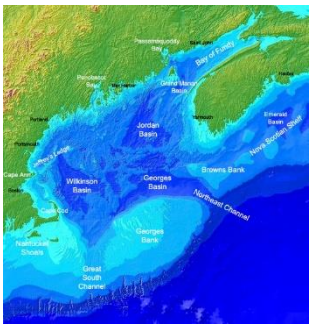
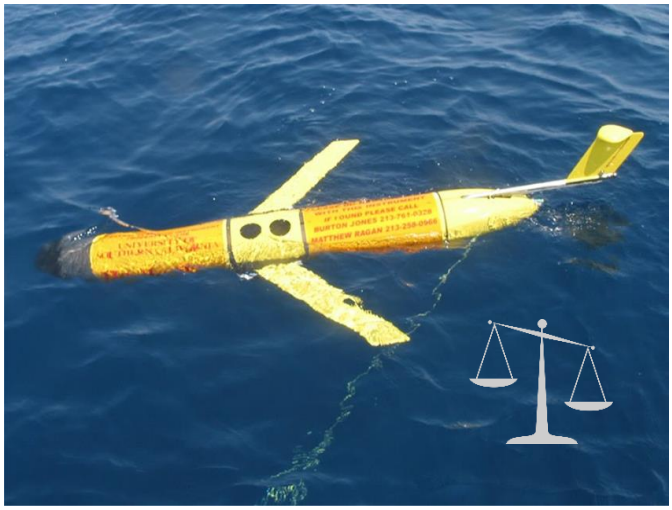
Priority Law and Policy Issues
Related to Autonomous and Unmanned Systems





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Priority Law and Policy Issues Related to Autonomous and Unmanned Systems[1]

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I. Introduction

In the Navy's March 2021 Unmanned Campaign Framework, the Secretary of the Navy noted that "To compete and win in an era of great power competition, the Department is committed to investing in advanced autonomy, robust networks, and unmanned systems to create true integrated human-machine teaming that is ubiquitous across the fleet."[6] The Framework further notes that "Unmanned systems will increase lethality, capacity, survivability, operational tempo, deterrence, and operational readiness."[7] For optimal success, the Navy must understand both the physical and legal environments in which it operates. As the technology and viability of these systems rapidly advance, it is vital to determine the legality of operations and acknowledge and address gaps in law and policy.

Policy and law concerning autonomous systems (AS) and unmanned systems (UxS) is developing and states are at varying stages regarding the development and regulation of these systems. While many nations have some strategies and policies related to these systems, there is little consensus on system-specific laws or policies at the international level. As a result, the laws that apply, especially internationally, are significantly older than the advanced technology that AS and UxS represent and were not written to apply to these cutting-edge systems. While this does not make them inherently incompatible, it does not provide a comprehensive approach to the challenges inherent in the design and use of these systems. For example, treaties such as the United Nations Convention on the Law of the Sea (UNCLOS) were not created to apply to these types of advanced technology. As a result, UNCLOS applies but with limitations and leaves outstanding legal and policy questions.

This report seeks to contribute to the DoD's call to "continue to lead the national and international discussions concerning [artificial intelligence] perception, policy and laws"[8] and the U.S. Navy's call to "develop policy to allow implementation of these capabilities and ensure that developed capabilities are legal and that they advance U.S. interests."[9]

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[1] This research was funded by the Consortium for Robotics and Unmanned Systems Education and Research (CRUSER) at the Naval Postgraduate School (NPS). All opinions expressed in this paper are the authors' and do not necessarily reflect the policies and views of CRUSER, NPS, or the Department of Defense.

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[6] U.S. Navy, *Department of the Navy Unmanned Campaign Framework* at 3 (2021) [hereinafter Unmanned Campaign Framework], https://www.navy.mil/Portals/1/Strategic/20210315%20Unmanned%20Campaign_Final_LowRes.pdf?ver=LtCZ-BPlWki6vCBTdgtDMA%3D%3D.

[7] Unmanned Campaign Framework at 6.

[8] Office of the Secretary of Defense, *Unmanned Systems Integrated Roadmap FY 2017-2042* at 19 (2018) [hereinafter Integrated Roadmap], https://www.defensedaily.com/wp-content/uploads/post_attachment/206477.pdf.

[9] U.S. Navy, *Department of the Navy Strategic Roadmap for Unmanned Systems* at 4 (2018) [hereinafter Strategic Roadmap].

To understand the current legal and policy landscape, this report explores the following research questions:

- How are AS and UxS defined?
- What are the key laws and policies that apply in the U.S. and internationally?
- What are the legal requirements for autonomous or unmanned systems to operate in different maritime zones?
- What are the legal requirements for AS or UxS in U.S. maritime zones when there are overlapping jurisdictions?
- What is the legal framework for environmental impact of marine based AS or UxS?

To answer these questions, the team conducted research and analysis on laws and policies and devised two scenarios to provide legal context. In these scenarios, an autonomous underwater vehicle (AUV) called Luke is taken through hypothetical scenarios to show which laws apply in different locations and how.[10] In Scenario 1, upon departure from a U.S. Navy installation, Luke travels through different U.S. and international maritime zones to conduct military surveillance. As its mission progresses, Luke must abide by certain laws/policies and its operators must understand and address the ambiguities inherent in some of the laws. This analysis focuses on three international Conventions related to maritime vessels and activities (UNCLOS, SOLAS, COLREGs); for each, Luke is assumed to be a vessel or ship. In Scenario 2, Luke travels through U.S., state and local maritime zones in Monterey Bay, California. The analysis focuses on relevant U.S. laws including the Marine Mammal Protection Act, Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and other relevant laws. The report concludes with key findings and future research questions.

II. Legal Landscape for Autonomous and Unmanned Systems

A. The Importance of Definitions

Defining AS and UxS is critical to understanding applicable laws and policies. Specifically, official military oriented UxS and Autonomous Weapons System (AWS) definitions were researched and analyzed to understand commonalities and differences and ensure compliance with U.S. and international law. How a system is defined can impact how it is regulated.

Research included definitions from the DOD Directive 3000.09 and U.S. Navy AS Strategy, and definitions from China, Russia, United Kingdom, Canada, and NATO. Analysis of these definitions revealed an overall similarity amongst the definitions. However, slight

[10] For this analysis, the term AUV includes both autonomous systems and unmanned systems. Savitz, Scott, Aaron C. Davenport, Michelle D. Ziegler, THE MARINE TRANSPORTATION SYSTEM, AUTONOMOUS TECHNOLOGY, AND IMPLICATIONS FOR THE U.S. COAST GUARD (Rand 2020), https://www.rand.org/content/dam/rand/pubs/perspectives/PE300/PE359/RAND_PE359.pdf.

differences in terminology can impact whether and how a law applies to a system. Depending on a state's priorities, it may define AS to exclude (or include) specific terminology so that a particular law applies. Internationally, there is a lack of an agreed-upon definition. This reflects the reality that laws and policies concerning AS and UxS are still developing.

