NOAA UAS Program

National Marine Sanctuaries UAS Applications

NOAA's Office of National Marine Sanctuaries serves as the trustee for a network of underwater parks encompassing more than 600,000 square miles of marine and Great Lakes waters.

Brendan Bray & Todd Jacobs
NOAA – Office on National Marine Sanctuaries
Operational Goals & Science Objectives

Implement ONMS UAS Strategy & Support NOAA’s Missions with Inter-Agency Partners

Science – Habitat & Living Marine Resources
Marine Monitoring
Emergency Response
Enforcement
Multi-Agency Arctic/Antarctic Operations
Multi-Platform Assessment

- Silver Fox and Manta (2005 – 2012)
- ScanEagle (2007, 2009 and 2016)
- Multi-copters (2010 - present)
- Puma (2008 - present)
**Approach: Operational Testing & Assessments**

*Implement ONMS UAS Strategy & Support NOAA’s Missions with Inter-Agency Partners*

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Definition</th>
<th>Puma</th>
<th>Ship</th>
<th>i45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Targeting Data</td>
<td>Streaming video</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science Data</td>
<td>Geo referenced HD (25 MP) still, Lidar and hyperspectral images</td>
<td>i45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Launch and Recovery</td>
<td>Launch/recovery from both a ship and shore</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Altitude</td>
<td>30m to 150m as required for sensor resolution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geographic Locations</td>
<td>Pearl and Hermes atoll, French Frigate Shoals, Laysan, and Lisianski in NWHI; windward shores of main HI islands plus southern tip of the Island of Hawaii. Kayak Island, outer shore in Kenai Fjords area and Priblof Islands in Alaska and the Olympic (outer) Coast of Washington State. Arctic.</td>
<td>Ship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geographic Locations for at-sea</td>
<td>Subtropical Convergence Zone (STCZ) 30-35N, 150-180W, Arctic</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Coverage</td>
<td>Near-shore area of 1165 km² (340 nm²); At-sea area of 10,000 km² (2915 nm²).</td>
<td>Ship</td>
<td>i45</td>
<td>Ship</td>
</tr>
<tr>
<td>Resolution</td>
<td>1 meter or better (1.4 - 5 cm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporal Sampling</td>
<td>Near-shore and at-sea once or twice (10) per year plus as needed during cleanups.</td>
<td>Ship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seasonal Window</td>
<td>Late winter and early spring in subtropical convergence zone; early spring through summer in Arctic, Alaska and Washington State.</td>
<td></td>
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</tr>
<tr>
<td>Data Access Time</td>
<td>Streaming video in realtime; still and IR images for post flight analysis.</td>
<td></td>
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</tbody>
</table>

*Requirements Study and Analysis of Alternatives informed Platform, Sensor and Application Decisions*
Accomplishments: Operational Assessments & Transition

*Implement ONMS UAS Strategy & Support NOAA’s Missions with Inter-Agency Partners*

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Assessment Location</th>
<th>PUMA</th>
<th>VTOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marine Monitoring</td>
<td>Several Assessments including Atlantic, Pacific, Gulf, Arctic</td>
<td>2011-17</td>
<td></td>
</tr>
<tr>
<td>Coastal Monitoring</td>
<td>Several Assessments including Atlantic, Pacific, Gulf, Arctic</td>
<td>2011-17</td>
<td></td>
</tr>
<tr>
<td>OLE</td>
<td>Several Assessments including Atlantic, Pacific, Gulf, Arctic</td>
<td></td>
<td>Policy</td>
</tr>
<tr>
<td>Oil at Sea</td>
<td>Several Assessments including California, Arctic (Real Oil)</td>
<td>2011-16</td>
<td></td>
</tr>
<tr>
<td>Oil on Shore (SCAT)</td>
<td>Several Assessments including California, Arctic (Real Oil)</td>
<td>2011-16</td>
<td></td>
</tr>
<tr>
<td>Marine Debris Sea</td>
<td>Several Assessments including Hawaii, Olympic Coast, Arctic</td>
<td>2011-16</td>
<td></td>
</tr>
<tr>
<td>Marine Debris Shore</td>
<td>Several Assessments including Hawaii, Olympic Coast, Arctic</td>
<td>2011-16</td>
<td></td>
</tr>
<tr>
<td>HI Monk Seals</td>
<td>NWHI</td>
<td></td>
<td>2014-15</td>
</tr>
<tr>
<td>Turtles</td>
<td>NWHI GRNMS</td>
<td></td>
<td>2014-15</td>
</tr>
<tr>
<td>Cetaceans</td>
<td>CINMS/NWHI</td>
<td></td>
<td>2012/14-15</td>
</tr>
<tr>
<td>Menhaden</td>
<td>GRNMS</td>
<td></td>
<td>2013-16</td>
</tr>
<tr>
<td>Sea Birds</td>
<td>Acceptable for cueing</td>
<td></td>
<td>2011-15</td>
</tr>
<tr>
<td>MIZOPEX</td>
<td>Marginal Ice Zone</td>
<td></td>
<td>2013-16</td>
</tr>
<tr>
<td>MDA/AIS</td>
<td>Sat data is available (Tested on other platforms)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERMA</td>
<td>Real Oil Spill / End-to-End test in Arctic &amp; Antarctic</td>
<td></td>
<td>2013-15</td>
</tr>
<tr>
<td>ACE</td>
<td>Coordinated through ERMA</td>
<td></td>
<td>2013-15</td>
</tr>
</tbody>
</table>

