with local & federal staff and resource users



Dissemination and Outcomes

- GIS layers, web page (<https://coastalscience.noaa.gov/projects/detail?key=128/>) NOAA Technical Report (coming) Results and Marxan decision-support tool used in marine zoning and regulatory review of the Florida Keys NMS
- Results used in ongoing SE Florida community planning exercise: "Our Florida Reefs"



Challenges

Dissemination

Not all data available through online data portal (coming!)

... but all data available on request (~50/year at PIFSC)

Getting science into right hands and in right form

Management/science divide

Management priorities & needs change

Political & other reasons why earlier targets become unfeasible.

Strong collaborative partnerships are key

Operational

Dependent on NOAA ships scheduling

Gaps

Deeper water and connected habitats not well studied

Improved life-history data would strengthen length-based modeling



Future Directions

- Improved integration of local and national monitoring
- Broadening and formalizing use of length-based modeling
- More collaborative work
 - with jurisdictional partners and NGOs
 - with federal managers & scientists
 - (stock assessment; protected resources; sanctuary & monument staff)
- Focus on coral reef resilience and recovery
 - e.g. in relation to herbivory



Publications (2010+)

Data & Technical Reports

- 1-3. McCoy et al 2016. Pacific Reef Assessment and Monitoring Program - Data Report - Ecological Monitoring 2015 - Reef Fishes and Benthic Habitats of the MHI, NWHI, PRIA and AS. Honolulu, Hawaii. PIFSC Data Report DR-16-02 (+ 2014, 2015 reports)
4. Kilfoyle et al 2015 SE Florida Coral Reef Fishery-Independent Baseline Assessment: 2012-2014 Summary Report. Florida Department of Environmental Protection 129 pp.
5. Pittman et al. 2014. Marine protected Areas of the U.S. Virgin Islands: Ecological Performance Report. NOAA Technical Memorandum NOS NCCOS 187. 89 pp.
6. Clark et al. 2014. Fish and Benthic Communities of the Flower Garden Banks National Marine Sanctuary: Science to Support Sanctuary Management. NOAA Technical Memorandum NOS NCCOS 179. 317 pp.
7. Friedlander et al 2013 Coral reef ecosystems of St. John, U.S. Virgin Islands: spatial and temporal patterns in fish and benthic communities (2001-2009). Silver Spring, MD, NOAA/National Centers for Coastal Ocean Science, 150pp. NOAA Technical Memorandum NOS NCCOS, 152pp.
8. Williams et al 2012. Status of coral reef fish assemblages and benthic condition around Guam: A report based on underwater visual surveys in Guam and the Mariana Archipelago, April-June 2011. NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-33
8. Ault et al, 2010. Assessment of Coral Reef Multispecies Fishery Resources and RNA Performance in Dry Tortugas National Park, 1999-2010. Final Report National Park Service Contract No. H5000065040-J5299-06-1017. 45 p
9. Pittman et al, 2010, Coral reef ecosystems of Reserva Natural de La Parguera (Puerto Rico): spatial and temporal patterns in fish and benthic communities (2001-2007). Silver Spring, MD, NOAA/National Centers for Coastal Ocean Science, 177pp. NOAA Technical Memorandum NOS NCCOS, 107

Other Publications

1. Ayotte et al. 2015. Coral Reef Ecosystem Division Standard Operating Procedures: Data Collection for Rapid Ecological Assessment Fish Surveys. PIFSCAdmin Rep 15-07
2. Williams & Ma. 2013. Estimating Catch Weight of Reef Fish Species Using Estimation and Intercept Data from the Hawaii Marine Recreational Fishing Survey. PIFSC Admin Report 13-04.
3. Brandt et al. 2009. A Cooperative Multi-Agency Reef Fish Monitoring Protocol for the Florida Keys Coral Reef Ecosystem. Natural Resource Report NPS/SFCN/NRR; 2009/150.

