How can you use the spatial information for the Marquesas?

- natural resources -

- NOAA – Florida Keys National Marine Sanctuary
- Florida Fish and Wildlife Commission
- NOAA – National Centers for Coastal Ocean Science

Photos courtesy of NOAA photo library
Where are locations of ‘special places’?
How much area is currently within zones?

<table>
<thead>
<tr>
<th>Management Zone</th>
<th>Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAs</td>
<td>2</td>
</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>2,981</td>
</tr>
<tr>
<td>Resource Total</td>
<td>2,983</td>
</tr>
</tbody>
</table>
Natural Resource Info

Metrics

• Habitat
  • Habitat types
  • Patch & linear reef
  • High relief reefs
  • Turtle grass density
• Coral
  • Stony coral
  • Soft coral
  • Resilient reefs
• Fish
  • Reef fish surveys
  • Fish aggregations
• Fauna
  • Conch aggregations
  • Sea turtle sightings

Photos courtesy of NOAA photo library
How are habitats distributed?

<table>
<thead>
<tr>
<th>Habitats</th>
<th>Area (Km²)</th>
<th>SPAs</th>
<th>Remaining FKNMS (Marquesas)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous reefs</td>
<td>0.5</td>
<td>0.0</td>
<td>57</td>
</tr>
<tr>
<td>Patch reefs</td>
<td>0.0</td>
<td>0.0</td>
<td>29</td>
</tr>
<tr>
<td>Hardbottom</td>
<td>0.6</td>
<td>0.0</td>
<td>266</td>
</tr>
<tr>
<td>Sand</td>
<td>0.3</td>
<td>0.0</td>
<td>492</td>
</tr>
<tr>
<td>Seagrass</td>
<td>0.3</td>
<td>0.0</td>
<td>408</td>
</tr>
<tr>
<td>Unmapped</td>
<td>0.0</td>
<td>0.0</td>
<td>1658</td>
</tr>
</tbody>
</table>
High Relief Reefs

Data source
- NMFS diver surveys

Metric
- **High relief reef**
  
  Average reef height of 1.6-3.3 ft within a circle 24.6 ft in diameter

Reference
Where are locations of high relief reefs?

<table>
<thead>
<tr>
<th>Management Zone</th>
<th>Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAs</td>
<td>0.48</td>
</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>0.42</td>
</tr>
<tr>
<td>Resource Total</td>
<td>1</td>
</tr>
</tbody>
</table>
Where are locations of high relief reefs?

<table>
<thead>
<tr>
<th>Management Zone</th>
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</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>0.42</td>
</tr>
<tr>
<td>Resource Total</td>
<td>1</td>
</tr>
</tbody>
</table>
Light detection & ranging (LiDAR) mapping: Depth

- Georeferenced spatial information on shape & surface characteristics of the Earth.
- Uses light pulse reflections to calculate distance (depth).
- Produces 3-d representation of shallow seafloor.
- 3-d seafloor complexity was processed to identify high relief in survey area

Photo: USGS
Resilient Reefs

Data source
R. Van Woesik analysis of Florida Reef Resilience Program coral surveys, 2005-2010

Study Methods
Data selected for high coral colony density, relatively low observations of disease and bleaching

Metrics
• Resilient reefs
Where are locations of resilient reefs?

<table>
<thead>
<tr>
<th>Management Zone</th>
<th>Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAs</td>
<td>0</td>
</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>2</td>
</tr>
<tr>
<td>Resource Total</td>
<td>2</td>
</tr>
</tbody>
</table>
Where are locations of resilient reefs?

<table>
<thead>
<tr>
<th>Management Zone</th>
<th>Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAs</td>
<td>0</td>
</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>2</td>
</tr>
<tr>
<td><strong>Resource Total</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

The locations of resilient reefs are indicated on the map. Resilient reefs are shown in red, and other features include FKNMS Boundary, SPAs, and Remaining FKNMS (Marquesas).
Where are locations of known fish aggregation areas?

