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Naval robots and rescue

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Abstract

The development of unmanned systems (UMS) for naval combat poses a profound challenge to existing conventions regarding the treatment of the shipwrecked and wounded in war at sea. Article 18 of the 1949 Geneva Convention II states that warring parties are required to take "all possible measures" to search for and collect seamen left in the water after each engagement. The authors of the present paper analyze the ethical basis of this convention and argue that the international community should demand that UMS intended for roles in war at sea be provided with the capacity to make some contribution to search and rescue operations.

Keywords: unmanned systems, drones, duty to rescue, shipwrecked, ethics, unmanned surface vehicles, unmanned undersea vehicles, unmanned maritime vehicles.

Introduction

Robots will play an important role in war at sea in the decades to come.[1] All around the world, navies are beginning to field unmanned aerial vehicles (UAVs), unmanned surface vehicles (USVs) and unmanned undersea vehicles (UUVs) to take on tasks that are "dull, dirty and dangerous" for human beings. In the remote future it is possible that wars between technologically advanced adversaries will be fought almost entirely using such systems. For the foreseeable future, however, wars at sea are likely to be fought by human beings and robots working alongside one another. The operational and strategic implications of this prospect are now beginning to receive significant attention.[2] The ethical and legal issues raised by the use of unmanned systems (UMS) in naval warfare have, as yet, received comparatively little attention.[3] In this article, we aim to raise

1 Bruce Berkowitz, "Sea Power in the Robotic Age", *Issues in Science and Technology*, Vol. 30, No. 2, 2014.

2 Tim Barrett, *The Navy and the Nation: Australia's Maritime Power in the 21st Century*, Melbourne University Press, Melbourne, 2017, pp. 53–55; Bryan Clark, *The Emerging Era in Undersea Warfare*, CSBA, Washington, DC, 2015; US Department of Defense (DoD), *Unmanned Systems Integrated Roadmap: FY2013–2038*, Washington, DC, 2014 (UMS Roadmap); US Navy, *The Navy Unmanned Surface Vehicle (USV) Master Plan*, Washington, DC, 2007 (USV Master Plan).

3 Robert Sparrow and George Lucas, "When Robots Rule the Waves?", *Naval War College Review*, Vol. 69, No. 4, 2016, offers the most comprehensive discussion of the ethical issues raised by the use of UMS in war at sea of which we are aware to date. The most extensive discussion of the legal issues of which we are aware is Capt. Andrew Norris, *Legal Issues Relating to Unmanned Maritime Systems*, US Naval War College, Newport, RI, 2013. See also Brendan Gogarty and Meredith Hagger, "The Laws of Man over Vehicles Unmanned: The Legal Response to Robotic Revolution on Sea, Land and Air", *Journal of Law, Information and Science*, Vol. 19, No. 1, 2008; Andrew H. Henderson, "Murky Waters: The Legal Status of Unmanned Undersea Vehicles", *Naval Law Review*, Vol. 53, 2006; Rob McLaughlin, "Unmanned Naval Vehicles at Sea: USVs, UUVs, and the Adequacy of the Law", *Journal of Law Information and Science*, Vol. 21, No. 2, 2011. The use of *autonomous* weapon systems in war at sea would, of course, raise issues discussed in the larger debate about the ethics of the development and deployment of autonomous weapon systems. For a recent survey and further sources, see Robert Sparrow, "Robots and Respect: Assessing the Case against Autonomous Weapon Systems", *Ethics and International Affairs*, Vol. 30, No. 1, 2016.

awareness of one particular ethical and legal issue: the impact of the development and deployment of UMS on the prospects of those individuals who find themselves in the water at the end of a military engagement. Article 18 of the 1949 Geneva Convention II (GC II) emphasizes that the strong expectation of mutual aid which has evolved over generations amongst those who go to sea exists even during wartime: at the end of each engagement, belligerent parties are expected to take "all possible measures to search for and collect the shipwrecked, wounded and sick".[4] The development of UMS for naval warfare threatens to undermine this expectation, because absent a deliberate decision to provide UMS with the capacity to contribute to search and rescue operations, whenever the only assets able to respond within a life-saving timeframe are unmanned, "all possible measures" may realistically be "none". There is, therefore, a real risk that the development of UMS for war at sea may eventually all but extinguish hope of rescue for those who are lost at sea in future conflicts.

In the first section of this article, entitled "UMS and the Future of Naval Warfare", we offer a brief survey of naval UMS that are either deployed already or in the advanced stages of development in order to motivate the discussion that follows. The second section, "The Moral Foundations of the Duty of Rescue", provides an account of the moral and pragmatic foundations of the duty of rescue in war at sea, emphasizing the benefits of the social practice of rescue for all those who go to sea. The third section, "UMS and Rescue: The Ethical Challenge", describes and emphasizes the challenge that the development of UMS poses to the future of this social practice. In the fourth section, "The Case Against a Duty of Rescue for UMS", we summarize the arguments that might be made to resist the idea that UMS should be required to have a capacity to contribute to search and rescue operations. As long as we think of UMS as weapons analogous to mines, torpedoes or cruise missiles, the idea that they should be provided with the means of contributing to search and rescue operations is likely to seem implausible. However, as we argue in the fifth section of the article, "The Case for a Duty of Rescue for UMS", the more complex the operations that UMS are tasked with become, the more it seems that they should

