

Treatment of Expendable Unmanned Systems Under U.S. Environmental Law



Figure 1 From left to right: U.S. Coast Guard cutter, littoral combat ship, Devil Ray T-38, and Saildrone Explorer in the Arabian Gulf on June 26, 2022. Photo by Chief Petty Officer Roland Franklin



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1: Introduction

Unmanned systems (UxS) are used increasingly by both military and nonmilitary actors.¹ While many are retrieved following their missions, others are intentionally left behind or deemed expendable. Over time, the buildup of expendable UxS will have impacts on terrestrial and maritime environments. This report reviews federal, state, and regional environmental statutes and the potential applicability to U.S. Navy expendable UxS operating in water, land, and air environments.

In order to assess the applicability of environmental laws to expendable systems, researchers first define expendable UxS. In order to show how U.S. environmental laws will apply, two hypothetical scenarios are presented, one based in the maritime environment and the other in air and over land. These scenarios help to show how U.S. environmental statutes apply to an expendable system operated, owned, and deployed by the U.S. Navy.

Next, the report provides a review of the water-based hypothetical scenario, including analysis and findings, and a similar review for the air-and-land scenario. Analysis of the two scenarios indicate that the deployment and operation of U.S. Navy expendable systems is largely legal within the maritime domain, although there may be limitations based on material, activity, and geography. Finally, the report concludes with recommendations.

2: Background

2.1: Expendable Systems

As previously noted in the report *Priority Law and Policy Issues Related to Autonomous and Unmanned Systems*, definitions are important factors in understanding applicable laws and policies but often are not delineated or incorporated in official government and military doctrines.² This is even more true for expendable systems as there is a lack of literature and absence of an official definition for these systems. This report defines expendable systems as an UxS that, after being used, little or no attempt is made to retrieve it. Further, UxS may have varying levels of autonomy and include different system types, such as aerial, submersible, and

¹ This report refers to Unmanned Systems as the overarching term to include unmanned systems that are either remotely operated or autonomous.

² Kristen Fletcher et al., "Priority Law and Policy Issues Related to Autonomous and Unmanned Systems," 2021, 20, https://nps.edu/documents/114698888/121733922/CRUSER_Priority+Law+%26+Policy+Issues+%28Dec+2021%29.pdf/e3b6a430-a00d-faf9-cfd3-fabea603ee1a?t=1643158769410.

surface vessels. While there is some debate as to whether an UxS is legally considered a vessel, this report asserts that an expendable system used in the maritime environment is considered a vessel. The abandonment of these systems into the environment raises questions surrounding their status as potentially being classified as pollution and litter.

Like many AS and UxS, expendable systems may complement and support an operation or mission by providing enhanced intelligence, surveillance, and reconnaissance (ISR) capabilities. There are financial, logistical, and strategic reasons why an expendable system may be employed over a non-expendable system. Expendable systems are in various stages of development, production, and operation.

2.1a: *Examples of Expendable Systems*

The Coyote Unmanned Aerial System (UAS) was developed by Raytheon and originally designed for military use. The small UAS has been utilized by the National Oceanic and Atmospheric Administration (NOAA) to collect weather data from a hurricane.³ In 2017, several Coyotes were dropped out of a P-3 Orion aircraft during Hurricane Maria. After being remotely operated for roughly an hour, the batteries were depleted with the system ultimately falling into the ocean and never recovered.⁴

Other existing expendable systems often include operational and training counter mining warfare systems. The Lockheed Martin Expendable Mobile ASW Training Target (EMATT) is a small, A-size (4 7/8-inch diameter, 36-inch length), autonomous underwater vehicle (AUV).⁵ The system was originally designed for use in antisubmarine warfare training. The AUV's directions concerning its depth, speed, direction, and sound may all be programmed prior to its placement into water.⁶ Once the system's batteries are depleted, it sinks to the bottom, making recovery improbable.

