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Secrets of the Deep: Defining Privacy Underwater

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The drones are coming.[1] *But not just to your neighborhood skies – to the world's oceans. From recreational robots designed to autonomously follow divers and record video of them to low-cost, remotely operated submersibles that put ocean exploration in the hands of the general public to sophisticated military submersibles able to autonomously gather intelligence throughout the oceans, the underwater drone market is exploding. But unlike on land, this explosion has not been accompanied by similar discussion of privacy concerns. Instead, the ocean's rapid shift away from an inaccessible operational sanctuary is one that is happening largely silently. And it is one that is happening in an economically critical environment with far fewer legal protections in place than on land. This Article examines this monumental shift, exploring for the first time privacy and trade secret protections from underwater surveillance. I argue that privacy protections are already unconstitutionally eroded underwater and must be strengthened in the face of widespread drone use.*

INTRODUCTION

"The ocean's mysteries will not remain hidden from rapidly developing technology . . . ." – Mary Ann Becker[2]

In 1948, oceanographer F.P. Shepard famously stated that we knew more "about the surface of the moon than about the vast areas that lie beneath three-fourths of the surface of our own planet."[3] Seventy years later, this statement remains largely true.[4] Historically, spatial and technological constraints have limited underwater exploration to highly funded commercial and military ventures.[5] But today these barriers to entry are changing. As drone technologies become cheaper and more powerful, underwater exploration is blossoming in

1. Robert Molko, *The Drones Are Coming! Will the Fourth Amendment Stop Their Threat to Our Privacy?*, 78 BROOK. L. REV. 1279 (2013); Megan Garber, *The Drones Are Coming: The FAA Just Issued the First Permit for Commercial UAV Operation*, ATLANTIC (June 10, 2014), https://www.theatlantic.com/technology/archive/2014/06/the-faa-just-approved/372508/; Jonathan Hunter, *The Drones Are Coming*, HILL (Sept. 27, 2016), http://thehill.com/blogs/congress-blog/homeland-security/297879-the-drones-are-coming.

2. Mary Ann Becker, Comment, *Regulating the Business of Culture: The Abandoned Shipwreck Act – Can Preservationists, Salvors, and Divers Sail in Calmer Waters?*, 51 DEPAUL L. REV. 569, 603 (2001).

3. F.P. SHEPARD, SUBMARINE GEOLOGY (1948).

4. Hilary Brueck, *Humans Are About to Touch the Deepest Corners of the Ocean for the First Time – An Endeavor as Dangerous as Landing on the Moon*, BUS. INSIDER (Oct. 28, 2018), https://www.businessinsider.com/submarine-to-visit-deepest-parts-of-the-ocean-in-five-deeps-expedition-2018-10.

5. Laurence Reza Wrathall, Comment, *The Vulnerability of Subsea Infrastructure to Underwater Attack: Legal Shortcomings and the Way Forward*, 12 SAN DIEGO INT'L L. J. 223, 236–37 (2010).

what some have called the "inner space race."[6] The advent of widely available underwater vehicles has not only expanded the commercial possibilities but for the first time put remotely operated submersibles in the hands of the general public.[7] Recreational drones carry high-resolution cameras and allow exploration of underwater shipwrecks and other features previously accessible only to highly technical dive teams or commercial submersibles.[8] As the founders of OpenROV, one of the first companies to manufacture these drones, put it, their goal is to create "a lot more eyes in the ocean."[9]

The magnitude of this shift should not be downplayed. Historically, underwater areas have been defined by the very absence of human eyes.[10] Vast spaces coupled with logistical difficulties have established the ocean as an "operational sanctuary" where even the most unsophisticated vessels and operators are unlikely to be detected.[11] Marine operations have long taken advantage of this fact, relying on their environment to ensure the secrecy of commercially and militarily critical equipment.[12] Underwater drone use is changing this status quo, and that fact's importance has been recognized by both military[13] and commercial[14] interests. The global oceans are a crucial part of the global economy, through commercial fishing, underwater mining, shipping, oil and gas extraction, and a host of other uses.[15] As the number of eyes in the ocean increases, new legal questions also arise about where and how these eyes can be used and whether they will interfere with the existing uses that have relied on secrecy for so long.

These questions have gone essentially unexplored in relation to underwater drones, but this is not the case with aerial drones. Aerial drones have seen an even more dramatic explosion in availability and use, prompting considerable discussion among scholars and policymakers on what privacy limits exist to prevent aerial drone surveillance.[16] Aerial drones, like underwater drones,

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6. Robert L. Wernli, *AUV Commercialization – Who's Leading the Pack?*, *in* OCEANS 2000 MTS/IEEE: CONFERENCE PROCEEDINGS 391, 394 (2000).

7. John Markoff, *A Drone Start-Up Explores Underwater*, N.Y. TIMES (June 26, 2016), http://www.nytimes.com/2016/06/27/technology/a-drone-start-up-explores-underwater.html.

8. *Id.*

9. *Id.*

10. *See* Wrathall, *supra* note 5, at 234.

11. *Id.*

12. *See id.* at 234–35. For example, telecommunications infrastructure is placed in this environment. *Id.*

13. *See* Andrew H. Henderson, *Murky Waters: The Legal Status of Unmanned Undersea Vehicles*, 53 NAVAL L. REV. 55, 57–58 (2006).

14. Wrathall, *supra* note 5, at 237–39.

15. OVE HOEGH-GULDBERG ET AL., WWF, REVIVING THE OCEAN ECONOMY: THE CASE FOR ACTION – 2015 at 7, 23 (2015), http://assets.worldwildlife.org/publications/790/files/original/Reviving_Ocean_Economy_REPORT_low_res.pdf.

16. *See, e.g.*, M. Ryan Calo, *The Drone as Privacy Catalyst*, 64 STAN. L. REV. ONLINE 29, 32 (2011); GREGORY MCNEAL, DRONES AND AERIAL SURVEILLANCE:

are able to access areas that were previously inaccessible – the low airspace above people's homes, for instance. This novel access has prompted extensive debate about the limits of private property and privacy interests in these previously inaccessible areas.[17]

Underwater drones prompt the same questions, though if aerial drones are notable for the sheer volume of privacy discussions they have spurred, underwater drones are notable for the opposite. The question of privacy rights at sea has received essentially no attention in the academic literature. Just as the clear limits of ownership above a person's property had no reason to be fully considered prior to the advent of aerial drones, so too has there been no reason to consider the extent of privacy and personal property underwater. As such, the legal regime of underwater privacy is a sketchy outline at best.

Intuitively, privacy in the oceans may seem a relatively esoteric question: unlike aerial drones where the potential privacy infringements are obvious and widespread,[18] the underwater implications are less clear. People do not have homes and correspondingly sacrosanct privacy rights underwater. However, the commercial, military, and recreational uses of the ocean represent a substantial and strategically crucial portion of our national economy.[19] From deep-sea drilling to aquaculture to undersea pipelines, a significant amount of commercial, recreational, and military activity happens underwater.[20] These activities have taken place out of sight of the public until now, with operators relying on secrecy both to disguise important commercial processes as well as hide in many cases flagrant law-breaking.[21] The potential for their surveillance raises serious concerns for many entities, and drone use has the capacity to completely change methods of operation in the underwater environment.

In just one example of how drones are changing marine operations, drones are increasingly being used to claim possession over sunken ships under the maritime law of finds and salvage. Historically, divers were often placed in extreme peril to find and claim sunken ships once treasure hunters had located them.[22] Today, drones have replaced divers both in searching for historical vessels as well as in legally claiming these vessels for salvors under maritime law.[23] Courts have found that "seeing" a shipwreck on a drone's video feed is

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CONSIDERATIONS FOR LEGISLATURES 2–4 (2014), https://www.brookings.edu/wp-content/uploads/2016/07/Drones_Aerial_Surveillance_McNeal_FINAL.pdf.

17. *See, e.g.*, Calo, *supra* note 16, at 32; MCNEAL, *supra* note 16, at 2–4.

18. MCNEAL, *supra* note 16, at 2–3.

19. *See, e.g.*, Wrathall, *supra* note 5, at 225–30 (discussing critical infrastructure in the ocean).

20. *See id.*

21. *See, e.g.*, Ian Urbina, *The Outlaw Ocean*, N.Y. TIMES (July 25, 2015), https://www.nytimes.com/interactive/2015/07/24/world/the-outlaw-ocean.html.

22. *See* Drew F.T. Horrell, Note, *Telepossession Is Nine-Tenths of the Law: The Emerging Industry of Deep Ocean Discovery*, 3 PACE Y.B. INT'L L. 309, 312–13 (1991).

23. *Id.* at 310–13, 321–22.

sufficient to establish a right to a ship,[24] creating an easy avenue for treasure hunters to make salvage claims. Courts have long upheld salvage claims based on Remotely Operated Vehicle ("ROV") observation: in 1989, the U.S. District Court for the Eastern District of Virginia famously found that telepresence established the right to the deep (and abundant gold-filled) shipwreck of the S.S. Central America.[25] This decision made telepresence capabilities an important part of salvage and had huge economic impacts on the marine salvage industry. In 1989, for example, the U.S. government "found" a shipwreck using a ROV and subsequently sold the salvage rights it had acquired to private investors to carry out salvage.[26] At the time this was revolutionary, but today the widespread availability of underwater drones makes buying and selling of underwater rights possible on a far grander scale. Treasure hunters in particular are afraid of competition for claims, as drones expand the possibilities for salvage claims to members of the public who were previously financially or logistically foreclosed from engaging in treasure-hunting activities.[27] Furthermore, this expansion also raises significant privacy and commercial confidentiality concerns. Traditionally, treasure hunting was a highly guarded, secret enterprise.[28] Public surveillance of the shipwrecks, their contents, and the retrieval methods has led to extremely heated disputes, and increasing surveillance by drones is likely to do the same.[29]

As underwater drones are becoming widely availability, questions about how underwater interests may be protected from outside surveillance are timely and novel. This Article addresses these issues, drawing on analogues from privacy discussions about aerial drones to understand what protections, if any, there may be from surveillance by drones operating underwater. In Part I, I give background information on the types and capabilities of drones currently operating in the marine environment. I also lay out the characteristics of existing maritime entities operating at sea and examine how they may be susceptible to drone surveillance. In Part II, I ask what personal privacy and commercial confidentiality rights these entities may have under existing U.S. law, addressing both public and private regimes. Part III looks at these rights in international waters under the the United Nations Convention on the Law of the Sea

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24. *Id.* at 338.

25. *Id.* at 338–342.

26. *Id.* at 355 n.200.

27. *See* Jeff Hecht, *Military Robot Subs Seek Out Sunken Treasure*, NEWSCIENTIST (May 27, 2008), https://www.newscientist.com/article/dn13990-military-robot-subs-seek-out-sunken-treasure/ (discussing cheaper underwater autonomous vehicles and their use to explore wreck sites without alerting competition).

28. *See* Terry Aguayo, *A Bountiful Undersea Find, Sure to Invite Debate*, N.Y. TIMES (May 19, 2007), https://www.nytimes.com/2007/05/19/us/19treasure.html (noting the secrecy involved with the find of a shipwreck).

29. *See* Frances Robles, *With Shipwreck Treasure Easier to Reach, a Duel Is On*, N.Y. TIMES (Nov. 30, 2015), https://www.nytimes.com/2015/12/01/us/with-shipwreck-treasure-easier-to-reach-a-duel-is-on.html (discussing "whether private companies should be able to claim and profit from historic treasures.").

("UNCLOS"). I find that our underwater privacy regimes are extremely weak in the face of Unmanned Undersea Vehicles ("UUV") surveillance and that the regimes protect far fewer rights for entities operating at sea than for comparable entities on land. I argue that judicial interpretation of privacy rights at sea to date has been dangerously eroded and that courts must strengthen these privacy protections before UUV surveillance becomes a maritime norm.

I. PRIVACY AT SEA: THE LAY OF THE LAND

The underwater environment is significantly different, both in legal governance and in practical aspect, than the terrestrial environment that most are familiar with. This Part addresses these differences, explaining what drone technologies exist currently as well as key aspects of the marine environments that they operate in. In the maritime world, perhaps more so than any other, the environmental characteristics inform the legal regime. Understanding these unique characteristics is critical to any analysis of the law governing this space.

A. Drones at Sea: The Current State of the Field

Aerial drones may be the more visible and prevalent form of drones currently, but maritime robots have been around for longer, making critical contributions to the marine economy.[30] Remote vessels at sea can be traced all the way back to 1898 when Nicholas Tesla demonstrated the first-ever use of radio waves to remotely control a moving object.[31] The object that Tesla controlled in what some have called "the birth of modern robotics" was a boat floating on a pond in Madison Square Garden.[32] This is illustrative not just of the long history of robots at sea but also of the important, but not necessarily intuitive, fact that in many key ways operating robots at sea is significantly easier than operating them on land.[33] Water for the most part lacks the trees, rocks, or

30. G. R. Shaw, *The Rise of the Predator Empire: Tracing the History of U.S. Drones*, UNDERSTANDING EMPIRE (2014), https://understandingempire.wordpress.com/2-0-a-brief-history-of-u-s-drones/.

31. *Id.*

32. *Id.*

33. *See* James A.R. Nafziger, *The Titanic Revisited*, 30 J. MAR. L. & COM. 311, 311 (1999).

other moving vehicles that make operation in terrestrial environments difficult.[34] This combined with the operational need for innovative robotic technologies has led to a long and robust history of remotely controlled vehicles at sea.[35]

Before delving into this history and the current capabilities of robots in the marine environment, a quick note on terminology is helpful. For the purposes of this Article, I will primarily be discussing underwater drones, or "[s]elf-propelled submersible[s] whose operation is either fully autonomous (pre-programmed or real-time adaptive mission control) or under minimal supervisory control and is untethered except, possibly, for data links such as a fiber optic cable."[36] Like many emerging technologies, these autonomous submersibles are called many different things by different entities. They are most commonly known as UUVs, Autonomous Underwater Vehicles ("AUV"s), and ROVs.[37] These all share the fundamental characteristics of being unmanned mobile submersible vehicles.[38] The differences between the categories lie in how they are controlled: remotely (ROVs – generally requiring a cable to the surface) or autonomously (AUVs).[39] For the purposes of this Article, I will use the broadest definitions – underwater drone or UUV – to encompass both remotely controlled and autonomous underwater vehicles. In the few cases where the type of control a UUV is under matters to my legal conclusions, I make this clear.

