



UAS Utilization in Conservation Resource Management

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Course Overview

This short course is designed to provide insight into the use of unmanned aerial systems (UASs) for natural resource management on DoD lands.

Working on military lands can prove challenging under the simplest of circumstances. The use of UASs can present new challenges, but (for the most part) they are solvable.

Topics include a review of current DoD use policies, approval processes, and example resource management applications. The course will provide an understanding of both the challenges and potential benefits of UASs for natural resource management on DoD lands.

Course Instructors

- Susan Cohen is a research biologist and the Associate Director of UNC Chapel Hill's Institute for the Environment. Susan has worked on natural resource projects on DoD lands for over 20 years including several natural resource projects that utilize drone technology. She has been integrating unmanned aerial systems on USMC installations for the last five years.
- Robert Knight is a wildlife biologist and the Program Manager for the Natural Resource Office at US Army, Dugway Proving Ground. Robert is a US representative on an international test and evaluation team supporting S&T acquisition and environmental permitting in host nations. He has extensive experience directing research programs on CONUS DoD Installations and utilizing UAS technology.
- David Delaney is a research wildlife biologist and bioacoustician working for the U.S. Army ERDC/CERL since 2001. David studies the potential impacts of military training on TES/Species of Concern, develops tools and techniques to assist natural resource managers on DoD lands, and is currently using UAS technology on DoD projects.

Course Objectives

1. Provide insight and “how to” guidance on the use of UASs for natural resource management on DoD lands.
2. Review current DoD use policies and approval processes
3. Provide examples of relevant applications through current SERDP/ESTCP projects
4. Provide an understanding of both the challenges and potential benefits of UAVs for natural resource management on DoD lands.

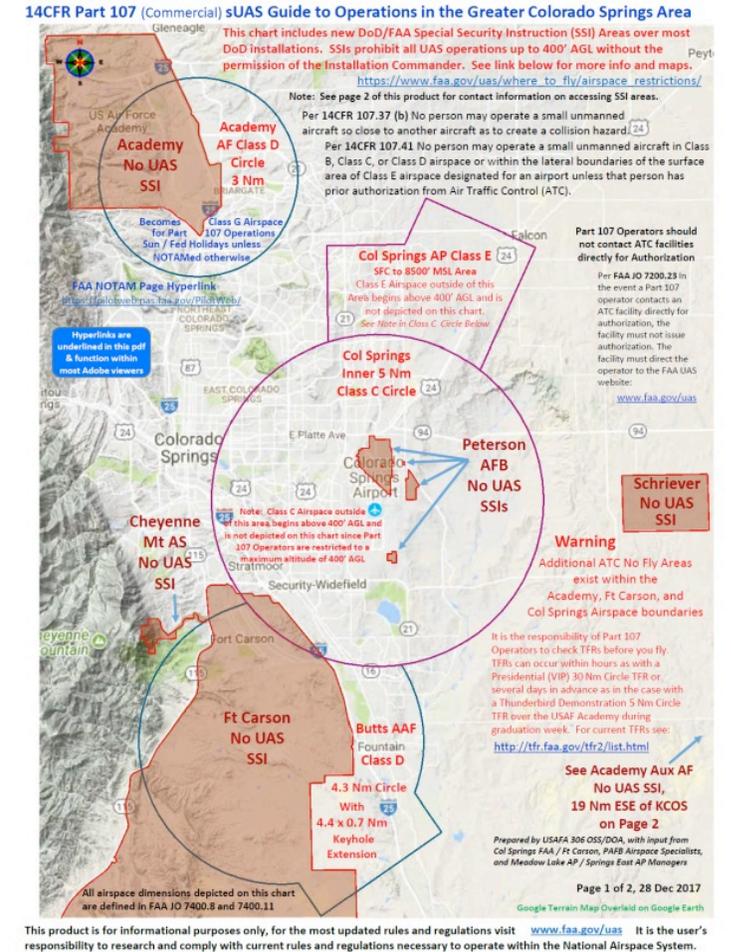
The Basic Rules



- Find an Advocate!
- Everyone needs a cyber waiver (with flag officer/SES endorsement).
- A cyber waiver does not give you permission to fly on an installation, it simply starts the process.
- The process to fly varies by Service, Installation, and your employer. The process is discoverable!
- Leave plenty of time to work through the system.

The Basic Requirements

- Cyber waiver
- Air space/FAA/Special Security Interest (SSI) areas
- Certificate of Air Worthiness, you may need it, or not....
 - UAS flown by contractor, do not need an IFC to fly
 - UAS flown by DoD employees, do need an IFC (NAVAIR AIRworks/ARC)
- Installations/Services largely set their own requirements for flying
Expect to regularly interact with and develop a special range request for:
 - range control/airspace manager
 - spectrum managers (around 2.4 GHz frequencies, FCC ID number for system)
 - mission assurance (data management, permissions to use data outside of DoD, etc..)
 - FAA Part 107



Who Approves Cyber Waivers?

Commercial-Off-The-Shelf Unmanned Aircraft System Security Assessment Delegation Minimum Requirements, 30 October 2018

- (U//FOUO) The designated Authorizing Officials are limited in authority to only approve Commercial-Off-The-Shelf (COTS) Unmanned Aircraft System (UAS) requests for procurement and use that will be operated in a benign and controlled environment as defined below and only for research and development training, or demonstration events. *Authority is with the Services.*
 - Parts: 1. COTS UAS Exemption Questionnaire
 2. Cyber Security Mitigation Plan
 3. pre- and post-Mission Tactics, Techniques, and Procedures
- (U//FOUO) Approval authority for all operational uses and for any uses in uncontrolled environments remain with Under Secretary of Defense for Acquisition and Sustainment (USD(A&S)) and DoD Chief Information Officer (DoD CIO) and are not delegated in this memorandum.