The use of expendable systems in the military environment are continually researched. As seen in the Department of Defense Fiscal Year (FY) 2022 Budget Estimates, the Navy is developing multiple systems that are deemed "expendable" indicating the continued interest in these types of systems. Of the expendable systems included in the Research and Development Budget, there is a small/medium unmanned underwater vehicle (UUV), the Mining Expendable Delivery Unmanned Submarine Asset (MEDUSA).⁷ The MEDUSA is a medium class UUV. It will be used for offensive mining missions and is capable of being launched from a submarine

³ Tim Wright, "Meet Coyote, the Latest (and Smallest) Hurricane Hunter," *Air and Space Magazine*, October 10, 2017, <https://www.smithsonianmag.com/air-space-magazine/noaa-sacrifices-drones-appease-poseidon-180965188/>.

⁴ Ibid.

⁵ "A-Size Autonomous Underwater Vehicles," Lockheed Martin, accessed August 2, 2022,

<https://www.lockheedmartin.com/en-us/products/a-size-autonomous-underwater-vehicles.html>.

⁶ *MK39 Expendable Mobile ASW Training Target and Field Programmability System (EMATT): A Small, Dynamic Submarine-Like Target* (Lockheed Martin: Mission Systems and Training, 2013). Accessed August 2, 2022, <https://www.lockheedmartin.com/content/dam/lockheed-martin/rms/documents/a-size-autonomous-underwater-vehicles/MK-39-productcard.pdf>.

⁷ Department of Defense, *Fiscal Year (FY) 2022 Budget Estimates: Research, Development, Test & Evaluation*, Navy, vol. 2, 5 vols., 2022.

through a torpedo tube. After delivering the allotted payload, the system is deemed as expendable and is not required to be recovered.⁸

2.1b: *Material Composition*

The types of materials used in expendable systems may indicate the system's impact on the environment. Understanding the system's impact on the environment can help in illustrating how certain statutes apply. For example, an abandoned system may be considered marine debris. NOAA defines marine debris as "any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes."⁹ Marine debris has the potential to injure and kill marine life, interfere with navigational safety, and pose a risk to human health.¹⁰

Some materials left in the environment may deteriorate within a few years while others may take several centuries. According to the Bureau of Safety and Environmental Enforcement, with information sourced from the U.S. EPA Gulf of Mexico Program, the biodegradation for marine debris is as follows: cardboard box (2-4 weeks), plywood (3 years), Styrofoam cup and tin can (50 years), Styrofoam buoy (80 years), aluminum can (200 years), plastic bottle (600 years).¹¹ Many materials become toxic as they interact or decay in the environment. Researchers published in the *Environmental Science Technology* journal state that:

Some plastic debris acts as a source of toxic chemicals: substances that were added to the plastic during manufacturing leach from plastic debris. Plastic debris also acts as a sink for toxic chemicals. Plastic absorbs persistent, bioaccumulative, and toxic substances (PBTs)... from the water or sediment.¹²

Risk to wildlife is to be considered. Wildlife that ingests plastic are at an increased risk for toxic effects or accumulation of toxins. These toxins may be passed up the food chain and into human diets through biomagnification.

The type and quantity of materials used may differ depending on the environment in which the system operates. Material requirements for a UUV vary compared to a USV. However, certain materials are typically essential regardless of the platform such as the fuel source and electronic components. Material composition is important in determining the lasting impact of expendable systems in the environment and how U.S. statutes apply.

⁸ David Hambling, "MEDUSA Is U.S. Navy's Secret Minelaying Submarine," *Forbes*, June 4, 2021, <https://www.forbes.com/sites/davidhambling/2021/06/04/medusa-is-us-navys-secret-minelaying-submarine/?sh=72a532111121>.

⁹ "What is marine debris?," National Ocean Service, accessed August 2, 2022, <https://oceanservice.noaa.gov/facts/marinedebris.html>.

¹⁰ Ibid.

¹¹ "Marine Debris Timeline of Biodegradation," Bureau of Safety and Environmental Enforcement, accessed August 2, 2022, <https://www.bsee.gov/sites/bsee.gov/files/marine-debris-timeline-epa.pdf>.

¹² Richard Engler, "The Complex Interaction between Marine Debris and Toxic Chemicals in the Ocean," *Environmental Science Technology* 46, no. 22 (October 2012): 12302–12315, <https://doi.org/10.1021/es3027105>.