Peer Review Papers

1. Williams ID, White DJ, Sparks RT, Lino KC, Zamzow JP, Kelly ELA, Ramey HL, 2016, Responses of Herbivorous Fishes and Benthos to 6 Years of Protection at the Kahekili Herbivore Fisheries Management Area, Maui. *PLoS One* 11(7): e0159100.
 2. Nadon MO, Ault JS, Williams ID, Smith SG, DiNardo GT, 2015. Length-Based Assessment of Coral Reef Fish Populations in the Main and Northwestern Hawaiian Islands. *PLoS One* 10 (8): e0133960.
 3. Williams ID, Baum JK, Heenan A, Hanson KM, Nadon MO, Brainard RE, 2015. Human, Oceanographic and Habitat Drivers of Central and Western Pacific Coral Reef Fish Assemblages. *Plos One* 10 (4): e0120516.
 4. Ault JS, Smith SG, Browder JA, Nuttle W, Franklin EC, Luo JG, Dinardo GT, Bohnsack JA. 2014. Indicators for Assessing the Ecological Dynamics and Sustainability of Southern Florida's Coral Reef and Coastal Fisheries. *Ecological Indicators* 44. Elsevier Ltd: 164–72.
 5. Ault JS, Smith SG, Bohnsack JA, Luo JG, Zurcher N, McClellan DB, Ziegler TA, et al. 2013. Assessing Coral Reef Fish Population and Community Changes in Response to Marine Reserves in the Dry Tortugas, Florida, USA. *Fisheries Research* 144: 28–37
 6. Heenan A, Williams ID, 2013. Monitoring Herbivorous Fishes as Indicators of Coral Reef Resilience in American Samoa. *PLoS One* 8 (11).
 7. Zgliczynski BJ, Williams ID, Schroeder RE, Nadon MO, Richards BL, Sandin SA. 2013. The IUCN Red List of Threatened Species: An Assessment of Coral Reef Fishes in the US Pacific Islands. *Coral Reefs* 32 (3): 637–50.
 8. Nadon MO, Baum JK, Williams ID, McPherson JM, Zgliczynski BJ, Richards BL, Schroeder RE, Brainard RE, 2012. Re-Creating Missing Population Baselines for Pacific Reef Sharks. *Conservation Biology* 26 (3): 493–503.
 9. Richards BL, Williams ID, Vetter OJ, Williams GJ. 2012. Environmental Factors Affecting Large-Bodied Coral Reef Fish Assemblages in the Mariana Archipelago. *PLoS One* 7 (2).
 10. Smith SG, Ault JS, Bohnsack JA, Harper DE, Luo JG, McClellan DB. 2011. Multispecies Survey Design for Assessing Reef-Fish Stocks, Spatially Explicit Management Performance, and Ecosystem Condition. *Fisheries Research* 109 (1): 25–41.
 11. Richards BL, Williams ID, Nadon MO, Zgliczynski BJ, 2011. A Towed-Diver Survey Method for Mesoscale Fishery-Independent Assessment of Large-Bodied Reef Fishes. *Bull Mar Sci* 87: 55–74.
 12. Williams ID, Richards BL, Sandin SA, Baum JK, Schroeder RE, Nadon MO, Zgliczynski BJ, Craig P, McLwain JE, Brainard RE, 2011. Differences in Reef Fish Assemblages between Populated and Remote Reefs Spanning Multiple Archipelagos across the Central and Western Pacific. *Journal of Marine Biology*
- 16+ other peer-review papers (including 2 Nature, Nature Communications, Global Change Biology)