UAS Cyber Waiver, Non-Program of Record Exemption Request Information

➤ **OSD UAS Waiver Board** **Current & Ongoing**

- UAS purchase and usage in “Uncontrolled/Combat” environments, Undersecretary of Defense

➤ **Benign/Controlled Environments** – OSD has delegated authority **to the Services**

- Approves sUAS purchase and usage in “benign” or “controlled” environments

Naval (Navy and USMC) Waiver Board, Effective Feb 21, 2019

Guidance for the Operation of DON Group 1 And 2 UAS, COMNAVAIRFORINST 3710.9, 20 Nov 17 (Ref: ALNAV074/18, October 2018) <https://intelshare.intelink.gov/sites/DONcotsuas>

Army Board, April 2019

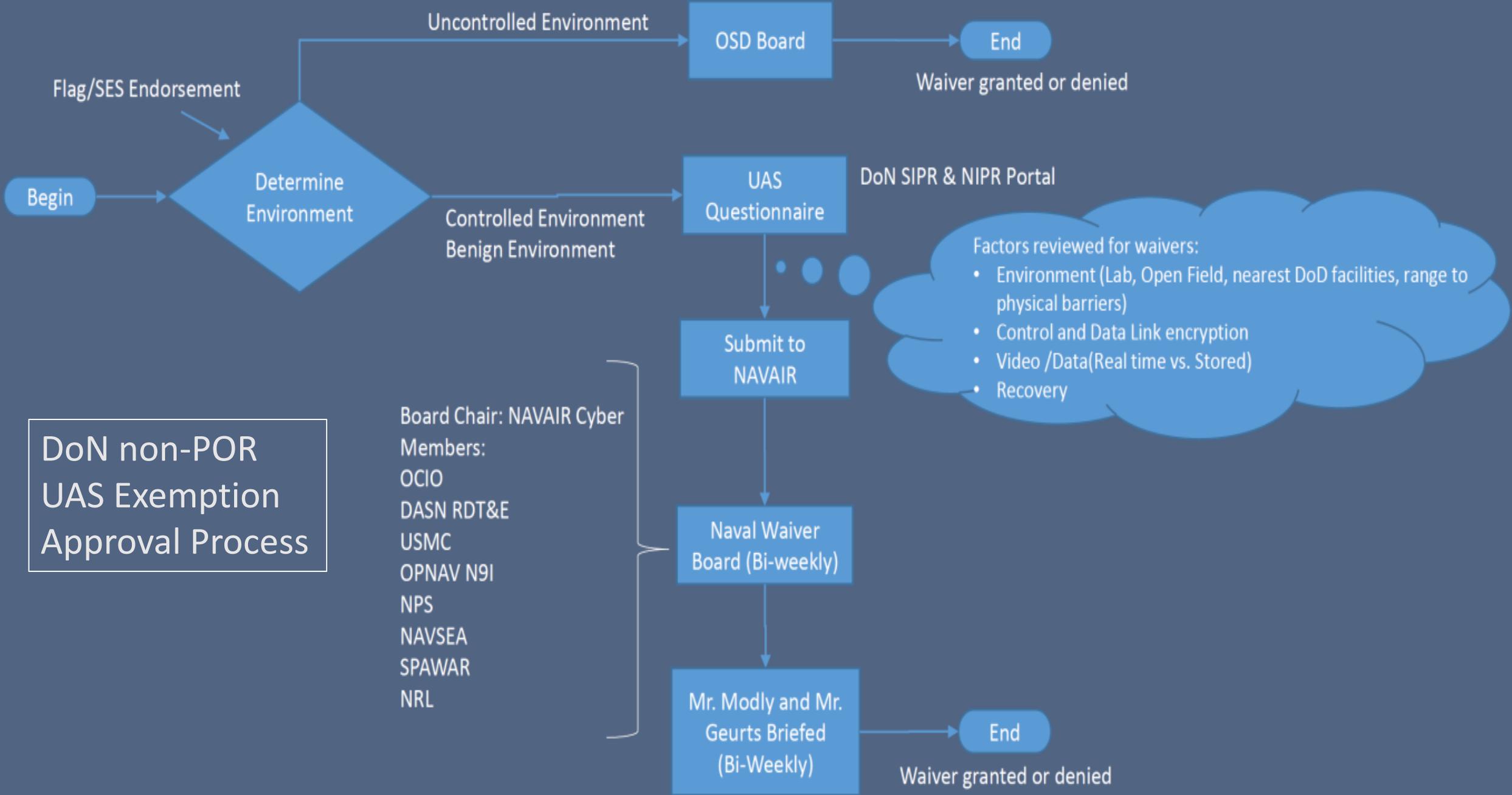
- Consolidated DoD - Army Cots UAS Cyber Security Waiver Business Rules

ALARACT 029/2019, April 17, 2019 <https://intelshare.intelink.sgov.gov/sites/cotsuasetsp>

Air Force Board, July 2019

MANUAL 11-50229 JULY 2019. Flying Operations sUAS Air Force Acquisition, Technology and Logistics (SAF/AQ) and AF Deputy, Chief Information Officer (SAF/CN) approval is required. Submittal by email.

**CAC cards required to
submit a waiver (flag
officer/SES signature)**



**DoN non-POR
UAS Exemption
Approval Process**

Board Chair: NAVAIR Cyber
 Members:
 OCIO
 DASN RDT&E
 USMC
 OPNAV N9I
 NPS
 NAVSEA
 SPAWAR
 NRL

- Factors reviewed for waivers:
- Environment (Lab, Open Field, nearest DoD facilities, range to physical barriers)
 - Control and Data Link encryption
 - Video /Data (Real time vs. Stored)
 - Recovery

After the cyber waiver, or before... airspace

➤ **UAS in DoD Restricted airspace – controlled by the installation (after the cyber waiver)**

➤ **UAS in National Airspace System (NAS) (after or before the cyber waiver), approval by FAA**

DoD UAS currently do not have direct access to the NAS. For DoD UAS to operate in the NAS, the DoD is required to obtain a Certificate of Waiver or Authorization (COA) from the FAA. Upon DoD request, the FAA may issue a Class G COA in uncontrolled airspace. Class D requires an additional waiver.