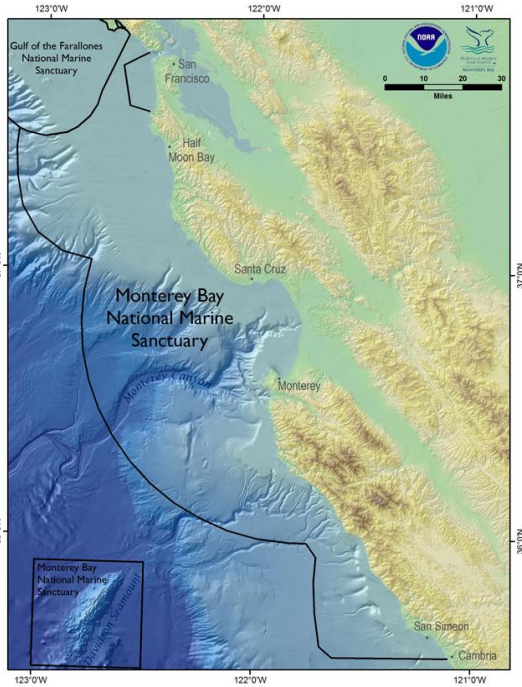


Figure 2: MBNMS Boundary Map¹³



Figure 3: Deployment of EMATT¹⁴

3: Hypotheticals

3.1: Hypothetical 1: Maritime Scenario

The first scenario is set in the maritime environment in the Monterey Bay region. The Monterey Bay National Marine Sanctuary (MBNMS) covers all of Monterey Bay and measures 276 miles of coastline and 6,094 square statute miles (4,601 nmi²) of ocean.¹⁵ The average distance is thirty miles from the shore and its deepest point is 12,743 feet.¹⁶ In hypothetical 1, the UxS is an Expendable Mobile ASW Training Target (EMATT) and travels through the MBNMS. Because of the area's status as a marine sanctuary, activities that may negatively affect the area's natural resources are managed more heavily than other areas off California's coast and sometimes prohibited.

3.1a: Key Domestic Acts/Statutes

One of the most prominent laws relating to water discharges and pollution is the Federal Water Pollution Control Act, commonly known as the Clean Water Act (CWA). The CWA requires a permit for the discharge of a pollutant into the waters of the U.S. which, for purposes

¹³ "MBNMS Map – Color," Monterey Bay National Marine Sanctuary, accessed August 5, 2022, <https://montereybay.noaa.gov/materials/mappages/mbnmscolormap.html>.

¹⁴ Mat Murch, 160422-N-TC720-038 BALTIC SEA, April 22, 2016, photograph, U.S. Navy, Baltic Sea, <https://www.flickr.com/photos/cne-cna-c6f/26508657621/in/photostream/>.

¹⁵ "Quick Facts: The Sanctuary at a Glance," Monterey Bay National Marine Sanctuary, accessed August 2, 2022, https://montereybay.noaa.gov/intro/mbnms_quickfacts.html.

¹⁶ Ibid.

of this scenario, includes Monterey Bay out to the edge of the territorial sea twelve nautical miles offshore.¹⁷ Under the act, a National Pollutant Discharge Elimination System (NPDES) permit is required for discharges. NPDES permits may be processed by federal and/or state agencies depending on the activity's scope and location.¹⁸ Certain activities may also fall under general nationwide permits which permit a category of discharges.¹⁹

Other federal acts relevant to deployment of an expendable system in the MBNMS include the Marine Plastic Pollution Research and Control Act (MPPRCA), Oil Pollution Act (OPA), Coastal Zone Management Act (CZMA), the Marine Protection, Research, and Sanctuaries Act (MPRSA), and the National Marine Sanctuaries Act (NMSA). The MPPRCA regulates the type of pollution that may be discharged into water.²⁰ Generally, there are fewer limitations the farther from shore the discharge takes place.²¹ However, the MPPRCA explicitly prohibits the discharge of plastic in the Sanctuary regardless of the distance offshore.²² The OPA primarily focuses on the prevention, reporting, and liability concerning oil spills.²³ The CZMA encourages states to create coastal management programs and, once approved, a state may review activities that affect its coast that are being conducted even in federal waters.²⁴ Except as authorized by a permit, MPRSA prohibits the transportation of materials with the purpose of dumping into the ocean.²⁵ The NMSA provides the authority for the designation and regulation of national marine sanctuaries.²⁶