- Mutton Snapper (Present)
- Permit (Reported)
- Gray Snapper
Sea turtle sightings

Data sources
• Inwater Research Group, FL

Species
• Loggerhead sea turtle (Caretta caretta)
• Green sea turtle (Chelonia mydas)
• Hawksbill sea turtle (Eretmochelys imbricata)
• Kemp’s ridley sea turtle (Lepidochelys kempii)

Study Methods
• Visual sightings collected 2006 - 2012

Metrics
• presence

Photo: Joe Marino
Where are locations of known turtle sightings?
Coral current and candidate ESA species

Data sources
- Sanctuary Coral Reef Ecosystem Assessment & Monitoring (SCREAM), Nova Southeastern University
- Florida Reef Resilience Program (FRRP)
- Coral Reef Ecosystem Monitoring Program (CREMP), FWC
- NOAA NMFS Protected Resources & FWC ESA monitoring

Species
- ESA Threatened: elkhorn (*Acropora palmata*), staghorn (*Acropora cervicornis*)
- State of FL Threatened: pillar (*Dendrogyra cylindrus*)
- Candidate ESA Endangered: elkhorn, staghorn, pillar, boulder star (*Montastraea annularis*), mountainous star (*M. faveolata*), star (*M. franksii*)
- Candidate ESA Threatened: sheet coral (*Agaricia lamarcki*), elliptical star coral (*Dichocoenia stokesii*)

Metrics
- presence
What proportions of sites with ESA coral species are present in current zones?
What proportion of sites with Threatened Staghorn corals are present in current zones?

Greatest colony densities and sizes in mid-channel & offshore patch reefs. 
What proportion of sites with Threatened Staghorn corals are present in current zones?

<table>
<thead>
<tr>
<th>Management Zone</th>
<th>Locations (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAs</td>
<td>75</td>
</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>94</td>
</tr>
<tr>
<td><strong>Resource Total</strong></td>
<td><strong>169</strong></td>
</tr>
</tbody>
</table>

44% of sites are present in current zones.
What proportion of sites with Threatened Elkhorn corals are present in current zones?

In 2012, nearly 80% of colonies were found in high-relief spur & groove reefs and offshore patch reefs. Coral density, size and occurrence were higher inside SPAs. 

What proportion of sites with Threatened Elkhorn corals are present in current zones?

<table>
<thead>
<tr>
<th>Management Zone</th>
<th>Locations (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAs</td>
<td>118</td>
</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>41</td>
</tr>
<tr>
<td>Resource Total</td>
<td>159</td>
</tr>
</tbody>
</table>

Pie chart showing 26% of sites are in SPAs, 74% are in Remaining FKNMS (Marquesas).

Elkhorn Coral Presence

- FKNMS Boundary
- SPAs
- Remaining FKNMS (Marquesas)
What proportion of sites with Threatened Pillar corals are present in current zones?

81 known sites with pillar coral present in the Florida Coral Reef Tract. 4 locations are in the Marquesas region.
What proportion of Threatened Pillar corals are present in current zones?

<table>
<thead>
<tr>
<th>Management Zone</th>
<th>Locations (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAs</td>
<td>2</td>
</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>2</td>
</tr>
<tr>
<td><strong>Resource Total</strong></td>
<td><strong>4</strong></td>
</tr>
</tbody>
</table>

![Map of Pillar Coral Presence](image)
What proportions of sites with Candidate ESA coral species are in current zones?

<table>
<thead>
<tr>
<th>Management Zone</th>
<th>Locations (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAs</td>
<td>88</td>
</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>179</td>
</tr>
<tr>
<td>Resource Total</td>
<td>267</td>
</tr>
</tbody>
</table>
Other ecosystem metrics

- Fish abundance
- Fish species richness
- Stony Coral cover
- Stony Coral species richness
- Soft Coral cover
- Soft Coral species richness
How can we tell what areas are good?

Rank survey site relative other sites in Marquesas.