1. Characteristics of UUVs

UUVs are already prevalent in the marine environment. For many, operating robots at sea remains considerably easier than comparable operations on land.[40] At the same time, despite our best efforts, the ocean remains a relatively

34. The current ongoing efforts to create self-driving cars illustrate this on-land complexity. *See* John Markoff, *A Guide to Challenges Facing Self-Driving Car Technologists*, N.Y. TIMES (June 7, 2017), https://www.nytimes.com/2017/06/07/technology/autonomous-car-technology-challenges.html.

35. *See* William J. Broad, *Undersea Robots Open a New Age of Exploration*, N.Y. TIMES (Nov. 13, 1990), https://www.nytimes.com/1990/11/13/science/undersea-robots-open-a-new-age-of-exploration.html.

36. Henderson, *supra* note 13, at 56 (alterations in original) (quoting U.S. DEP'T OF NAVY, THE NAVY UNMANNED UNDERSEA VEHICLE (UUV) MASTER PLAN 4 (2004), https://www.navy.mil/navydata/technology/uuvmp.pdf).

37. *Id.*

38. *Id.*

39. Stephanie Showalter, *The Legal Status of Autonomous Underwater Vehicles*, 38 MARINE TECH. SOC'Y J. 80, 80 (2004); *see also* Robert L. Wernli, *AUV's – The Maturity of the Technology*, SPACE & NAVAL WARFARE SYS. CTR. (May 2000), http://auvac.org/uploads/publication_pdf/AUV'S%20-%20The%20maturity%20of%20the%20technology.pdf.

40. For example, an autonomous car requires an extremely high degree of precision in its movements and reactions to successfully navigate crowded city streets. *See* Norman Mayersohn, *The Computer Chauffeur Is Creeping Closer*, N.Y. TIMES (Oct.

inaccessible environment for humans. This may seem obvious, but the corollary that follows is an important one: to reach the majority of the ocean, the only option has been to develop innovative technologies to support or replace human explorers. Unlike terrestrial environments, where even the harshest environments are open to humans with the proper exposure protection, the ocean remains effectively closed without extensive life support systems – or as is increasingly the case, without robotic equipment.

This physical reality has had important consequences for the state of robotics in the ocean. While the development of autonomous systems specifically at sea has roughly followed the timeline we see on land, ROVs have existed in the marine environment and (uniquely) been used by non-military entities for far longer.[41] These ROVs have had crucial scientific,[42] cultural,[43] and military roles,[44] from the discovery of the Titanic[45] to widespread clearing of underwater mines.[46] The sophistication in ROVs accreted over decades of use is crucial to understand, as it forms the basis for the explosion of semi-autonomous and autonomous UUVs that we see today. ROVs have been developed to complete increasingly complex and specialized tasks; the addition of autonomous governing systems to this technological framework creates today's UUVs.[47]

It is helpful to think about the capabilities of undersea robots along four spectrums: sensory, manipulative, communication/control, and propulsion. I delve into these capabilities here to illustrate clearly what exactly current UUVs can do.

19, 2018), https://www.nytimes.com/2018/10/19/automobiles/the-computer-chauffeur-is-creeping-closer.html. Contrast that with a UUV operating essentially alone in the midst of miles of water. *See* Brendan Gogarty & Meredith Hagger, *The Laws of Man over Vehicles Unmanned: The Legal Response to Robotic Revolution on Sea, Land and Air*, 19 J.L. INFO. & SCI. 73, 79 (2008). Things are not always this simple, however, and strategic requirements generally will place drones in significantly more congested areas such as ports. *See id.* at 92–93 (discussing increasingly advanced unmanned surface vehicles that could operate in semi-autonomous mode and the use of UUVs in "all aspects" of the Navy).

41. Gogarty & Hagger, *supra* note 40, at 76–81 (describing the history of unmanned vehicle development).

42. *See, e.g.*, Wernli, *supra* note 6, at 392.

43. *See, e.g.*, Ian Sample, *New Technologies Bring Marine Archaeology Treasures to Light*, GUARDIAN (Dec. 29, 2016), https://www.theguardian.com/science/2016/dec/29/new-technologies-bring-marine-archaeology-treasures-to-light.

44. *See, e.g.*, Daniel A.G. Vallejo, Note, *Electric Currents: Programming Legal Status into Autonomous Unmanned Maritime Vehicles*, 47 CASE W. RES. J. INT'L L. 405, 408–09 (2015).

45. Nafziger, *supra* note 33, at 212.

46. Wernli, *supra* note 39; *see also* Richard F. Dole, Jr., *The Contours of American Trade Secret Law: What Is and What Isn't Protectable as a Trade Secret*, 19 SMU SCI. & TECH. L. REV. 89 (2016).

47. *See* Wernli, *supra* note 6, at 392.

The longest standing and most complex use of ROVs in the undersea environment has been as passive sensing devices.[48] The vast and opaque nature of the ocean has made this role particularly valuable for both commercial and militarily strategic purposes.[49] Today, the majority of robots undersea are equipped with extensive sensory arrays.[50] The most obvious of these are cameras that capture the visual environment that the robot is operating in. However, low light and high turbidity often combine in marine environments to yield very low visibility conditions. This can be combatted with high-powered lights; however, bright lights have very high energy costs and may be impractical for long-term monitoring tasks. Relying on vision often yields only a limited picture of underwater activities.

The constraints on visual sensing in the marine environment mean that the majority of marine robots are equipped with significant additional sensory equipment. The scope of this sensory equipment in turn significantly expands the scope of potential privacy violations.[51] Sensory equipment varies greatly depending on the role of the robot, but standard marine robots are likely to be equipped with auditory, pressure, and temperature sensors in addition to more specialized equipment to determine the oxygen content, color, salinity, pH, and other standard oceanographic measures of the water surrounding the robot.[52] This data gives the robot a more comprehensive picture of the water column, the vertical stretch of water between the surface and the seafloor surrounding it, which is not only useful for information gathering purposes but is often also critical for the operation of the robot as it regulates its buoyancy.[53] The average UUV today is equipped with a vast suite of sensory equipment able to collect highly detailed information about the environment around it, which raises significant questions about what, if any, legal limits exist over what UUVs can monitor.

In addition to the sensing capabilities of UUVs, much technological effort is currently focused on increasing the ways that undersea robots are able to actively engage with the environment around them. Robots with sophisticated arms have been crucial tools in the recovery of treasure and other wreckage

48. *See* Gogarty & Hagger, *supra* note 40, at 79.

49. *See* Wrathall, *supra* note 5, at 234–35.

50. *See, e.g.*, *Virginia Tech Researchers Unveil Large Robotic Jellyfish that One Day Could Patrol Oceans*, VA. TECH. DAILY (Apr. 3, 2013), https://www.vtnews.vt.edu/articles/2013/04/040313-engineering-robotjelly-fishcyro.html.

51. Contrast this to the present situation with aerial drones, where visual privacy is far and away the largest privacy concern being discussed. *See, e.g.*, Calo, *supra* note 16, at 30.

52. *See, e.g.*, *Flexible Design Supports Wide Range of Sensors and Payloads*, LIQUID ROBOTICS, https://www.liquid-robotics.com/wave-glider/supported-sensors/ (last visited Mar. 5, 2018).

53. *See, e.g.*, *id.*

deep at sea.[54] Commercial operators rely on similar robots to inspect and maintain deep-sea infrastructure.[55] The capabilities of UUVs to interact with their surroundings vary greatly.[56] While less interesting in the specific context of privacy, and therefore largely outside the scope of this Article, the manipulative abilities of UUVs raise other significant legal questions, such as how vulnerable underwater communications networks are to attack.[57]

Communication between UUVs and the surface is a unique challenge. Unlike aerial drones, many of which can be operated relatively simply with radio waves, underwater robots are much more difficult to reach with traditional signals.[58] This hurdle has been overcome by tethering robots to a mother ship.[59] This tether bundles power and communication lines to provide electricity and communication signals to the robot.[60] Tethers may also include steel (or Kevlar) cable to mechanically link the ROV to the surface ship and provide additional physical control, though this depends on the design and propulsion system of the robot.[61] Tethered ROVs are inherently limited in their operational capabilities, however, as they cannot stray too far from the mother ship. This limitation has been perhaps the largest obstacle to more widespread UUV use to date.

In recent years however, there has been an explosion in methods to untether ROVs. These methods take advantage of the rapid growth in robot autonomy more broadly and generally require that UUVs operate semi-autonomously or autonomously,[62] though methods that allow short-range communication with radio or acoustic signals are in development.[63] The advent of autonomous UUVs does away with the need for constant communication between

54. Yakov Malkiel, *An Evolutionary Look at the Law, Technology, and Economics of Sunken Treasure*, 44 J. MAR. L. & COM. 195, 202 (2013).

55. Gogarty & Hagger, *supra* note 40, at 104.

56. *Compare* Malkiel, *supra* note 54, at 202, *with* Markoff, *supra* note 7.

57. *See, e.g.*, Wrathall, *supra* note 5, at 237–28.

58. *See* Rick Robinson, *On Their Own*, GA. TECH RESEARCH HORIZONS (2015), http://www.rh.gatech.edu/features/their-own.

59. Wrathall, *supra* note 5, at 237–38.

60. D. RICHARD BLIDBERG, THE DEVELOPMENT OF AUTONOMOUS UNDERWATER VEHICLES (AUV): A BRIEF SUMMARY 2 (2001), http://ausi.org/publications/ICRA_01paper.pdf.

61. Romano Capocci et al., *Inspection-Class Remotely Operated Vehicles – A Review*, 5 J. MARINE SCI. & ENGINEERING 1, 9–11 (2017).

62. Vallejo, *supra* note 44, at 409.

63. *See* Stefania Giodini et al., *Can I Communicate with My AUV?*, HYDRO INT'L (July 26, 2016), https://www.hydro-international.com/content/article/can-i-communicate-with-my-auv (discussing what factors can impact underwater acoustic communications based on information derived from sea trials).

a human and the robot, allowing it to travel untethered and under its own autonomous control.[64] Semi-autonomous robots generally surface at pre-determined intervals and are able to communicate with shore-based controllers during these times.[65] These surface intervals allow the UUV not only to download any new operational instructions but also to transmit the data it has gathered back to shore via satellite.[66] Depending on the operational goals of the robot, these intervals may need to be relatively frequent if the amount of data being gathered exceeds the storage capacity of the robot or if frequent changes in mission are expected. Once an untethered robot is submerged, it is effectively unreachable, rendering the pre-planning of regular surface communication intervals a crucial element of UUV control.

The last key technological piece that is important to understand when discussing UUVs is propulsion. UUVs can be divided into two main propulsion categories: active and passive. Actively propelled robots use battery technology to power propulsive systems.[67] Their ranges are inherently limited by the size of the batteries powering them. However, these UUVs have been the beneficiaries of recent improvements in battery technology, allowing them to travel far greater distances than in the past.[68] Sophisticated buoyancy technologies further require very little energy to allow UUVs to actively move up and down in the water column.[69] The result of these advances in technology has created current models that are capable of operating underwater for up to thirty days – previously unheard of durations.[70]

The potential for long-term deployments is even higher for passively propelled robots. Passively propelled robots are a more recent development but have generated a great deal of interest, particularly from military and scientific parties who are interested in their long-term data collection capacities.[71] These passively propelled UUVs use power generated by waves or other energy around them to move throughout the water column, opening the possibility for

64. *See* Greg Mone, *Untethered in the Deep*, MIT TECH. REV. (Dec. 18, 2007), https://www.technologyreview.com/s/409266/untethered-in-the-deep/ ("[AUVs] can cover large areas without constant monitoring – and they don't require a large surface vessel to launch them, or trained operators on board to pilot them.").

65. Oscar Schofield et al., *The Robot Ocean Network*, AM. SCIENTIST (2013), https://www.americanscientist.org/article/the-robot-ocean-network.

66. *Id.*

67. Wrathall, *supra* note 5, at 238.

68. Jeffrey Lin & P.W. Singer, *Not A Shark, But a Robot: Chinese University Tests Long-Range Unmanned Mini Sub*, POPULAR SCI. (June 4, 2014), http://www.popsci.com/blog-network/eastern-arsenal/not-shark-robot-chinese-university-tests-long-range-unmanned-mini-sub.

69. Salimzhan A. Gafurov & Evgeniy V. Klochkov, *Autonomous Unmanned Underwater Vehicles Development Tendencies*, 106 PROCEDIA ENGINEERING 141, 142–43 (2015).

70. *Id.*; *see also* Vallejo, *supra* note 44, at 406.

71. *See Drone to Police Massive UK Marine Reserve*, BBC NEWS (Mar. 11, 2016), https://www.bbc.com/news/technology-35783564.

extremely long-range missions.[72] Taken together, the advent of more advanced battery technologies as well as passive propulsion methods for UUVs has created a reality where very few areas of the surface ocean are out of reach for UUVs.