Excluding the CWA, the acts listed have varying degrees of exemptions for a U.S. Navy deployed EMATT. The OPA, for example, has exemptions for public vessels including an expendable system owned and operated by the U.S. military.²⁷ The MPRSA does not apply to these systems due to its definition of dumping.²⁸ The MPRSA's definition of dumping in the U.S. Code excludes "the intentional placement of any device in ocean... for a purpose other than disposal, when such construction or such placement... occurs pursuant to an authorized Federal

¹⁷ CWA definitions of "discharge of pollutant" and "pollutant" may be found in 33 U.S.C. 1362. For more information, see "Summary of the Clean Water Act," United States Environmental Protection Agency, accessed August 2, 2022, <https://www.epa.gov/laws-regulations/summary-clean-water-act>.

¹⁸ "NPDES Permit Basics," United States Environmental Protection Agency, accessed August 2, 2022, <https://www.epa.gov/npdes/npdes-permit-basics>.

¹⁹ "Nationwide Permits Chronology and Related Materials under CWA Section 404," United States Environmental Protection Agency, accessed August 2, 2022, <https://www.epa.gov/cwa-404/nationwide-permits-chronology-and-related-materials-under-cwa-section-404>.

²⁰ 33 U.S.C. 1401-1445. 2022.

²¹ 33 U.S.C. 1411-1421. 2022.

²² Ibid.

²³ "Summary of the Oil Pollution Act," United States Environmental Protection Agency, accessed August 2, 2022, <https://www.epa.gov/laws-regulations/summary-oil-pollution-act>.

²⁴ "Federal Consistency," California Coastal Commission, accessed August 2, 2022, <https://coastal.ca.gov/fedcd/fedcndx.html>.

²⁵ 33 U.S. Code § 1402(f), 2022.

²⁶ "Legislative History of the National Marine Sanctuaries Act," National Marine Sanctuaries, accessed August 2, 2022, https://sanctuaries.noaa.gov/about/legislation/leg_history.html.

²⁷ 33 U.S.C. § 2702 (c)(1). 2022.

²⁸ 33 U.S.C. § 2701 (29). 2022.

or State program.”²⁹ In addition, security related concerns may sometimes limit the ability of a state to review certain federal actions that are deemed “necessary in the interest of national security.”³⁰ The Navy may posit that its deployment of an EMATT is in furtherance of national security and is exempt from the dumping prohibition in MPRSA and consistency review under the CZMA.³¹

3.1b - *Agencies involved in Monterey Bay National Marine Sanctuary*

Deploying an expendable system within the MBNMS may require prior authorization or notice to the following relevant agencies: the EPA, U.S. Coast Guard, California State Water Resources Control Board, federal and/or state fish and wildlife agencies, Office of National Marine Sanctuaries, California State Lands Commission and the California Coastal Commission. The list of agencies to contact may grow or shrink depending on the use, location, and impact of the expendable system.

The permitting process is important in deploying expendable systems in the MBNMS. Title 15, Part 922 of the U.S. Code of Federal Regulations (CFR) provides direction on permissible, prohibited, and permit requiring activities. Under those regulations, permit requests are processed by the sanctuary. MBNMS is not able to permit some prohibited activities, such as drilling for oil, but MBNMS may issue a permit, subject to terms and conditions, to conduct prohibited activities if certain criteria identified in the CFR are met. When processing permit applications for deploying expendable system, sanctuary staff must balance the impact of a discharge and abandonment on the sanctuary with its potential benefit.³² Certain processes and plans may be required to mitigate risk to the sanctuary; for example, requiring aerial drones to float ensures easy retrieval if they fall into the sanctuary’s waters.³³

Other variables affect the agencies involved in a deployment including the system’s impact on the ecosystem, endangered species, marine mammals, and navigation of other vessels. If an expendable system becomes a navigational hazard to other mariners, the U.S. Coast Guard should be contacted.³⁴ When a system’s activities constitute an incidental take or harassment of marine mammals or certain protected species, then one or all the following agencies may need to be contacted for consultation, authorization, or permitting: NOAA Fisheries, California Department of Fish and Wildlife, and U.S. Fish and Wildlife (as required by the Endangered Species Act, Marine Mammal Protection Act, Migratory Bird Treaty Act, and California

²⁹ 33 U.S.C. § 1402(f). 2022.