4 Geneva Convention (II) for the Amelioration of the Condition of Wounded, Sick and Shipwrecked Members of Armed Forces at Sea of 12 August 1949, 75 UNTS 85 (entered into force 21 October 1950), Art. 18. This expectation is both longstanding as an article of law (for example, Hague Convention (X) for the Adaptation to Maritime War of the Principles of the Geneva Convention, 1907, Art. 16(1)), and broadly cast as an obligation, as in, for instance, International Committee of the Red Cross (ICRC), *Commentary on the Second Geneva Convention: Convention (II) for the Amelioration of the Condition of the Wounded, Sick and Shipwrecked Members of Armed Forces at Sea*, 2nd ed., 2017 (ICRC Commentary on GC II), para. 1619. Importantly, of course, an obligation to rescue also exists in peacetime: see International Convention for the Safety of Life at Sea, 1184 UNTS 278, 1 November 1974. See also Martin Davies, "Obligations and Implications for Ships Encountering Persons in Need of Assistance at Sea", *Pacific Rim Law and Policy Journal*, Vol. 12, No. 1, 2003; Irini Papanicolopulu, "The Duty to Rescue at Sea, in Peacetime and in War: A General Overview", *International Review of the Red Cross*, Vol. 98, No. 902, 2016; Robert D. Peltz, "Adrift at Sea – The Duty of Passing Ships to Rescue Stranded Seafarers", *Tulane Maritime Law Journal*, Vol. 38, No. 2, 2014; Matteo Tondini, "The Legality of Intercepting Boat People Under Search and Rescue and Border Control Operations with Reference to Recent Italian Interventions in the Mediterranean Sea and the Ecthr Decision in the Hirsi Case", *Journal of International Maritime Law*, Vol. 18, No. 1, 2012.

also be required to have the capacity to contribute to search and rescue operations. In the sixth section, "Designing UMS for Rescue", we therefore discuss the ways in which various classes of UMS might be provided with this capacity. We conclude that the international community should quickly move to establish an expectation that UMS will be provided with the capacity to make some contribution to search and rescue operations in order that, in the future, belligerent parties will continue to be able to meet their obligations under Article 18 of GC II.

UMS and the future of naval warfare

Unmanned systems are systems that comprise the necessary elements to control an unmanned vehicle and, according to the US Department of Defense (DoD), minimally consist of "equipment, network and personnel".[5] When referring to the maritime domain, UMS may be divided into systems that support the operations of two subcategories of unmanned maritime vehicles (UMVs) – USVs and UUVs — and include "all necessary support components, and the fully integrated sensors and payloads necessary to accomplish the required missions".[6] USVs operate "with near continuous contact with the surface of the water",[7] while UUVs are "self-propelled submersible(s) whose operation is either fully autonomous (pre-programmed or real-time adaptive mission control) or under minimal supervisory control".[8] Of course, navies are also intensely interested in the potential of UAVs for contributing to operations at sea.

The DoD acknowledges that the military demand for UMS "continues unabated" and that their application in a growing number of combat scenarios is expanding. The US Navy already deploys UMS to undertake tasks such as mine neutralization, intelligence, surveillance and reconnaissance (ISR), and special operations.[9] While we have concentrated here on the US programs with which we are most familiar, other major military powers are also rapidly moving to develop and deploy naval UMS.[10] Consequently, there are now more UMS being developed for naval warfare than we can hope to list here. However, even a brief survey of some of the most well-known and/or sophisticated systems

5 DoD, *DoD Dictionary of Military and Associated Terms*, Washington, DC, 2017, p. 246.
6 UMS Roadmap, above note 2, p. 8.
7 USV Master Plan, above note 2, p. 7.
8 US Navy, *The Navy Unmanned Undersea Vehicle (UUV) Master Plan*, Washington, DC, 2004, p. 4. Beyond conventional hull configurations, USVs "include hydrofoils and semi-submersible (i.e., continuously snorkeling) crafts": see USV Master Plan, above note 2, p. 7.
9 UMS Roadmap, above note 2, p. 109.
10 Some information about the British, Russian and Chinese programmes is available at: www.royalnavy.mod.uk/search?q=Maritime+Autonomy+Surface+Testbed; "United Kingdom Naval Drones", *Naval Drones*, available at: www.navaldrones.com/United-Kingdom-Naval-Drones.html; "China's Naval Drones", *Naval Drones*, available at: www.navaldrones.com/China.html; "Russia's Naval Drones", *Naval Drones*, available at: www.navaldrones.com/Russian-Naval-Drones.html.

demonstrates the investment that navies around the world are making in robots for use in war at sea.

