

Maritime Security in the Age of Autonomous Ships

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Abstract: Maritime history dates back thousands of years, and one constant throughout this time has been that ships plying the oceans have people aboard. With the appearance of ships without onboard crew on our seascape, this certainty has come to an end. Yet, rules aimed at ensuring maritime security are firmly based on the assumption that perpetrators act from on board the offender ship and that a human-human encounter between enforcers and suspects at sea takes place, with the possibility for direct interaction and communication as well as an exchange of physical documentation. This chapter probes the consequences that the use of unmanned ships to compromise maritime security entails for the continued applicability and relevance of rules designed to prevent and suppress crime at sea. It concludes that the need for regulatory steps is evident. While a formal amendment of relevant treaties, such as the UNCLOS, the Vienna Convention (1988) and the SUA Conventions (1988, 2005), seems out of sight, the turn to unmanned ships will more likely be accommodated through informal law – at least for the time being.

Keywords: Autonomous Ships, Unmanned Ships, Maritime Autonomous Surface Ships (MASS), Maritime Security, Law Enforcement, Crimes at Sea, IMO

1 A Game Changer for the Commission of Crimes at Sea

From the vantage point of maritime security, the advent of autonomous ships is a double-edged sword. Autonomous ships have great potential to reduce lawlessness at sea by augmenting the capabilities, effectiveness and reach of maritime law enforcement operations while squeezing their costs. At the same time, however, this novel type of vessel provides criminals with a cutting edge as it opens new avenues to the commission of crimes at sea while lowering the perpetrator's risk of being killed, injured, arrested, or even detected (Petrig, 2020). Criminals are usually quick to embrace new technologies (Goodmann, 2015), which is no different for autonomous ships: offenders have already started relying on this new technology to commit crimes at sea.

Among the most widely reported incidents are the attacks by Houthi rebels with remote-controlled boats rigged with explosives against merchant ships, warships and installations in the Red Sea, which started in 2017 and are ongoing (Haugstvedt, 2021). Although the technology deployed is rudimentary and features a do-it-yourself touch, its potential to cause harm is immense. Exemplary in this respect is a foiled attack against an oil tanker, which could have produced a large secondary explosion resulting in major (environmental) harm (Reuters, 2020). With autonomous technology

becoming increasingly potent, cheaper and user-friendly, the “gap between attack capabilities and defense capabilities” is expected to widen further (Brundage et al., 2018).

Moreover, as drug cartels have adapted their criminal strategies continuously in the past to lower risks, raise profits and evade enforcement action (Coito, 2021), autonomous technology is very likely to become a hallmark of drug trafficking in the not-too-distant future. Reports that Spanish and Italian authorities have detected unmanned crafts built and even used to smuggle drugs evidence the turn to autonomous ships for trafficking purposes (Sands, 2022; Sutton, 2019). With the introduction of large unmanned commercial ships looming on the horizon (Bates Ramirez, 2022), enforcers must also prepare for the scenario where illicit cargo – such as narcotics (McLaughlin & Klein, 2021) or other prohibited items, including illegally traded weapons or goods falling under a sanction regime – is transported alongside lawful cargo.

Autonomous ships are thus already a game changer for the commission of crimes at sea – and even more so with technologies used for their construction and operation moving through further innovation stages and maturing.

2 A Watershed Moment for Maritime Security Law

The introduction of autonomous ships also amounts to a watershed moment for the law. It is true that the world of shipping has experienced tremendous change in the past century and norms governing it “proved flexible enough to accommodate technological developments, from sail to steam to containerisation” (Carey, 2017). Yet, past technological innovations have all aligned with the premise on which rules of the law of the sea and maritime law rest: that ships carry an onboard crew responsible for their navigation, task and mission (IMO Doc MASS-JWG 1/2, 2022). With the appearance of autonomous ships, this age-old certainty – not to say truism – ended abruptly. In the maritime security context specifically, a series of assumptions underpinning relevant rules no longer necessarily apply: that perpetrators act from on board the offender ship; that enforcer crafts have law enforcement officials embarked; and that a human-human encounter between enforcers and suspects “in theatre” takes place, with the possibility for direct interaction and communication as well as an exchange of physical documentation. The absence of an onboard crew calls into question the continued applicability and relevance of many rules designed to suppress crime at sea as the assumption on which they are built is no longer met. After a remark on terminology, a selection of them is discussed.