2. Uses of UUVs

Having set out some of the key characteristics of current marine robots, I now turn to a brief overview of who is using these robots and how. Understanding these uses presents the crucial background for an inquiry into how UUV operation may infringe on existing marine privacy rights and commercial confidentiality. Military, commercial, and scientific users all have longstanding relationships with ROVs and are expanding their operations significantly as UUV technologies improve. Recreational users, additionally, are relatively new UUV users but are increasingly common as UUVs become more prevalent and affordable.

a. Military

The military is by far the longest standing and most pervasive user of robots in the marine environment.[73] Military UUVs have a variety of purposes; the most traditional (and most obvious) is surveillance.[74] Just as manned submarines have been a crucial part of the military's intelligence-gathering strategy, so too have unmanned submersibles become invaluable for their ability to collect information discretely.[75] The advantages of using unmanned submersibles for information gathering are relatively clear – their smaller form and ability to travel great distances without the need to surface are obvious strategic advantages for reconnaissance operations. There are also no concerns about loss or capture of human life if unmanned submersibles are sent into hostile

72. *Id.* It is worth noting that despite the apparent similarities, these passively propelled robots are significantly different than traditional and widespread oceanographic drifter "floats." While floats, such as the ARGO floats that have been deployed by NOAA in the hundreds over the last decade to monitor basic ocean chemistry, engage in many of the sensing and communication functions that robots do, they are distinct from robots in that they are uncontrollable. *See* Thayer Walker, *Wave-Powered Monitor Is Moving Beyond Listening to Whales*, N.Y. TIMES (Feb. 23, 2009), https://www.nytimes.com/2009/02/24/science/24wave.html. Oceanographic floats drift with the ocean's currents and are incapable of moving to specific locations or manipulating the environment around them. *Id.*

73. Gogarty & Hagger, *supra* note 40, at 78.

74. Henderson, *supra* note 13, at 57.

75. *See* U.S. DEP'T OF NAVY, THE NAVY UNMANNED UNDERSEA VEHICLE (UUV) MASTER PLAN 9 (2004), https://www.navy.mil/navydata/technology/uuvmp.pdf ("UUVs are uniquely suited for information collection due to their ability to operate at long standoff distances, operate in shallow water areas, operate autonomously, and provide a level of clandestine capability not available with other systems.").

areas. However, there are significant disadvantages to using UUVs for surveillance. In December 2016, a U.S. UUV was captured at sea by the Chinese military, sparking an international furor.[76] The features that make UUVs most attractive for long-term undetected missions also make them uniquely prone to capture – small size and semi-autonomous operation that may not allow for effective escape maneuvering, for starters. Hostile capture incidents are likely to increase further as UUV usage continues to escalate in coming decades.

In addition to surveillance, the U.S. military has capitalized on the unmanned nature of UUVs to use them for abnormally dangerous activities, such as minesweeping.[77] The potential military and strategic value of UUVs is the subject of significant research efforts to broaden the UUV's scope of action to include defensive measures (including both minesweeping and anti-submarine warfare), offensive measures (weapons delivery), as well as the traditional information gathering (and more recently deception) role.[78]

b. Commercial

Commercial interests primarily use robots in oil and mineral exploration, installation of underwater infrastructure, and salvage work.[79] In these environments, where it is extremely costly and sometimes impossible to reach equipment with manned submersibles or divers, UUVs are essential. Significant research and development ("R&D") in commercial robots over time in response to these needs has yielded sophisticated UUVs that are capable of carrying out diverse and complex tasks, from mechanical maintenance of deep-sea structures to sophisticated data collection about the seabed.[80] UUVs are also used to conduct underwater geological and archaeological surveys, to assess the viability of undersea cable routes, and to discover deep-sea wrecks.[81] Current estimates project a forty-two percent increase in the commercial UUV industry between 2014 and 2018.[82]

c. Scientific

The scientific community, while less well-funded than the military or commercial sectors, has also found extensive uses for UUVs. These robots

76. *See* Harriet Agerholm, *China Seizes US Navy Underwater Drone in International Waters of South China Sea*, INDEPENDENT (Dec. 16, 2016), http://www.independent.co.uk/news/world/asia/china-seize-us-navy-underwater-vehicle-south-china-sea-one-china-taiwan-a7480016.html.

77. Henderson, *supra* note 13, at 58.

78. *Id.* at 57–58.

79. *Id.* at 57.

80. Gogarty & Hagger, *supra* note 40, at 104–05.

81. Henderson, *supra* note 13, at 57.

82. *Global AUV Fleet to Increase 42% by 2018*, WESTWOOD GLOBAL ENERGY GROUP (Apr. 1, 2014), https://www.westwoodenergy.com/news/press-release/press-release-global-auv-fleet-to-increase-42-by-2018/.

have been invaluable in gathering information about the marine environment beyond what is attainable from oceanographic research vessels.[83] One ROV alone, the storied Alvin, is responsible for confirming deep-sea ridge spreading (and thus solidifying the theory of plate tectonics), discovering the existence of hydrothermal vent communities (arguably the largest oceanographic discovery of the last century), and discovering the sunken wreck of the Titanic, among other things.[84]

Scientists have been the major force behind the creation of passively powered UUVs.[85] Major gaps currently exist in our scientific understanding of the ocean environment, particularly open ocean and deep-sea ecosystems.[86] This is in part due to the relative inaccessibility of these areas – fully staffed scientific research cruises can cost over $50,000 per day.[87] Comparatively, newly developed, passively propelled drones cost less up front and can be deployed for years at a time.[88] These drones have the potential to dramatically advance scientific understanding of ocean ecosystems.

d. Recreational

The world of recreational UUV use is a very new one. While commercial and military robots have been heavily used for decades due to necessity, there have been few reasons for the general public to use underwater vehicles. Recently, however, the proliferation of aerial drones combined with lower costs for undersea submersibles has opened this market to recreational users. While companies manufacturing low-cost underwater drones have generated a great deal of media interest, there are still relatively few actually being used by the general public.[89] Despite this, diverse groups, notably journalists and citizen scientists, have expressed interest in more widespread availability and use of

83. *20,000 Colleagues Under the Sea*, ECONOMIST (June 9, 2012), https://www.economist.com/science-and-technology/2012/06/09/20000-colleagues-under-the-sea.

84. *Human Occupied Vehicle Alvin*, NOAA, http://oceanexplorer.noaa.gov/technology/subs/alvin/alvin.html (last visited Mar. 15, 2019). Alvin is a submersible that is capable of carrying passengers, but it also utilized a robotic vehicle in its work on the Titanic. *Id.*

85. *See* Walker, *supra* note 72.

86. *See* Brueck, *supra* note 4.

87. Rex Dalton, *US Ocean-Research Projects in Dire Economic Straits*, NATURE (Apr. 30, 2008), https://www.nature.com/news/2008/080430/full/453007a.html.

88. *See, e.g.*, IBUBBLE, https://ibubble.camera/ (last visited Mar. 5, 2019); OPENROV, https://www.openrov.com/ (last visited Mar. 5, 2019).

89. *See* Marnette Federis, *Growing Popularity of Underwater Drones Raises Similar Concerns as Aerial Counterparts*, CAP. PUB. RADIO (July 1, 2016), http://www.capradio.org/articles/2016/07/01/growing-popularity-of-underwater-drones-raises-new-questions/ (discussing how OpenRov hopes to increase the number of eyes underwater).

undersea drones.[90] Current models range from exploratory ROVs intended to allow land-based observation of underwater features[91] to AUV models meant to follow and film divers while they are underwater.[92]

Looking at the diverse capabilities of drones currently and the many entities using them, the future for robots at sea is strong. As UUVs are increasingly untethered and autonomous, the options are nearly limitless. Market estimates predict the UUV industry will be $5.2 billion by 2022.[93]

B. The Marine Environment

Understanding the capabilities of UUVs helps us to understand how these robots can and do operate at sea. To determine how they may infringe on privacy and commercial interests at sea, we first need to consider what exactly these other interests at sea are. In the case of the opaque marine environment, these entities are not always readily apparent either literally or figuratively. In this Section, I briefly review the most relevant entities operating in the oceans today and their key operational features as background for understanding what privacy rights these entities may have.

The most obvious, and most prevalent, entities at sea are ships. Over 87,000 merchant ships alone are operating on the ocean as of the time this Article was written; this number increases dramatically when naval and fishing vessels are added to the equation.[94] Ships at the most basic level share the characteristic of being an enclosed hull capable of moving through the water. Beyond this, ship design and use varies dramatically depending on the type and purpose of the vessel. In some cases, vessels move expeditiously through the oceans, not stopping and with minimal activity taking place in the water around the ship (cruise ships and merchant shipping vessels, for instance).[95] In other cases, ships stop frequently, deploying gear and interacting actively and openly with the ocean environment around them (fishing vessels, research vessels, and

90. *See, e.g.*, *Activities & Applications*, OPENROV, https://www.openrov.com/applications/ (last visited Mar. 5, 2019) (advertising robotic use to check for fishing spots or for maintenance on citizen boat).

91. *See id.*

92. *Id.*; IBUBBLE, *supra* note 88.

93. *Unmanned Underwater Vehicle (UUV) Market Worth 5.20 Billion USD by 2022*, MARKETSANDMARKETS, http://www.marketsandmarkets.com/PressReleases/unmanned-underwater-vehicles.asp (last visited Mar. 5, 2019).

94. Craig Jallal, *How Many Ships Are There in the World?*, SHIPPING RES. & FIN. (July 31, 2012), https://shippingresearch.wordpress.com/2012/07/31/how-many-ships-are-there-in-the-world/.

95. It should not be ignored, however, that while ships may seem to be relatively isolated from the water around them, significant discharge of water and other waste byproducts occurs from these vessels. *See* OFFICE OF WASTEWATER MGMT., U.S. ENVTL. PROTECTION AGENCY, EPA-800-R-11-001, GRAYWATER DISCHARGES FROM VESSELS 6 (2011), https://www3.epa.gov/npdes/pubs/vgp_graywater.pdf.

oil and gas tenders). Exactly how a vessel operates has significant implications for the attendant privacy concerns the vessel and its crew are likely to have.

Regardless of the type of ship, a great deal of information about the ship's operations can be gleaned from the water around it. Ships are constantly taking on seawater and discharging this raw water as exhaust, bilge, and gray water.[96] Analyzing the chemical composition of these fluids can reveal many details of how and for what purpose a ship is being run, including revealing criminal activity and regulatory non-compliance.[97] Additional information can be gleaned from the acoustic signature of a ship – a fact that submarines have long taken advantage of.[98] Thus, while visual observation of a ship's hull may be what we first think of when considering privacy rights in the ocean, there is a far vaster, and more interesting, suite of information potentially observable. This information is likely to be available regardless of whether a ship stops frequently and puts gear over the side or never stops and all operations remain completely contained inside the vessel.

Aside from ships, the majority of remaining property in the ocean is commercial infrastructure.[99] These installations take the form of oil and gas drilling rigs, undersea pipelines, aquaculture facilities, and undersea mining and offshore renewable energy generation, among others.[100] This subsea economy is a large and growing one – in 1998, the industry was $4.9 billion; by 2003 it had more than doubled to nearly $12 billion.[101] Like vessels, how these commercial installations interact with the environment around them has large implications for their privacy rights. Also, like vessels, the level of environmental interaction differs significantly depending not only on the type of installation but also on the specific installation itself. While many commercial operations interact with the ocean environment in ways that are visually obvious to observers – be it through setting out fishing nets or drilling into the ocean crust – there are also installations where the purpose is largely invisible to visual observation.[102] From a trade secret perspective, UUVs present one of the first

96. *See Cruise Ship Discharges and Studies*, EPA, https://www.epa.gov/vessels-marinas-and-ports/cruise-ship-discharges-and-studies (last visited Mar. 5, 2019).

97. *See* United States v. Royal Caribbean Cruises, Ltd., 11 F. Supp. 2d 1358, 1361 (S.D. Fla. 1998) (noting generally the identification of an unauthorized oil discharge by a cruise ship).

98. *See* Gareth Evans, *Understanding Acoustic Signatures*, NAVAL TECH. (Oct. 20, 2017), https://www.naval-technology.com/features/understanding-acoustic-signatures/. The "acoustic signature" is "the noise and vibrations a vessel and its on-board equipment and systems make in the water." *Id.*

99. There is also military infrastructure, but the size and extent of these installations remains largely unknown (for now – increased UUV use has the potential to change this) due to military secrecy combined with the operational opacity of the ocean. *See* Wrathall, *supra* note 5, at 234.

100. *See, e.g.*, HOEGH-GULDBERG ET AL., *supra* note 15, at 23; Wernli, *supra* note 6, at 391.

101. Wernli, *supra* note 6, at 391.

102. *See* Wrathall, *supra* note 5, at 234.

opportunities for the activities engaged in by these entities to be seen and monitored by outside observers through non-visual sensory devices.

Private property interests also exist less frequently in the form of land leases.[103] Outright ownership of the ocean and the seafloor beyond the twelve nautical mile territorial limits is prohibited under UNCLOS.[104] Within twelve miles from shore, ownership of the seafloor, but not the water itself, may be allowed under U.S. law.[105] Ownership of submerged lands is generally granted to states within three miles of the coastline and the federal government in the zone from three to twelve miles.[106] State laws vary, but the majority allow the leasing of subsea lands within their jurisdictions, though any subsea leases are subject to the restrictions of the Public Trust Doctrine.[107] The federal government also allows leasing of submerged lands under the Outer Continental Shelf Lands Act.[108] These leases grant possessory, use, and sometimes exclusionary rights, but by nature they are inherently more limited than full private property rights.[109]

The last important entities at sea are people themselves. While limited in our ability to be in the ocean without being physically inside a vessel, recreational diving is a popular enough endeavor that these interests should not be overlooked. When people spend time in the ocean, they are likely to do so in places that are relatively busy from a marine perspective.[110] Popular, coastal dive sites can see hundreds of divers a day.[111] Recreational UUVs are already being marketed to divers; and some of them are able to follow divers autonomously throughout a dive while taking video footage.[112] It is a short step from

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103. *See* Gail Osherenko, *New Discourses on Ocean Governance: Understanding Property Rights and the Public Trust*, 21 J. ENVTL. L. & LITIG. 317, 341 (2006).

104. United Nations Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 400 [hereinafter UNCLOS]. The United States follows these provisions despite not ratifying UNCLOS. David L. Larson, *National Security Aspects of the United States Extension of the Territorial Sea to Twelve Nautical Miles*, 2 TERR. SEA J. 189, 216–17 (1992).

105. *See* U.S. COMM'N ON OCEAN POLICY, AN OCEAN BLUEPRINT FOR THE 21ST CENTURY 72 (2004), https://govinfo.library.unt.edu/oceancommission/documents/full_color_rpt/000_ocean_full_report.pdf.

106. *Id.* at 70–72.

107. Osherenko, *supra* note 103, at 345–48.

108. *Id.* at 354.

109. Union Oil Co. of Cal. v. Morton, 512 F.2d 743, 747 (9th Cir. 1975) ("The lease does convey a property interest enforceable against the Government, of course, but it is an interest lacking many of the attributes of private property.").

110. *See Survey Shows Where Boaters Go and How They Spend Time, Money*, MARCO, http://portal.midatlanticocean.org/ocean-stories/recreational-boating/ (last visited Mar. 5, 2018).