Aerial drones are in many ways the poster child for the utility of UMS, and naval forces have been quick to see their potential for war at sea. The US Navy has deployed the MQ-8B Fire Scout autonomous helicopter to Afghanistan and to the Littoral Combat Ship. A larger version of this helicopter system, the MQ-8C, has recently been developed.[11] While the storied UCAS-D/UCLASS project has now evolved into the MQ-25 Stingray, with the primary role of providing an unmanned aerial refuelling capacity, it remains possible that this system or a descendant thereof will eventually take on more ambitious roles, including ISR and perhaps even combat roles.[12]

Discussions of UUVs invariably promote their role in ISR, and the US Navy has identified persistent ISR in contested or inaccessible (denied) areas as a task uniquely suited to UUVs. In part, this is due to the expectation that UUVs achieve a clandestine capability beyond that of other naval systems and will provide greater protection to high-value assets and personnel during ISR.[13] UUVs such as the Sea Stalker and Sea Maverick operate at depths of up to 1,000 feet and are specifically designed for ISR missions and target acquisition, while the former is also capable of carrying weapons.[14] UUV programmes such as those of the Mk 18 Mod 2 Kingfish and Mk 18 Mod 1 Swordfish complement the ISR capabilities of these and similar UUVs. The mission capabilities of the Kingfish are stated to include surface warfare/anti-surface warfare and mine warfare/organic mine countermeasures, while the capabilities of the Swordfish include mine warfare/organic mine countermeasures and, in addition, explosive ordinance disposal.[15]

As the technology matures it is anticipated that naval UMS will fulfil more complex roles such as harbour security and ocean tracking,[16] and the US DoD's ambitious programme of research and deployment of UMVs extends to weaponized operations.[17] Increasingly, the roles envisioned for naval robots include combat operations. For example, the US Navy's USV Master Plan[18] identified high-priority missions for USVs that include support for maritime

11 See "Fire Scout", *Northrop Grumman*, available at: https://tinyurl.com/y9zkjojz.
12 Sam LaGrone, "Pentagon to Navy: Convert Uclass Program into Unmanned Aerial Tanker, Accelerate F-35 Development, Buy More Super Hornets", *USNI News*, 1 February 2016, available at: https://tinyurl.com/hwk9gtx; Kris Osborn, "Navy Awards MQ-25 Stingray Tanker Deal", *Defense Systems*, 24 October 2016, available at: https://defensesystems.com/articles/2016/10/24/stingray.aspx.
13 UUV Master Plan, above note 8, p. 9.
14 "Sea Stalker UUV", *Naval Drones*, available at: www.navaldrones.com/Sea-Stalker-UUV.html; "Sea Maverick UUV", *Naval Drones*, available at: www.navaldrones.com/Sea-Maverick.html. The Sea Stalker and Sea Maverick programmes were respectively initiated in 2008 and 2009, with both undergoing final demonstration in 2010: see US Defense Science Board (DSB), *The Role of Autonomy in DoD Systems*, Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, Washington, DC, 2012, p. 89.
15 DSB, above note 14, p. 88.
16 For a detailed outline of current and future operations, see UMS Roadmap, above note 2, pp. 109, 88.
17 See DSB, above note 14, pp. 85–86.
18 USV Master Plan, above note 2, pp. 11, 38.

interdiction operations, antisubmarine warfare (ASW), and surface warfare, with USVs anticipated to utilize lethal and non-lethal weapons. The equivalent UUV Master Plan[19] identified amongst the high-priority missions ISR, but also ASW, payload delivery and time-critical strikes.[20] Perhaps most ambitious is the development of a large-displacement UUV capable of open ocean transit and operating without direct human supervision for over seventy days.[21] The DoD intends this UUV to have ASW capabilities,[22] and Clark suggests that the large-displacement UUV will be able to carry and deploy large quantities of common very lightweight torpedo.[23] In the USV domain, the ASW continuous trail unmanned vehicle, or Sea Hunter, is a large USV that is currently undergoing testing in open waters. The 132-foot trimaran USV has successfully hosted an ISR payload and is intended to operate in the open seas for over a month at a time, with the capacity to cover thousands of kilometres.[24]

The system that arguably has the most potential today to contribute to combat operations is the Protector USV. The Protector has a rigid inflatable hull structure and is reconfigurable so as to enable flexibility in mission performance. The range of missions includes ISR, ASW, naval warfare and anti-surface warfare, and the fifth generation (11-metre) variant launched in 2012 includes a "Mini-Typhoon" weapon station. The weapon station supports small-calibre guns such as the Browning .50-calibre machine gun and a 40-mm grenade launcher and can accommodate Spike missiles, with the latter successfully launched in a recent munitions demonstration by Rafael Advanced Defense Systems.[25] It is reported that the Spike missile unit (Typhoon MLS-ER) mounted on the Protector supports Spike ER missiles, which have operating modes that enable missile steering post-launch or "fire and forget".[26] The subsystems on the

19 UUV Master Plan, above note 8, pp. 7–15.

20 The US DSB has reiterated the centrality of combat missions to the research and deployment of UMVs: see DSB, above note 14, p. 17.

21 See *ibid.*, p. 86.

22 See Richard Scott, "ONR to Swim Ahead on ASW Package for Large UUV", *IHS Jane's Navy International*, 20 November 2014.