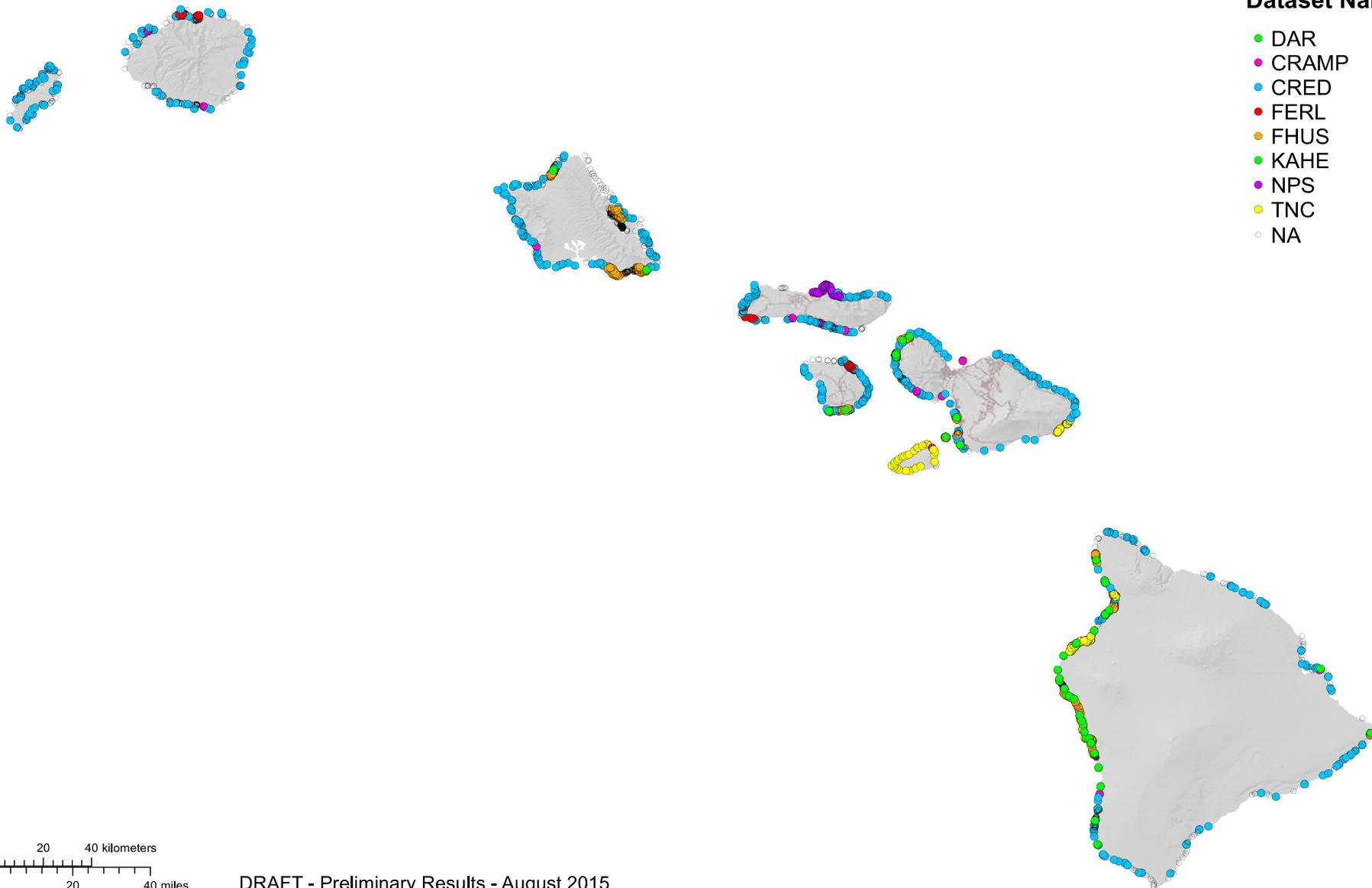


Following slides are there to be potentially
used I response to questions



Dataset Name

- DAR
- CRAMP
- CRED
- FERL
- FHUS
- KAHE
- NPS
- TNC
- NA



DRAFT - Preliminary Results - August 2015

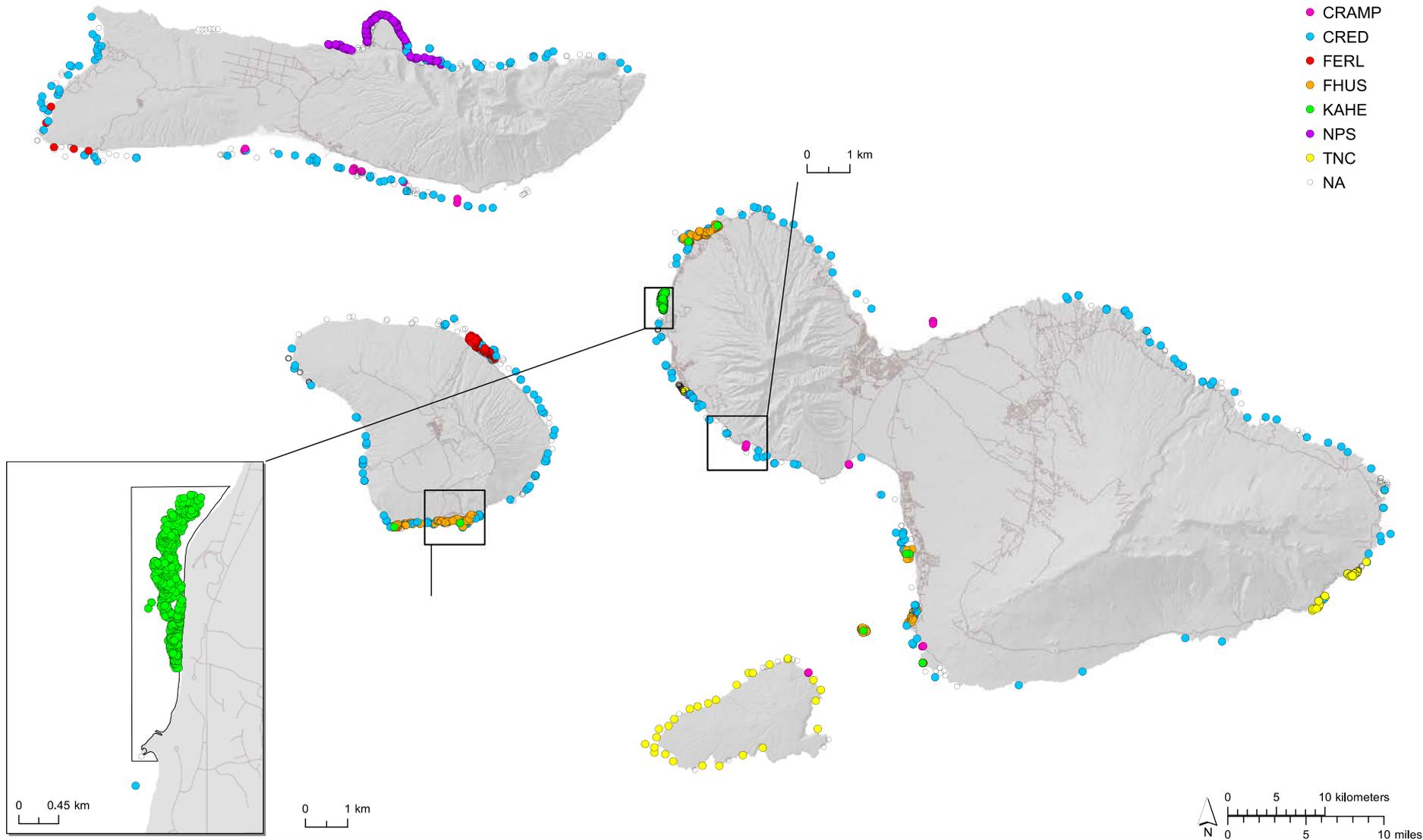


NOAA
CORAL REEF
CONSERVATION PROGRAM

y Results - August 2015

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- DAR
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Atlantic Applications of NCRMP/ RVC Reef-fish Visual Monitoring Data

Multiagency adoption of standard visual reef fish data collection method.

NOAA (NMFS, NOS, National Marine Sanctuary Program, NCCOS, CRCP-NCRMP (National Coral Reef Monitoring Plan), **National Park Service (NPS)**, **Florida** (Dept. Environmental Protection (FDEP), Fish and Wildlife Commission (FFWC), U. of Miami, Nova SE University.