³⁰ 16 U.S.C. § 1456(3)(a). 2022.

³¹ James Kraska, “Oceanographic and naval deployments of expendable marine instruments under U.S. and international law,” *Ocean Development & International Law* 26, no. 4 (1995): 334, <https://doi.org/10.1080/00908329509546066>.

³² Sophie De Beukelaer (Permit Coordinator at MBNMS), interviewed by Philip DeCocco, 8 July 2022.

³³ Ibid.

³⁴ “Vessel Damage and Navigation Hazard,” Marine Debris Program, accessed August 2, 2022, <https://marinedebris.noaa.gov/why-marine-debris-problem/vessel-damage-and-navigation-hazard>.

Endangered Species Act).³⁵ Harassment of a marine mammal can be caused by noise pollution; one way the EMATT does not cause disturbance is by keeping its sound emission under 160db, a de minimis amount.³⁶

3.1c - EMATT in MBNMS

The scenario of an EMATT deployment within the MBNMS is based on actual research deployment of these systems. Naval Postgraduate School (NPS) researchers obtained a permit for the temporary deployment of up to four EMATTs in the MBNMS each year.³⁷ The permit's provisions set in place help mitigate risks to the Sanctuary and ensure compliance with Sanctuary guidelines. One example of such a provision is a result of the statute that prevents the abandonment of a vessel in the Sanctuary.³⁸ Accordingly, provisions in the permit require the EMATT to pass through the Sanctuary and be left in the waters outside of the Sanctuary.³⁹ The permit also stipulates that a plan must be submitted prior to deployment of the system.⁴⁰ A typical EMATT has an estimated maximum range of around 40 nautical miles before battery depletion. Given that the Sanctuary can be as wide as 53 nautical miles, the system must be discharged well offshore. The system's inability to be tracked and auto-correct its path, with no way to determine whether the EMATT was abandoned beyond the Sanctuary's boundary or not, further supports the importance of making a detailed pre-deployment plan that accounts for such risk.⁴¹ Overall, the EMATT can legally be deployed in the maritime environment under major environmental statutes and agencies. However, there may be conditions on operation due to the system's use, geographic location, and impact in the region.

³⁵ Note: 'Take' under the Endangered Species Act is "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." 16 U.S.C. § 1532. 2022. See also Name Definitions; "Incidental Take Authorizations Under the Marine Mammal Protection Act," NOAA Fisheries, accessed August 2, 2022, <https://www.fisheries.noaa.gov/permit/incidental-take-authorizations-under-marine-mammal-protection-act>; "Incidental Take Permits," California Department of Fish and Wildlife, accessed August 5, 2022, <https://wildlife.ca.gov/Conservation/CESA/Permitting/Incidental-Take-Permits#50033467-applications>; Migratory Bird Treaty Act of 1918," U.S. Fish and Wildlife, accessed August 5, 2020, <https://www.fws.gov/law/migratory-bird-treaty-act-1918>; "Summary of the Endangered Species Act," United States Environmental Protection Agency, accessed August 5, 2020, <https://www.epa.gov/laws-regulations/summary-endangered-species-act>.

³⁶ Dr. John Joseph. Interviewed by Philip DeCocco, Monterey, California, 13 July 2022.

³⁷ Monterey Bay National Marine Sanctuary, "Quick Facts: The Sanctuary at a Glance."; Office of National Marine Sanctuaries, "Monterey Bay National Marine Sanctuary Research Permit: Permit #MBNMS-2020-001", February 10, 2020.

³⁸ 15 CFR § 922.132. 2022.

³⁹ Office of National Marine Sanctuaries, "Monterey Bay National Marine..."

⁴⁰ Ibid.

⁴¹ Dr. John Joseph. Interviewed by Philip DeCocco, Monterey, California, 13 July 2022.