The analysis shows the advancements made by the U.S. in recent years and the strength of U.S. AS strategies, with several agencies having produced roadmaps for the use of AS. For consistency, this report will use the NATO definition of AS and the U.S. Department of Defense definition of AWS. NATO defines an AS as "a system that decides and acts to accomplish desired goals, within defined parameters, based on acquired knowledge and an evolving situational awareness, following an optimal but potentially unpredictable course of action."[11] The DoD defines an AWS as "A weapon system that, once activated, can select and engage targets without further intervention by a human operator."[12] These definitions contain elements commonly recognized in policies related to AS.

B. Understanding the Legal Landscape

The law applicable to autonomous and unmanned systems depends on a variety of factors including the type of vehicle, level of autonomy and where the system is operating. With this rapidly advancing technology, it is challenging for the legal and policy frameworks to keep pace. Even so, there are laws that will apply and policy contexts being established. For example, product liability law, contract law, tort law or even criminal law may be applied if a system does not operate as promised or causes injury to persons or property. There is precedent to help understand the question of accountability of designers and operators for these systems or what happens when something goes wrong. But, the lack of a clear legal framework, especially with technology changing quickly, means that guidance documents, Executive Orders, and agency strategies can shed light on what a legal framework may need in the future and the direction that the U.S. and other countries are taking.

DOD has several documents that provide guidance on its approach of using autonomous and unmanned systems in military or national security operations. For weaponized systems, the DOD Directive 3000.09 "establishes DOD policy and assigns responsibilities for the development and uses of autonomous and semi-autonomous functions in weapon systems, including manned and unmanned platforms."[13] The Navy's Unmanned Campaign Framework explicitly calls for clarity and understanding of law, policy and ethical principles for these systems, including "an enduring central tenet to their use [which] will be the continued exercise of appropriate levels of human judgment."[14]

This report focuses on the use of an unweaponized underwater autonomous vehicle and, as noted in the scenarios below, the legal landscape is dominated by U.S. maritime and international maritime law. These systems often use and rely upon artificial intelligence and

[11] NATO GLOSSARY OF TERMS AND DEFINITIONS (2020).
[12] DOD Directive 3000.09 at 13-15.
[13] DOD Directive 3000.09 at 1.
[14] Unmanned Campaign Framework at 31.

machine learning; laws and policies regarding these elements are evolving each year. While this report does not delve deeply into these peripheral issues, some key developments include the following.

- Executive Order 13859, Maintaining American Leadership in Artificial Intelligence, was issued in 2019 and prioritizes investments in AI research and development, making federal data and models more accessible, setting AI governance standards, building the AI workforce, and protecting the U.S. AI advantage;[15]

- The Defense Innovation Board of the Department of Defense proposed AI Ethics Principles for DOD. Based on these recommendations, DOD adopted ethical principles in February 2020 that build on the U.S. Military's existing ethics framework based on the U.S. Constitution.[16]

- In June 2021, the White House Office of Science and Technology Policy and the National Science Foundation formed the National AI Research Resource Task Force, convening academic, government and industry experts to assess and provide recommendations on the feasibility and advisability of establishing a National AI Research Resource.[17]

- Finally, as a member state of UNESCO, the U.S. agreed in November 2021 to adopt the first ever global agreement on the Ethics of Artificial Intelligence, aiming to realize the advances that AI can bring to society while reducing risks.[18]

There are a variety of autonomous and unmanned systems in use and potentially different regulatory and governance frameworks for each. For example, for unmanned aircraft systems, commonly called drones, there are additional considerations and laws that apply as compared to the maritime environment. At the national level, it is estimated that over 1.1 million recreational drones are registered with the Federal Aviation Administration.[19] Additional requirements apply

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[15] White House, Executive Order 14859 (February 11, 2019), https://www.federalregister.gov/documents/2019/02/14/2019-02544/maintaining-american-leadership-in-artificial-intelligence.

[16] U.S. Department of Defense, *DOD Adopts Ethical Principles for Artificial Intelligence* (February 24, 2020), https://www.defense.gov/News/Releases/Release/Article/2091996/dod-adopts-ethical-principles-for-artificial-intelligence/.

[17] White House, *The Biden Administration Launches the National Artificial Intelligence Research Resource Task Force* (June 10, 2021), https://www.whitehouse.gov/ostp/news-updates/2021/06/10/the-biden-administration-launches-the-national-artificial-intelligence-research-resource-task-force/.

[18] United Nations Educational, Scientific and Cultural Organization, *Recommendation on the Ethics of Artificial Intelligence* (November 25, 2021), https://en.unesco.org/news/unesco-member-states-adopt-first-ever-global-agreement-ethics-artificial-intelligence.

[19] National Conference of State Legislatures, *Current Unmanned Aircraft State Law Landscape* (August 3, 2021), https://www.ncsl.org/research/transportation/current-unmanned-aircraft-state-law-landscape.aspx.

depending on the type of drone and purpose.[20] At the state level, since 2013 when states began to debate if and how drone technology should be regulated, "at least 44 states have enacted laws addressing drones and an additional three states have adopted resolutions."[21] Common issues addressed in the legislation include elements also important for maritime systems including defining what an unmanned aircraft system is and how they may be used by public or private actors. In addition, with the development of autonomous vehicles, while the U.S. still has no federal regulatory framework,[22] an estimated 29 U.S. states have enacted legislation related to autonomous vehicles and 11 governors have issued state executive orders related to these vehicles.[23]

Finally, in 2021, with the significant growth in maritime autonomous surface ships (MASS) , the Maritime Safety Committee of the International Maritime Organization completed a regulatory scoping exercise to analyze relevant ship safety treaties, in order to assess how MASS can be appropriately regulated.[24] Like with other autonomous systems, the level of autonomy matters: the exercise considered varying degrees of autonomy from a crewed ship with automated processes and decision support (Degree One) to a fully autonomous ship (Degree Four). And, like other efforts, a key issue that arose was how to appropriately define MASS and relevant terms including master, crew, or responsible person. Other gaps and themes identified include treaties that directly reference manual operations and implications for search and rescue.[25]

C. Weaponized Systems

There is much debate around the development and use of lethal autonomous weapon systems (LAWS). While some of the same requirements will apply to autonomous systems whether they are weaponized or not, LAWS have additional requirements and considerations.

Parties to the Convention on Conventional Weapons have been meeting since 2014 on LAWS, including the U.S., Canada, and the UK. The CCW effort includes a Group of Governmental Experts (GGE) that recommended 11 principles on LAWS which were adopted by consensus in 2019. Importantly, these principles concluded *inter alia* that "International

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[20] *See* Federal Aviation Administration, *Unmanned Aircraft Systems (UAS)* (2021), https://www.faa.gov/uas/.