Data used for fishery stock assessments (SEDAR – S.E. Data Assessment & Review)

- Hogfish (2012, 2004) - 2015 overfished and overfishing (SAFMC and FDEP)
- Mutton snapper (2016, 2007) 2016 New fishing regulations under consideration
- Black grouper (2009)
- Red grouper (2013, 2009, 2015)
- Goliath grouper (2014, 2009, 2004)
- Yellowtail snapper (2010, 2003) 2010 – determined not overfished & no overfishing

Data used for Ecosystem Assessment

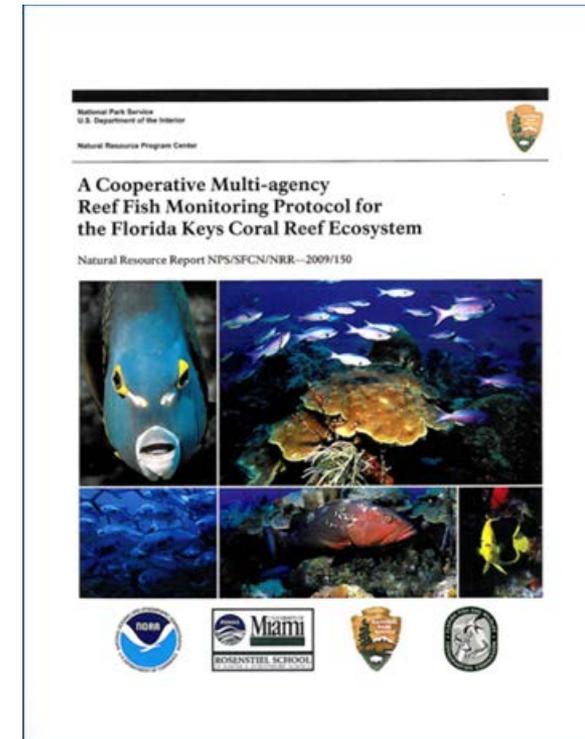
- Invasive species - lionfish invasion in FKNMS (Ruttenberg et al. 2012)
- Described Bicolor damselfish ecology (Goldstein 2015, Ph.D. dissertation)
- Ground-truth Marine Biodiversity Observation Network e-DNA (MBON, 2015)