Figure 4: CICADA (Red Drones) and Deployment Drone⁴²

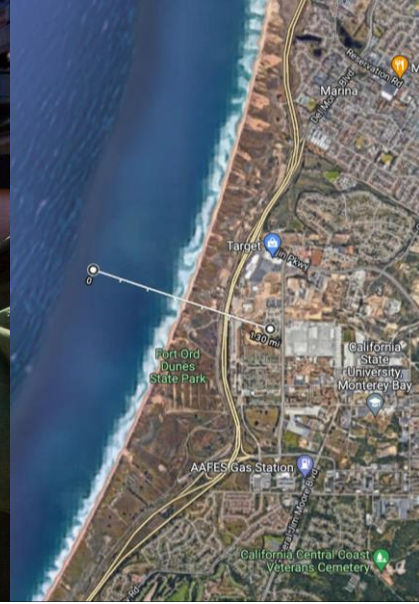


Figure 5: Satellite Image Flight Path⁴³

3.2 – Hypothetical 2: Air and Land Scenario

In scenario 2, a remotely piloted UAS owned and operated by the U.S. Navy is launched from land and vertically flies to an altitude of 3,000 feet and flies 3,500 feet offshore. Upon reaching its mark offshore, the UAS’s payload of twenty-five Close-In Covert Autonomous Disposable Aircrafts (CICADA) is released. The CICADAs, which have a glide ratio of 3.5 to 1 (distance forward to altitude lost) and weight of 1.2 ounces, begin their descent towards their destination back on land.⁴⁴ After release of the 25 CICADAs, the deployment UAS returns to its launch location for recovery. Upon initial release, five of the CICADAs malfunction and freefall into the water of the Sanctuary and drift on the water’s surface. The remaining twenty CICADAs fulfill their mission to collect and relay weather data during their journey inland. The CICADAs are programmed to land at a predetermined destination of former barracks property owned by the City of Marina, CA that are that are slated for redevelopment.⁴⁵ Upon landing within fifteen feet of the CICADA’s preprogrammed GPS target, the batteries are depleted and the systems are not recovered.

⁴² David Bowman, *NASA software engineer, Matthew Vaughan (left), and a fellow researcher prepare the payload of Close-In Covert Autonomous Disposable Aircraft, or CICADAS, for the Hives*, 2019, photograph, NASA, <https://www.nasa.gov/feature/langley/drones-swarm-over-beaver-dam>.

⁴³ City of Marina map, Google Maps, accessed July 19, 2022, https://www.google.com/maps/place/Marina,+CA/data=!4m2!3m1!1s0x808de4a0ba711be1:0xc22827b95df909d6?s_a=X&ved=2ahUKEwjYyoKzmzLD5AhWfKkQIHVGQBQkQ08gF6BAgCEAE.

⁴⁴ “Swarms of CICADA Drones Could Aid Hurricane Research,” Live Science, accessed August 3, 2022, <https://www.livescience.com/59966-tiny-stackable-gliding-drones.html>; Note: Glide ratio of 3.5:1 means meaning the system can travel forward 3.5ft for every 1ft of altitude.

⁴⁵ “City Parks Barracks and Cypress Knolls Buildings Blight Removal,” City of Marina, accessed August 3, 2022, <https://www.cityofmarina.org/1145/City-Parks-Barracks-and-Cypress-Knolls-B>.

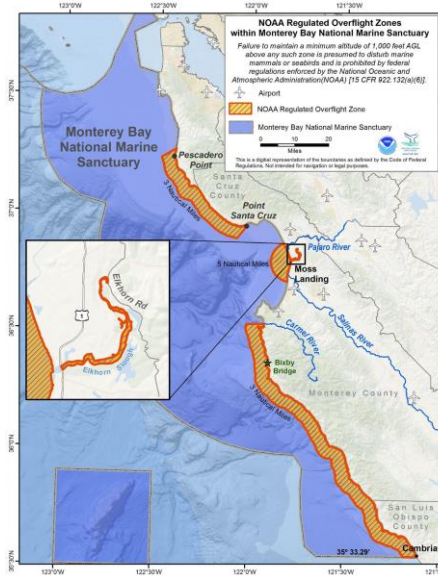


Figure 6: MBNMS Overflight Zones Map⁴⁶



Figure 7: Enhanced Map⁴⁷

3.2a – Key Statutes and Agencies

The pertinent laws and permitting agencies for operation in the air and land environments is determined based on the location and impact of the expendable system. To be deemed as “no impact,” the operation of the CICADAs must not disturb or incidentally take certain regulated species. The Federal and California Endangered Species Acts, the Marine Mammal Protection Act, and the Migratory Bird Treaty Acts prohibit the harassment or incidental take of certain species without proper authorization and permitting.⁴⁸ Accordingly, permitting and authorization for such actions to these species are processed through NOAA Fisheries, California Department of Fish and Wildlife, and U.S. Fish and Wildlife offices.