2.1 Terminology

At the present juncture, both the concept of “autonomy” and the various “levels of autonomy” remain elusive against the backdrop of differing interpretations and understandings proposed in practice and doctrine. In this chapter, the term “autonomous ship” is used in a generic way to denote crafts “which, to a varying degree, can operate independent of human interaction” (IMO Doc LEG 106/WP.5, 2019). Thereby, the focus is on one specific feature that ship automation may bring about: that vessels no longer carry an onboard crew; they are “unmanned”. In IMO parlance, these are ships featuring autonomy degrees three or four (remotely controlled or fully autonomous ships without onboard crew), as ships of degrees one and two (ships with automated processes and

decision support or remotely controlled ships having seafarers on board) still feature an onboard crew (IMO Doc LEG 106/WP.5, 2019).

To be sure, unmanned ships do not entail the complete absence of human involvement – even if the term may feed this perception. However, the persons’ manner, level, place and time of involvement in the operation and mission of unmanned ships differs from traditional vessels (Petrig, 2020). This may even hold true for vessels still having an onboard crew, which, however, is starkly reduced with key functions carried out elsewhere, notably on shore (IMO Doc LEG 107/8/17, 2020). These changes regarding human involvement are sufficient to challenge the application of maritime security rules and may even disturb the entire mechanics of the legal framework aimed at suppressing crimes at sea – as will be demonstrated hereunder.

2.2 The Notion of Ship

When considering the criminal use of unmanned crafts, the first issue to clarify is arguably whether they amount to “ships” or “vessels”. It is because many maritime security provisions – be it, for instance, offense definitions, authorizations to enforce the law or provisions on cooperation to suppress crime at sea – comprise a reference to either one of these terms. Yet, to seek a generally valid answer to this question seems a futile exercise.

Firstly, this is due to the broad range of ship automation technology already in use and still in development. The large vehicle-carrying *Soleil*, for example, cannot be distinguished from a conventional car ferry from the outside (Coxworth, 2022). By contrast, the “underwater drones” recently seized by the Spanish police in a counter-drug operation – each capable of transporting around 200 kilograms of narcotics – have a closer resemblance to a long-drawn metal waste container than what one deems to be a ship (Sands, 2022). Not only the appearance of unmanned waterborne crafts but also their capabilities differ greatly. In addition, the same type of craft may be used for various tasks and missions.

The second reason why the question of whether unmanned watercrafts are ships defies a clear “yes or no” answer is to be found in the law. There is simply no single, generally valid definition of the term “ship”. Instead, treaties comprise differing definitions – each crafted with a view to best serve the respective treaty’s object and purpose. The drafters of the SUA Convention (1988), for example, opted for an expansive definition of “ship”, one that – together with the definition of “fixed platform” in the Fixed Platforms Protocol (1988) – covers as many targets at sea as possible (IMO Doc SUA/CONF/CW/WP.18, 1988). As per Article 1, a ship “means a vessel of any type whatsoever not permanently attached to the sea-bed, including dynamically supported craft, submersibles, or any other floating craft”. Given the inclusive wording (“of any type whatsoever” and no explicit mention of an onboard crew), the purpose of the treaty and its drafting history, unmanned offender crafts are likely to fall under this definition, which is identical in the SUA Convention (2005) (Petrig, 2021). UNCLOS, in turn, despite relying heavily on the notions of “ship” and “vessel,” does not define them – for good reason. As the definition of “ship” depends on the subject matter and context of the rules in which it appears and given that UNCLOS aspires to regulate “all issues relating to the law of the sea” (UNCLOS, preamble), a single definition would be neither possible

nor helpful (Noyes, 2012). What amounts to a “ship” or “vessel” must thus be discerned with regard to a specific provision.

In sum, a meaningful answer as to whether an unmanned waterborne craft is a “ship” in the legal sense can only be obtained through a case-by-case assessment that considers both the technology and the law at stake (Allen, 2018).