(Guidance for the Domestic Use of Unmanned Aircraft Systems in U.S. National Airspace, 18 August 2018 (Delegating authority to approve domestic sUAS to the Services. Includes R&D, contractors, DoD)

DoD pilots - DoD/FAA COA

Contractors – letter from Installation, FAA approval

- New designation of Special Security Interest (SSI) areas
- SSI: FAA UAS NOTAM FDC 7/7282, all sUAS flight operations prohibited within airspace over select national security sensitive facilities, surface to 400'
 - Since the new SSI regulations released, there is no framework for approval (used to be an email)
 - Submit request via DroneZone (<https://faadronezone.faa.gov/#/>) with an approval letter from a DoD

OSD COTS UAS Cyber Policy Docs

- **Deputy Secretary of Defense Memorandum “Unmanned Aerial Vehicle Systems Cybersecurity Vulnerabilities,” May 23, 2018.** DoD Inspector General found the DoD had not implemented an adequate process to assess cybersecurity risks associated with COTS UAS. This memo suspended the purchasing and operations of COTS UAS. Directed Defense Agencies to account for all COTS UAS in 30 days.
- **Deputy Secretary of Defense Memorandum “Delegation of Authority to Approve Exemptions for Using Commercial-Off-The-Shelf Unmanned Aerial Systems in Support of Urgent Needs,” June 1, 2018.** Deputy Secretary of Defense designated the Under Secretary of Defense for Acquisition and Sustainment (USD A&S) and the DoD Chief Information Officer (DoD CIO) as the Joint approval authority for exemptions.
- **Deputy Secretary of Defense Memorandum “Commercial-Off-The-Shelf Unmanned Aerial Systems Implementation Guidance,” June 1, 2018.** Provides guidance on Exceptions and Exemptions and the process to obtain an Exemption.
- **Under Secretary of Defense A&S Memorandum “Commercial-Off-The-Shelf Unmanned Aerial Systems Implementation Guidance,” June 19, 2018.** Provides guidance on accounting requirements for COTS UAS.
- **Under Secretary of Defense A&S Memorandum “Commercial-Off-The-Shelf Unmanned Aerial Systems” July 24, 2018.** Provides guidance on Educational Institutions and Laboratories conducting research with COTS UAS to support DOD needs.
- **Deputy Secretary of Defense Memorandum “Delegation of Authority to Approve Exemptions for Using Commercial-Off-The-Shelf Unmanned Aerial Systems in support of Urgent Needs”, Nov 16, 2018.** Delegates the authority for “Benign” or “Controlled” environments to the Military Services and DoD Components. “Uncontrolled/Combat” environment authority retained at OSD level.
- **Secretary of Defense Memorandum “Guidance for the Domestic Use of Unmanned Aircraft Systems in U.S. National Airspace,” August 18, 2018.** Guidance for the domestic use of DoD unmanned aircraft systems (UAS) in U.S. National Airspace to ensure that such use is in accordance with U.S. law and DoD policy.

UASs and USMC – standing up a UAS program for DoD civilians.

- Region-wide integration of UAS technology into DOD natural resource management through demonstration, coordination, training, and outfitting. CONFIRM RC19-D3-5218
- Enhancing the capability and efficiency of DoD land management by using commercial unmanned aerial vehicles to assess the impacts of fires and coastal storms. REDDIE RC-18-5187



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the ENVIRONMENT
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Project Objectives



- USMC Installation East (MCIEAST) lacks the expertise and capacity needed to develop comprehensive UAS protocols for its civilian workforce, specifically with regards to natural resources.
- Lack of a strategic UAS protocol results in one-off approval processes, no real time capabilities, and no process for incorporating the capabilities, efficiency, and safety of UASs into DoD natural resources management.
- This project demonstrates a strategic, operational framework for training, coordination, and application, on a regional level, that address these deficiencies.

Technology/Methodology Description

- Development of a mobile training platform to facilitate adoption of this technology across MCIEAST installations.
- Integration with MCIEAST leadership, installation staff, GIS, airspace managers, to develop, refine, and codify protocols.
- Creation of a suite of small UASs for regional dissemination to installations.
- Demonstrations with broad applications and establishment of paths for integrating UAS data into installation GIS workflows.



Training - Finalize and validate regional installation UAS protocols, including a pathway to professional remote pilot certification



CONFIRM
Training
protocols

Finalize and validate for
regional deployment

Mobile Training Teams deployed for on-site training for
MCIEAST (REDDIE)

Week 1

- aviation fundamentals for basic & advanced flight ops
- pre-flight, mission and contingency planning
- launch operations, flight maneuvers
- mapping, dynamic sensing, situational awareness
- recovery operations and inspections
- data transfer

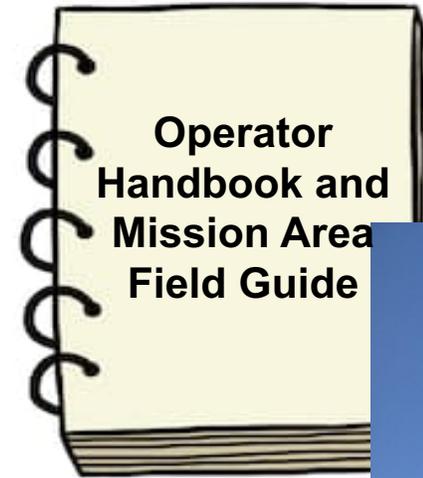
Week 2

- application of ground course material
- mission kit equipment
- conduct mission rehearsals, brief, execute and debrief training & mission flight profiles
- training on software/ GIS workflows for processing and analyzing data

MCIEAST approval and adoption to fulfill USMC training requirements (based on CJCSI BUQ II standards).

Protocols - Finalize and validate regional installation UAS protocols, including a pathway to professional remote pilot certification

- Standard operating procedures with guidance for government agency operations
- UAV remote sensing methods, techniques, and procedures.
- Sample air traffic control letter of agreement
- Certs of Airworthiness
- FAA Certificate of Authorization, writing guidance for DoD facilities
- Cyber-security waivers, issue awareness, and resolution