Although the CICADAs and other drones do not plan for interaction with the water, the MBNMS and NOAA Fisheries remain important authorities for operation over the maritime environment. Within the MBNMS there are four regulated overflight zones. Within these zones, flight below 1,000 feet is prohibited without authorization from the Sanctuary.⁴⁹ In this scenario, the CICADA’s flight path is planned to steer clear of these zones to ensure adherence to regulations. It is also important to note what became of the CICADAs that malfunctioned. The five CICADAs floating in the Sanctuary are in violation of the NMSA and MBNMS regulations prohibiting the depositing of material in the Sanctuary.⁵⁰ Accordingly, the five CICADAs that are floating in the Sanctuary should be recovered by the responsible party involved.

⁴⁶ “Overflight Map,” Monterey Bay National Marine Sanctuary, accessed August 5, 2022, <https://montereybay.noaa.gov/materials/mappages/overflightmap.html>.

⁴⁷ Ibid.

⁴⁸ “Resource Issues: Aircraft, Model Aircraft, & Drones,” Monterey Bay National Marine Sanctuary, accessed August 3, 2022, <https://montereybay.noaa.gov/resourcepro/resmanissues/aircraft.html>.

⁴⁹ Ibid.

⁵⁰ 15 CFR § 922.132 (a)(2). 2022.

The Federal Aviation Administration (FAA) is the regulatory authority over UAS operation, including CICADAs. The Navy can operate under civil small unmanned aircraft systems regulations⁵¹ or as a public aircraft with a Certificate of Waiver or Authorization (COA) under 49 U.S.C. §40102(a) and § 40125.⁵²

In addition, both state and county statutes apply to the twenty remaining CICADAs that landed in their designated area. The abandonment of the CICADAs may be considered illegal dumping under California Penal Code Section 374.3.⁵³ The abandonment of the systems within the City of Marina may also be considered littering under Monterey County Code of Ordinance 10.41.040.⁵⁴ Interestingly, there is little in the literature or case records to indicate that the state and county codes have been used to prosecute or fine expendable systems that are abandoned. Furthermore, the Navy may argue it is exempt from these laws in the interest of national security or its impact is de minimis. Relevance of the exemption of DoD from environmental laws will be addressed in the larger project report.

3.2b - *Weather Balloons*

Weather balloons are a similar system that may be deemed as “expendable” after deployment as they would not be likely to be recovered. Comparable to the CICADA scenario, there may be laws that exempt weather balloons.

Approximately 75,000 weather balloons are launched in the U.S. every year.⁵⁵ These unmanned balloons are essential to the collection of weather forecasting data. Weather balloons, primarily made of latex or synthetic latex, often carry a parachute and radiosonde (a device that relays temperature, humidity, and pressure data from the balloon while the parachute ensures a safe descent) as a payload.⁵⁶ The National Weather Service describes the instrument as being “expendable”, with roughly only 20% of the weather balloon radiosondes deployed each year in the U.S. being recovered, leaving about 56,000 abandoned.⁵⁷

Weather balloons seem to exist in a gray area of the law with a scarce amount of literature regarding the legal standing of spent balloons once they land. Due to winds and their high-altitude nature, balloons could travel many miles from their launch point landing in various unintended environments.⁵⁸ While the parachute helps to mitigate the risk that no property or humans are directly injured by the descending balloon material and radiosonde, it cannot be guaranteed. Furthermore, the balloon scraps and parachute can pose a risk to wildlife; birds and

⁵¹ 14 CFR 1 (F) (107). 2022.

⁵² “Operate a Drone, Start a Drone Program,” Federal Aviation Administration, accessed August 3, 2022, https://www.faa.gov/uas/public_safety_gov/drone_program

⁵³ Cal. Pen. Code § 374.3. 2022.