23 B. Clark, above note 2, p. 13.

24 The Sea Hunter is now considered a medium-displacement USV, a characterization that reveals the US Navy's interest in extending its surface combatant capabilities. See Richard Scott, "Surface Navy 2017: Sea Hunter Trials to Inform Unmanned Debate for Next Surface Combatant", *IHS Jane's Navy International*, 11 January 2017; Geoff Fein, "Sea Hunter Begins Operational Testing, Readies for 2017 Colregs Certification", *Jane's International Defence Review*, 5 December 2016; Richard Scott, "Talons Raised Aloft in USN Testing", *IHS Jane's Navy International*, 17 November 2016.

25 "Protector USV", *Naval Drones*, available at: www.navaldrones.com/protector.html; "Protector Unmanned Surface Vehicle (USV), Israel", *Naval Technology*, available at: www.naval-technology.com/projects/protector-unmanned-surface-vehicle/.

26 Huw Williams, "Rafael Launches Spike Missiles from Protector USV", *Jane's International Defence Review*, 8 March 2017.

Protector, such as the electro-optical director, enable day and night target tracking and boast a high probability of "target hit and kill".[27]

For the moment most of these systems are tele-operated rather than autonomous, but it is clear that, as relevant technologies improve, UMS will be granted more and more autonomy.[28] The communication infrastructure required to control UMS remotely is a weak point of these systems and is an obvious target for attack by a technologically sophisticated adversary. This is especially the case with submersibles. The difficulties of transmitting large amounts of data over distances underwater render it impossible to remotely control submersibles in real time. Indeed, the moment a submersible emits any sort of signal in order to transmit data to a human controller, it renders itself liable to detection and destruction by the enemy.[29] As other nations begin to deploy autonomous systems, it is not inconceivable that the operational tempo will increase so that eventually it is only autonomous systems that are capable of making an effective contribution to some forms of combat at sea.[30]

Should war at sea ever come to be fought entirely by UMS, the need for combatants to conduct search and rescue operations might be greatly reduced. Even then, though, it seems likely that military transports will continue to carry troops across the oceans. It is also possible that civilian vessels with crew and/or passengers on board might be sunk deliberately, if subject to attack as a result of their conduct (for example, as auxiliaries under San Remo Manual Rule 13(h), or as neutral merchant vessels which have lost their exemption from attack in accordance with San Remo Manual Rule 67), or accidentally, or even as acceptable collateral damage during the targeting of a high-value military objective.[31] Moreover, given the uneven rate at which technologies are introduced around the world, there will be an extended period wherein wars are fought using both manned and unmanned systems. As long as people continue to brave the seas during wartime, some individuals will inevitably end up in need of rescue. The question of what UMS will be capable of doing in this circumstance is therefore likely to remain a vital one for several decades at least.

27 "Protector Unmanned Surface Vehicle (USV), Israel", above note 25.

28 Peter Warren Singer, *Wired for War: The Robotics Revolution and Conflict in the 21st Century*, Penguin, New York, 2009, pp. 126–128; R. Sparrow, "Robots and Respect", above note 3.

29 There are intimations in the literature that recent technological breakthroughs have significantly increased the capacity of submersibles to communicate with other vessels and shore installations without revealing their location (see, for instance, B. Clark, above note 2, p. 14). In particular, short-burst transmissions from deployed devices, timed to transmit after the submarine has left the area, are within the current inventory. Nevertheless, we think it is unlikely that any such technology will allow continuous tele-operation of a UUV under combat conditions without jeopardizing the safety of the UUV.

30 Thomas K Adams, "Future Warfare and the Decline of Human Decision Making", *Parameters*, Vol. 31, No. 4, 2001; R. Sparrow, "Robots and Respect", above note 3.

31 Louise Doswald-Beck (ed.), *San Remo Manual on International Law Applicable to Armed Conflicts at Sea*, Cambridge University Press, Cambridge and New York, 1995. It is possible that eventually, once the technology becomes available, most commercial shipping will also be unmanned, in which case it is only the presence of troop transports or commercial passenger vessels that would establish a risk of persons being left shipwrecked, wounded or sick.

The moral foundations of the duty of rescue

The ethical tradition of just war theory and the modern law of armed conflict, also known as international humanitarian law (IHL), abjure both pacifism and "total war" in order to try to civilize what seems to be an inescapable human evil: war.[32] Roughly speaking, these ethical and legal (respectively) traditions try to balance the demands of military necessity with the moral obligation of respect for humanity.[33] One – not the only – way of attempting to realize this balance is to give each of these demands its due in succession. War typically has a rhythm and a tempo, which consists of periods of combat interrupted by periods of relative quiet. While some of the moral and legal obligations on combatants – for instance, not to make civilians the object of attack[34] – are most demanding during combat, others may be relaxed for the period during which combatants are actually fighting, only to return with more force after combat has ended. An important example of an obligation of the latter sort is the legal obligation to assist the wounded and inter the dead, which, although it must be met on a continuous basis ashore, is only required between engagements at sea. This obligation is outlined in Geneva Convention I (Article 15) and Geneva Convention IV (Article 16)[35] but receives an especially clear expression in GC II, owing to the fact that (as will be discussed further below) because the sea itself is a threat to all those who go to sea, a failure to care for the sick, wounded and shipwrecked is especially egregious in this context.[36] Article 18 of GC II states:

> After each engagement, Parties to the conflict shall, without delay, take all possible measures to search for and collect the shipwrecked, wounded and sick, to protect them against pillage and ill-treatment, to ensure their adequate care, and to search for the dead and prevent their being despoiled.