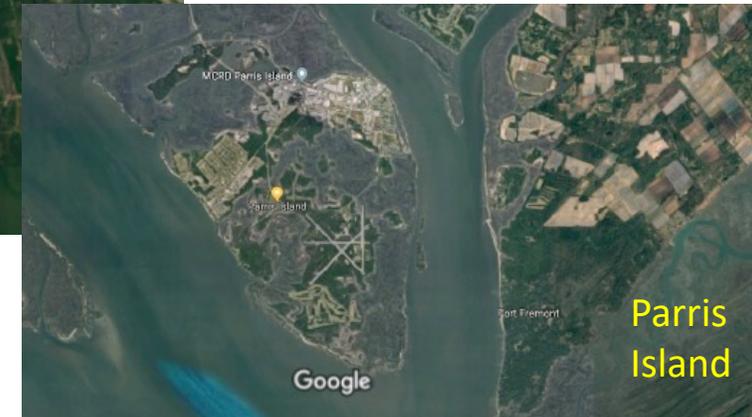
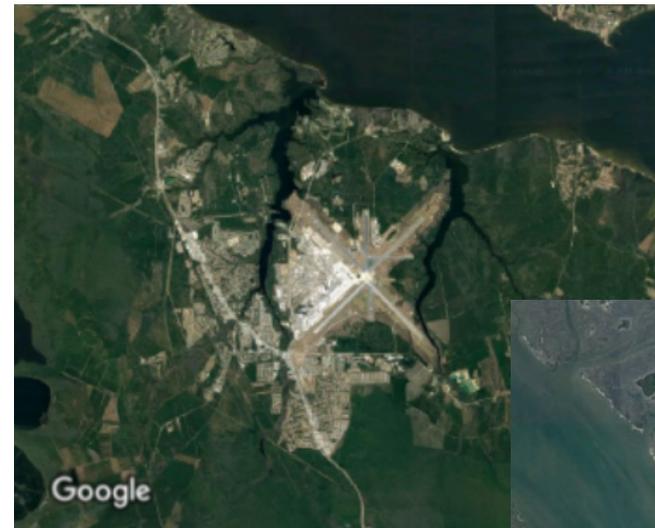
Mission Kits - Creation and dissemination of standardized UAS mission kits and training materials, established on objective-based requirements.



Demonstrations - Integrate UAS technology through demonstrations that represent a range of UAS applications for DoD management.



A comprehensive suite of multi-platform/multi-sensor missions to answer a wide array of environmental management questions.



Fire Management

Burn Mapping with TNC

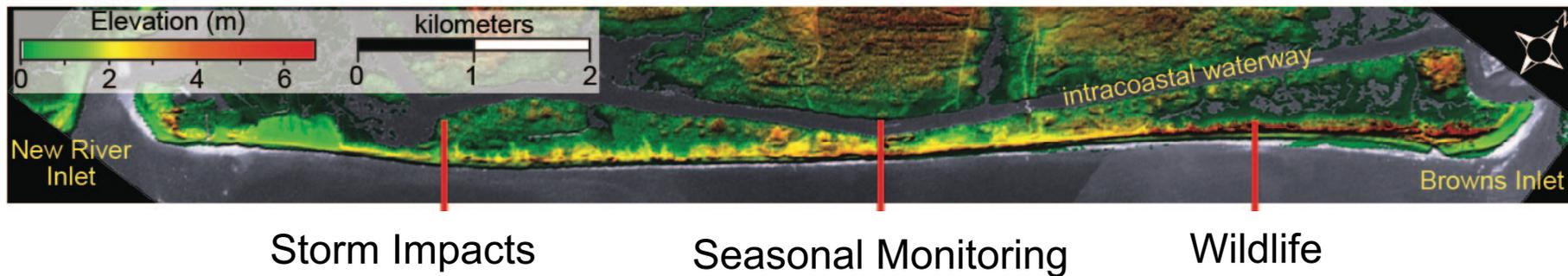


Burn Brief and Test Flights



Coastal Monitoring and Storm Impacts

Onslow Beach Study Area, 3100 acres Mapped with eBee



Accuracy
Assessment

Use of the “Data MULE” Unmanned Aircraft System to Remotely Download Ground Based Sensor Data on Military Lands



RC-18-D3-5101

**David Delaney
U.S. Army ERDC/CERL**

**Dr. Jean Pan
NAVFAC EXWC**

**Zane Mountcastle
Mission Mule**



Technical Objectives

- Demonstrate that the Data MULE UAS can be successfully deployed to download data from remote ground-based camera traps
- Validate the effectiveness of the Data MULE UAS compared with standard ground-based method



Data Mule Payload

Airframe

- Wingspan 60"
- Length: 32.6"
- Weight: 8.4-9.9 lbs
- Range: 53 km (33 mi)
- Payload capacity: 1.5 lbs
- Cruise speed: 33-40 mph
- Flight time: 50-59 min with payload