⁵⁴ Monterey County, CA, Littering generally, Ch. 10.41 § 10.41.040

⁵⁵ “Weather Balloons,” National Weather Service, accessed August 3, 2022, https://www.weather.gov/bmx/kidscorner_weatherballoons.

⁵⁶ Ibid.

⁵⁷ Ibid.

⁵⁸ Ibid.

other animals, mistaking them for food, may eat and later die from balloon ingestion.⁵⁹ California statutes prohibit the release of balloons made from electrically conductive material, such as mylar.⁶⁰ However, exemptions have been made for balloons used in governmental or scientific research projects that do contain conductive material.⁶¹ To note, latex is not an electrically conductive material, thus balloons of this type are not restricted under the state statute. Additionally, the state statute does not address the balloon's legal status upon landing. If a weather balloon landed in the same location as the CICADA, there is a question whether the abandoned balloon would be considered littering or dumping similar to the CICADA.

CICADAs and weather balloons are clearly different systems that have varying environmental impacts yet still comparable in function. Both systems collect data for a federal agency with the size of the systems' payload posing little direct risk to property or humans during descent. Importantly, both are unlikely to be recovered. There is a similar deficiency of legal literature and precedents on the treatment of both CICADAs and weather balloons. However, until policy, law, or courts deliberate, there is too little evidence to suggest that CICADAs would be treated the same as weather balloons which have been in use for much longer. Further, it seems unreasonable to apply the exemptions that weather balloons receive to CICADAs when weather balloons seem to have questionable legal status themselves.

4 – Recommendations and Conclusion

Several statutes discussed in this review of the maritime environment include exemptions for a U.S. Navy deployed expendable system that would have otherwise considered its abandonment littering or dumping. Despite these exemptions, there is rationale for the Navy to comply with these statutes during peace-time operations. By doing so, the Navy would limit pollution in all environments by recovering the systems or by using alternative methods or materials that will limit these systems impact on the environment.

In addition, the Navy's compliance with these statutes is financially responsible. In the coming years, hundreds of millions of dollars will be spent on ocean and marine debris clean-up programs.⁶² For the Navy to be creating and contributing to marine debris while Congress funds other agencies to clear and prevent it makes little financial sense. Adherence to the statutes also will help the Navy to meet Executive Orders and Navy/DoD policies concerning protection of the environment.⁶³ Lastly, the deployment of expendable systems over a long period of time can

⁵⁹ "Degradable balloons are not the solution," Wageningen University, accessed August 3, 2022, <https://www.wur.nl/en/article/3.-Degradable-balloons-are-not-the-solution.htm>.

⁶⁰ Cal. Pen. Code § 653.1. 2022.

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⁶² "EPA Announces \$524 Million Investment to Improve Health of Waterways and Oceans as Biden-Harris Administration Celebrates Earth Week," United States Environmental Protection Agency, accessed August 3, <https://www.epa.gov/newsreleases/epa-announces-524-million-investment-improve-health-waterways-and-oceans-biden-harris>.

⁶³ "In Case You Missed It: Biden-Harris Administration Works with Global Partners to Drive Ocean Action to Combat the Climate Crisis and Boost Ocean Economy at UN Ocean Conference," The White House, accessed

result in obstacles for future military operations. Despite singular cases being permitted as de minimis, the collective, continued, and increased use of expendable systems in the maritime domain may create a navigational hazard to vessels and obscure the true state of the sea floor. Overall, limiting the use of these systems and fully complying with statutes is beneficial for achieving current and future Navy objectives.

The lack of both literature and current legal statutes concerning AS, UxS, and expendable systems remains an obstacle for a comprehensive analysis of the legal landscape. Laws related to UxS are slow to keep up with the development of these technologies. The U.S. Navy will continue to deploy expendable systems but it is important for operators to understand the gaps in the law. The impact these systems have on the environment may dictate their scope of use. The system's use, material composition, and geographic location of abandonment are key in determining impact. The previous variables are also important to understanding which and how agencies and statutes would apply to the system. Overall, a large gap exists in the environmental legal landscape concerning the use of expendable systems and further analysis will be provided in the EAG report issued in December 2022.

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