As the International Committee of the Red Cross (ICRC) Commentary on GC II notes, "The obligation to 'take all possible measures' applies, as a

32 Just war theory is a tradition of moral, political and philosophical argument regarding the ethics of war, which has strongly influenced the development of IHL. Classically, just war theory is concerned both with the question of when States are justified in resorting to war (*jus ad bellum*) and with the question of how wars may permissibly be fought (*jus in bello*). The most influential contemporary source on just war theory is Michael Walzer's *Just and Unjust Wars: A Moral Argument with Historical Illustrations*, published by Basic Books and now in its fifth edition (2015). For an account of the history of this tradition, see James T. Johnson, *Ideology, Reason and Limitation of War: Religious and Secular Concepts, 1200–1740*, Princeton University Press, Princeton, NJ, 1981.

33 Declaration Renouncing the Use, in Time of War, of Explosive Projectiles under 400 Grammes Weight, 1868; Geoffrey S Corn *et al.*, *The Law of Armed Conflict: An Operational Approach*, Wolters Kluwer Law and Business, New York, 2012.

34 Protocol Additional (I) to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts, 1125 UNTS 3, 8 June 1977 (entered into force 7 December 1978) (AP I), Art. 48.

35 Geneva Convention (I) for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field of 12 August 1949, 75 UNTS 31 (entered into force 21 October 1950) (GC I); Geneva Convention (IV) relative to the Protection of Civilian Persons in Time of War of 12 August 1949, 75 UNTS 287 (entered into force 21 October 1950).

36 I. Papanicolopulu, above note 4.

matter of international humanitarian law, to the 'Parties to the conflict' as a whole."[37]

A proper understanding of the strength and ethical grounds of this obligation is essential in order to comprehend just what is at stake when it is threatened by the introduction of UMS. There are at least four separate considerations which support establishing an expectation on belligerent parties that they will conduct search and rescue operations at the end of each engagement.

First, because the oceans are an unpredictable and dangerous environment (and are doubly so during wartime), anyone may find themselves in the water, desperately hoping to be rescued. The hostile nature of the marine environment means that even individuals in good health who are left behind when the warring forces move on face almost certain death by drowning or exposure. When one needs to be rescued, the benefits of the existence of the social practice of rescue are enormous. By contrast, the costs of affirming the obligation in ordinary circumstances will generally be low. Most vessels will only be called upon to conduct search and rescue operations infrequently. In wartime, once an enemy vessel has been sunk or disabled, the deaths of those on board will make little further contribution to securing military victory, especially compared to the alternative of their being taken prisoners of war.[38] As the benefits of maintaining the expectation that the warring parties will conduct search and rescue operations as required are large and the costs small (most of those who affirm their willingness to conduct such operations will never be called on to do so), it is in the interests of every person who goes to sea – and especially of those who go to sea in wartime – that this expectation exist.

Second, the practice of conducting search and rescue operations serves the vital interests of the families and loved ones of those lost at sea. Not knowing whether one's son or daughter, or husband or wife, is dead or alive – or knowing that they are dead, but being unable to conduct a proper funeral service for them in the absence of their mortal remains – can be devastating.[39] Of the considerations we treat here, this one provides the strongest support for the obligation to recover and prevent the despoiling of the bodies of those killed in the course of war at sea.

Third, as well as directly serving the interests of those lost at sea and those who care about them, acknowledging a duty of rescue also provides members of both these groups with hope where otherwise they would have none. Independently of whether or not those who are lost at sea are actually rescued, leaving vulnerable people without hope of rescue – abandoning them – would be a further and distinct evil. Similarly, leaving the relatives of those lost at sea

37 ICRC Commentary on GC II, above note 4, para. 1619.

38 It is true that there are sometimes significant inconveniences associated with the transport and care of prisoners of war. Nevertheless, these are clearly outweighed by the benefits of the practice to those who would otherwise be left to drown.

39 Pauline Boss, "Families of the Missing: Psychosocial Effects and Therapeutic Approaches", *International Review of the Red Cross*, Vol. 99, No. 905, 2017.

without hope that they will learn the fate of their loved ones adds cruelty to misfortune.

Finally, and relatedly, affirming a duty of rescue acknowledges an important truth about war and affirms the humanity of our enemies. Combatants are enemies by virtue of being combatants, and not as individuals; as Rousseau notes, it is States that have reasons to wage war and that go to war.[40] Until their nations go to war, individual combatants typically have no reason to try to kill enemy nationals, nor would they be justified in doing so.[41] When an enemy is rendered *hors de combat* by virtue of being sick, wounded or shipwrecked, they cease to be a combatant and become instead, ethically – if not legally – speaking, just another human being in need.[42] In acknowledging this fact, the social practice of conducting search and rescue operations between engagements plays an important role in civilizing war more generally.