2.3 Offense Definitions

The use of autonomous ships for malicious purposes further raises the question of whether a specific offense definition can be fulfilled if offenders rely on unmanned rather than manned crafts. This is crucial not only for the ultimate prosecution of suspects but also for taking enforcement measures at sea as this is generally predicated on the existence of reasonable grounds for suspecting that a vessel engages in a specific offense. The question again eludes a simple answer as much depends on the relevant provision’s wording and interpretation. Broadly speaking, three different drafting techniques can be identified to define offences – depending on which one is used, it is easier or more challenging to argue that the crime in question can be committed using an unmanned ship.

On one end of the spectrum, various provisions refer to ships – rather than persons – engaging in the prohibited conduct. By way of example, Article 111(1) UNCLOS authorizes hot pursuit if there is “good reason to believe that the ship has violated the laws or regulations” of the coastal state. In similar fashion, Articles 17(2) and 17(3) of the Vienna Convention (1988) refer to a “vessel ... engaged in illicit traffic”. This drafting technique seems startling as, after all, the commission of crimes is intrinsically linked with human conduct. However, it is precisely because of the assumption that ships are manned – underlying the entire law of the sea – that the drafters did not deem it necessary to always distinguish carefully between the ship and persons on board. In the present context, this odd wording makes it easier to support the idea that the offense in question can be committed by both manned and unmanned vessels.

On the spectrum’s other end, there are offense definitions that not only refer to a ship but also to a specific category of persons – such as the master or crew – whom the drafters assumed to be on board. The paradigmatic example is piracy: Article 101(a) UNCLOS requires that the harmful act is “committed ... by the crew or the passengers of a private ship”. While a “passenger” has, perforce, to be on board the ship, the term ‘crew’ could be interpreted as covering a remote crew – at least if perpetrators use remote-controlled crafts, thus exercising contemporaneous control over the device used to engage in crime at sea. Such interpretation is more challenging if the offender launches an “intelligent” craft capable of making decisions and determining actions en route without human intervention, for example, based on sensor data. Compared with remote-controlled vessels, the link between the perpetrator and the ship is much looser, and it may be more challenging to argue that persons simply launching a system belong to the “crew ... of a private ship” (Petrig, 2020).

The third type of offense definition mentions neither a ship nor a category of persons traditionally assumed to be on board a ship undertaking the prohibited activity; rather, it is worded in a neutral

fashion and simply refers to a “person” engaging in the relevant conduct. Such drafting technique has, for example, been used in the context of the SUA Conventions (1988, 2005). This is no coincidence as the possibility of contributions from dry land has been envisaged – albeit not by persons controlling unmanned ships from on shore, but by corporations (Petrig, 2021). Despite this rather accommodating wording, doubts have been expressed whether remote operators of unmanned ships or persons deploying an “intelligent” craft are covered by the offense definitions (IMO Doc LEG 107/8/5, 2020).

In sum, regardless of an explicit mention in the respective offense definition, the assumption has always been that ships used to engage in crime at sea carry an onboard crew. A common understanding of whether these offenses can be committed using unmanned ships is yet to be developed.

2.4 Communication and Interaction

During a law enforcement response, communication between the enforcers and suspects is key. In cases where offender ships do not carry an onboard crew, the question ensues with whom and how law enforcement officials interact. The response differs depending on the type of craft on which criminals rely. The spectrum is huge, ranging from water-borne “metal containers” with GPS-technology construed for smuggling drugs with which communication is hardly possible (Sands, 2022) to 300 TEU unmanned commercial ships – akin to the one that recently went into operation in China (The Maritime Executive, 2022) – equipped with the latest communication technology. The focus of the following is on ships with which enforcers are, in principle, able to interact.

The first step in a gradual law enforcement response usually consists of conveying the suspect ship a signal to stop. The relevant rules in place not only reflect the assumption that human beings on board are supposed to be the recipient of the signal but, at times, also the then prevailing technology. In this vein, Article 111(4) UNCLOS refers to “a visual or auditory signal to stop”. Yet, today even manned ships are no longer hailed by waving flags or using megaphones but rather through more modern means, such as VHF messages. In the Arctic Sunrise Arbitration, the tribunal confirmed that the respective rules “must be interpreted in the light of their object and purpose, having regard to the modern use of technology” (para 259). However, for unmanned offender ships, it is not simply about using new technology or, more generally speaking, how to communicate with the suspect ship. Rather, this new type of vessel involves a new allocation of tasks, which also affects the question with whom enforcers interact.