- **High** Top 25%
- **Medium** Middle
- **Low** Bottom 25%

- **High** 75 – 100%
- **Medium** 25 – 75%
- **Low** >0 – 24%
Data sources
NOAA NMFS and partners including University of Miami, FWC, etc

Study Methods
Diver-based stationary surveys on hardbottom reef

Metrics
• Fish abundance
• Fish species richness
• Grouper-snapper complex abundance
• Nassau-Goliath grouper abundance
• Marine life fishery fish species abundance
• Top 10 marine life fishery fish species abundance
• Parrotfish abundance
• Barracuda abundance
• Permit abundance

Photo courtesy of FKNMS
Fish Metrics

• Fish abundance: How many fish?
• Fish species richness: How many species of fish?
Where are locations of high fish species richness?
Where are locations of high fish species richness?
Where are locations of high fish species richness?

<table>
<thead>
<tr>
<th>Management Zone</th>
<th>Locations (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAs</td>
<td>38</td>
</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>46</td>
</tr>
<tr>
<td>Resource Total</td>
<td>84</td>
</tr>
</tbody>
</table>

**Fish Species Richness**

- High

Legend:
- FKNMS Boundary
- SPAs
- Remaining FKNMS (Marquesas)
Where are locations of high fish abundance?

<table>
<thead>
<tr>
<th>Management Zone</th>
<th>Locations (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAs</td>
<td>32</td>
</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>50</td>
</tr>
<tr>
<td>Resource Total</td>
<td>82</td>
</tr>
</tbody>
</table>
Eastern 1/3 of Marquesas region
Central 1/3 of Marquesas region
Western 1/3 of Marquesas region
Where are locations with high fish species richness and total abundance?
Where are locations with high fish species richness and total abundance?
Coral

Data sources
- Nova Southeastern University (SCREAM)
- Florida Reef Resilience Program (FRRP)
- Coral Reef Ecosystem Monitoring Program (CREMP), FWC

Metrics
- Stony coral
  - Benthic cover (%)
  - Density
  - Species richness
- Soft Coral (Octocoral)
  - Benthic cover (%)
  - Density
  - Species richness

Photo courtesy of TNC
Hard Corals

• Stony Coral cover: How much of the hard bottom is covered in coral?
• Stony Coral species richness: How many species?
Where are locations of high coral cover?

<table>
<thead>
<tr>
<th>Management Zone</th>
<th>Locations (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAs</td>
<td>4</td>
</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>23</td>
</tr>
<tr>
<td>Resource Total</td>
<td>27</td>
</tr>
</tbody>
</table>
Where are locations of high coral species richness?

<table>
<thead>
<tr>
<th>Management Zone</th>
<th>Locations (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAs</td>
<td>31</td>
</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>30</td>
</tr>
<tr>
<td>Resource Total</td>
<td>61</td>
</tr>
</tbody>
</table>

Stony Coral Species Richness

- High

Legend:
- FKNMS Boundary
- SPAs
- Remaining FKNMS (Marquesas)
entire Marquesas region
Eastern 1/3 of Marquesas region
Western 1/3 of Marquesas region

No data
Where are locations with high coral species richness and cover?
Where are locations with high coral species richness and cover?
Soft Coral

• Soft Coral cover: How much of the hard bottom is covered in soft coral?
• Soft Coral species richness: How many species?
Where are locations of high soft coral cover?

<table>
<thead>
<tr>
<th>Management Zone</th>
<th>Locations (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAs</td>
<td>5</td>
</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>9</td>
</tr>
<tr>
<td>Resource Total</td>
<td>14</td>
</tr>
</tbody>
</table>
Where are locations of high soft coral species richness?

<table>
<thead>
<tr>
<th>Management Zone</th>
<th>Locations (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAs</td>
<td>2</td>
</tr>
<tr>
<td>Remaining FKNMS (Marquesas)</td>
<td>11</td>
</tr>
<tr>
<td>Resource Total</td>
<td>13</td>
</tr>
</tbody>
</table>
entire Marquesas region
Eastern 1/3 of Marquesas region
Central 1/3 of Marquesas region
Western 1/3 of Marquesas region

No data
Where are locations with high fish species richness and total abundance?
Where are locations with high coral species richness and cover?