Two features of this formulation of the moral obligation on combatants are widely held to be crucial to its implications in practice. First, while the exhortation to act "without delay" emphasizes the urgency of the task, as observed above the obligation to rescue shipwrecked seamen applies only "after each engagement", which is to say after the particular local action has paused or concluded such as to allow search and rescue activity.[43] In particular, unless a truce has been agreed, participants are not expected to rescue those left stranded in the water immediately after an enemy ship is sunk, if there remain nearby other enemy ships or other forces (such as aircraft) capable of engaging in combat. Second, while the formulation "all possible measures" sets the bar high, our account of what is possible will itself have to be subject to an implicit test of its reasonableness. As the ICRC Commentary on GC II puts it:

> The scope of what a Party to the conflict is actually required to do on the basis of Article 18(1) will depend on the interpretation of the qualifier "possible". What will be possible in the circumstances is inherently context-specific. Thus, the measures that must be taken in each case have to be determined in good faith, based on the circumstances and the information reasonably available to

40 Jean-Jacques Rousseau, *The Social Contract*, trans. Maurice Cranston, Penguin, London, 2003, p. 56. The phenomena of civil wars and counter-insurgencies problematizes Rousseau's claim, but even in cases of non-international armed conflicts the actors must be collective and "State-like" in order to justify the description of a conflict as "war" rather than as another less organized form of political violence, such as civil unrest or banditry.

41 Robert Sparrow, "'Hands up Who Wants to Die?': Primoratz on Responsibility and Civilian Immunity in Wartime", *Ethical Theory and Moral Practice*, Vol. 8, No. 3, 2005.

42 The legal status of (former) combatants who have become non-combatants by virtue of being *hors de combat* is more complicated given that, for instance, they may be taken as prisoners of war where civilian non-combatants may not. Legally speaking, therefore, although it is prohibited to attack them, such persons remain "enemy" nationals. See, *inter alia*, Article 3 common to the four Geneva Conventions; GC I, Art. 12; GC II, Art. 12; AP I, Arts 10, 41(2); Protocol Additional (II) to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of Non-International Armed Conflicts, 1125 UNTS 609, 8 June 1977 (entered into force 7 December 1978), Arts 4, 7.

43 GC II, Art. 18.

> both the commanders on the spot or nearby and to the other organs acting on behalf of the Party to the conflict.[44]

Some actions that might be theoretically possible will not be expected of combatants where, for instance, carrying them out would represent an unacceptable and disproportionate risk to their own lives, as well as to the capability their vessel represents. Indeed, the law is explicit on this in both peacetime and wartime contexts, and there are a number of well-known and well-litigated examples, such as the Laconia Order, where these limits have been discussed at length.[45] Both of these limits on the obligation acknowledge that the rights of combatants (and non-combatants) to self-preservation and the demands of military necessity must be weighed alongside our concern for the lives of those who are sick, wounded or shipwrecked.

UMS and rescue: The ethical challenge

The development and advent of UMS arguably poses a profound challenge to existing conventions regarding the treatment of the shipwrecked and wounded in war at sea. As observed above, the belligerent parties are required to take "all possible measures" to search for and collect the sick, wounded and shipwrecked at sea after each engagement. However, unless UMS are consciously and deliberately provided with the capacity to conduct such search and rescue operations, they are unlikely to have any capacity to do so. If no measures are possible given the resources available, then warring parties will *in practice* have no obligation to conduct search and rescue operations at the end of each military engagement.[46] As a consequence, those left in the water after an attack by an unmanned system may be denied any hope of rescue, when previously they would at least have had some cause for hope of rescue after an attack by a manned vessel. In effect, UMS may reduce the risk to the lives and capability of friendly combatants at the cost of increasing the risks to adversary and neutral

44 ICRC Commentary on GC II, above note 4, para. 1636.

45 The Laconia Order was issued by Grand Admiral Karl Dönitz of the German Navy in 1942, subsequent to an Allied attack on a German U-boat involved in rescuing the survivors of a German attack on the Royal Mail steamer *Laconia*. The order instructed the commanders of the U-boat fleet to cease conducting rescue operations. Dönitz's having issued the Laconia Order was one of the matters at stake in Dönitz's trial for war crimes at Nuremberg. See *Nuremberg Trial Proceedings*, Vol. 13, 125th Day, 9 May 1946, available at: http://avalon.law.yale.edu/imt/05-09-46.asp; G. Harry Bennett, "The 1942 Laconia Order, the Murder of Shipwrecked Survivors and the Allied Pursuit of Justice 1945–46," *Law, Crime and History*, Vol. 1, No. 1, 2011; Maurer Maurer and Lawrence J. Paszek, "Origin of the Laconia Order", *Royal United Services Institution Journal*, Vol. 109, No. 636, 1964; William J Fenrick, "The Exclusion Zone Device in the Law of Naval Warfare", *Canadian Yearbook of International Law*, Vol. 24, 1986, p. 103. See also note 53 below.