In a traditional setting, it is quite plain who the primary interlocutory of enforcers is: the master, who is the person “in charge” on board the vessel, including for queries from officials and authorities. However, with unmanned ships, new actors such as remote operators enter the scene, triggering a series of principled questions: Who will perform the role and functions traditionally incumbent on the master if the vessel is without an onboard crew? Will functions traditionally allocated to one single person be distributed among different types of actors? Could a legal rather than a natural person bear the ultimate responsibility for carrying out specific functions? Suppose there is still a residual crew on board the offender ship; in that case, other intricate questions arise: Can a residual crew on whom tasks are incumbent, which historically were carried out by the “black gang” rather than the master, be the interlocutor of enforcement officials at sea? Or can a residual

crew only be the interlocutor if they have – next to shore-based actors – a major actual or potential (for example, in case of system failure) role in the vessel’s operation?

The determination of the meaning of terms denoting actors involved in the operation of unmanned ships, such as master, crew and remote operator, is among the high-priority issues to be considered in the context of the envisaged IMO MASS Code (IMO Doc MASS-JWG 1/2, 2022). The clarification of who is responsible for what with regard to an unmanned ship is essential knowledge to design procedures at the interface between the operation of unmanned ships and law enforcement activities at sea, such as those relating to communication and interaction.

2.5 Boarding, Verification of Nationality and Search

The drafters of boarding provisions assumed that both the determination of nationality and any further examination of the suspect ship, such as a search of the cargo, take place on board. Moreover, they presumed that facts are established through human-human interaction and the exchange of physical documents, such as the certificate of registry or the bill of lading. Not consistently, but sometimes, this assumption explicitly accrues from the provision’s wording. Article 110(2) UNCLOS, for instance, mentions the option of sending a boat under the command of an officer to the suspect vessel to determine its nationality. Moreover, it stipulates that “further examination” takes place “on board the ship”.

The physical boarding of a suspect unmanned vessel, however, raises a spate of operational questions. They include “how to conduct a boarding when there is no master or crew to answer questions regarding the craft’s nationality, to maneuver the craft to accommodate the boarding, or to present the necessary documents once the boarding team is on board” (Allen, 2018). Moreover, “if you put a boarding team on board an uncrewed vessel, what is to stop it [from] sailing off again” with “the boarding team suddenly disappearing off and being taken hostage?” (Tuckett, 2021). Given the practical challenges of an unmanned ship’s physical boarding, it is worth considering whether a remote or even virtual exercise of the right to visit to establish nationality and obtain information about potentially unlawful activities and the ship’s cargo is legally permissible under Article 110 UNCLOS and similar provisions.

A remote determination of nationality is notably possible by sighting the markings and numbers on the ship’s hull, which unmanned ships of a certain size and function are likely to be obliged to display. This should be considered lawful as it is the usual flag verification method when exercising the right of approach and does not interfere with the freedom of navigation of the suspect ship if – as usual these days – exercised from a distance (Lewis, 2015). The more delicate question is whether a virtual determination of nationality using cyber means is legally permissible. The Tallinn Manual 2.0 (Schmitt, 2017) is one of the few sources discussing this, yet views – expressed in the context of traditional ships – are diametrically opposed. Some experts argue that a virtual visit would be a reasonable way of exercising this enforcement power and less intrusive than a physical one; moreover, the respective provisions would not in any way restrict the means for conducting a visit. Other experts opine that a virtual visit does not comport with the underlying assumption of the provision, which is an onboard visit; moreover, it could be more intrusive compared to a document check on board as more information may be obtained than is necessary to

verify nationality. Importantly, these views were collected specifically regarding the “use cyber means to verify the nationality of the vessel concerned by monitoring its communications or inspect its cyber infrastructure remotely” (Schmitt, 2017). The latter scenario seems to imply that enforcers penetrate the operational and/or information technology systems of suspect ships, which may entail certain risks for the safety of the ship, cargo and crew.