BirdsEye View FireFly6 Pro

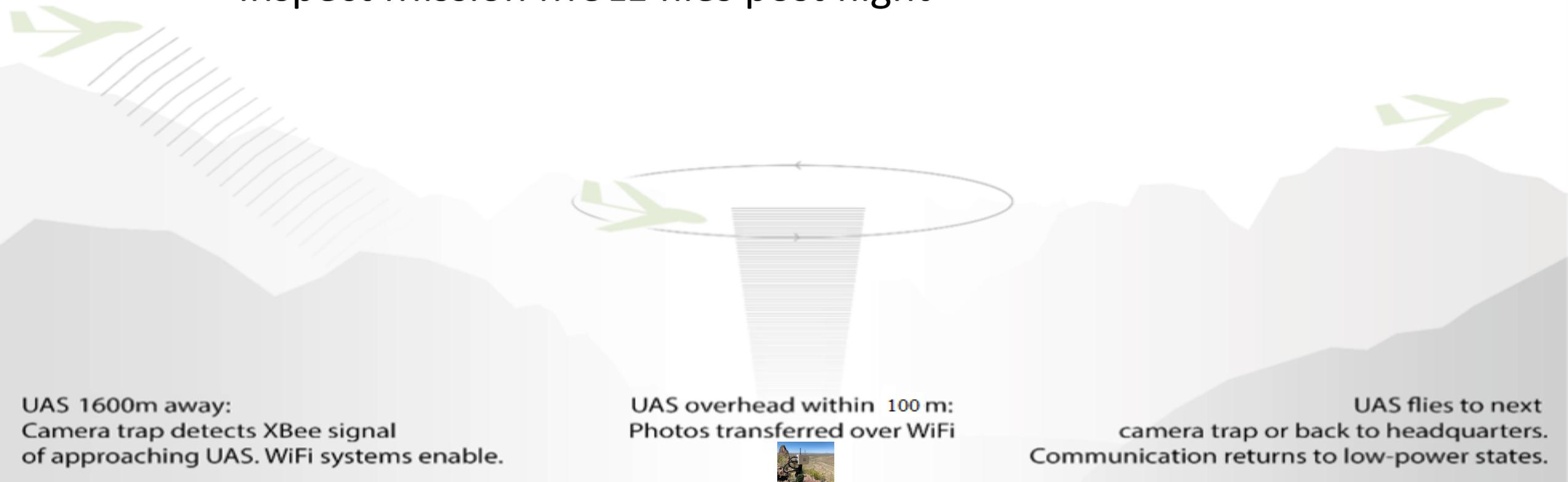
Technical Approach

- Demonstrate effectiveness of Data MULE UAS at downloading remote camera trap data compared with ground based method
- Field test FireFly6 Pro UAS as a Data MULE on Barry M. Goldwater Range East (2019), Point Mugu, and San Nicolas Island (2020)
- FireFly6 Pro UAS provides long range flight (~ 1 hour), portability, vertical take/off landing (VTOL), automated mission execution



Mission Planning/Execution

- Develop mission plans using BirdsEye View planner software
- Establish take off/landing zones
- Conduct automated missions using VTOL capability
- Inspect Mission MULE files post flight





BirdsEye View Planner Software



Joystick: Not Detected

COM3

CONNECT

Joystick Control

57600



AltHold

0 (Home)

100

Quick Telemetry Logs DataFlash Logs

Altitude (m) Distance to Home (m)

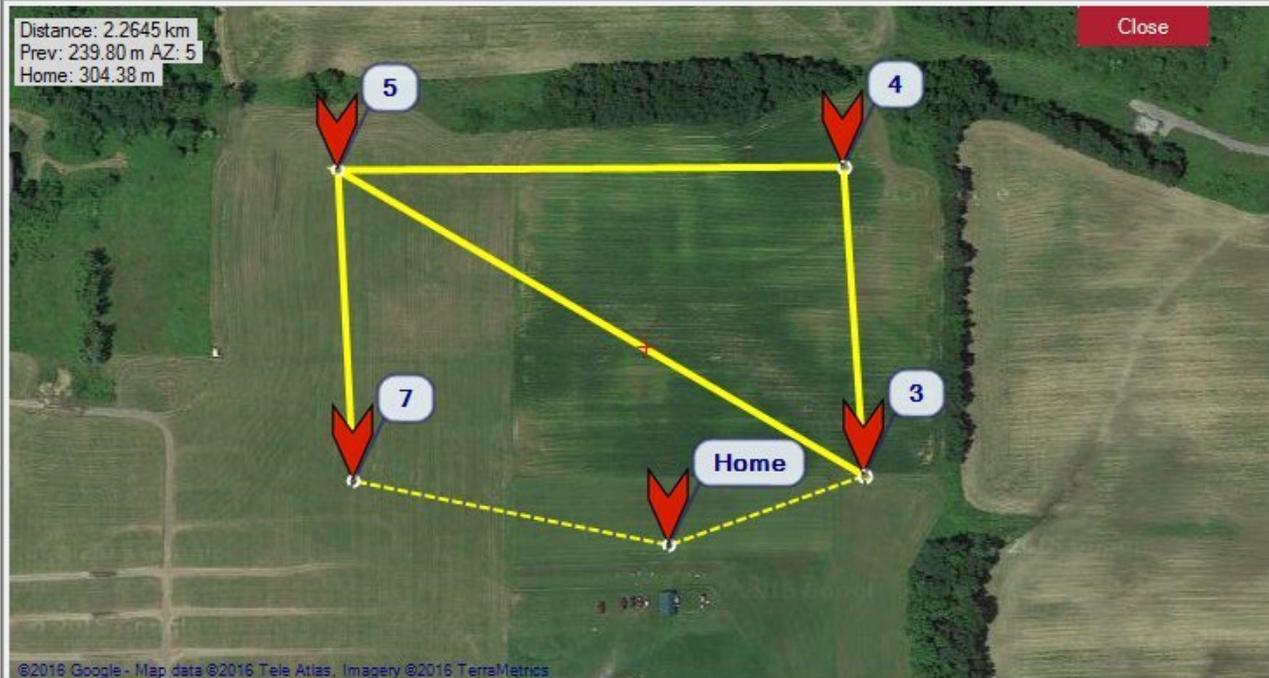
0.00 0.00

Sat Count Gps HDOP

0.00 0.00

Bat used EST (mah) Bat Voltage (V)

0.00 0.00



ACTION >>

GEO 42.874549
-77.192892
265.28m

Grid [View KML](#)

GoogleHybridMap

Status: loaded tiles

Saved FireFLY6atChiefsf

[Home Location](#)

Lat 42.872113

Long -77.191197

Alt (abs) 188

WAYPOINTS

Default Alt 100

	Command	Dela				Lat	Long	Alt	Delete	Up	Down	Grad %	Dist	AZ
1	TAKEOFF	2	0	0	0	0	0	40	X	⬆️	⬆️	0	0	0
2	DO_TRANSITION_TOGGLE	0	0	0	0	0	0	0	X	⬆️	⬆️	0	0	0
3	WAYPOINT	0	0	0	0	42.8724259	-77.1899951	100	X	⬆️	⬆️	96.2	103.9	70
▶ 4	WAYPOINT	0	0	0	0	42.8738255	-77.1901238	100	X	⬆️	⬆️	0.0	156.0	356
5	WAYPOINT	0	0	0	0	42.8738098	-77.1932352	100	X	⬆️	⬆️	0.0	253.6	270
6	DO_JUMP	3	2	0	0	0	0	0	X	⬆️	⬆️	0.0	157.4	180
7	WAYPOINT	0	0	0	0	42.8724023	-77.1931386	40	X	⬆️	⬆️	-38.3	156.7	177
8	RETURN_TO_LAUNCH	0	0	0	0	0	0	0	X	⬆️	⬆️	0	0	0

Example of Multiple Mission Flight



- Autonomous take off/landing
- Multiple missions from single area
- Multiple missions per flight
- Beyond VLOS
- Beyond Telemetry range