111. *See* David Zakai & Nanette E. Chadwick-Furman, *Impacts of Intensive Recreational Diving on Reef Corals at Eilat, Northern Red Sea*, 105 BIOLOGICAL CONSERVATION 179, 185 (discussing the recommend number of dives per site per year and recommending a 5,000–6,000 cap for Eilat location).

112. *See supra* note 89 and accompanying text.

this to governmental UUVs being used to monitor dive sites and ensure divers are not breaking any environmental regulations.

Looking at the larger picture of UUV operation in the marine environment, two trends are clear: technological improvements are allowing UUVs to reach places with surveillance methods unprecedented in the history of the operationally opaque ocean, while at the same time human military, commercial, and recreational uses of the ocean are burgeoning. The ocean is thus rapidly becoming more crowded with entities that are not necessarily used to sharing their space. UUVs in particular present real surveillance threats as commercial, military, and recreational users increasingly seek to use them to glean information about the surrounding ocean environment. The strategic and commercial value of this information is extremely high: the operational difficulties of the ocean mean that any gains in efficiency are hard-won but have huge payoffs. UUVs have the potential to contribute vast swaths of new information to these efforts, from observations of ocean conditions themselves to better understandings of how other operations at sea maximize their operational processes.

II. PRIVACY AT SEA UNDER U.S. LAW

Underwater drones are increasingly common and increasingly capable.[113] These technologies are opening the world's oceans to new commercial and recreational players while greatly expanding the capabilities of those already operating in the oceans. In the face of this growth, major questions exist about what, if any, rights marine operators have to conduct their affairs without external surveillance. In this Part, I address this question in the context of U.S. law. I first look to what privacy rights exist under U.S. private law, assessing specifically how private property rights and privacy interact in the ocean. I then turn to the broader privacy rights that may be afforded under U.S. public law with an analysis of how the Fourth Amendment applies to governmental surveillance at sea. I look in both these cases at the differing rights afforded to private and commercial marine operators. I argue that existing privacy rights at sea have been unconstitutionally eroded. This will only be exacerbated by the advent of UUVs, which provide an important opportunity to redress past judicial erosions of privacy protections by recognizing and solidifying marine privacy rights.

Our current laws evolved when privacy at sea was virtually guaranteed by environmental conditions. No additional regulation was needed to protect these interests. Only in recent years has the potential for privacy invasions become a reality in the marine environment through UUV use. We are now in the mismatched situation where technological capabilities have advanced rapidly, allowing robots to enter the marine environment, before any legal regime exists to effectively limit their operation. In its current form, U.S. law allows

113. *See* discussion *supra* Section I.A.

surveillance in the marine realm that would clearly be considered unconstitutional terrestrially.[114] Before UUV use increases further, this discrepancy must be remedied to ensure that privacy interests at sea are adequately protected in the future.

A. Underwater Privacy Under U.S. Private Law

In the world of aerial drones, where privacy issues have been numerous and contentious, tort claims provide a major potential avenue of recovery.[115] U.S. tort law is also the umbrella under which underwater privacy infringements by non-governmental actors using UUVs will be evaluated. I turn first to these protections provided by tort law, drawing analogies both from aerial drone use as well as from related maritime contexts. U.S. tort law provides explicit privacy protections through the "privacy torts" of intrusion upon seclusion, false light, public disclosure of private facts, and appropriation of name.[116] In addition to these, the tort doctrines of trespass and nuisance also contribute heavily to our understanding of privacy rights through their delineation of the limits of personal property. These doctrines have proven to be some of the most essential in establishing the extent of privacy infringement by aerial drones,[117] and thus, it is these I turn to first in analyzing the marine analogs. I find that trespass and nuisance actions are both unlikely to be cognizable in most cases in the marine environment, but some protections for commercial entities may exist from UUV observation under trade secret law.

1. Trespass and Nuisance

Trespass actions protect the rights of property owners from invasion by third parties. While trespass is not explicitly a cause of action that protects privacy rights, it does so by proxy, as it prevents entry into privately owned areas. On land, trespass is a relatively cut and dried action: entry without permission onto another's privately owned land is trespass.[118] This tort requires actual entry onto private land – threatening to enter or hovering at the boundaries of private property is not sufficient to create a trespass.[119] However, once entry onto another's land has occurred, a trespass action is cognizable whether

114. *See* discussion *infra* Section II.B.

115. *See generally* Troy A. Rule, *Airspace in an Age of Drones*, 95 B.U. L. REV. 155 (2015).

116. RESTATEMENT (SECOND) OF TORTS § 652A, Westlaw (database updated Oct. 2018).

117. *See* A. Michael Froomkin & P. Zak Colangelo, *Self-Defense Against Robots and Drones*, 48 CONN. L. REV. 1, 24–27 (2015) (discussing what constitutes aerial trespass).

118. RESTATEMENT (SECOND) OF TORTS § 158.

119. *Id.*

or not any damages arise as a result of the trespass.[120] In practice, this means that the mere presence of a drone in the air above private property is sufficient to form the basis for a trespass claim if the drone is low enough to be effectively within the bounds of private property.[121]

Determining exactly how far above and below the surface these private rights extend, however, has been a touchstone issue in debates about aerial drones.[122] The property rights associated with land ownership are generally thought to extend upwards to "as much of the space above the ground as []he can occupy or use in connection with the land."[123] Thus, intrusions into the immediate reaches of the airspace above the land are considered trespass in the same way that intrusions directly onto the land itself would be.[124] In terrestrial contexts, this prevents aerial drones from operating in very low airspace areas – 83 feet above the land in the landmark *Causby* case – with the general limit to these private property rights hovering somewhere around 100 feet above the ground.[125]

Similar rights to own (or lease) land and chattels exist in the marine environment. Private parties may own (or, more often, lease) portions of the seafloor as well as vessels and other structures in the water column itself.[126] These private parties have property rights that prevent trespass onto their vessels and structures just as they would onto land.[127] In cases where UUVs use manipulative capabilities to physically interfere with vessels or leased land parcels, a trespass action would be cognizable underwater just as it is terrestrially. However, this is unlikely to be a frequent occurrence: UUVs are primarily used for their passive sensing capabilities.

The more interesting question, and the more important one from a privacy standpoint, is how far property rights extend in the water column around private property. Whether a UUV can get within inches of a leased piece of seafloor and undertake surveillance or whether it has to stay hundreds of feet above it has critical implications for privacy. Courts have not yet had the occasion to decide of the limits of property rights in the marine environment, so here I look to the terrestrial regime as a possible analogue.

In the case of seafloor ownership, some private property rights should extend above the seabed. Just as terrestrial property is usually populated with buildings, marine operations leasing land at sea generally build structures that extend above the seafloor.[128] Both the airspace above terrestrial plots and the

120. *Id.* However, some courts are unlikely to honor these claims of "technical trespass." *See* Froomkin & Colangelo, *supra* note 117, at 23, 27–29.

121. *See* United States v. Causby, 328 U.S. 256, 264 (1946).

122. *See* Froomkin & Colangelo, *supra* note 117, at 26.

123. *Causby*, 328 U.S. at 264.

124. MCNEAL, *supra* note 16, at 8.

125. *Causby*, 328 U.S. at 263–64.

126. *See* Osherenko, *supra* note 103, at 318, 353.

127. These rights are subject to the Coast Guard's statutory right to board, among other things discussed *infra* Section II.B.

128. A drilling rig would be a common example.

water above seafloor leases is public space, however, on land, courts have recognized that an extension of the privacy rights upward into the airspace is necessary to ensure the "owner's full enjoyment of the property."[129] At sea, those leasing the seafloor are likely entitled to the same legal protections. Just as terrestrial buildings need a buffer of privacy rights around them, so too should marine operations have privacy rights that extend above the seafloor to ensure their full use of the property. These rights on land have been recognized both for commercial and residential structures, and so too should both types of structures at sea have attendant private property rights. However, determining the extent of these privacy rights beyond the seafloor presents a significantly different problem in the marine realm than terrestrially.

The marine environment makes the upper limit of property rights above the seafloor much more difficult to determine than on land. Terrestrially, houses are rarely taller than two stories while skyscrapers may reach 300 feet. Property rights above structures are proportional to these heights. However, distances are vastly different at sea. Seafloor leases are routinely occupied by drilling rigs or other structures that may stretch from the surface of the ocean to the seafloor – often thousands of feet. In these cases, applying land analogues is less helpful. If commercial installations routinely occupy the entire water column above leased land, one interpretation could be that property rights above the seafloor should extend to the surface. But extending property rights above seafloor parcels as far as the surface is directly at war with the fact that the water column is, by definition, not subject to private ownership.[130] Because of this, privacy rights above the seafloor are unlikely to extend upwards in tandem with the structures on them as on land. Instead, private property rights associated with seafloor leases in some cases may extend upwards to the limit of the structures placed on the seafloor (if these structures do not extend upwards more than a couple hundred feet). In other cases, where structures extend all the way from seafloor leases to the surface, courts are ultimately unlikely to find any extension of property rights at all. Freedom of navigation is enshrined throughout both U.S. and international law,[131] and any attempt to restrict free access to the water column would present serious conflicts with this doctrine. Ultimately, structures in the water column that are in some way attached to a seafloor lease but far distant from it may have closer analogs in vessels or other mobile property that is located throughout the water column.

At sea, the majority of private property is not fixed to the seafloor or associated in any way with real property leases. Looking at cases of private property in the water column itself (e.g., vessels, fixed buoys, and fishing traps), the property in question is not real property. Instead, these chattels are not attached, legally or physically, to any particular piece of land. The terrestrial analogues here are to things like cars rather than houses. American courts have found that people do not have any reasonable expectation of privacy around

129. *Causby*, 328 U.S. at 265.

130. *See* Osherenko, *supra* note 103, at 341.

131. *Id.*

cars or other private property that is located in public areas.[132] If this is translated to the maritime world, it appears, at first glance, that no buffer zone of ownership and its attendant bar on trespass should exist around vessels and other maritime property that are not real property.

But the maritime world may not be directly analogous to land in this case. Certain military and commercial structures at sea are afforded legal protection in the form of exclusion zones around them.[133] These exclusion zones are intended to ensure the safety both of the commercial installations and of any vessels operating near them.[134] Exclusion zones do not carry with them explicit private property rights over the water or any submerged lands, though they do grant lessees exclusionary rights, widely understood to be part of the property "bundle" of rights.[135] This right is sufficient to serve as the grounds for a trespass action if there is intrusion into an exclusion zone.[136]

While these exclusion zones do create the potential for trespass actions, the more difficult question is whether exclusion zones may be indicative of a different norm in how marine property is understood. Widespread exclusion zones around structures and vessels could support the opposite finding from that on land: that property rights in chattels may extend to the area around them. This is unlikely to be the case. If anything, needing to alter the existing regime to create extra protections through exclusion zones suggests that this level of protection is uncommon and unnecessary for most purposes. Exclusion zones stand out from the normal legal regime and suggest that buffers around structures at sea must be explicitly created in order to be enforceable. Similar analogies exist on land, where safety zones may be placed around dangerous industrial facilities. In these cases, safety zones do not indicate a norm of private property rights. Thus, in the marine world, privacy buffers around structures and vessels are unlikely to be upheld.

It is important to remember that these areas immediately adjacent to private property are likely to be crucial areas for underwater surveillance. Underwater visibility is much more restricted than visibility in the air. As such, the only viable locations for visual surveillance will be directly next to an underwater object. Understanding the limits of property rights then is critical in that sense – on land, binoculars or sophisticated commercial cameras can be used to observe from a distance,[137] but this is simply not a possibility in much of the ocean. This is not to say that visual surveillance is the only option. Underwater

132. Katz v. United States, 389 U.S. 347, 351 (1967) ("What a person knowingly exposes to the public . . . is not a subject of Fourth Amendment protection.").

133. *See* Osherenko, *supra* note 103, at 319 (listing statutory exclusion zones).

134. *Id.*

135. *Id.* at 332.

136. *See id.* In fact, the existence of exclusion zones alone may make trespass actions particularly difficult to prove in the immediate vicinity of structures that do not have them. It is easy to imagine a court viewing the lack of an exclusion zone as evidence of the lack of privacy rights.

137. *See* Dow Chem. Co. v. United States, 476 U.S. 227, 231 (1986).

drones are likely to obtain their most interesting information from other sensory equipment. However, in cases where visual imagery is needed, underwater drones realistically may need to be within (much) less than fifty feet of an object to obtain usable images.

The extent of private property rights thus forms an important element of privacy protections at sea. Unclear limits on private property coupled with the location of maritime structures in waters that are ultimately public suggest that trespass is unlikely to be a productive legal claim except in cases where UUVs physically interfere with structures or leased parcels of land. In cases of mere surveillance, trespass is unlikely to be cognizable even when the observation is occurring from waters directly next to a marine structure.

In cases where activities do not directly interfere with private property or support a trespass claim, plaintiffs often turn to a nuisance claim. Nuisance claims can be brought when a private party's "interest in the private use and enjoyment" is infringed upon by a third party.[138] This is a much broader cause of action than trespass and one that may potentially be open to those seeking redress from observation by underwater drones. Bringing a successful nuisance claim requires showing that the actions in question substantially interfered with the use of the property, however.[139] In the context of drones at sea, this may be difficult to show. Except in the most egregious cases, a drone that simply hovers close to another vessel or structure, passively observing, is unlikely to cause the kind of disturbance that is traditionally associated with nuisance claims.[140] There has been relatively clear consensus that in the case of aerial drones, unwanted observation, in and of itself, would not provide the grounds for a viable nuisance claim.[141] This same principle should hold true for drones in the marine environment.

2. Other Private Law Protections

The "privacy torts" are less likely to be applicable in protecting privacy at sea than simple trespass claims. Tortious invasion of privacy may occur in cases of unreasonable intrusion upon seclusion, public disclosure of private facts, false light, and appropriation.[142] For present purposes, the only one of these likely to limit drone operation at sea is intrusion upon seclusion. Intrusion upon seclusion may be shown when there is an intrusion upon a reasonable expectation of seclusion and the intrusion would be highly offensive to a reasonable person.[143] What constitutes a reasonable expectation of privacy at sea

138. RESTATEMENT (SECOND) OF TORTS § 821D, Westlaw (database updated Oct. 2018).

139. *Id.* § 821F ("There is liability for a nuisance only to those to whom it causes significant harm . . . .").