Data used to evaluate current Marine Reserves and potential MPA sites

- FKNMS (1997); FKNMS Tortugas Ecological Reserves (2001, NOAA, FWC, Fla Trustees)
- Dry Tortugas National Park - Research Natural Area (2006, NPS, FWC)
- Biscayne National Park Ecological Reserve (2015, NPS, FWC)
- SE Florida Reefs (2012-2014 FDEP-FWC; Kurfoyle et al. 2014, Ferro et al. 2005)

Data used to evaluate Endangered Species Act (ESA) nominations

- Yellowtail Damselfish (2014 – determined to be not endangered)
- Nassau Grouper (2016 - listed as Threatened under ESA)



RVC-NCRMP data used successfully to evaluate coral reef condition, identify 14 MPA “areas of interest” and potential marine reserve boundaries and in Biscayne National Park and southeastern Florida (FDEP,

Non-extractive aesthetic fisheries



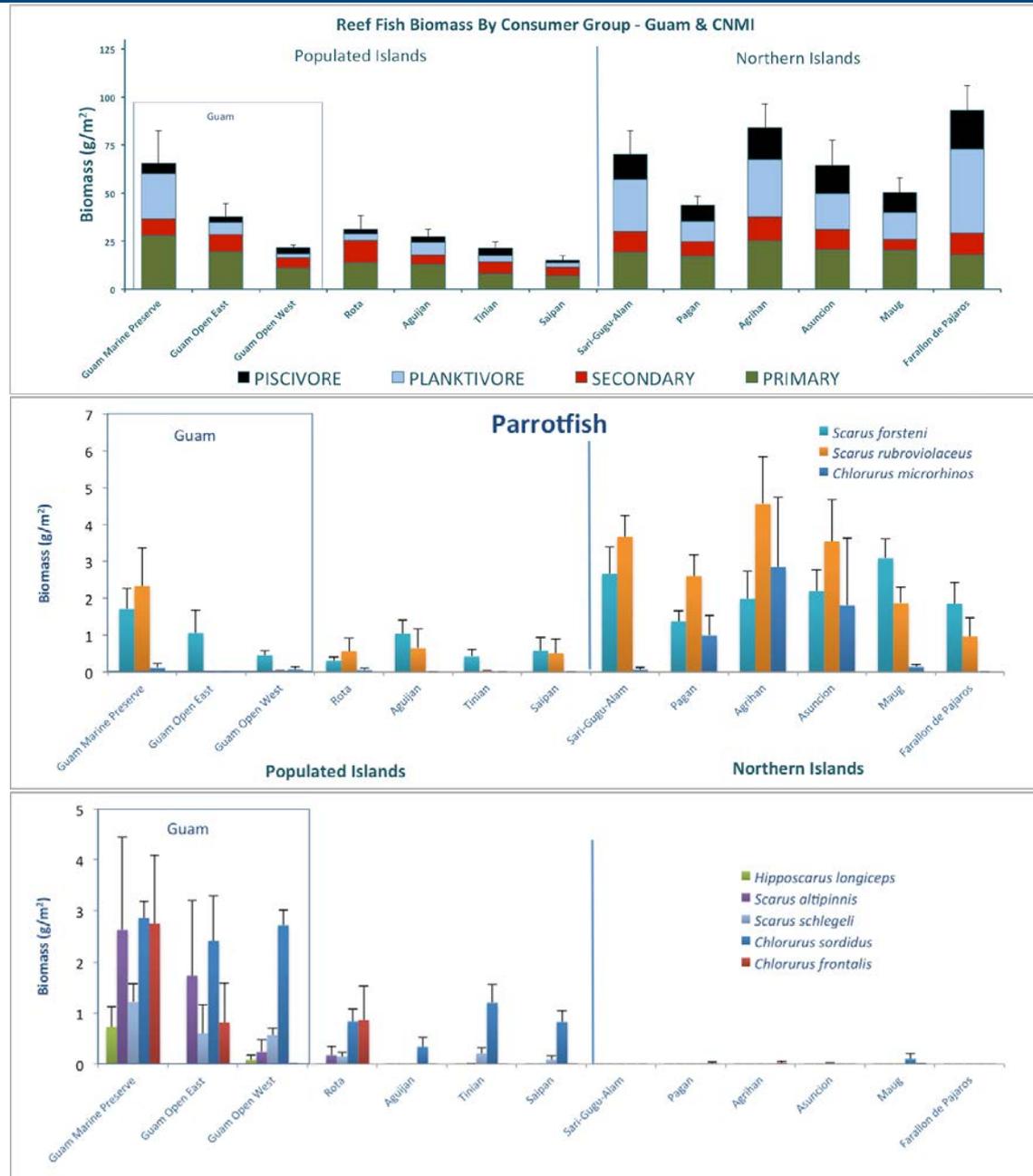
Photo by J.A. Bohnsack



Biscayne National Park General Management Plan
Approved June 5, 2015

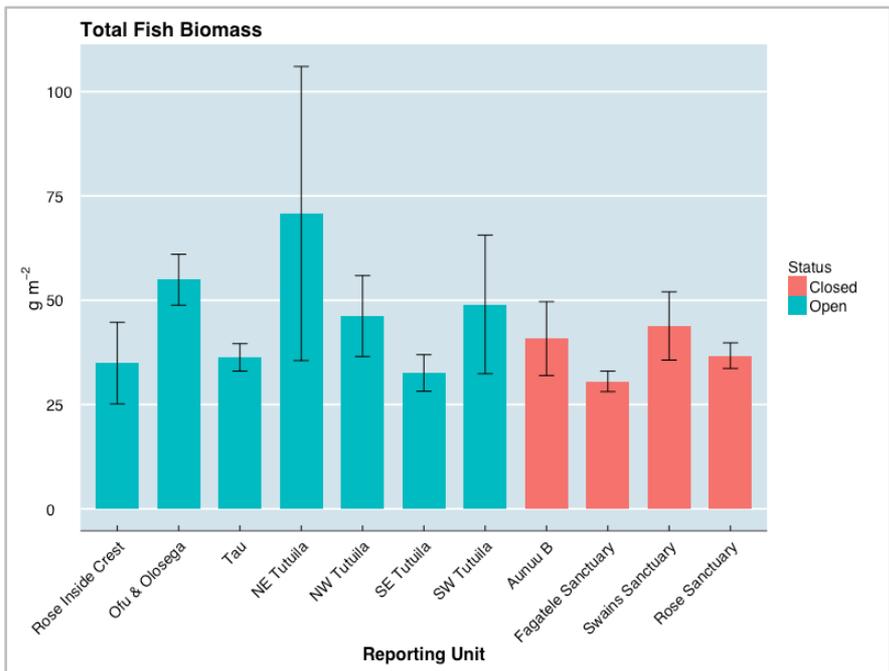
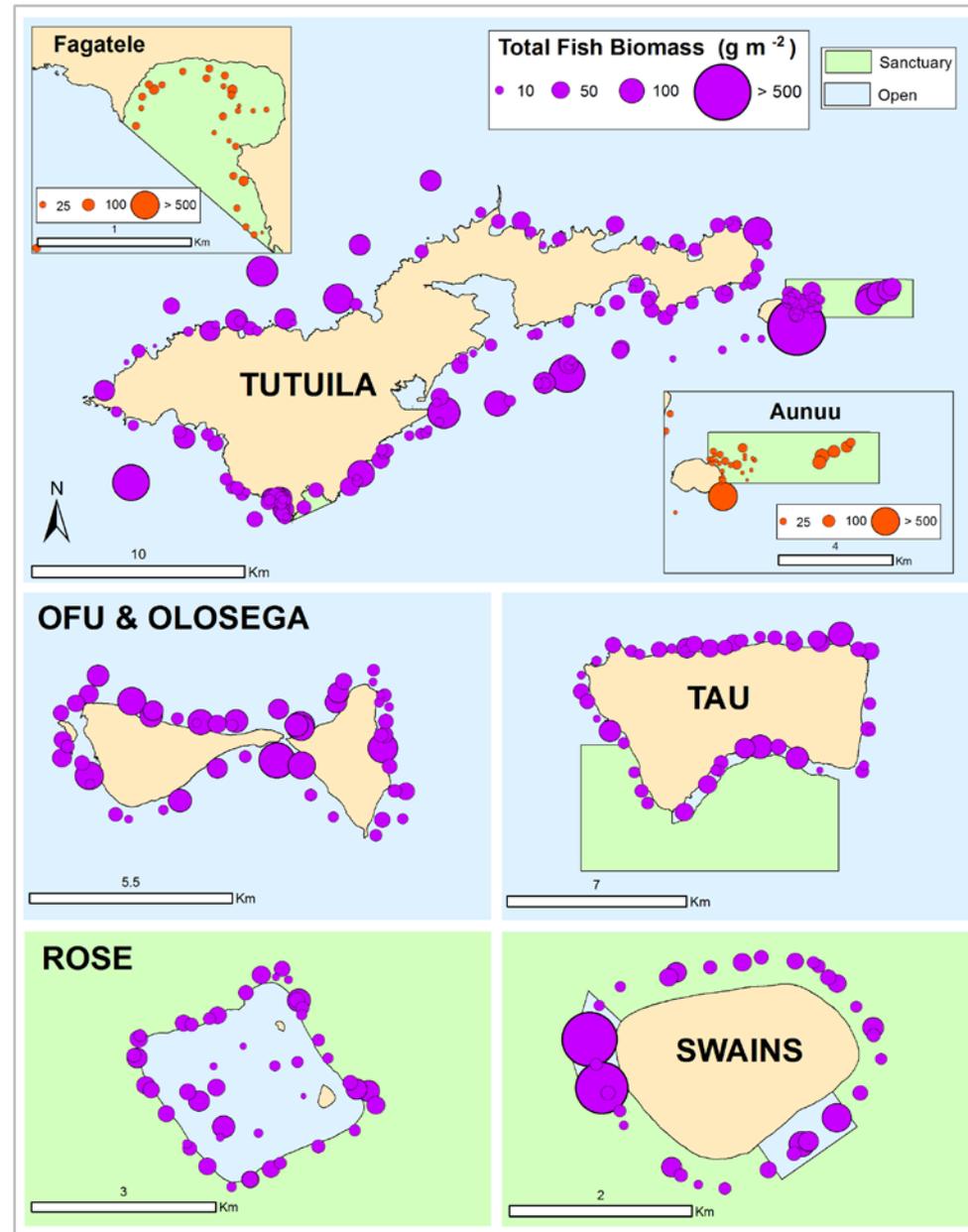
Context provided by RAMP