UAS Loiter/Data Download

Loiter Area

Ground Control Station



● Autonomous data collection

Flights

	Date	Action			
+	2019-03-17 23:02:50	Download			
+	2019-03-17 23:02:49	Download			
-	2019-03-17 23:02:49	Download			
	Data Station ID	Percent Downloaded	Downloaded Files	Total File	
	105	<div style="width: 40%;"><div style="width: 40%;"></div></div>	400	900	● Incomplete
+	2019-03-17 23:02:48	Download			
+	2019-03-17 23:02:45	Download			
+	2019-03-17 23:00:56	Download			

Download History

- Wake up data station
- Connect to data station
- Connect to data station sensor
- Download all available data
- Shut down data station

Data Output

Date		Data Output					Action
2019-08-14 01:33:03							Download 
Data Station ID	Percent Downloaded	Downloaded Files	Total Files	Total Data Downloaded (MB)	Average Download Speed (Mbps)	Status	
116	<div style="width: 100%;"><div style="width: 100%;"></div></div> ✓	57	57	35.42	1.79	● Complete	
120	<div style="width: 100%;"><div style="width: 100%;"></div></div> ✓	0	0	0.00	0.00	● Complete	
2019-08-14 01:32:08							Download 
Data Station ID	Percent Downloaded	Downloaded Files	Total Files	Total Data Downloaded (MB)	Average Download Speed (Mbps)	Status	
113	<div style="width: 100%;"><div style="width: 100%;"></div></div> ✓	154	154	94.78	1.36	● Complete	
2019-08-14 01:27:22							Download 
Data Station ID	Percent Downloaded	Downloaded Files	Total Files	Total Data Downloaded (MB)	Average Download Speed (Mbps)	Status	
128	<div style="width: 0%;"><div style="width: 0%;"></div></div> ✗	0	0	0.00	0.00	● Incomplete	

U.S. Army Corps UAS Program

- Formation of U.S. Army Corps Headquarters Aviation
- HQ Aviation and team approve all UAS mission plans and related documents and procedures
- Obtain waivers to fly UAS on DoD lands
- Director of HQ Aviation submits requests for waiver approval for UAS operations
- Acquire an Air Worthiness Release for operation of UAS
- Development of an online process for submitting and having UAS mission plans approved
- Establishment of Aircrew Training Program Manager positions to manage UAS project activities at each Corps organization
- Submission of Daily Fitness for Operations and Risk Assessment Worksheets when flying missions
- Requirement to pass the FAA Remote Pilot Part 107 test
- Staying current through USACE Policy

Installation Collaboration

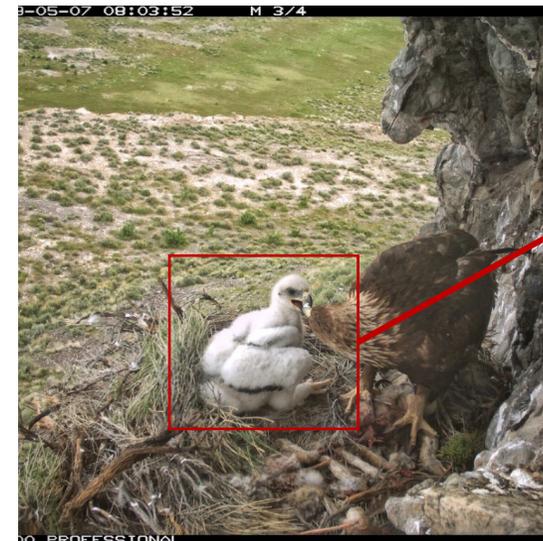
- Establish a point of contact and secure installation support
- Installation approval of project related procedures/documents:
 - a) Standard Operating Procedure
 - c) Health and Safety Plan
- Approval and coordination with Airspace/Range Management Offices on airspace use and ground access during non-military training periods
- Identification of any potential issues with conducting aerial and/or ground-based field work (e.g., sensitive cultural and natural resource sites and activities)
- Approval of Trip Safety Plans for all UAS missions: Details who, what, where, and when for field operations for installation review and approval

DPG Problem Statement

- Dugway Proving Ground (DPG) is a Major Range Test Facility Base (MRTFB) for chemical and biological weapons defense
- DPG is also home to multiple breeding pairs of Golden Eagles
 - Protected under the Bald and Golden Eagle Protection Act (BGEPA)
- **Presence of Eagles can impact mission timelines and available testing grid and training range**
 - Current monitoring efforts are designed to maximize total training days and available locations
 - Current on-foot monitoring methods are time-consuming and lack efficiency in determining changes in nesting status