140. *See* Benjamin D. Matthews, Comment, *Potential Tort Liability for Personal Use of Drone Aircraft*, 46 ST. MARY'S L. J. 573, 594 (2015).

141. *Id.*

142. 62A AM. JUR. 2D *Privacy* § 26, Westlaw (database updated Nov. 2018).

143. *Id.* § 34.

is discussed in detail below in the context of the Fourth Amendment. Here it is sufficient to note that in cases where private matters are observed by drones (e.g., on boats that the owners use as homes), parties may have a cause of action under this tort. However, it is unlikely that this could be used more broadly as a privacy protection for commercial interests.

Facts that are gleaned with UUVs and subsequently publicized may also form the basis for actions based on public disclosure of private information. Additional party-specific privacy protections may be available based on the specific circumstances.

3. Laws Applying to Commercial Entities

Finally, there is a set of protections that are only potentially relevant for commercial maritime interests – those that protect trade secrets. Commercial operations at sea may be using proprietary methods, equipment, or techniques that they have developed to maximize their economic efficiency in the difficult ocean operating environment. Observation of these methods by UUVs could reveal to other commercial or private entities information that hurts companies economically and allows proprietary methods to be distributed widely. Trade secrets law may protect companies in these cases.

Historically, trade secrets were protected through tort law's cause of action for misappropriation of trade secrets.[144] In an effort to improve and standardize trade secret protection, the common law tort cause of action has today been superseded by the Uniform Trade Secrets Act ("UTSA") in all but three states.[145] Because of its nearly universal adoption I will focus on the protections provided by the UTSA with the caveat that specific state interpretations will vary depending on their own historical relationship with the UTSA.[146]

Under the UTSA, for information to be considered a trade secret it must be information, "including a formula, pattern, compilation, program, device, method, technique, or process," that "derives independent economic value, actual or potential, from not being generally known to, and not being readily ascertainable by proper means" and "is the subject of efforts that are reasonable under the circumstances to maintain its secrecy."[147]

Processes, techniques, and equipment used by commercial marine operations should fall in the category of "a formula, pattern, compilation, program,

144. *See* RESTATEMENT (FIRST) OF TORTS § 757, Westlaw (database updated Oct. 2018).

145. *Legislative Fact Sheet – Trade Secrets Act*, UNIFORM L. COMMISSION, https://perma.cc/W38B-8Q7E (captured Apr. 6, 2018). Those states are Massachusetts, New York, and North Carolina. *Id.*

146. Interpretation will vary even more so in North Carolina – one of the states that has not yet adopted the UTSA and has significant coastal resources. *See id.*

147. UNIF. TRADE SECRETS ACT WITH 1985 AMENDMENTS § 1(4) (UNIF. LAW COMM'N 1985).

device, method, technique, or process" protected by the UTSA.[148] Courts interpret this provision of the UTSA broadly: it is considered a non-exhaustive list, and courts have included in this category other types of information as distinct from "methods and devices," such as customer lists.[149] The operations of commercial maritime entities, including their equipment, techniques, and methods, are thus also likely to be included.

However, this conclusion is less clear when it comes to some of the most valuable information held by commercial marine operations – the exact location they are operating in. For many fixed structures, such as mining operations and oil and gas drilling, their general operating locations are available as part of the leases they are required to obtain.[150] However, within these leases, the exact location of resource deposits often remains unclear as commercial entities develop multiple exploratory mines or wells before beginning full resource extraction.[151] Locational information is even less available for mobile entities, such as fishing vessels and commercial shippers, whose exact routes represent highly valuable commercial information. While some fishing vessels in the United States are required to disclose their location to the government to aid in fisheries management, the government in turn guarantees that this information will not be disclosed to any other entities.[152] Despite this guarantee, many fishermen still disclose incorrect information to the government out of fear that their secret fishing locations will be made available to competing parties.[153] Past National Oceanic and Atmospheric Administration ("NOAA") rulemakings that implement increasingly stringent monitoring requirements for fishing vessels have generated many comments concerned with the potential release of trade secrets as part of new monitoring regimes that require location disclosures.[154] Terrestrially, some courts have recognized that the exact location of potential oil fields is a trade secret.[155] Extending this to the marine realm and considering the non-exhaustive definitions in the UTSA, locational

148. *See id.*

149. *See* Dole, Jr., *supra* note 46, at 94 & n.28.

150. *See Offshore Oil & Gas*, U.S. DEP'T OF THE INTERIOR, https://revenuedata.doi.gov/how-it-works/offshore-oil-gas/ (last visited Mar. 5, 2019).

151. *See id.*

152. *See* U.S. COAST GUARD, U.S. DEP'T OF HOMELAND SECURITY, CG-4100N (08-07), NAT'L VESSEL MONITORING SYSTEM (N-VMS) DATA NON-DISCLOSURE AGREEMENT (2007), https://media.defense.gov/2017/Oct/23/2001830854/-1/-1/0/CG_4100N.PDF.

153. *See, e.g.*, Long Island Fisherman Pleads Guilty to Falsifying Document and Lying to Federal Investigators, DEP'T OF JUST. (June 2, 2016), https://www.justice.gov/opa/pr/long-island-fisherman-pleads-guilty-falsifying-documents-and-lying-federal-investigators.

154. Magnuson-Stevens Fishery Conservation and Management Act; Seafood Import Monitoring Program, 81 Fed. Reg. 88,975, 88,987 (Dec. 9, 2016) (to be codified at 15 C.F.R. pt. 902, 50 C.F.R. pts. 300, 600).

155. *See* Amoco Prod. Co. v. Laird, 622 N.E.2d 912, 920–21 (Ind. 1993).

information is also likely to be considered a protected "formula, pattern, compilation, program, device, method, technique, or process," provided it also meets the remaining two provisions of the UTSA's definition.[156]

Commercial maritime operations will find the barriers posed by the second part of the UTSA harder to overcome. The first requirement, that the information in question derive "independent economic value, actual or potential, from not being generally known to, and not being readily ascertainable by proper means by, other persons who can obtain economic value from its disclosure or use," is relatively straightforward.[157] Courts have found that this criterion is met as long as the information is novel, kept secret from competitors, and economically valuable.[158] In the case of marine operations, novel technologies or methods used to effectively harvest resources from the ocean are likely to meet the standard of deriving independent economic value from not being generally known. While any techniques shared with competitors would not qualify as a trade secret under this definition, those techniques are also the information that operators are least likely to object to having observed by UUV.

The more difficult question in analyzing this standard is whether the methods and equipment being used by commercial entities at sea constitute information that is readily ascertainable using "proper means." If they are, then no trade secret protection will exist. Historically, as discussed previously,[159] information on the methods and techniques being used in remote areas of the ocean by private operators would not have been readily ascertainable to outside parties. Deep-sea commercial operations are usually prohibitively far from shore, and the majority of interesting commercial methods or equipment are only visible beneath the surface of the ocean. Thus, for many years information about commercial vessel operations was unlikely to be "readily attainable." With the advent of UUVs, this information is much more easily obtained without resorting to any improper methods. However, use of UUVs to investigate distant commercial operations may not reach the level of "readily attainable." In the majority of states, courts look to the amount of time, money, and effort expended to obtain the information in question to make such determination.[160] In the case of UUVs, a significant amount of time, money, and effort would generally be required to obtain any meaningful information about commercial marine operations. This may vary based on how distant an operation is from shore among other things, but even in these cases the cost of obtaining and piloting a UUV, while relatively low compared to historical equivalents, is still significant. In light of this, details about the technologies and methods being used by commercial marine operations likely would not be considered readily

156. *See* UNIF. TRADE SECRETS ACT WITH 1985 AMENDMENTS § 1(4) (UNIF. LAW COMM'N 1985).

157. *See id.* § 1(4)(i).

158. Dole, Jr., *supra* note 46, at 95.

159. *See supra* text accompanying notes 146–54.

160. *See* Dole, Jr., *supra* note 46, at 100.

attainable and thus would meet this requirement of the UTSA – for the time being at least.

The last part of the trade secrets definition requires that information be "the subject of efforts that are reasonable under the circumstances to maintain its secrecy."[161] As with the previous consideration of whether marine operations information is "readily attainable," this presents an interesting interpretational problem in areas of the ocean where operations are inherently secret due to their location. Terrestrially, companies can show that they have made efforts to maintain secrecy by taking measures intended to limit disclosure to employees or third parties or by protecting their information via physical barriers.[162] For commercial marine ventures, similar efforts may be taken to ensure that information is not disclosed by employees or others. Secrecy measures are particularly notorious in the fishing industry.[163] However, commercial entities at sea do not generally take additional measures to protect outsiders from viewing their specialized equipment or techniques. Given that to date there has been no need to take extra secrecy measures, this is not likely to be a dispositive factor in assessing trade secrets applicability. Courts historically have attributed less importance to this factor than to the preceding two, and efforts to maintain secrecy through the historically necessary channels, such as preventing disclosure by employees, may be sufficient to show reasonable efforts to maintain secrecy have been taken.[164]

All told, technical information that commercial marine ventures use to their economic advantage and have some desire to keep secret is likely to be considered a trade secret, though the exact outcome will depend both on the specific state and the facts in question. If information is protected as a trade secret, UUVs will be limited in collecting this information. A UUV collecting any details on the methods or equipment being used by commercial operations that was proprietary enough to be considered a trade secret would be subject to a trade secrets claim for misappropriation. Misappropriation occurs when trade secrets are acquired, disclosed, or used without permission.[165] In the case of UUVs, simple observation may be enough to show that trade secrets have been "acquired," subjecting UUV operators immediately to trade secret claims.

Trade secret protection may thus represent some of the strongest protections for marine operators from UUV surveillance, though this protection is limited to commercial entities. Other private law protections have boundaries that are far less clear and will be shaped significantly by judicial interpretation in the coming years.

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161. UNIF. TRADE SECRETS ACT WITH 1985 AMENDMENTS § 1(4)(ii).

162. *See* Dole, Jr., *supra* note 46, at 102–03.

163. *See, e.g.*, Meghan Miner, *Trade Secrets at Sea – How Much Information Is Enough?*, COMPASS (Dec. 4, 2012), https://www.compasscicomm.org/single-post/2012/11/26/Trade-Secrets-At-Sea%E2%80%94How-Much-Information-Is-Enough.

164. *See* Dole, Jr., *supra* note 46, at 100–03.

165. UNIF. TRADE SECRETS ACT WITH 1985 AMENDMENTS § 1(2).

B. Underwater Privacy Under U.S. Public Law

Protection from individual actors may be increasingly important as recreational and commercial UUV use swells, but protection from government surveillance is likely to be a far greater issue. The ocean, both in U.S. territorial waters and on the high seas, is notorious as an "operational sanctuary" – that is, a place where enforcement of regulations is in many ways impossible.[166] The result of this is that many areas of today's oceans are effectively lawless.[167] Despite the best efforts of the U.S. Coast Guard and other enforcement bodies, monitoring ship and commercial activity on an ocean basin scale is practically impossible. Widespread safety, environmental, immigration, and fiscal violations are the norm, as are more extreme crimes like piracy, slavery, and murder.[168]

UUVs offer the U.S. government a chance to monitor and enforce the law over greater scales than ever before. The Coast Guard and others have recognized the potential importance of this development, devoting significant funds to research and development of UUVs.[169] As plans are being laid to increase governmental monitoring, the question of what limits exist to this monitoring is a critical one. In this Section, I examine the boundaries the U.S. Constitution places on governmental surveillance underwater. First, I look at the Fourth Amendment background that forms the basis of limits on governmental searches. I then apply this existing law to different classes of entities at sea, finding that in almost all cases the Fourth Amendment's protections against government surveillance are likely to be significantly weaker at sea than on land. I argue that already eroded marine privacy protections are faced with potentially fatal threats as governmental UUV use expands.

On land, Fourth Amendment law is well developed though constantly evolving. At sea, however, this precedent remains, in many ways, in its infancy.[170] Large gaps exist in our understanding of what is and is not protected at sea by the Fourth Amendment primarily because until now there has been no need to consider them. Cases of governmental search and seizure of commercial structures at sea, for instance, have simply not occurred; to search this way in previous decades would have been cost-prohibitive. The increasing availability of UUVs has changed this. For the first time, broad scale governmental surveillance of activities taking place in the ocean is a viable prospect both technologically and economically. This is occurring at the same time that

166. *See* Wrathall, *supra* note 5, at 234.

167. *See id.*

168. *See* Urbina, *supra* note 21.

169. *See, e.g.*, SCOT T. TRIPP, RESEARCH & DEVELOPMENT CENTER, U.S. COAST GUARD, AUTONOMOUS UNDERWATER VEHICLES (AUVS): A LOOK AT COAST GUARD NEEDS TO CLOSE PERFORMANCE GAPS AND ENHANCE CURRENT MISSION PERFORMANCE 4 (2006), http://www.dtic.mil/dtic/tr/fulltext/u2/a450814.pdf.

170. *See* Lauren Estrin, Comment, *The Preservation of Privacy Interests at Sea: The Need for Meaningful Scope Limits on Custom Official and the Coast Guard's Sweeping Authority to Search Vessels*, 29 TUL. MAR. L. J. 105, 124 (2004).

non-drone technologies have opened the ocean to broader commercial and recreational interests, leading to an explosion in the number of entities working in the ocean.[171] We stand now at a point where rapidly increasing use is followed by exploding governmental monitoring with no clear understanding of what, if any, limitations our privacy regimes place on this governmental surveillance.

1. Fourth Amendment Background

Before delving specifically into what privacy rights exist for different entities at sea, I turn to a basic discussion of the relevant portions of Fourth Amendment law. The Fourth Amendment forms the foundation of privacy protections under U.S. law, applying to all territory under the jurisdiction of the United States.[172] This includes ocean waters up to twelve miles from shore as well as all U.S. flagged vessels.[173] Any drones operated by the government in these areas must comply with the Fourth Amendment, which protects the "right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures."[174]

Current Fourth Amendment case law is built on the United States Supreme Court's decision in *Katz v. United States*, which found that a search is unconstitutional under the Fourth Amendment when a person has "exhibited an actual (subjective) expectation of privacy and . . . the expectation be one that society is prepared to recognize as 'reasonable.'"[175] Two elements must be met for a privacy right to exist under *Katz* – a demonstrated intent to keep the activities in question private and a finding that this expectation is societally justified.[176] Both of these prongs create special problems in the case of marine surveillance, a world where – to date – privacy has not been a major concern of individuals or society.