1. Biomass in preserves comparable to remote portions of archipelago
2. Parrotfish assemblage
 - northern islands dominated by large-bodied species
 - southern islands dominated by small-bodied species
3. Guam marine preserves have both



Other Projects

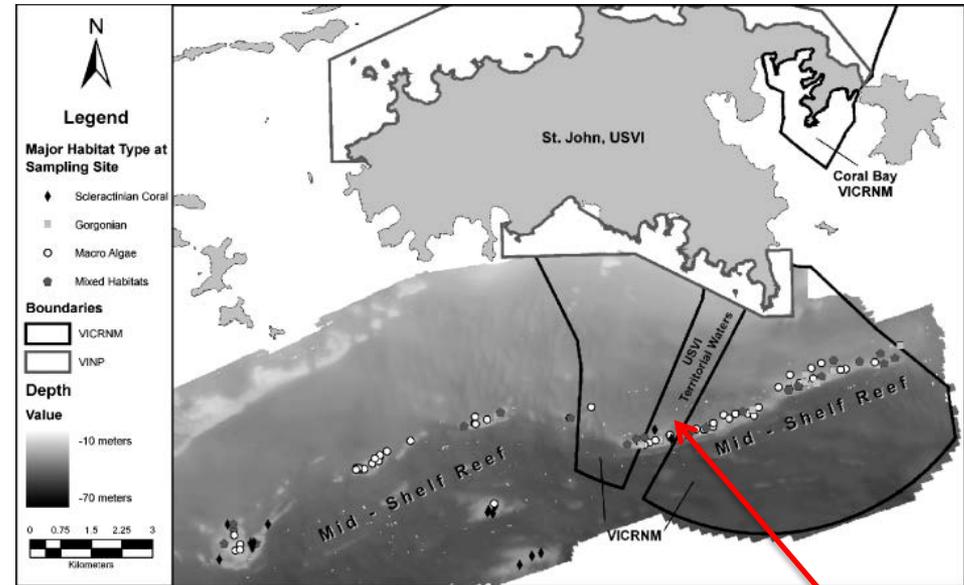
- Hawaii DAR ... Parrotfish assessment
- Samoa DMWR ... Climate Vulnerability ... Community
- MMA Assessment
- American Samoa Marine Sanctuaries ... Baseline Assessment