1 day old

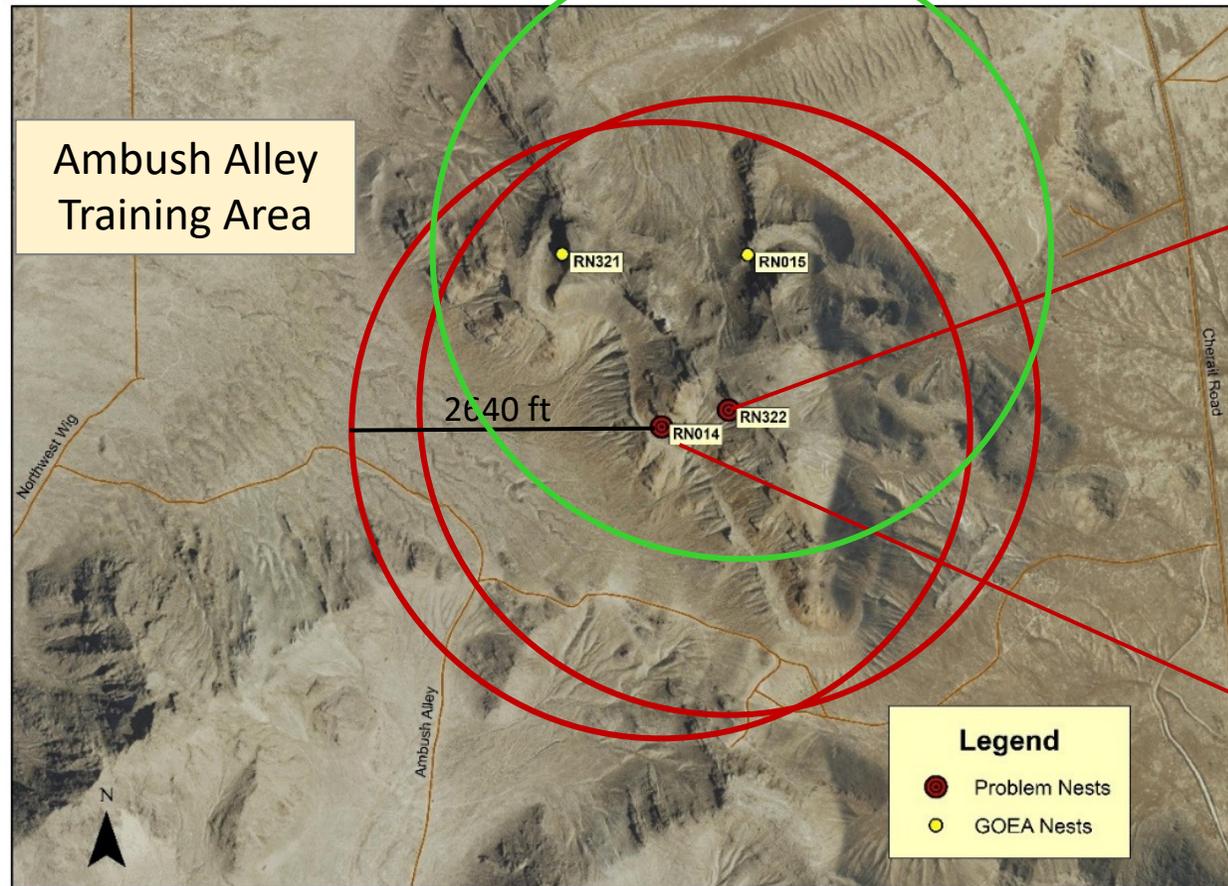


4 weeks old



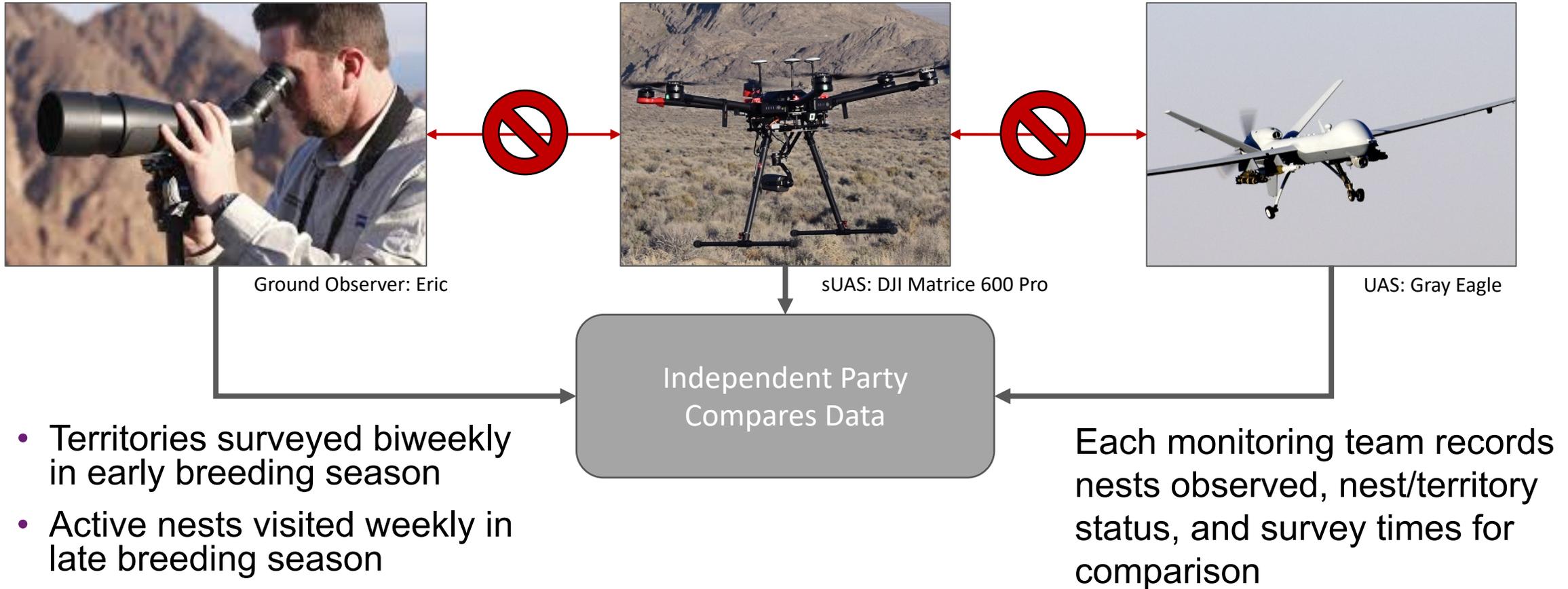
DPG Example Scenario – Ambush Alley

Known Golden Eagle Nests in the Wig Mountain Territory



Methods

-- A blind study between monitoring platforms --



Year 1: sUAS Summary

Strengths

- Quick and efficient if nest location is known
- Able to monitor multiple nests in one 10min flight
- Grid photos of cliffs useful for locating new nests in complex terrain
- Very easy to determine activity of a nest from above
- Could visit every known nest during every survey