*Observation Strategy Advancements were made with Inter-Agency & Industry Partners*
Puma-AE Milestones
Maritime & Polar Strategy

Mission Concept Review (Super Gimbal test in NWHI)
USGC, NOAA, NAVAIR Coordination

AeroVironment Briefing & Shearwater Testing (Net Capture & Antenna)
Puma System Upgrade & Testing

Polar Star Fit-Check and FAM

Rapid Proto-Typing & Deployment
Maritime, Arctic & Antarctic
Readiness Levels 5>8

R&D, T&E, Spiral Development, Operational Assessments

- Due Regard Operations
- Beyond Line-of-Sight (5 NM)
- Puma Envelope Expansion
- Weather Criteria Expansion
- Ship Recovery System
  - Net Capture Recoveries tested by NOAA (3/15)
  - Net Capture System (Final Clearance 7/15)
- 24MP Nadir Camera (Tested 1/15)
- 14MP Camera/Lidar (Tested 1/15)
- Super HD Gimbal AE (Q3CY15)

- Transition Planning
- Training & Operating Manuals
- Maintenance Plan & Manuals
- Sparing and Support
- Data Management Plan
- Net-Capture & Antenna Upgrades/Testing
- Polar Star Cruise
  - Net-Capture
  - Extended Range
  - Advanced Payload (Ground, Land & Shipboard)

Deep Freeze Deployment (NSF Coordination)

12/30/15-02/24/16
Transition: Research > Development > Transition (RL Movement)
Implement ONMS UAS Strategy & Support NOAA’s Missions with Inter-Agency Partners

Requirements Capture moves the readiness levels towards an operational capability Enforcement, Marine & Shore Monitoring (Including Arctic), Advanced Payloads – RL 8
Additional Partnerships (who have shared in our successes)

In close cooperation with the NOAA Line Offices, Government, Industry & Academia

Joint Operations have increased Maritime Services Interoperability
Puma-AE owned and operated by every maritime service – Readiness Level 9
Science & Technical Challenges and Solutions
Implement ONMS UAS Strategy & Support NOAA’s Missions with Inter-Agency Partners

- Operating sUAS BVLOS – due regard operations.
- Spontaneity of UxS Operations - platforms / operators need to be at operational sights used to respond to emergencies and events in real time.
- Remote and/or hazardous operations ideal for UxS data gathering
- More equipment is coming to market. Batteries and payloads are getting better (longer range/duration flights) and higher resolution imagery.
- Manned – Unmanned Systems Teaming (MUM-T)
- VTOL that is designed to operate from boats and water landings.

Requirements Capture moves the readiness levels towards an operational capability
Enforcement, Marine & Shore Monitoring (Including Arctic), Advanced Payloads – RL 8
Future Direction & Operations

Implement ONMS UAS Strategy & Support NOAA’s Missions with Inter-Agency Partners

- Regular Sanctuary Operations for Marine Monitoring & Emergency Response
- Inter-Agency Support for Marine Domain Awareness
- Arctic Shield 2017 & 18
- Test Bed - Continued unmanned systems advancements for Research, Development & Transition