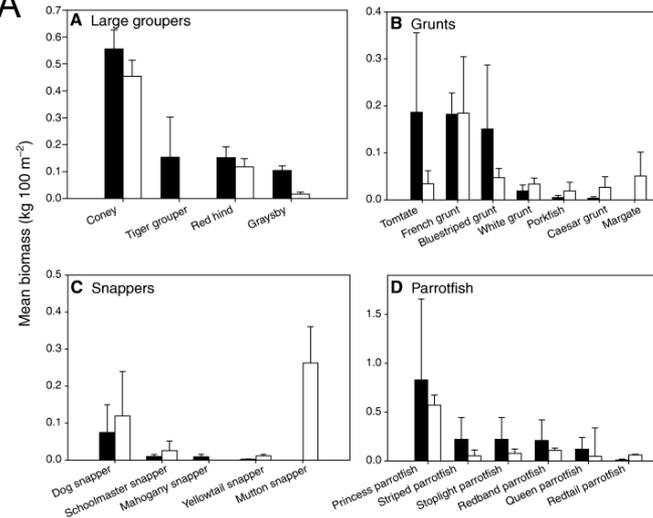
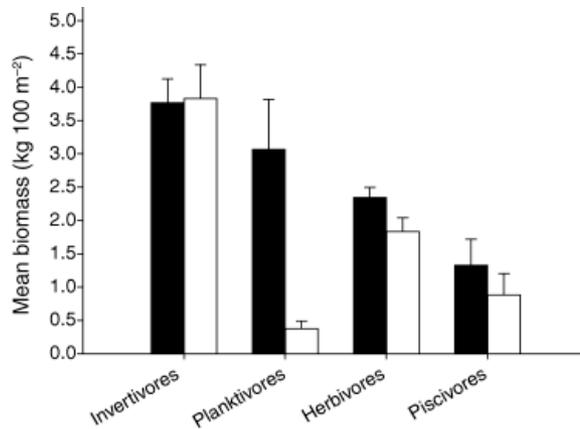
USVI

Context (data from CREM pre2010)

1. Fish and benthic metrics greater outside of MPA in disputed region
2. Management in process of working with fishermen to “exchange” parcels of territory



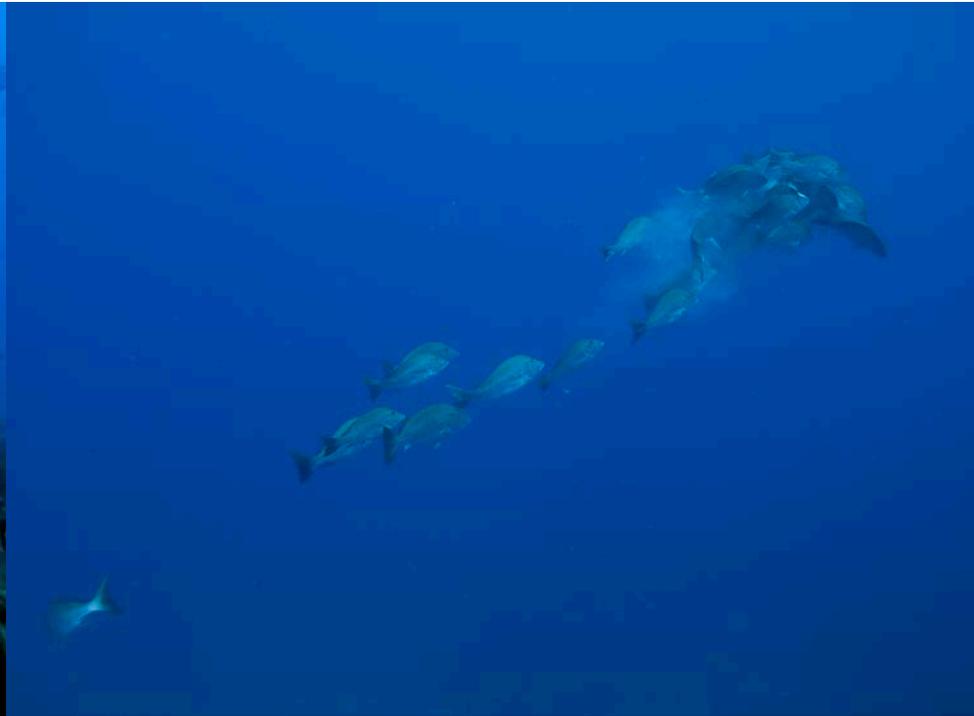
Black bars are outside, white bars inside MPA



This “wedge” is unprotected but has much better habitat than MPA on neither side!!



MPAs: Spawning Aggregations in Dry Tortugas



- Assessed status of recovery of exploited reef fish stocks, focus on mutton snapper, *Lutjanus analis*
- Examine top down control of invasive lionfish by higher than normal populations of native predators in reserves
- Quantify recently discovered aggregation of cubera snapper, *Lutjanus cyanopterus* (@ Riley's Hump in DTO)