[2121] *Id.*

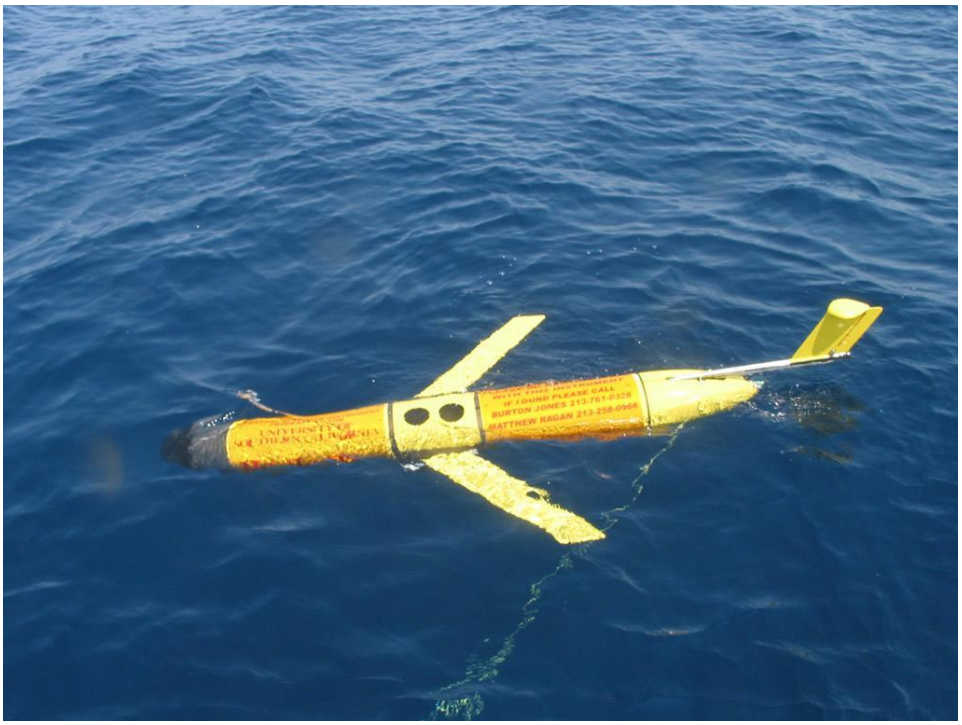
[22] For analysis of this gap, *see* Gibson Dunn, *Artificial Intelligence and Automated Systems Legal Update (2Q21)* at Section D, (August 11, 2021), https://www.gibsondunn.com/artificial-intelligence-and-automated-systems-legal-update-2q21/#_Toc79572867.

[23] National Conference of State Legislatures, *Autonomous Vehicles: Self-Driving Vehicles Enacted Legislation* (February 18, 2020), https://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx.

[24] International Maritime Organization, *Autonomous Ships: Regulatory Scoping Exercise Completed* (May 25, 2021), https://www.imo.org/en/MediaCentre/PressBriefings/pages/MASSRSE2021.aspx.

[25] International Maritime Organization, *Outcome of the Regulatory Scoping Exercise for the Use of Maritime Autonomous Surface Ships (MASS)* (June 3, 2021), https://wwwcdn.imo.org/localresources/en/MediaCentre/PressBriefings/Documents/MSC.1-Circ.1638%20-%20Outcome%20Of%20The%20Regulatory%20Scoping%20ExerciseFor%20The%20Use%20Of%20Maritime%20Autonomous%20Surface%20Ships...%20(Secretariat).pdf.

humanitarian law continues to apply full to all weapons systems, including the potential development and use of lethal autonomous weapon systems."[26] In addition, it states that "Human responsibility for decisions on the use of weapons systems must be retained since accountability cannot be transferred to machines… [and] considered across the entire life cycle of the weapons system."[27] These new principles represent the current approach to LAWS in the international community.



U.S. Navy Unmanned Buoyancy Glider[28] / Source: U.S. Navy

III. Scenario 1: International Waters & EEZs

Luke is the fictional AUV similar to the unmanned buoyancy glider pictured above. Luke operates fully autonomously, without a mothership, as a military surveillance vehicle for the U.S. Navy. Luke is clearly and correctly labeled as a U.S. Navy vessel with the appropriate lights and other necessary components to prevent it from being a navigational hazard.

Luke's journey begins with its launch at the Portsmouth Naval Shipyard in Kittery, Maine. Luke autonomously navigates through the U.S. territorial sea and Exclusive Economic Zone (EEZ) and into the high seas. After conducting surveillance in the high seas, Luke travels

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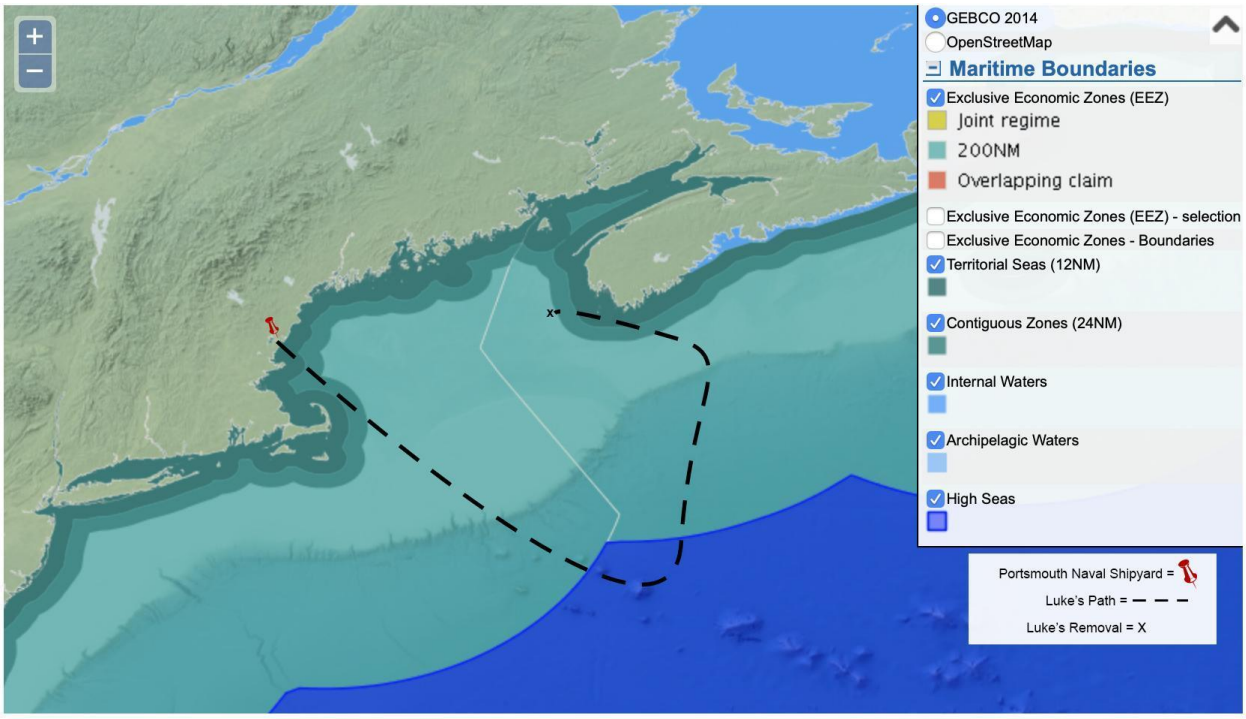
[26] Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems, *Report of the 1029 Session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems* at 13 (September 25, 2019) [hereinafter GGE Report], https://documents.unoda.org/wp-content/uploads/2020/09/CCW_GGE.1_2019_3_E.pdf.