46 Alternative formulations would be to insist either that the belligerent parties still have an obligation but would have no way of fulfilling it or that they would have an excuse for not fulfilling their obligations. Either way, though, they would in practice have no obligation to perform any particular action that might benefit those in need of rescue in such a case.

sick, wounded and shipwrecked persons.[47] Not only would this make war at sea more dangerous for all people physically in the battlespace, but it would also undermine a social practice which, as argued above, plays an important role in civilizing war and underpinning respect for IHL more generally. Such an outcome from the adoption of UMS would be doubly unfortunate given that an influential argument in favour of developing UMS – especially autonomous versions thereof – rests on the claim that their introduction will reduce the risks to non-combatants and save non-combatant lives.[48]

Things would be different if UMS did have the capacity to conduct search and rescue operations. In this case, "all possible measures" would include the use of UMS, and warring parties would be obligated to use UMS to try to save the lives of those left adrift in the waters, or otherwise imperilled, at the end of each engagement.

The question at hand, then, is how we should conceptualize the legal and ethical obligations of parties regarding search and rescue operations in the new circumstances established by the development of UMS. Should we expect the designers and manufacturers of these systems to, wherever possible, provide them with the capacity to conduct, or at least facilitate, search and rescue operations? This moral question is an urgent one because choices made in the design of the first few systems will play an important role in shaping future expectations.

Unless the international community acts quickly to establish such an expectation, designers are likely to design systems that will eventually extinguish any hope of rescue for those imperilled at sea in wartime. Critics have often worried that the development of UMS distances those launching or operating these systems from the consequences of their actions. Typically their concern is that the geographic and (perhaps) emotional distance from the target provided by these systems will make it easier for people to kill and therefore more likely to do so.[49] A version of this concern may also arise regarding the duty of rescue: one might worry that people controlling tele-operated systems will be less motivated to save the lives of individuals drowning hundreds of kilometres away than they would be if those individuals were actually nearby. However, the relevant issue here is the distance between the *designers* of the systems and the circumstances of

47 Paul W. Kahn, "The Paradox of Riskless Warfare", *Philosophy & Public Policy Quarterly*, Vol. 22, No. 3, 2002, has argued that, alongside other systems involved in high-tech warfare, UMS systematically transfer risks from combatants to non-combatants in ways that threaten traditional justifications for the use of force. To our knowledge, however, we are the first to notice this particular way in which such a shift might occur.

48 Ronald C. Arkin, "Lethal Autonomous Systems and the Plight of the Non-Combatant", *AISB Quarterly*, No. 137, 2013.

49 Bryan Bender, "Attacking Iraq, from a Nev. Computer", *Boston Globe*, 3 April 2005; P. W. Singer, above note 28, pp. 330–333; David L. Ulin, "When Robots Do the Killing", *Los Angeles Times*, 30 January 2005. For critical evaluation of this claim, see Robert Sparrow, "Robotic Weapons and the Future of War", in Jessica Wolfendale and Paolo Tripodi (eds), *New Wars and New Soldiers: Military Ethics in the Contemporary World*, Ashgate, Surrey and Burlington, VA, 2011. For a discussion of the implications of the geographical distance between the operators and the actions of remotely controlled systems for the extent to which the operators can cultivate the martial virtues, see Robert Sparrow, "War without Virtue?", in Bradley Jay Strawser (ed.), *Killing by Remote Control*, Oxford University Press, Oxford, 2013.

their use.[50] Engineers who design UMS have little reason to fear that one day they might find themselves adrift in the water praying that someone will rescue them. Consequently, unlike those who actually go to sea, they have little personal reason to concern themselves with the future of the conventions regarding search and rescue. By distancing those who have the power to initiate or withhold search and rescue operations from those who may need them, the development of UMS for war at sea poses a unique challenge to the future of the conventions regarding the conduct of search and rescue operations in wartime.

The case against a duty of rescue for UMS

Arguments *against* an obligation to provide UMS with the capacity to conduct rescue operations may take two forms. First, it may be denied that there is any ethical – let alone legal – obligation at all on the designers of UMS to provide them with the capacity to conduct search and rescue operations. Second, it may be argued that while an ethical obligation to do this does exist, it is outweighed by other morally relevant considerations.

There are, in turn, two ways to make the first argument. One way to do so is by drawing attention to the use, design and historical development of other weapons. Many of the UMS currently on the drawing board are plausibly thought of as "smart" mines or torpedoes, or as light aircraft. Naval mines and torpedoes have a long history of military use despite having no capacity to conduct search and rescue operations. Nor has there been much, if any, pressure on the designers of these weapons and/or the systems that support them to provide them with such.[51] Similarly, cruise missiles have no capacity to conduct search and rescue operations, and there has been – to our knowledge – no complaint about this fact. Many of the strike aircraft used in war at sea also have very

50 Engineers and weapon designers have almost always been a long way from the front lines, of course. What is distinctive about UMS is that the design and programming of these weapons encompasses more and more aspects of their use. Indeed, the logical end point of the development of UMS is the creation of systems that only need to be launched before proceeding to conduct combat operations entirely autonomously. In this case, the designers of these systems would become responsible for *all* of the decisions previously made by the combatants who formally carried out this combat role. For a discussion of the ethical issues that arise in the course of the design of UMS more generally, see Robert Sparrow, "Building a Better Warbot: Ethical Issues in the Design of Unmanned Systems for Military Applications", *Science and Engineering Ethics*, Vol. 15, No. 2, 2009.