Weaknesses

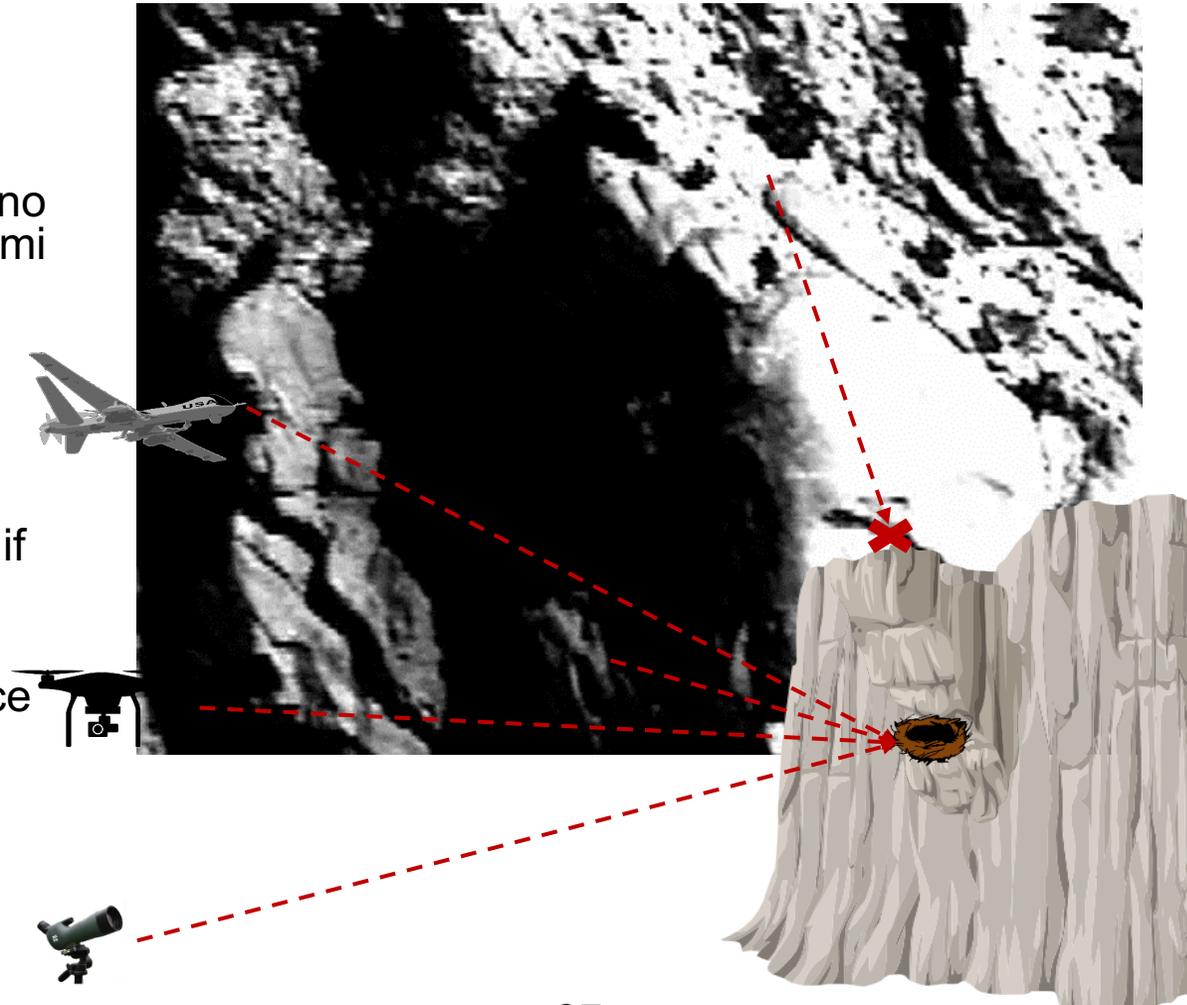
- **Significant bureaucratic challenges led to 3wk break in monitoring**
- Extreme weather (esp. cold temps) limit battery and flight time
- High winds significantly impact image quality
- Some nests beyond reach if no road access within 1.5 mi
- Issues with terrain interfering with control signals



Year 1: UAS Summary

Strengths

- Able to view nests with no ground access within 2 mi
- Thermal camera very useful in cool temperatures
- Very quick and efficient if nest location is known
- Good training experience for student pilots with RIAC



Weaknesses

- Realities of flight scheduling led to very few flight days approved
- Limitations of platform payloads in finding unoccupied nests
- Angle of approach too steep to see nests obstructed by terrain
- Need very detailed nest metadata to succeed



sUAS Waiver Process

- Exemption to Policy (waivers) to operate Commercial Off the Shelf sUAS was delegated to the services in early 2019 from OSD.
 - Reference: ALARACT 029/2019- Consolidated DOD-Army COTS UAS Cyber Security Waiver Business Rules
- Submittal is made through SPIRNET

The sUAS platform must be modified with hardware/software that mitigates potential cyber security risks

- Need to determine location of use, time of use, airspace, operator, certificate of authorization and cybersecurity risk assessment.
- Pilots must have FAA Part 107 Certification and ensure that flight team is trained.
- Standard Operating Procedures
- System Safety Management Plan
- Material Risk Assessment Memo
- Operational Risk Acceptance Memo
- All of which is submitted to receive an Airworthiness release.
- All of the above documents are then submitted with the Airworthiness release, with the detailed request for exemption to policy and signed memo by a FO/GO/SES.



Project - Education and Data Collection and Training

- Range Commander's Council Sustainability and Environmental Group
 - September 2019 (Presentation and OSD CONSU Range Questionnaire)
~30 MRTFB responses
- SERDP/ESTCP Symposium (Poster Session and sUAS Short Course)
 - December 2019 (Poster Session and sUAS Short Course)
- DoD Partners in Flight (PIF) and Partners in Amphibian and Reptile Conservation (PARK)
 - February 2020 (Presentation and OSD CONSU Range Questionnaire)
~150 responses
- NMFWA 2020 sUAS Symposium and Panel Discussion
 - March 2020 (Full day UAV training course)
~ 125 people trained



RCC sUAS Questionnaire (August 2019)

- A sUAS questionnaire was sent out to identify member range efforts to utilize sUAS for natural resource monitoring and develop an inventory of best practices, resources, and lessons learned that can be promulgated across the Ranges.
 - Sent to CONUS ranges through RCC/SEG
 - Received responses from 12 MRTFB's
- **One range indicated that they do use sUAS** to monitor RX fire, wildfire, endangered species, forestry. Monitoring began in 2017 using the DJI Phantom **but recently were denied a waiver.** The sUASOs with BUQ1 & BUQ2 CBT trained people to operate the platform.

Questions included:

- **Does your range use sUAS to monitor natural resources?**
- What do you monitor?
- When did you begin using sUAS to monitor natural resources?
- What sUAS platform do you use?
- Do you have a waiver to use this platform?
- Who operates the platform?
- **If you could use a sUAS to monitor natural resources, would you?**
- If you could use a sUAS to monitor natural resources, what would you monitor? Many would monitor a variety of natural resources and possibly cultural resources.



Contact Info

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Open Forum/Q&A/Discussion

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