[27] *Id.*

[28] U.S. Navy Photo. See Sam LaGrone, *Updated: Chinese Seize U.S. Navy Unmanned Vehicle* (December 16, 2016), https://news.usni.org/2016/12/16/breaking-chinese-seize-u-s-navy-unmanned-vehicle.

into the Canadian EEZ.[29] It continues to collect military surveillance data as it passes through the Canadian EEZ. While en route, Luke passes through Canadian territorial waters. Upon doing so, Luke surfaces until its exit of Canadian territorial waters. Once beyond the territorial sea and back into Canada's EEZ, Luke prepares to submerge again. Before this is possible, a Chinese military warship extracts the AUV from the water and onto its deck. The Chinese warship had prior consent to conduct marine scientific research in the EEZ by Canada.

This section will work through the hypothetical and analyze the laws that apply in each of the maritime zones along Luke's journey. The report also will address the legality of the Chinese vessel's actions.



Map of Luke's Journey through U.S and Canadian Maritime Zones[30] / Source: Census of Marine Life

Scenario Background

Before addressing the legality of Luke's journey and acquisition by the Chinese warship, it is important to understand how Luke is characterized under maritime laws. The analysis focuses on UNCLOS, the international agreement that establishes a legal framework for all marine and maritime activities, and related maritime laws including International Convention for the Safety of Life at Sea (SOLAS) and Convention on the International Regulations for Preventing Collisions at Sea of 1972 (COLREGs). Because these conventions predate advanced

[29] NOAA's Office of Coast Survey provides more information on maritime zones: https://nauticalcharts.noaa.gov/data/us-maritime-limits-and-boundaries.html#general-information (last visited Dec 29, 2021).

[30] Census of Marine Life, *Maritime Boundaries Geodatabase*, Maritime Boundaries and Exclusive Economic Zones (200NM), Version 11 (2021).

autonomous technology, application of these laws sometimes requires assumptions. Arguing the basis for Luke as a vessel is beyond the scope of this report but there is room for debate about how to accurately characterize these systems, especially given the different systems and programs in use.[31]

Vessel or Warship

Even before it is launched, Luke's characterization under UNCLOS must be determined; i.e., is Luke a vessel/ship or a warship? The distinction is important because UNCLOS does not hold a warship to the same standards as a vessel or ship. While UNCLOS does not define the terms vessel or ship, it does define warship. UNCLOS defines a warship as "a ship belonging to the armed forces of a State bearing the external marks distinguishing such ships of its nationality... and manned by a crew which is under regular armed forces discipline."[32] The requirement of "manned by a crew" excludes Luke from a warship designation. For this analysis, Luke is assumed to be a vessel under UNCLOS.

Characterizing Luke is important for U.S. law as well. For example, if Luke was a large, unmanned surface vessel (LUSV) or a medium unmanned surface vehicle (MUSV), it would have to gain special authorization before its operation. The National Defense Authorization Act of 2021 requires that these vessels gain prior approval from the Secretary of Defense as meeting DoD standards including having "demonstrated in vessel-representative form, fit, and function."[33]

Types of control

Additionally, it is important to identify and understand the level of human control in maritime AS. Depending on how it is controlled, certain liability and regulations may apply. If a mothership is nearby and controlling the AS (even partially or periodically), it is not a fully autonomous system. With a remote controlled AS, a human is in the loop controlling its actions. As the name implies, with a fully autonomous system, the system has complete autonomy in which the human is out of the loop.[34] It is possible for a system to have a variety of controls. For example, a system could be remotely controlled from a mothership or be autonomous in certain phases of its mission and controlled in others. In this scenario, Luke is fully autonomous during its mission.

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[31] For further discussion, see Simon McKenzie. *When Is a Ship a Ship? Use by State Armed Forces of Uncrewed Maritime Vehicles and the United Nations Convention on the Law of the Sea*, 21 Melbourne Journal of International Law 1 (2020).

[32] UN General Assembly, *Convention on the Law of the Sea*, 10 December 1982, Article 29, pp 34-35 [hereinafter UNCLOS].

[33] Pub Law No. 116-283, National Defense Authorization Act for Fiscal Year 2021, Section 227 (January 1, 2021).

[34] Human in the loop and human out of the loop are important concepts in the control of autonomous systems and artificial intelligence. For a general understanding, *see* Robert Mazzolin, *Artificial Intelligence and Keeping Humans "in the Loop"*, (Centre for International Governance Innovation 2020).

Types of data collection

The type of data collection being performed will affect how the law applies to the vessel. For example, UNCLOS regulates marine scientific research (MSR) differently than military data collection. UNCLOS defines MSR as "any study, whether fundamental or applied, intended to increase knowledge about the marine environment, including all its resources and living organisms, and embraces all related scientific activity."[35] MSR falls under the sovereignty of a coastal state. Accordingly, permission by a coastal State is required to conduct MSR in its EEZ & territorial waters. Military data includes a variety of information collected by the military for military use such as data collected for transit or oceanographic data. Military surveillance is the collection of surveillance data by and for the military; this could include hydrographic or acoustic monitoring.

Military surveillance and military data are not considered MSR. It is the U.S. position that vessels conducting military surveillance and data collection need no permission from the coastal State. However, other States posit that collecting military data and/or surveillance does require prior permission from the coastal State. In addition to different state positions, defining these categories can be difficult as there are many instances where the lines between military surveillance, data collection and MSR are blurred.

Luke in U.S. Territorial Waters and EEZ

As a U.S. vessel, Luke's passage through U.S. territorial waters and EEZ is a straight-forward analysis under UNCLOS. Upon departure from Kittery, Maine, Luke may legally operate in the territorial waters and EEZ without additional measures.

In addition to UNCLOS, however, other legal standards apply even in U.S. waters. Luke must abide by SOLAS rules and standards; SOLAS applies throughout Luke's journey. The convention's goal is to ensure that maritime vessels are safe to operate, whether in a vessel's construction or navigation techniques. Chapter V of SOLAS focuses on safety of navigation and applies to all vessels and ships aside from "warships, naval auxiliaries and other ships owned or operated by a Contracting Government and used only on government non-commercial Service."[36] Even though an AUV like Luke does not fit the anticipated criteria for a vessel or ship, most nations that operate AS or UxS take the position that SOLAS applies to these systems as vessels. As this analysis assumes Luke is a vessel, it must abide by these requirements. Accordingly, the chapter focuses on the vessel's navigational capabilities to ensure its safety and that of other vessels in the area.

As a vessel, Luke must also abide by COLREGs which ensures the safety of the operating vessel and those around it. Safety is ensured through certain requirements, such as the

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[35] United Nations Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs, MARINE SCIENTIFIC RESEARCH: A REVISED GUIDE TO THE IMPLEMENTATION OF THE RELEVANT PROVISIONS OF THE UNITED NATIONS CONVENTION ON THE LAW OF THE SEA (2010).