An utterly different scenario, which is not contemplated in the Tallinn Manual 2.0 (Schmitt, 2017), is the virtual inspection of e-certificates that, for example, entail information about the ship’s nationality. While the many documents that a ship must carry are traditionally all in paper format, the trend goes – also for conventional ships – towards e-certificates. One of the biggest flag states, Liberia, has been treating e-certificates of registry that can be verified online for their genuineness and status in real-time as “original” and “authentic” since 2006 (Watt, 2019). Responding to this trend, the IMO issued “Guidelines for the Use of Electronic Certificates” to ensure a consistent and secure practice (IMO Doc FAL.5/Circ.39/Rev.2, Annex, 2016). The use of e-certificates by unmanned ships, notably the format they could take and how they could be requested and produced absent seafarers on board, will be considered in the context of a future IMO MASS Code (IMO Doc MASS-JWG 1/2, 2022). Clarification on these aspects will allow for more elaborate discussion of the permissibility and limits of virtually determining unmanned ships’ nationality as part of a maritime law enforcement response.

If suspicion remains after documents have been checked, the right of visit authorizes “further examination on board” as per Article 110(2) UNCLOS. In the context of ships without an onboard crew, this notably entails the question of whether a remote or virtual search of the cargo is feasible and lawful. The deployment of modern – and specifically autonomous – technology by enforcers already allows for some types of remote searches to be conducted. For instance, autonomous underwater systems can search for “oddities such as trapdoors, moon pools, or hidden cargo compartments” in the suspect ship’s hull. Further, they can identify “unusual phenomena”, such as traces of chemical, biological, nuclear, radiological, or explosive material or the presence of human beings in “cargo” holds (US Navy USV Master Plan, 2007). Autonomous aerial systems, in turn, could not only provide footage of illicit cargo from a bird’s perspective but also identify certain substances. The European Maritime Safety Agency is, for example, relying on the so-called “sniffer”, a device attached to an unmanned aerial vehicle that can track down ships using prohibited fuel (EMSA, 2022). A virtual visit, on its part, is possible for those unmanned ships, which will carry digital certificates containing information about their cargo, such as an e-bill of lading. Remote and virtual visits may also prove useful in the context of a traditional, manned ship as a search of cargo on the open sea is, at least for ships transporting their cargo in containers, generally not a feasible option (Haines, 2016).

The permissibility of a remote or virtual exercise of the right of visit will ultimately also depend on whether safeguards, such as those stipulated in Article 8bis SUA Convention (2005), can be respected. The provision notably comprises a series of requirements aimed at ensuring that only authorized law enforcement vessels and officials take enforcement action and that the master and crew of the suspect are put in a position to verify this. Specifically, only warships or state crafts clearly marked and identifiable as being on government service and sanctioned to enforce the law

are authorized to take enforcement measures; officials on board must be “uniformed or otherwise clearly identifiable members of law enforcement”; and they must “provide appropriate government-issued identification documents for examination by the master of the ship upon boarding”. Yet, if offenders rely on unmanned ships, there is simply no person on board who could see and check markings, uniforms and IDs. What in such a case could and should amount to functional equivalents – for example, a sort of e-authentication of authorities – has yet to be analyzed.

While the master and crew are obviously aware of being subjected to enforcement measures in cases of physical boarding, a remote or virtual exercise of the right of visit may go unnoticed. Yet, such knowledge seems crucial if the suspicion proves unfounded and the ship has not itself set the cause for the intervention by enforcers, giving rise to a right of compensation (Article 110(3) UNCLOS). Without being aware of the remote or virtual visit, conduct cannot be attributed, and responsibility is thus not established. But even if it can, it is not readily obvious what the loss and damage of the ship in question is in cases of a remote or virtual visit. Unlike physical boarding, they will often not cause any delay, which is the primordial ground for compensation. Yet, if enforcers access a ship’s operational or information technology systems, it is conceivable that the ship’s operation is affected. In the case of accessing e-certificates, more information may be retrieved than allowed under the respective authorization, which may potentially amount to a violation of a commercial secret.

Overall, the operational feasibility and legal permissibility of a remote or virtual exercise of the right of visit needs further consideration. The clarification on the use of e-certificates during the debates concerning a potential IMO MASS Code is essential to further design an appropriate law enforcement response to unmanned ships engaged in crime at sea – at least for those vessels that are required to carry such certificates.