Katz was further extended in the Court's decision in *Kyllo v. United States* – a decision that provides additional insight into what level of surveillance by UUV may be allowable.[177] In *Kyllo*, the Court addressed whether police use of a thermal-imaging device to scan a person's home was constitutionally permissible.[178] The Court found that it was not, noting that "obtaining by sense-enhancing technology any information regarding the interior of the home that

171. *See* Svati Kirsten Narula, *America's Ocean-Powered Economy*, ATLANTIC (Mar. 21, 2014), https://www.theatlantic.com/business/archive/2014/03/americas-ocean-powered-economy/284516/.

172. United States v. Verdugo-Urquidez, 494 U.S. 259, 267 (1990).

173. UNCLOS, *supra* note 104, at 400 ("Every State has the right to establish the breadth of its territorial sea up to a limit not exceeding 12 nautical miles, measured from baselines determined in accordance with this Convention."); *id.* at 433.

174. U.S. CONST. amend. IV.

175. 389 U.S. 347, 361 (1967) (Harlan, J., concurring).

176. *Id.*

177. 533 U.S. 27 (2001).

178. *Id.* at 29.

could not otherwise have been obtained without physical 'intrusion into a constitutionally protected area,' constitutes a search – at least where . . . the technology in question is not in general public use."[179] In coming to this conclusion, the Court emphasized the need to protect the private sanctity of the home.[180] This recognition of more stringent privacy protections for the intimate areas of the home has been a universal theme in Fourth Amendment interpretation, particularly in cases where new technologies are being used.[181] *Kyllo* also raises the question of the constitutionality of new, sophisticated sensory technology – an important consideration in the case of UUVs. Taken together, *Kyllo* and *Katz* introduce the Fourth Amendment framework that I will consider in more detail as it applies to marine UUV use. I look to specific cases from the marine realm as well as from terrestrial drones to understand potential application at sea.

Thus, in addition to *Katz*'s considerations of what society is prepared to consider reasonable, effective analysis of maritime UUV use also needs to establish whether any areas at sea are effectively equivalent to areas of the home and thus subject to heightened privacy protections. To address these factors, I first turn to *Katz*'s first prong, finding that a subjective expectation of privacy generally exists at sea. I then turn to *Katz*'s second prong, analyzing how the Fourth Amendment has been interpreted at sea in the past and whether different types of maritime operators have a reasonable expectation of freedom from surveillance. Last, I address the sensory capabilities of UUVs themselves and argue that the government's use of certain types of sensing devices is unlikely to be constitutional. As a result, I argue that while the existing Fourth Amendment case law correctly provides only limited protection to purely commercial entities, it fails to provide the protections due to living spaces at sea. In the face of increasing potential for infringement on seaborne living spaces by UUVs, it is critical that these be strengthened.

2. A Subjective Expectation of Privacy Usually Exists at Sea

Demonstrating a subjective expectation of privacy, the first element of *Katz*, is one that normally receives little attention from courts,[182] but it raises interesting issues underwater. In the terrestrial context, exhibiting an expectation of privacy is often a straightforward and not particularly thought-intensive endeavor. It can be as simple as closing a door behind you in a phone booth[183]

179. *Id.* at 34 (citation omitted) (quoting Silverman v. United States, 365 U.S. 505, 512 (1961)).

180. *Id.* at 40.

181. *Id.* at 33, 35–36.

182. WAYNE R. LAFAVE, SEARCH AND SEIZURE: A TREATISE ON THE FOURTH AMENDMENT § 2.1(c) (5th ed. 2012), Westlaw (database updated Oct. 2018) ("[L]ittle attention has been given to the independent significance of the first factor or to precisely how it is to be interpreted").

183. Katz v. United States, 389 U.S. 347, 359 (1967).

or placing your belongings in a bag that is not transparent.[184] Courts have found that as long as actions are out of the general view of the public, an expectation of privacy has been shown.[185] Doors or walls are enough to create this expectation.[186] These have some meaning because they stand apart from the many places that are not surrounded by doors or walls: porches, backyards, or public roads to name a few. At sea this same distinction generally does not exist. Nearly everything operating in the marine environment is completely enclosed for the simple functional reason that it would otherwise be full of water. Thus, if all it takes to demonstrate an intent to keep marine activities private is that these activities not be visible to the general public, this factor would nearly always be met at sea by simple operational necessity.[187] Courts tend to find that so long as items are not exposed in plain view this element is satisfied, regardless of the functional question of *why* they are not in plain view.[188]

From the perspective of potential invasions of privacy by drones, however, what is inside a ship is less interesting than what is going on around it. While drones may have some hull-penetrative capabilities,[189] the majority of observations by UUVs will be of the outside of marine structures. Whether a subjective expectation of privacy is exhibited in these cases is much less clear. Maritime interests may take some precautions to protect their privacy in the form of radar use to observe any nearby vessels, but these measures tend to be haphazard and incomplete.[190] It is unclear whether this is because these entities do not care about the privacy of their facilities or simply because they reasonably expect that their remote location and the opacity of seawater will prevent anyone from observing them. A manifestation of a subjective expectation of privacy may then be extremely difficult to assess in marine environments. This first factor is often conflated with the second part of *Katz*, and many academics argue that Fourth Amendment privacy rights should not turn on whether a target manifested a subjective expectation of privacy.[191]

184. Bond v. United States, 529 U.S. 334, 338–39 (2000).

185. Lee Tien, *Doors, Envelopes, and Encryption: The Uncertain Role of Precautions in Fourth Amendment Law*, 54 DEPAUL L. REV. 873, 874–75 (2005).

186. *Id.* at 874.

187. One exception here would be open-ocean aquaculture where installations are open to the environment.

188. Eric Dean Bender, Note, *The Fourth Amendment in the Age of Aerial Surveillance: Curtains for the Curtilage?*, 60 N.Y.U. L. REV. 725, 753–54 (1985).

189. *See supra* text accompanying note 95.

190. *See, e.g.*, Hong Li et al., *Security and Privacy in Localization for Underwater Sensor Networks*, IEEE COMM. MAG., Nov. 2015, at 56, 56.

191. *See, e.g.*, Morgan Cloud, *Pragmatism, Positivism, and Principles in Fourth Amendment Theory*, 41 UCLA L. REV. 199, 250 (1993).

3. Is an Expectation of Privacy from Surveillance by UUVs Reasonable?

The second prong of *Katz* is the more important consideration in establishing marine privacy rights: is there an expectation of privacy that society is prepared to recognize on and around underwater facilities? In the maritime context, there are two critical inquiries: what reasonable expectations of privacy exist at sea in general and what reasonable expectations of privacy exist specifically from surveillance by drones?

Turning to the first of these, courts have found that more limited Fourth Amendment protections exist at sea than on land. The majority of the cases arise on ships[192] – areas where governmental intrusion is the norm under the Coast Guard's sweeping right to board.[193] Under the authorization of 14 U.S.C. § 89, Coast Guard officers "may at any time go on board of any vessel subject to the jurisdiction, or to the operation of any law, of the United States."[194] While the resulting searches are technically limited to safety and document inspections, in practice the Coast Guard routinely uses these for much broader purposes, including searches for drugs and other contraband.[195] The constitutionality of this broad statutory grant of authority to conduct "boarding[s] that would be unconstitutional under any reasonableness standard"[196] is the subject of robust and ongoing debate in the academic community.[197] This debate is for the most part not echoed by courts, however. The Coast Guard's sweeping right to board and search ships continues to be upheld, and it is widely understood that Fourth Amendment protections are consequently so weak as to be meaningless in many cases at sea.[198]

The entirety of Fourth Amendment law at sea stems from these direct Coast Guard vessel boardings. However, UUVs are unlikely to engage in this type of direct search on a vessel. Instead, UUVs are more likely to gather data on the outside of commercial installations or vessels, perhaps using acoustic and other sensors to obtain information about the inside of the vessel. While the limits of Fourth Amendment protections may be relatively clear in the case of direct boardings on ships themselves, these limits have not yet been established for surveillance occurring around them. Here, I look to what, if any, privacy rights are likely to exist around vessels, commercial installations, and

192. *See* James S. Carmichael, *At Sea with the Fourth Amendment*, 32 U. MIAMI L. REV. 51, 52–54 (1977).

193. 14 U.S.C. § 89 (2018).

194. *Id.* § 89(a).

195. Megan Jaye Kight, Note, *Constitutional Barriers to Smooth Sailing: 14 U.S.C. § 89(a) and the Fourth Amendment*, 72 IND. L. J. 571, 572 (1997).

196. Howard S. Marks, *The Fourth Amendment: Rusting on the High Seas?*, 34 MERCER L. REV. 1537, 1560 (1983).

197. *See generally* Estrin, *supra* note 170, Kight, *supra* note 195; Linda A. Newland, *Searches and Seizures at Sea: Trying to Balance Governmental Interests Against the Fourth Amendment*, 16 TUL. MAR. L. J. 319 (1992).

198. *See* Estrin, *supra* note 170, at 111–12.

other marine entities and argue that current Fourth Amendment protections must be made more robust.

a. Unmanned Commercial Structures

I look first at the privacy rights that exist around fixed commercial structures that are characterized by the absence of people living on them. Drilling rigs, undersea cables, and mining equipment are examples of uninhabited structures. In the next Section, I will turn to structures that are mobile and occupied by humans under the broad umbrella of vessels.

On land, commercial structures enjoy Fourth Amendment protections[199] but ones that are less protective than those afforded to private homes.[200] Courts have recognized that the strength of the Fourth Amendment is greatest when protecting the intimate areas of people's homes.[201] In commercial areas, these intimate details are not found and consequently the privacy regime covering these areas is far weaker.[202] Lesser protections are also justified for businesses where the general public has an invitation to enter – to not allow law enforcement to enter would be unreasonable.[203]

In practice, the lesser protections that commercial properties are afforded under the Fourth Amendment means that observation of industrial facilities is generally allowed so long as police officers do not enter onto premises from which the public is excluded.[204] In cases of aerial surveillance, even surveillances occurring with sophisticated and new technologies, governmental observation of industrial premises has been allowed under the Fourth Amendment.[205] In the landmark *Dow Chemical* case, the court based this conclusion on the understanding that "an industrial complex is more comparable to an open field and as such it is open to the view and observation of persons in aircraft lawfully in the public airspace immediately above or sufficiently near the area for the reach of cameras."[206] However, observations that enable law

199. *See, e.g.*, See v. City of Seattle, 387 U.S. 541, 543 (1967) ("The businessman, like the occupant of a residence, has a constitutional right to go about his business free from unreasonable official entries upon his private commercial property.").

200. New York v. Burger, 482 U.S. 691, 699–700 (1987) ("An expectation of privacy in commercial premises, however, is different from, and indeed less than, a similar expectation in an individual's home.").

201. Kyllo v. United States, 533 U.S. 27, 37 (2001) ("In the home, our cases show, *all* details are intimate details, because the entire area is held safe from prying government eyes." (alteration in original)).

202. Dow Chem. Co. v. United States, 476 U.S. 227, 236 (1986) ("The intimate activities associated with family privacy and the home and its curtilage simply do not reach the outdoor areas or spaces between structures and buildings of a manufacturing plant.").

203. *See, e.g.*, Maryland v. Macon, 472 U.S. 463, 470 (1985).

204. *See* Air Pollution Variance Bd. v. W. Alfalfa Corp., 416 U.S. 861, 865 (1974).

205. *See, e.g.*, *Dow Chem. Co.*, 476 U.S. at 233–34.

206. *Id.* at 239.

enforcement to "see" inside buildings are unlikely to be constitutional even under the relaxed Fourth Amendment application to commercial structures.[207]

This central understanding of how the Fourth Amendment applies to terrestrial structures provides the basis for how the Fourth Amendment is likely to be applied to commercial structures at sea. As on land, commercial structures at sea are not characterized by the "intimate details" that would make them the subject of heightened privacy requirements and would be likened to an open field. Following *Dow Chemical*, governmental visual observation of commercial facilities is likely to be upheld in the marine context just as it in terrestrially.[208]

However, there are significant differences between the physical aspects of commercial facilities on land and at sea. On land, factories and other industrial structures are located on (often vast) parcels of land that are privately owned. Thus, most of the relevant activities happening around these factories occur on private land. In contrast, at sea there is generally no private ownership of the water surrounding commercial installations.[209] That is not to say that no activity occurs in these zones – commercial structures at sea have many different things occurring around them. From commercial divers to ROVs to boats ferrying workers and cables running to shore, fixed commercial structures sit at the center of a complicated web of activity. Commercial activity, which on land is likely to be primarily on private property, is in publicly owned and accessible waters. In light of this, some might argue that commercial structures at sea should be subject to even weaker privacy protections than on land. Weaker privacy protections are unlikely, however, given that courts have likened the privately-owned land around industrial buildings to "open fields."[210] Although not public property, open fields share many characteristics with public ocean waters while having few of the heightened rights that come with private property ownership. The similarities between industrial facilities on land, located on unprotected open fields, and at sea, located in public waters, are strong and support a similar Fourth Amendment application. Furthermore, even on land – where private and public land delineations are frequent and clear – courts have generally found that reasonable expectations of privacy, not ownership lines, are the critical factor in determining where Fourth Amendment protections apply.[211] At first glance then, governmental visual surveillance around marine commercial structures likely is legal when carried out from public waters.

This becomes slightly more complicated in the case of non-visual surveillance, particularly when technologies being used can potentially penetrate the

207. *Id.*

208. *See id.*

209. Exceptions to this may exist in areas where the seafloor is being leased. *See supra* text accompanying notes 104–06.

210. *See Dow Chem. Co.*, 476 U.S. at 236.