[36] International Maritime Organization (IMO), *International Convention for the Safety of Life at Sea*, 1 November 1974, 1184 UNTS 3, Chapter V, https://www.refworld.org/docid/46920bf32.html (last visited Dec. 29, 2021).

appropriate use of lighting or "right of way" rules. Applicable COLREGs rules are to be followed during Luke's entire trip. The International Maritime Organization (IMO) passes the obligation of enforcement and implementation of many rules, including those from COLREGs, onto a nation's credible authority. Thus, the U.S. Coast Guard is responsible for implementing and enforcing IMO rules for U.S. vessels.

Luke in International Waters

As Luke departs the U.S. EEZ, it enters the high seas or international waters. Under UNCLOS Article 87, Luke may legally enter the high seas. Article 87 establishes the freedom of the high seas and stipulates that "the high seas are open to all States, whether coastal or land-locked."[37] This article protects freedom of navigation and freedom of scientific research (with some limits). Even with this freedom, while Luke exercises its rights, it must do so with "due regard for the interests of other States in their exercise of the freedom of the high seas"[38] or exercising their other rights. As discussed in more detail below, if Luke operates with due regard, there is no special authorization needed while in international waters.

Luke in Canada's EEZ

After operating in the high seas, Luke enters Canada's EEZ. UNCLOS Article 58 allows Luke to operate (with limits) in Canada's EEZ. Many of the allowable activities are like that of Article 87 (see *Luke in International Waters*), such as navigation and overflight or the laying of submarine cables.[39] In general, Article 58 protects the freedom of a state to use another state's EEZs for non-economic purposes.[40]

Luke is more restricted in Canada's EEZ, however. Notably, UNCLOS Articles 56 and 246 reserve certain rights for the coastal state. Article 56 states that the coastal states reserve the "sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living"[41] within their EEZ. One of the specified freedoms is the sole right to authorize or perform marine scientific research (MSR) in the EEZ. Accordingly, as noted in Article 246 "Coastal States... have the right to regulate, authorize and conduct marine scientific research in their exclusive economic zone and on their continental shelf in accordance with the relevant provisions of this Convention."[42] Because Luke is performing military surveillance and not MSR, Luke may continue its activities in Canada's EEZ.

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[37] UNCLOS at Article 87.

[38] *Id.*

[39] UNCLOS at Article 58.

[40] Simon McKenzie. *Autonomous Technology and Dynamic Obligations: Uncrewed Maritime Vehicles and the Regulation of Maritime Military Surveillance in the Exclusive Economic Zone*, 11 Asian Journal of International Law 146 (2021) [hereinafter Autonomous Technology].

[41] UNCLOS at Article 56.

[42] UNCLOS at Article 246.

Due Regard

Exercising the right to surveillance (or military data collection) is not without limitations. While in Canada's EEZ, Luke must abide by UNCLOS Article 58 paragraph 3 which limits Luke's freedoms to those which maintain due regard for the coastal State. Specifically, it states, "States shall have due regard to the rights and duties of the coastal State and shall comply with the laws and regulations adopted by the coastal State.…"[43]

Due regard is "allowing for the 'accommodation of competing interests' by balancing states' freedom of action with the necessity for self-restraint. States must balance their own freedom of action and claims of jurisdiction against the freedoms and claims of others."[44] In terms of Luke's military surveillance in the area, due regard requires that the execution of surveillance will have no or little impact on Canada's economic and environmental rights as the coastal State. Furthermore, any impact should involve an appropriate balancing of competing rights.[45] Due regard is not clearly defined but rather determined on a case-by-case basis. A balance often is struck when the vessel and the coastal states have conflicting rights.

Due regard applies to both Luke as the vessel and Canada as the coastal State: Canada also must demonstrate due regard for Luke while in its EEZ. Article 56 paragraph 2 states, "the coastal State shall have due regard to the rights and duties of other States and shall act in a manner compatible with the provisions of this Convention."[46] Luke must also have due regard as mentioned in Luke in *International Waters* section (specifically Article 87) and as mentioned in *Luke in Canada's EEZ* (Article 58, paragraph three).

Luke in Canada's Territorial Sea

Coastal States exercise full sovereignty over the territorial sea including the air space above the sea and over the seabed and subsoil. In this zone, the only right that can be exercised by Luke is that of innocent passage. UNCLOS Article 17 states, "ships of all States… enjoy the right of innocent passage through the territorial sea."[47] Article 20 sets requirements for this passage; it states, "In the territorial sea, submarines and other underwater vehicles are required to navigate on the surface and to show their flag."[48] Upon entering Canada's territorial sea, as a submerged vessel, Luke must resurface and be clearly marked and labeled as a U.S. autonomous system.

The most applicable rule for Luke or any vessel while passing through another coastal State's territorial waters is to do so innocently. Article 19 of UNCLOS defines the meaning of innocent passage. It states, "[p]assage is innocent so long as it is not prejudicial to the peace, good order or security of the coastal State. Such passage shall take place in conformity with this

[43] UNCLOS at Article 58, Paragraph 3.
[44] McKenzie, *Autonomous Technology* at 167.
[45] McKenzie, *Autonomous Technology* at 172.
[46] UNCLOS at Article 56, Paragraph 2.
[47] UNCLOS at Article 17.
[48] UNCLOS at Article 20.

Convention and with other rules of international law."[49] Furthermore, the Article identifies activities that are against the peace, good order, and security of the coastal State. Such activities include "any act aimed at collecting information to the prejudice of the defence or security of the coastal State... any act of wilful and serious pollution contrary to this Convention… the carrying out of research or survey activities… [and] any other activity not having a direct bearing on passage."[50] Luke is in compliance with Article 19 as it is not polluting during its passage and, because it has no prior permission from Canada to collect surveillance data, it limited its surveillance to that necessary for safe navigation/passage upon entering the territorial sea.

Legality of Luke Being Taken

Upon entering the Canadian EEZ and before submerging, Luke was taken out of the water by a Chinese warship. China's rationale was that Luke was a navigational hazard and was unlabeled in violation of law. Warships such as the Chinese vessel can pick up an unmanned floating vessel such as Luke and inspect it. However, it may be kept only if it is deemed a navigational hazard and is unlabeled. In this scenario, Luke complied with navigation rules and was properly labeled. Luke was designed in accordance with the navigational, seaworthiness, and safety requirements as outlined in SOLAS and COLREGs. Luke also was correctly labeled and marked via previously completed requirements from SOLAS, COLREGs, and Article 20. Under this scenario, there was no legal basis to take Luke.

IV. Scenario 2: State Waters, Territorial Sea and Environmental Considerations

Littoral operations of UxS are an important asset of the U.S. Navy.[51] The use of both AS and UxS have the potential to enable more efficient operations in both nearshore and offshore waters. Scenario 1 showed the importance of understanding the offshore maritime zones and international boundaries. In Scenario 2, Luke is deployed entirely in U.S. waters. It is released into Monterey Bay, California, which includes nearshore and offshore environments and multi-layered jurisdictions at the local, state, and federal levels. While operating in nearshore environments where there is more natural and human activity, it is important for operators of autonomous and unmanned systems to know the zones at the local, state, and federal level, what is allowed and protected in each of these zones, and the agency or entity with jurisdiction. Scenario 2 addresses these elements and includes discussion of risks including release of hazardous materials and implications of disposable or expendable UxS.