2.6 Arrest and Prosecution of Suspects

With offenders relying on unmanned ships to commit crimes at sea, states conducting maritime law enforcement operations are stripped of one of the most compelling enforcement measures – the arrest of suspects at sea to subject them to criminal prosecution (CMI Position Paper, 2018). In the likely case that the offender acts from shore, the suppression of crime at sea will heavily depend on enforcement action on dry land. Moreover, it may well be that the offender sits in a state different from the one in whose waters the crime was committed or the one that interdicted the vessel in international waters. Hence, it will only be possible to arrest the suspect and to bring him or her to justice through a cooperative effort between the interdicting state (inter alia, possessing important evidence) and the state where the suspect happens to be. This, in turn, hinges upon both the willingness and ability of the latter state to take steps leading towards the arrest of the suspect and his or her prosecution or extradition.

Not all states may be willing to take such steps; it is conceivable that states shield persons using their territory to commit crimes through unmanned ships or at least tolerate such behavior. Further, states may practically not be able to arrest persons because the commission of crimes using auton-

onomous technology will often allow offenders to act in anonymity or to cloak their identity (Brundage et al., 2018). Challenges of this nature may, for instance, arise in the context of attacks akin to the ones carried out by Houthi rebels described earlier in this Chapter.

As regards commercial unmanned ships that can, for instance, be used for smuggling purposes, it is essential for maritime security to ensure that they possess nationality and that the flag state is able to arrest persons involved in the operation of the ship. As enforcement jurisdiction is generally limited to a state's own territory, a flag state can only arrest remote operators located in its territory. If, by contrast, the flag state is solely the place of incorporation of a shell company and the actual operations are carried out from another state, the flag state has little means to enforce the law against persons committing crimes involving unmanned ships flying its flag. In such a situation, a serious enforcement gap would arise as the interdicting state cannot arrest suspects because they are not on board the offender ship, while the flag state cannot do so because they are not in its territory. The future MASS Code offers an opportunity to define the link that a remote operation center and remote operator must feature with the flag state. If the link is defined too loosely, the flag of convenience problem will be accentuated in the case of unmanned ships (Van Hooydonk, 2014). The bottom line should thus be that a remote operation center has its seat, real operations and personnel in the flag state.

3 The Regulatory Way Ahead

This overview has demonstrated that the introduction of unmanned ships queries the continued applicability and relevance of many – if not most – rules designed for the suppression of crime at sea. The need for regulatory steps is thus evident. Yet, maritime law enforcement is governed by a complex web of rules, which not only stem from the international and domestic levels but also pertain to various fields of law, such as the law of the sea, transnational criminal law and international human rights law. While the means and procedures to adapt the law to new realities differ greatly between these different sets of rules, a general observation regarding the regulatory way ahead is still possible.

For the time being, formal amendment of relevant treaties seems out of sight. UNCLOS, which is the center piece of regulation for all activities at sea, including maritime security, is very unlikely to be subjected to formal amendment for both legal and political reasons. Further, within the UNODC, there seems currently no initiative under way to even discuss the impact of the advent of autonomous ships on treaties adopted under its auspices and relevant for the suppression of crime at sea, such as the Vienna Convention (1988). As regards the four SUA treaties, which belong to the more than 50 treaties for which the IMO is responsible, there is little appetite to formally amend them. Rather than through an update of formal law, the turn to autonomous ships will more likely be accommodated through informal law – at least for the time being. Indeed, the characteristics ascribed to informal law make it a particularly suitable tool to regulate autonomous ships, the construction and operation of which involves several emerging technologies, each of which is complex, inchoate and developing at an unprecedented pace. First of all, informal law is a tool that can get the normative ball rolling as it usually allows to find common ground in a previously unregulated field more easily as compared to treaty negotiations. Further, an informal instrument

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allows to bridge the time until firmer commitment is possible. Moreover, it permits to collect first regulatory experience that can be integrated in a later formal instrument; and it can be updated rather effortlessly compared with treaties if the technology further develops. Finally, it is also conceivable that formal law only sets out the broad principles, while detailed regulation is left to the more adaptable informal law in the long run (Petrig, 2022).

Against this backdrop, it is of little surprise that the IMO envisages, in a first move, the adoption of a non-binding IMO MASS Code (IMO Doc MASS-JWG 1/2, 2022). While the planned Code does not directly address maritime security, this Chapter has demonstrated that the transversal issues which it is likely to cover are highly relevant for the suppression of crimes at sea committed by unmanned ships. The Code is thus an important first step on the long regulatory path ahead to accommodate autonomous ships in the maritime security legal framework.

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