211. It is important to delineate this from trespass, where property boundaries are a crucial delineating line, as discussed *supra* Section II.A.1.

hull to "see inside" a commercial structure. In finding that aerial surveillance of industrial facilities did not constitute a search in *Dow Chemical*, the Court emphasized that "the [Environmental Protection Agency] was not employing some unique sensory device that, for example, could penetrate the walls of buildings and record conversations in Dow's plants, offices or laboratories, but rather a conventional, albeit precise, commercial camera . . . ."[212] In assessing the constitutionality of UUV surveillance, any sensory equipment that is able to penetrate the superstructures of marine vessels and other equipment would immediately seem to be suspect under the Fourth Amendment. This is certainly possible with current acoustic sensing technologies – sound waves propagate far better underwater and can easily allow listening devices to hear conversations going on inside vessels.[213] Acoustic or thermal imaging technologies allowing the government to see inside structures are unlikely to be a constitutional method of surveillance.

Applying limited privacy protections to industrial marine structures is consistent with the Fourth Amendment rationale that we see on land. Just as the court in *Dow Chemical* recognized that industrial facilities are not imbued with the same intimate details that make privacy rights so important in the home,[214] marine structures, too, are marked by an absence of intimate features. Indeed, there are no significant characteristics of marine industries that would support a divergence from this terrestrial norm for policy reasons except perhaps the longstanding expectation that operations at sea have historically been free from observation due to their location. From a policy perspective, this expectation of privacy has for the most part yielded societally unfortunate consequences because widespread disregard of basic human rights, environmental, and criminal laws are the norm throughout the world's oceans.[215] If anything, increased observation of previously secretive marine operators may help to reveal the most egregious lawbreakers at sea and make law enforcement more feasible on an ocean-basin scale.[216] In light of this, finding that marine industrial structures enjoy limited privacy protections from outside visual surveillance has support both from terrestrial case law as well as broader societal aims.

b. Manned Structures and Vessels

Vessels are distinct from commercial structures both because they are mobile and because they are not used purely for industrial purposes. Vessels

212. *Dow Chem. Co.*, 476 U.S. at 238.

213. *See* Chris Fox, *Technologies for Ocean Acoustic Monitoring*, OCEAN EXPLORER, https://oceanexplorer.noaa.gov/explorations/sound01/background/technology/technology.html (last visited Mar. 5, 2019).

214. *Dow Chem. Co.*, 476 U.S. at 239.

215. *See* Urbina, *supra* note 21.

216. In fact, efforts are currently underway to use UUVs and other technologies for this very purpose. *See Unmanned Systems*, SECURE OUR OCEANS, http://secureoceans.org/categories/unmanned_systems (last visited Mar. 5, 2019).

boast human crews that not only work but also live onboard the ships.[217] The spaces in which they live create an important distinction given that the protections of the Fourth Amendment are strongest in the "intimate areas of the home."[218] If courts were to find that these same intimate elements are present onboard ships, stricter Fourth Amendment protections against searches should apply, as many scholars have argued.[219]

This distinction between the potentially intimate areas of vessels and commercial structures at sea is unimportant except in cases where UUVs are able to obtain information about the inside of a vessel. When observation is merely external, no personal details are likely to be obtained and vessels are not significantly distinct from commercial structures. Like commercial structures, external visual observation of vessels is probably not a Fourth Amendment violation so long as it takes place from public waters.[220] However, where UUVs use hull-penetrative technologies, the constitutionality of observation will turn on the distinction between the intimate living spaces and public spaces on vessels, as well as the type of sensors the UUV itself is using.

Turning to the first of these, courts do draw a distinction between the living quarters and public spaces of a vessel in cases assessing searches incident to the Coast Guard's right to board.[221] Recognizing that crew living spaces have many of the intimate details characteristic of the home, courts have noted that crewmembers retain a legitimate expectation of privacy in their own quarters whether they are shared with others or not.[222] How strong this expectation of privacy is depends on the nature and use of the vessel, with courts more prepared to recognize privacy rights the longer the vessel is at sea under the rationale that ships away from shore for months at a time are truly the homes of their crewmembers.[223]

However, this distinction in practice is a weak one. While courts give some theoretical credit to the idea that living quarters should be free from governmental searches absent a warrant, in practice, courts have upheld them whenever searches are carried out in these areas.[224] These searches are generally justified under the Coast Guard's statutory authority to conduct administrative safety and document searches, with courts noting that so long as documents or safety equipment are stored in private living areas, the Coast Guard has a right to access those areas as part of their statutory mandate.[225] This

217. *See, e.g.*, *Life Aboard Ship*, FEDNAV (May 30, 2016), http://www.fednav.com/en/media/life-aboard-ship.

218. Kyllo v. United States, 533 U.S. 27, 37 (2001).

219. *See, e.g.*, Daniel L. Cullum, Comment, *The Fourth Amendment and Maritime Drug Searches: Is There a "Legitimate Expectation of Privacy" on Vessels at Sea?*, 1994 U. CHI. LEGAL F. 367, 369–70 (1994); Kight, *supra* note 195, at 590–93.

220. *See* discussion *supra* Section II.B.3.a.

221. *E.g.*, United States v. Cardona-Sandoval, 6 F.3d 15, 21–22 (1st Cir. 1993).

222. *E.g.*, *id.*

223. Cullum, *supra* note 219, at 381–82.

224. *See* Kight, *supra* note 195, at 575–85.

225. Cullum, *supra* note 219, at 376.

judicial conclusion overlooks the reality that any properly equipped vessel is required to have safety equipment in crew living quarters, such as fire extinguishers and personal flotation devices.[226] In light of this, the Coast Guard has effectively unlimited authority to search any area of a ship, regardless of what "intimate details" of crewmember lives may be present. Academic commentators have long lamented the sweeping authority courts have granted to the Coast Guard pursuant to this statutory right, with many arguing that the current standards result in routine Fourth Amendment violations.[227] As potential for surveillance at sea increases dramatically, it is critical to solidify and strengthen the distinction between living spaces and public spaces at sea.

This is even more pressing given that rationalizing limited Fourth Amendment protections on the basis of maritime safety is a tenuous argument at best in the case of UUVs. While the Coast Guard boards vessels specifically to check that safety equipment on board complies with statutory requirements, any proposed safety rationale for observation of a vessel by UUV is much less concrete. In searching vessels to understand their compliance with safety regulations, the Coast Guard focuses on determining whether vessels have the appropriate life safety equipment, including fire extinguishing systems, life rafts, personal flotation devices, navigational lights, and distress communication methods.[228] Additionally, Coast Guard searches seek to assess whether vessels are legally documented and comply with appropriate customs and immigration protocols.[229] Even highly sophisticated UUVs with hull-penetrating sensing devices would be unable to obtain any meaningful information about the vessel's documentation or how many fire extinguishers are located in the ship's engine room. Attempting to apply the same safety rationale to justify governmental UUV observation of vessels is thus unlikely to be successful. This is not to say that UUVs have no function in assessing a vessel's compliance with safety regulations more generally: important information about what ships are discharging and whether they are violating environmental pollution laws may ultimately be one of the most useful potentials of UUVs. However, discharge information is not generally included in the scope of the Coast Guard's boarding authority under 14 U.S.C. § 89(a).[230] Regardless, this type of information would be gathered by UUVs about the outside of vessels and would certainly not be sufficient to justify the observation of intimate details about the persons onboard them with thermal or acoustic technologies. Thus, UUV observation should not be protected under the same rationale that has led to the unfortunate

226. *See* 46 C.F.R § 25.30-20 (2016).

227. *See, e.g.*, Cullum, *supra* note 219, at 369–70; Kight, *supra* note 195, at 575–76; Newland, *supra* note 197, at 320.

228. *See* United States v. Thompson, 710 F.2d 1500, 1507 (11th Cir. 1983); *see also* Online Virtual Vessel Safety Check, U.S. COAST GUARD AUXILIARY, http://wow.uscgaux.info/content.php?unit=V-DEPT&category=virtual-safety-check (last visited Mar. 5, 2018).

229. Cullum, *supra* note 219, at 373–74 & nn.28–29.

230. *See* 14 U.S.C. § 89(a) (2018).

erosion of Fourth Amendment rights onboard ships to date. Living spaces must be free from intrusive surveillance by UUVs.

Beyond the constitutional limits that should be placed on observation of living spaces by UUV, additional limits may exist for general UUV surveillance due to its status as a new technology. Using newly developed and sophisticated technologies that are not widely available to the general public has been understood by courts to create potential Fourth Amendment violations, as society may not yet be prepared to recognize that observation by these devices is reasonable.[231] UUVs themselves are new technologies, as are many of the sensory devices that they carry. I look to the potential Fourth Amendment limits placed on surveillance by each of these in turn.

First, while UUVs themselves are becoming increasingly common in the ocean, it is unlikely that they are common enough that commercial and other marine interests should expect observation by them. UUVs have been used for decades, but to date their use has been limited both in function and in scale. ROVs, by definition, can only be used in the area immediately around commercial installations or vessels, connected to these vessels as they are with a tether. Facilities operating on their own far from any other structures would historically have no reason to expect any type of UUV to be near them, let alone observing them. This is likely to support a judicial finding that an expectation of privacy from observation by UUV is reasonable. How long this remains reasonable will depend on how rapidly UUV use and surveillance proliferate.

The visual capabilities of UUVs are unlikely on their own to pose any additional Fourth Amendment issues. Advanced visual technologies that allow police officers to see into homes are restricted under the Fourth Amendment.[232] However, the same magnification technologies used to observe industrial complexes have been allowed under current Fourth Amendment case law.[233] As such, visual observation by UUV may be restricted so long as UUV use remains new and unexpected but is unlikely to pose any additional issues beyond this.

Other forms of UUV surveillance, however, are more constitutionally ambiguous. With visual observation inherently limited in its utility by low visibility in much of the oceans, other methods of surveillance, such as chemical, thermal, and acoustic imaging, will be more prevalent. These sensing capacities dramatically expand the capabilities of UUVs, potentially allowing them to "see" inside vessels. Constitutionally this raises additional concerns. In the case of technologies that are able to penetrate buildings, courts have raised concerns when these technologies are able to ascertain intimate details of the home.[234]

231. Kyllo v. United States, 533 U.S. 27, 34 (2001).
232. *Id.*
233. Dow Chem. Co. v. United States, 476 U.S. 227, 238–39 (1986).
234. *Kyllo*, 533 U.S. at 37, 40.

Chemical sensing capabilities open the possibility for government entities to "see" what is occurring inside vessels. Chemical water content and acoustic and pressure sensing devices may be able to gain a far broader picture of underwater activity than just visual sensing. Because of this, these devices are likely to become important tools for government monitoring of underwater behavior. Particularly in relation to environmental regulations, which often prohibit chemical releases, devices that are able to ascertain whether any chemicals are being emitted into the water may be crucial in discovering and litigating environmental non-compliance. In the terrestrial context, police use several techniques that sense the chemical content of air outside homes or cars to detect drugs inside with varied constitutional results. The Court has found that police use of dogs to smell around cars – a common investigative technique – is constitutional[235] while bringing a dog onto the front porch of a home to sniff for drugs is unconstitutional.[236] In finding that bringing a dog onto a porch to conduct a search was unconstitutional, the majority's decision hinged on their finding that the front porch was part of the home and thus police entry to conduct a search without permission constituted a search for Fourth Amendment purposes.[237]

Courts, however, are likely to treat vessels more like cars than homes. UUVs conducting surveillance from outside a vessel will not be on the equivalent of a front porch. Instead, they will be conducting their surveillance from public waters, just as drug dogs investigating cars are searching in public areas. While courts do sometimes recognize that vessels have home-like living spaces inside of them, at present, courts do not extend this umbrella of protection to the other parts of the vessel.[238] UUV sensing technologies that can ascertain the chemical content of water around the ship to understand what is going on inside of it would thus likely be analogized to trained dogs sniffing around the exterior of a car. Assuming that no other interference with the vessel happens during this surveillance, courts are likely to find that, just like with cars, external surveillance from public vantage points is constitutional.

Treating vessels like cars is problematic – however neat the analogy. Current judicial interpretation already allows for arguably unconstitutional searches of crewmembers' private living quarters, and allowing UUV surveillance of the outside of vessels will further infringe the crewmembers' rights. Current maritime Fourth Amendment precedent makes a distinction between the intimate living spaces of vessels and the public spaces, but that distinction should not be applied to permit widespread UUV surveillance. Although the Coast Guard has statutory authority to board vessels to conduct safety and document searches, no such rationale exists for hull-penetrative UUV technology. Furthermore, while the motor vehicle exception allows Fourth Amendment searches of Recreational Vehicles ("RV"s), which have a similar combination

235. Florida v. Harris, 568 U.S. 237, 248 (2013).
236. Florida v. Jardines, 569 U.S. 1, 9 (2013).
237. *Id.* at 6–7.
238. *See* Estrin, *supra* note 170, at 115–16.

of living spaces as ships, the primary rationale behind this exception is to prevent these mobile vehicles from getting away from law enforcement.[239] This argument is less relevant for the Coast Guard, as there is always a right to stop and board vessels under their statutory authority.[240] In the absence of a safety or exigency rationale, searching inside of enclosed private property absent a warrant should be constitutionally barred under the Fourth Amendment. This is even more critical given that vessels are the homes of the crewmembers onboard them. It does not matter that some areas of the vessel are used for less intimate purposes, like propulsion. The areas of the home most likely to yield illegal marijuana growing, for instance greenhouses and basements, are similarly not associated with particularly intimate details. Nonetheless, these spaces are included under the broad protection afforded to the home as a whole. Courts do not attempt to ascertain which areas of the home are the most intimate areas, instead the act of living in a space renders the whole space the subject of heightened privacy protections. This same rationale should apply to vessels. While crewmembers may sleep in certain areas of a vessel, this does not mean that the intimate details of their lives are not found throughout the ship. Intimate activities are just as likely to happen (and are perhaps more likely) to happen outside of the bunks. Just as entire homes are protected under the Fourth Amendment, so too should entire ships. That any governmental rationale for hull-penetrative surveillance is weak at best simply enforces this point.

c. Over People

The last category of major interest in the maritime realm where privacy rights may come into play are the interests of people themselves. This may seem to be a relatively insignificant class given the dearth of humans in most areas of the ocean, however, recent drone developments targeted towards divers make this an important consideration. The iBubble, for instance, is a prototype drone designed specifically to operate with divers, tracking and filming their movements.[241] While the iBubble's designers describe it as designed to provide divers with films of themselves diving for their own use and entertainment,[242] the potential privacy questions that surround the iBubble and similar devices are significant. While systemized governmental monitoring of diving may be far in the future, monitoring of areas where diving is popular and the local environment has been degraded by human interference could be achieved easily by sending a UUV to continuously monitor the activities of divers. In these cases, Fourth Amendment issues may arise if divers held a reasonable expectation of privacy from government surveillance.