A. Applicable Laws

Guidance from Aerial Systems Regulations

As noted above, regulations are more developed for unmanned systems that operate in the aerial environment. While several agencies have jurisdiction, the lead regulatory agency for

[49] UNCLOS at Article 19.
[50] *Id.*
[51] Unmanned Campaign Framework at 3.

Unmanned Aerial Vehicles is the Federal Aviation Administration (FAA). The extensive federal regulations for aerial AS include definitions, operating rules, rules for operating systems over human beings, and training requirements.[52] The National Oceanic and Atmospheric Administration (NOAA) also has regulations and sanctions around aerial vehicle usage related to marine mammal viewing and for the protection of those animals. The laws applied to aerial systems can provide useful models and lessons learned for the development of laws related to maritime systems.

For example, the National Environmental Policy Act (NEPA) requires federal agencies to ensure that environmental considerations are factories into their decision-making processes.[53] For the FAA, "the NEPA process ensures that:

- FAA decision makers understand the potential environmental impacts of proposed authorizations;
- FAA fully discloses the potential impacts to the human environment from the proposed activities; and
- FAA evaluates the reasonable alternatives to the proposed activities."[54]

The NEPA process will apply to federal agencies and AS or UxS in the maritime environment as well. In addition, consultation and permits may be needed for operation of AS or UxS under other laws such as the Endangered Species Act (ESA)[55], Marine Mammal Protection Act (MMPA)[56] and Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act or MSA).[57] Over time, the more mature regulations related to aerial systems may help develop policies and regulations under these laws for the maritime environment.

It is important to note that while these systems must comply with these laws, they can also help meet the laws' goals. For instance, passive acoustic technology has been combined with an autonomous system to monitor more effectively and protect the North Atlantic Right Whale, ones of the most endangered whale species in the world.[58] This aligns an autonomous system with the goals of the MMPA and ESA. In addition, NOAA Fisheries, which is the primary agency to implement the MSA, has included remote and unmanned systems sampling

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[52] 14 C.F.R. § 107.

[53] NEPA reviews must be completed for actions that could cause reasonably foreseeable effects on the human environment, whether the actions are taken by the agency itself or the actions are taken by non-government actors seeking federal agency authorization. For NEPA analysis in the context of the FAA and drones, see Federal Aviation Administration, *National Environmental Policy Act and Drones*, https://www.faa.gov/uas/advanced_operations/nepa_and_drones/ (last visited Dec 29, 2021).

[54] *Id.*

[55] 16 U.S.C. §§ 1531 – 1544.

[56] 16 U.S.C. §§ 1361 – 1407.

[57] 16 U.S.C. §§ 1801 – 1891.

[58] Florida Atlantic University, *'Whoop' – New Autonomous Method Precisely Detects Endangered Whale Vocalizations*, News Wise, September 15, 2021.

and monitoring into its climate science strategy.[59] The increase in use of these systems for these goals can further understanding about how to best manage their use in the maritime environment.

Environmental Risks and Hazards in the Maritime Environment

As noted, underwater AS can contribute to scientific understanding and environmental monitoring, but their use also come with potential environmental and ecological hazards which can be challenging to overcome especially in the maritime environment. These include introducing noise into the maritime environment, unintended release of hazardous substances, damage to sensitive habitat or harmful interactions with marine mammals.

Many AUVs are equipped with an array of sensors including types of sonar. The use of sonar aboard an AUV can impact marine mammals. The anthropogenic sound exposure could interfere with the animal's spatial awareness, cause potential hearing loss or stranding, and interference with abundance of prey.[60] While the use of sonar from an AUV is presumably at a smaller scale than a ship-based sonar, the risk is still evident. Operators will need to ensure the sound does not constitute harassment under the MMPA and seek consultation and permits as needed.

Given the hazardous materials that make up batteries and other technology used on AUVs, the ability to recover lost or broken devices is important and should be factored into the programming and building phase of the AUV. Although there is no current requirement for permitting regarding batteries aboard UxS in the maritime environment, NOAA's Office of Protected Resources and NOAA Fisheries have guidance for scientific research using small, unmanned aircraft systems. In the permitting process, it includes the requirement of information about the battery life aboard the unmanned aerial system.[61] This legal framework may be a model for underwater vehicles to account for the types of batteries being placed into the environment and what the battery composition is. In the case of discharges into U.S. waters, the Clean Water Act[62] will apply and in cases of unclaimed or lost underwater autonomous systems (like Luke), the Marine Debris Act[63] directs NOAA to identify, determine sources of and remove marine debris.

In many coastal areas, there are existing protected or managed marine areas that can affect how a system may be operated. In Scenario 2, Luke is released into Monterey Bay which

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[59] Link, Jason S., Roger Griffis, Shallin Busch (Eds.), *NOAA Fisheries Climate Science Strategy* (2015) at 42.

[60] Zeddies, D.G., M. Zykov, H. Yurk, T. Deveau, L. Bailey, I. Gaboury, R. Racca, D. Hannay, and S. Carr. 2015. *Acoustic Propagation and Marine Mammal Exposure Modeling of Geological and Geophysical Sources in the Gulf of Mexico: 2016–2025 Annual Acoustic Exposure Estimates for Marine Mammals*. *See also* Parsons, E.C.M.. *Impacts of Navy Sonar on Whales and Dolphins: Now beyond a Smoking Gun?*, 4 Frontiers in Marine Science 295 (2017).

[61] National Oceanic and Atmospheric Administration Office of Marine and Aviation Operations, *NOAA Unmanned Aircraft Systems* (2017), https://www.omao.noaa.gov/sites/default/files/documents/NOAA%20UAS%20Handbook.pdf (last visited Dec 29, 2021).

[62] 33 U.S.C. §§ 1251 – 1388.

[63] 33 U.S.C. §§ 1951 – 1959.

is part of the Monterey Bay National Marine Sanctuary. The Sanctuary includes prohibited and regulated activities such as:

> (4) Drilling into, dredging, or otherwise altering the submerged lands of the Sanctuary; or constructing, placing, or abandoning any structure, material, or other matter on or in the submerged lands of the Sanctuary, except as incidental and necessary…
>
> (9) Deserting a vessel aground, at anchor, or adrift in the Sanctuary.
>
> (10) Leaving harmful matter aboard a grounded or deserted vessel in the Sanctuary.[64]

While the regulations were not written specifically for the release of AS, they apply to a lost or abandoned system in the Sanctuary as they may cause harm to marine mammals, discharge of battery chemicals, and/or other ecological or environmental damage. One way to mitigate potential harmful waste from AS is to explore alternative fuel options; new non-toxic and sustainable battery technologies include sulfur, aluminum, and seawater powered batteries that would mitigate the impact on the ocean and coastal environment.

The habitat in these areas may also be a concern: the MSA calls for identification and protection of Essential Fish Habitat (EFH) to support the biological sustainability of marine fisheries.[65] The MSA directs NOAA Fisheries to minimize adverse effects on EFH from certain activities and directs other federal agencies, including the Navy, to consult with NOAA Fisheries on any potential actions that may adversely affect EFH. Under the MSA, an adverse effect is direct or indirectly physical, chemical, or biological alterations that include changes to waters or substrate, species and their habitat, other ecosystem components and the quality and/or quantity of EFH.[66] Autonomous system operators can seek digital maps online to understand where EFH is located and how that habitat may overlap with habitat of protected species.

B. Luke's Deployment in Monterey Bay

To put these laws into context, Scenario 2 places Luke in Monterey Bay, California to conduct a research mission. Because Luke's second mission occurs entirely within U.S. waters (in fact, entirely within the U.S. territorial sea), there is no international concern with Luke's activities. However, like many coastal areas, there are several special zones and overlapping jurisdiction to be aware of.

As noted above, Monterey Bay is included in the Monterey Bay National Marine Sanctuary (MBNMS). Created by federal law, the MBNMS encompasses a shoreline length of 276 miles stretching from north of San Francisco to south of Big Sur. The entire area is over

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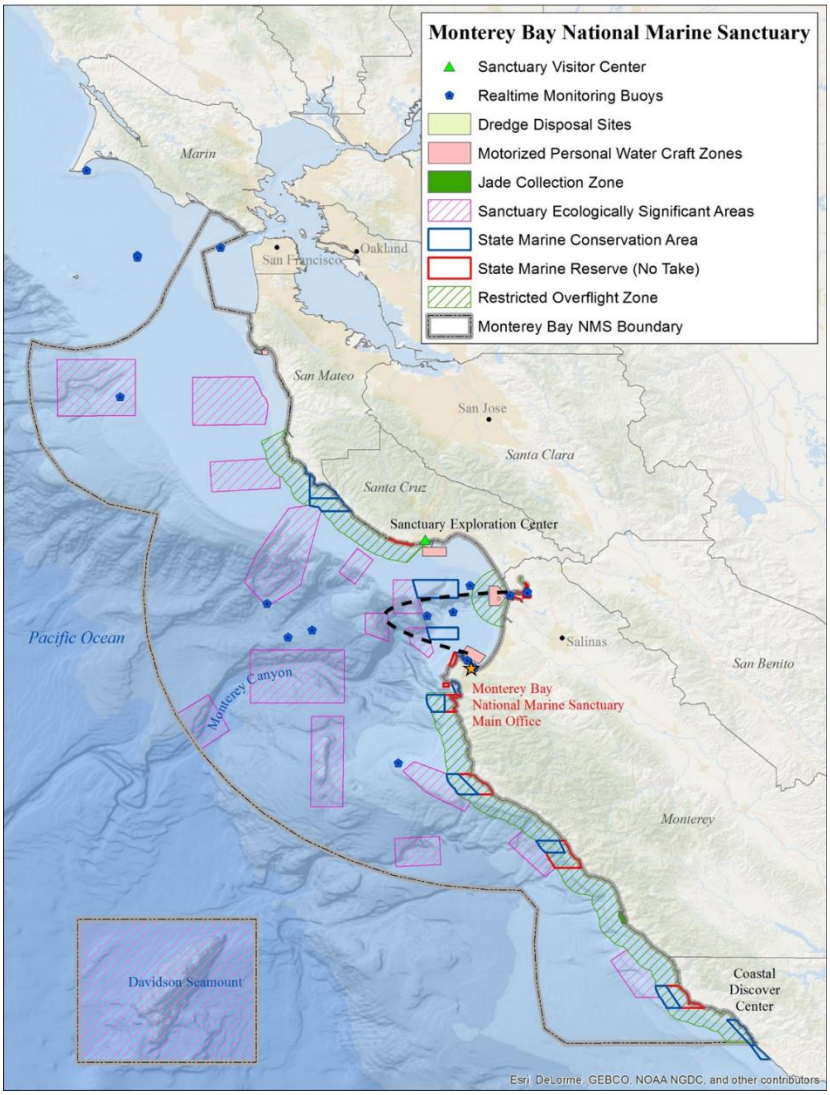
[64] Monterey Bay National Marine Sanctuary, 15 CFR § 922.

[65] 16 U.S.C. §§ 1801 - 1891(d).

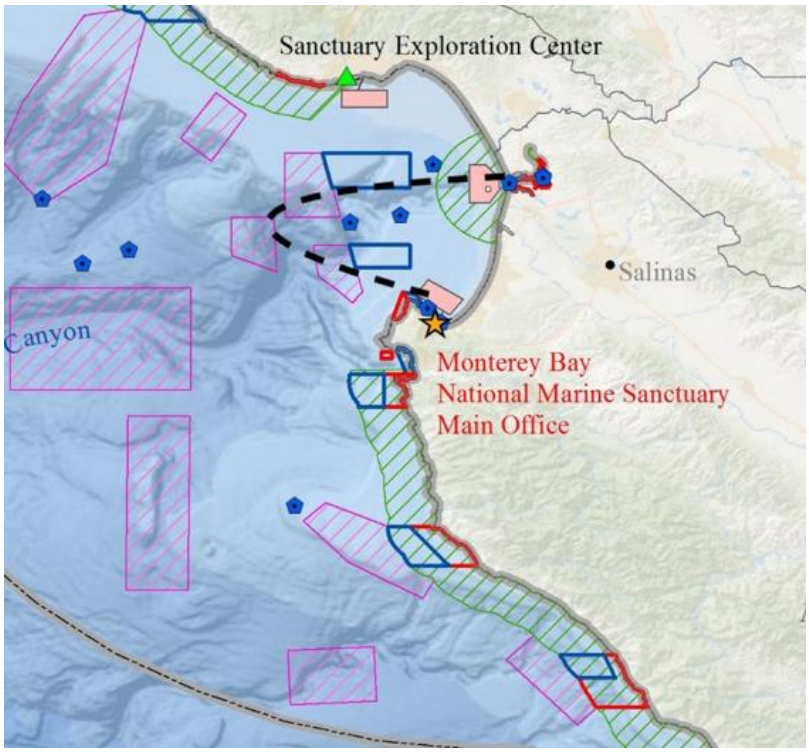
[66] NOAA Fisheries, *Consultations for Essential Fish Habitat,* https://www.fisheries.noaa.gov/national/habitat-conservation/consultations-essential-fish-habitat (last visited Dec 29, 2021).

6,000 square miles and extends about 30 nautical miles oceanward of California.[67] Within the bay, there are multiple areas that are designated as special areas or reserves; these areas have different managed uses and other restrictions and are governed by multiple jurisdictions and agencies. In Scenario 2, Luke travels from the Monterey Bay Aquarium Research Institute in Moss Landing, through the Monterey Canyon, and ends its mission at Hopkins Marine Station in Pacific Grove; this mission is shown on the maps below, denoted with the bold dashed black line.