239. California v. Carney, 471 U.S. 386, 393 (1985).
240. *See* 14 U.S.C. § 89(a) (2018).
241. IBUBBLE, *supra* note 88.
242. *Id.*

People are frequently subject to government surveillance in public spaces on land. The government is allowed to conduct terrestrial surveillance to the extent that it does not interfere with a reasonable expectation of privacy.[243] Similarly, private parties can sometimes surveille each other: courts have generally found that no reasonable expectation of privacy exists in public spaces where other people can see you.[244] However, the extent to which our lives may be tracked by modern technology is controversial. The public generally finds aerial drones that track a specific person's movements more invasive than security cameras or other passive surveillance devices the same way it finds any surveillance of one person in public spaces that continues for an extended period of time more invasive than other forms of surveillance.[245] Nevertheless, courts still use the baseline standard of reasonable expectation of privacy when evaluating the privacy issues these devices raise.[246]

It is unclear whether diver-tracking drones would be considered a privacy invasion under the definition of a reasonable expectation of privacy that society is prepared to recognize as reasonable.[247] Given the newness of underwater drone technology,[248] it may be that diver-tracking drones are not devices whose use society is currently prepared to recognize as reasonable. However, as these UUVs become more commonly used by divers or the government in popular dive sites, the expectation of underwater privacy might stop being reasonable. Just as in public spaces on land, divers generally dive in areas where many others can see them – and this is a reality that undermines their expectation of privacy.

In sum, the Fourth Amendment may protect surveillance from government UUVs for a time while these technologies remain new, however, in the long run it is unlikely that the Fourth Amendment will protect divers from government surveillance. It is also important to look at the policy aims of the Fourth Amendment in determining whether this result is correct. Understanding what society recognizes as reasonable should require an analysis of "the customs and values of the past and present."[249] In this context, allowing government drones to observe various entities at sea would be inconsistent with

243. *See* Margot E. Kaminski, *Drone Federalism: Civilian Drones and the Things They Carry*, 4 CAL. L. REV. CIR. 57, 59–60 (2013).

244. *See id.* at 68, 70.

245. *Id.* at 72.

246. *Id.* at 68–70.

247. Katz v. United States, 389 U.S. 347, 361 (1967) (Harlan, J., concurring) ("My understanding of the rule that has emerged from prior decisions is that there is a twofold requirement, first that a person have exhibited an actual (subjective) expectation of privacy and, second, that the expectation be one that society is prepared to recognize as 'reasonable.'").

248. *See* discussion *supra* Section I.A.2.

249. United States v. White, 401 U.S. 745, 786 (1971) (Harlan, J., dissenting).

the ideals of a free and open society in that it would require unreasonable burdens on any who wished to maintain their privacy.[250]

There are strong policy arguments for encouraging a more robust privacy regime at sea than may currently exist under the Fourth Amendment. While some inherent privacy protections are built into land-based structures simply through the existence of private property boundaries, no such limits exist at sea. Thus, while terrestrial buildings are shielded from intrusion and observation by the government (or competing commercial interests) due to the simple fact that they are surrounded by private property, installations at sea enjoy none of the same privacy buffer.[251]

Despite the policy considerations that argue for privacy protections at sea comparable to those on land, at present neither public nor private law provides them. Scholars have argued for more Fourth Amendment protections for maritime operations.[252] These calls to date seem to have fallen on deaf ears. As UUV use increases, however, privacy concerns likely will draw more public and legal attention. Perhaps this attention will allow for a thorough reconsideration of how the Fourth Amendment continues to be misapplied at sea.

III. PRIVACY UNDER THE LAW OF THE SEA CONVENTION

I now turn to privacy rights under international law. U.S. jurisdiction extends out twelve nautical miles from the coastline, with the area beyond this subject to UNCLOS.[253] However, vessels flagged in the United States are always subject to U.S. jurisdiction and law, regardless of their location in the world.[254] Similarly, all vessels operating in international waters are subject to the laws of their flag state,[255] while commercial structures are subject to the laws of the nation they have obtained seafloor leases from.[256] Thus, privacy issues on the high seas will for the most part be dealt with under the national law applicable to the vessel in question. However, there are some cases where understanding the international legal regime governing privacy and UUV operation may be important in delineating privacy rights more broadly. I explore these here.

The main difference in privacy protections in international waters is in the realm of public law. For private law concerns, issues of trespass are likely to be resolved under the umbrella of national law. Public privacy protections on the high seas, however, are not governed by the Fourth Amendment, and its

250. *See* Anthony G. Amsterdam, *Perspectives on the Fourth Amendment*, 58 MINN. L. REV. 349, 403 (1974).

251. *See* discussion *supra* Section II.A.1.

252. *See, e.g.*, Cullum, *supra* note 219, at 388; Newland, *supra* note 197, at 346–47.

253. UNCLOS, *supra* note 104, at 400.

254. Robert D. Peltz & Lawrence W. Kaye, *The Long Reach of U.S. Law over Crimes Occurring on the High Seas*, 20 U.S.F. MAR. L. J. 199, 215 (2008).

255. UNCLOS, *supra* note 104, at 434.

256. *See id.* at 400.

equivalent does not exist on an international level. The main privacy protections under international law instead will stem from private property rights as well as any restrictions on UUV operation that may exist under UNCLOS.

Determining private property rights at sea is difficult under UNCLOS.[257] Ownership of submerged land resources remains one of the more contentious elements of this already contentious treaty.[258] However, just as within territorial waters, commercial entities operating both on the high seas and within Exclusive Economic Zones ("EEZ"s) are regularly granted leases to exploit natural resources on the sea floor.[259] International leases are functionally very similar to U.S. leases and those granted within the U.S. EEZ are of course identical to leases in U.S. territorial waters. Thus, both national and international seafloor leases create the same private property rights.

Like U.S. national law, UNCLOS recognizes a right for law enforcement of any country to board any vessel operating in international waters but only in specific circumstances.[260] This right is significantly more limited under UNCLOS than the Coast Guard's broadly interpreted right under U.S. law.[261] Specifically, UNCLOS gives naval vessels a right to board ships when the navy suspects a vessel under their jurisdiction has committed a crime defined under that state's laws.[262] Piracy, transportation of slaves, and other limited crimes are subject to universal jurisdiction.[263] Aside from this right to board, vessels operating lawfully on the high seas are understood to have the freedom of navigation and are generally allowed to operate freely.[264]

UNCLOS' guarantee of the freedom of navigation does not explicitly preserve the right to be free of unreasonable searches for a ship.[265] The lack of an explicit prohibition on searches, coupled with a long and storied history of submarine surveillance in the oceans, likely means that UUV observation will generally be allowed under UNCLOS so long as it does not interfere with the protected freedom of navigation. UNCLOS' guarantee of freedom of navigation is subject to specific regulations of the flag state of any UUV carrying out observations, however, with which vessels must comply.[266]

I now turn briefly to examine what limits the UNCLOS places on how drones operate and whether these operations may infringe on privacy rights.

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257. *See id.*

258. *See* Osherenko, *supra* note 103, at 341. Significantly, whether or not coastal States own the resources in their EEZs has been hotly debated. *Id.*

259. *Id.* at 331.

260. *Id.* at 438. The remainder of the time, vessels can only be boarded either by their flag State or the State whose waters they are operating in. *See id.* at 405–06, 433–34. Obviously, "[w]arships on the high seas have complete immunity from the jurisdiction of any State other than the flag State." *Id.* at 435.

261. *See supra* text accompanying notes 191–97.

262. *See* UNCLOS, *supra* note 104, at 434.

263. *Id.* at 436–38.

264. *Id.* at 432–33.

265. *See id.*

266. *See id.* at 433.

UNCLOS provides a framework that governs the operation of vessels in the territorial seas and EEZs of other nations. While UNCLOS has no provisions that specifically cover privacy rights at sea, there are several considerations that may limit the operation of drones in ways that would infringe on privacy rights.

Generally speaking, the critical determination in assessing drone operation under UNCLOS will be whether drones are considered vessels. This question has been the subject of considerable debate by scholars who have reached no certain conclusion.[267] Functionally, however, there are few other places where UUVs are likely to fit into the international legal regime. While it may be uncertain whether free-swimming drones would be considered vessels, they are even less likely to fall into the categories of "platforms or other man-made structures," "aircraft," or "submarine cables or pipelines," which constitute the other major classes UNCLOS describes.[268] Functionally, then, if drones are not considered vessels, they would likely fall into a legal no man's land under the UNCLOS. This would effectively exempt them from most substantive UNCLOS provisions, such as the Article 210 prohibitions on dumping that prohibit "any deliberate disposal of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea."[269] Assuming that this result is likely to be disfavored by the international community, drones are probably considered vessels under UNCLOS – at least until UNCLOS issues further guidance.

If UUVs are considered vessels, then their operation under UNCLOS is allowed globally, subject to the same freedoms and restrictions as any other ship. On the high seas, states and their vessels have the freedom of navigation to the extent that such navigation does not interfere with the rights of other states.[270] The freedom of navigation is not explicitly defined beyond "the right to sail ships,"[271] but this freedom has been understood broadly to protect the normal operation of vessels. Given that the majority of vessels today are equipped with similar sensory equipment to the average UUV, it is likely that UUV operation would generally be allowed on the high seas under this freedom of navigation when carrying out ordinary information gathering. If the drones being operated are conducting scientific research, their operation is also protected under the freedom of marine scientific research codified in Article

267. *See, e.g.*, Henderson, *supra* note 13, at 66–67 (2006) (arguing that free-swimming UUVs were likely to be considered vessels); Showalter, *supra* note 39, at 80 (stating that UUVs would likely only be considered vessels if engaging in activities related to commerce or navigation, such as carrying cargo; they would not be so considered if engaging in purely scientific study or observation of the ocean environment); Vallejo, *supra* note 44, at 411 (contending that because they are unmanned, UUVs do not fall into the definition of vessels laid out by international maritime agreements).

268. *See* UNCLOS, *supra* note 104, at 399, 419.

269. *Id.* at 399.

270. *Id.* at 432–33.

271. *Id.* at 433.

143.[272] Additional freedoms and restrictions, such as the requirement that the high seas be used only for peaceful purposes, may impact drone operation generally but are unlikely to have considerable impact from a privacy perspective.[273]

Within the EEZs of other countries, UUVs operate with the same freedom of navigation found on the high seas and are limited only by coastal state jurisdiction over the resources in this zone.[274] This resource-based jurisdiction may impact how drones can be used in these areas. Specifically, Article 56 provides sovereign rights for the coastal state over "exploring and exploiting, conserving and managing the natural resources" within a 200-mile limit.[275] Commercial drone operation may be limited within the EEZ to the extent that it infringes on this coastal state right to resource exploitation.

Drone operation within the territorial sea itself may be allowed (if UUVs are considered ships) under the right to innocent passage.[276] This is a restricted right, however, and likely places significant limits on what drones are permitted to do within a twelve-mile territorial limit. Innocent passage is limited to navigation for the purpose of traversing the territorial sea or proceeding to a port.[277] Furthermore, ships that engage in "collecting information to the prejudice of the defense or security of the coastal State," "research or survey activities," or "any other activity not having a direct bearing on passage" are specifically excluded from this right of innocent passage.[278] Thus, drones operating in any information gathering capacity are unlikely to be allowed in the territorial sea of other nations while engaging in these activities. They may be allowed to pass through territorial waters if the sensors are turned off under the right to innocent passage, however, this passage is also limited by the requirement that they operate on the surface if they are underwater vehicles.[279]

It is important to note that even if drones are not within the twelve-mile territorial sea of another state, they may still be subject to the jurisdiction and national laws of that state if they are found to be "in touch with the shore."[280] Under this jurisdictional exception, "a state may exercise authority to prevent violation or evasion of its revenue, customs, immigration, or sanitary laws . . . by ships hovering off the territorial limit, or in touch with the shore."[281] Historically, these were thought to be the most important laws likely to be broken

272. *Id.* at 448.

273. *Id.* at 443, 447. Except if UUVs are engaged in military activities, though this provision of UNCLOS has not stopped decades of comparable surveillance by military submarines.

274. *Id.* at 418.

275. *Id.* at 419.

276. *See id.* at 404.

277. *Id.*

278. *Id.* at 404–05.

279. *See id.* at 405.

280. *See* 48 C.J.S. *International Law* § 14, Westlaw (database updated Dec. 2018).

281. *Id.*

at sea.[282] In its current state, this exception is unlikely to have a significant impact on UUVs carrying out surveillance activities unless surveillance is related to customs or immigration violations. As privacy becomes a bigger issue, it may be interesting to see whether these categories expand at all to allow states the jurisdiction to enforce against privacy invasions in territorial waters.

The international regime will be secondary to individual national ones when assessing privacy protections against UUV surveillance at sea. Under UNCLOS, drones are likely to be considered vessels and given the same freedom of navigation as other vessels. UNCLOS further has less restrictive provisions governing both private property ownership and government surveillance than those in U.S. law. As such, UNCLOS is unlikely to be a major factor in establishing and enforcing maritime property and privacy regimes.

CONCLUSION

The explosion in UUV use for observation leads to serious questions about what privacy protections exist underwater. From private property rights to Fourth Amendment constitutionality, the bounds of legal rights underwater remain in many ways untested. UUVs are likely to bring new issues to light, illuminating a privacy regime underwater that remains fundamentally weak. Private property rights are inherently limited by the public nature of ocean waters, while Fourth Amendment protections have been eroded to the point of uselessness in many marine contexts. Entities operating in today's oceans should be aware of the threat to their privacy interests. In the best-case scenario, UUV use and surveillance can serve as a catalyst for more robust maritime privacy protections. Courts should recognize that vessels are living spaces and extend the Fourth Amendment's umbrella protections covering the sanctity of the home to cover them, as well as prevent any hull-penetrative surveillance by UUV.

282. *See* UNCLOS, *supra* note 104, at 405–06.