Map 2: MBNMS boundaries variety of managed areas in Monterey Bay / Source: NOAA

[67] Monterey Bay National Marine Sanctuary, 15 CFR § 922.



Map 3: Insert from Map 1 enlarged to show Luke's path / Source: NOAA

On its journey, Luke exits the Moss Landing harbor, transiting through a Restricted Overflight Zone; this zone requires that motorized aircraft stay above a minimum altitude to avoid disturbing wildlife.[68] There is also a Motorized Personal Water Craft (MPWC) Zone. Should Luke cause an accident or damage to a vessel while in the MPWC, the NOAA Office of Law Enforcement holds the primary responsibility for the enforcement of sanctuary regulations, as well as throughout the entire MBNMS Boundary. An agreement is established with the US Coast Guard, the California Department of Fish and Wildlife, the California Department of Parks and Recreation, and any other pertinent agencies to assist with enforcement as needed.[69]

Along the shore of Moss Landing lies The Moss Landing Marine Laboratories' (MLML) Scientific Seawater Intake Monitoring Station,[70] annotated and classified as a Realtime Monitoring Buoy. Another monitoring buoy exists in the vicinity of Luke's path. This buoy is identified as Station 46092 – MBM1 (an offshore mooring equipped with ocean-monitoring sensors)[71] and is owned and maintained by MBARI, a private, nonprofit research center. Should any collision or damage occur, NOAA and MLML would be involved.

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[68] Overflight Rules and Regulations for the Channel Islands, Monterey Bay, Gulf of the Farallones, and Olympic Coast National Marine Sanctuaries, 15 CFR § 922.

[69] Monterey Bay National Marine Sanctuary, *Resource Management Issues: Motorized Personal Watercraft FAQ*, https://montereybay.noaa.gov/resourcepro/resmanissues/mpwc/faq.html#mpwc_faq14 (last visited Dec 29, 2021).

[70] Moss Landing Marine Laboratories [hereinafter MLML], *MLML Public Data Portal*, http://pubdata.mlml.calstate.edu/seawater/index.php (last visited Dec 29, 2021).

[71] Monterey Bay Aquarium Research Institute, *CeNCOOS Data Portal*, https://data.cencoos.org/#metadata/20716/station, (last visited Dec 29, 2021).

Once Luke travels into the deep abyss of the Monterey Submarine Canyon, it will encounter multiple sites marked as Sanctuary Ecologically Significant Areas (SESAs) as well as State Marine Conservation Areas. Although these areas are under the same regulations as the MBNMS, they are designated as "areas that encompass remarkable, representative, and/or sensitive marine habitats, communities, and ecological processes… are focal areas for facilitating research with partners in order to better understand natural and human-caused variation, as well a resource protection."[72]

Given Luke's proximity to the California coast, there are state and local regulations that will apply. One of the areas Luke travels through is the Pacific Grove Marine Gardens Conservation Area. This California marine protected area is relatively small; however, it was strategically placed along the border of two other Marine Reserves (Asilomar and Lovers Point-Julia Platt) to establish continuity and an "interconnected network that would help to preserve the flow of life between marine ecosystems."[73] Within this area, it is unlawful to "injure… any living, geological, or cultural marine resource."[74] Should Luke cause harm to an animal or other listed element of the area, the CADFW would have jurisdiction in responding.

It is important to note that researchers release AS into Monterey Bay on a regular basis, generally without any harm to habitat, marine wildlife, or other maritime users. The overlapping jurisdictions and variety of protected areas do not prohibit – nor generally hinder in any way – the operation of these systems; in fact, the value of these systems for research purposes is highlighted in many policy documents and regulations. Legally, however, it is valuable to understand the location of these areas, the agency with primary jurisdiction should damage occur, and a general awareness of the ecological sensitivity and/or specialized uses present in the areas.

C. Future Questions Regarding Unmanned Systems

While unmanned systems can be both cost effective and safer than alternative manned systems, the use of disposable (or "expendable") UxS can give an even greater benefit. Current use and development of autonomous expendable devices are more robust in aerial environments. Examples of these systems include the Lagrangian microsensors (disposable microsensors that are deployed via UAV) and the Close-In Covert Autonomous Disposable Aircraft (CICADA). The CICADA is described as "a concept for a low-cost, GPS-guided, micro disposable air vehicle that can be deployed in large numbers to 'seed' an area with miniature electronic

[72] Monterey Bay National Marine Sanctuary, 15 CFR § 922 (2021).

[73] California Marine Protected Areas, *Pacific Grove Marine Gardens State Marine Conservation Area* (2021).

[74] Cal. Code Regs. tit. 14 § 632 (available at https://wildlife.ca.gov/Conservation/Marine/MPAs/Network/Central-California#27248551-pacific-grove-marine-gardens-state-marine-conservation-area).

payloads."[75] Although these systems work in tandem with an autonomous aerial vehicle, they are not intended to be retrieved at the end of their use.

There are parallels between aerial usage of disposable autonomous vehicles and that of developing disposable autonomous underwater vehicles. There is currently a gap in assessing the legal and environmental risks of disposable systems in both the air and maritime environments. This research team will dive deeper into answering the questions and applications of laws regarding expendable systems in 2022.

V. Conclusion

The policy/legal area of autonomous and unmanned systems is evolving, particularly in the adoption of regulations specific to unmanned and autonomous systems. While most laws applying to these systems were not written specifically for the systems, there are laws that apply and provide guidance for design and operations. Under Scenario 1, there is general agreement that several international maritime conventions - namely UNCLOS, SOLAS and COLREGs - apply to AS and UxS. Because these conventions were written prior to the advent of advanced autonomous technology, their application is not exact and provisions may still be debated, especially at the international level. Similarly, under Scenario 2, there are U.S. laws at the federal, state, and local level that will apply depending on the activity and where the system is operating. Similarly, these laws also were not written for these systems, but they offer a legal framework for the operation of AS and UxS in various maritime zones domestically and internationally.

The rapidly evolving technology of these systems challenges the law; law and policy will lag the technology development. However, a more coordinated approach can fill these gaps quicker; interdisciplinary approaches that include law, policy, ethics, engineering, computer science and other relevant disciplines can help laws and policies to evolve, clarifying how they apply and ensuring systems' design and operations meet the current legal and ethical principles.

Research and collaboration for this research project revealed specific legal questions and policy concerns that arise often in Navy and DoD work, the need to address potential environmental hazards resulting from expendable UxS and international legal questions arising in the classified environment. Analysis can inform those setting policy and those designing and operating UxS and offer a better understanding of applicable law and potential consequences. These issues will be pursued in Year 2 of the project.

[75] Edwards, Daniel J., Aaron D. Kahn, Stearns B. Heinzen, Trenton Z. Young, Nicholas J. Arnold, Christopher S. Bovais, and Daniel Newton. *CICADA Flying Circuit Board Unmanned Aerial Vehicle* (2018), https://doi.org/10.2514/6.2018-1008 (last visited Dec 29, 2021).