51 Distinguishing between weapons, weapon systems and agents remains a significant challenge in terms of both law and ethics when assessing compliance with obligations. See Robert Sparrow, "Twenty Seconds to Comply: Autonomous Weapon Systems and the Recognition of Surrender", *International Law Studies*, Vol. 91, 2015. Regrettably, compliance with the ongoing obligation upon States to conduct weapons reviews on all new means and methods of warfare (AP I, Art. 36) is far from universal. See, generally, ICRC, "A Guide to the Legal Review of New Weapons, Means and Methods of Warfare: Measures to Implement Article 36 of Additional Protocol I of 1977", *International Review of the Red Cross*, Vol. 88, No. 864, 2006.

limited capacity to affect search and rescue operations, and this is not seen as a moral failing on the part of their designers.[52]

Another way to deny that there is any ethical or legal obligation on the designers of UMS to provide them with the capacity to conduct search and rescue operations is to insist that the suggestion that there *is* such an obligation misidentifies UMS as *participants* in warfare, when in fact they are only tools used by the real participants – human beings. Belligerent parties have a legal obligation to conduct search and rescue operations after each naval engagement, but they have no legal or ethical obligation to use weapons that can themselves conduct such operations. Consequently, there is no legal or ethical obligation on designers to provide weapon systems with the capacity to conduct such operations. This second line of argument is itself strengthened by the first, which already implicitly highlights the nature of UMS as weapon systems – indeed, in many cases, as weapons – by analogy with other weapons.

Even if there is some ethical obligation on the designers of UMS to provide these systems with the capacity to conduct search and rescue operations, this obligation could be outweighed by other morally relevant considerations. As noted above, the legal – and, arguably, ethical – obligation on human combatants is limited by their right to self-preservation and the need to preserve the military capability that they represent, and a similar argument might be made on behalf of UMS. In some cases, conducting rescue will place the unmanned system itself in jeopardy, if not immediately, then in future engagements – for instance, by making it easier for the enemy to locate and track it. This is particularly relevant to submersibles, the military utility of which is to a large extent a product of their capacity to operate undetected by enemy forces.[53] More controversially, it might be argued that the cost to the effectiveness of UMS as weapon systems involved in providing them with the capacity to conduct search and rescue operations is too high, given that UMS without such capacity will typically be faster, lighter,

52 Strike aircraft do typically possess the capacity to notify nearby surface vessels of the existence of survivors in the water after an engagement, and are morally obligated to do so when they do possess this capacity.

53 Historically, the conventions and protocols regulating maritime conflict, particularly relating to rescue, centre on the conduct of surface ships, posing distinct problems for submarines. First, as the military utility and strategic advantage of submersibles depends on their status as "stealth vehicles", detection uniquely threatens their military capability and makes them highly vulnerable to enemy attack. Consequently, regulations that oblige participation in surface operations distinctively jeopardize submersible vehicles. Second, submarines have few crew and limited space and resources, all of which restricts their ability to perform rescue. Accordingly, it has been unclear historically what is required of these vehicles in providing for the safety of non-combatants. See Jeffrey Legro, *Cooperation under Fire: Anglo-German Restraint During World War II*, Cornell University Press, Ithaca, NY, 1995, pp. 35–40. During the Nuremberg Trials, Germany argued that as the "security of the submarine is, as the first rule of the sea, paramount to rescue", and because of the "unusual additional danger" that rescue presented to submarines, there was cause for an exception to the rescue duty of submersible vehicles. Further, they argued that for the reasons we have mentioned here (space, crew, stealth), the submarine was "subject to special considerations" as rescue "prejudices the military mission". Subsequently, while it was accepted that on 17 September 1942 Grand Admiral Dönitz of the German Navy had forbidden all rescue efforts by submarines, the sentencing of Dönitz for war crimes "was not assessed on the ground of his breaches of the international law of submarine warfare". *See Nuremberg Trial Proceedings*, Vol. 18, 179th Day Tuesday, 16 July 1946, available at: http://avalon.law.yale.edu/imt/07-16-46.asp; *Judgement: Doenitz*, available at: http://avalon.law.yale.edu/imt/juddoeni.asp.

cheaper and more reliable. An argument can be made that any such sacrifice of combat effectiveness is morally relevant insofar as better weapons enable warfighters to preserve their own lives and the military capability they represent. This argument is, however, properly controversial because, by its very nature, just war theory places moral limits on the activities of warring States and combatants, and these limits sometimes require them to resile from policies or actions that they would otherwise be inclined to adopt in the pursuit of military victory.

The case for a duty of rescue for UMS

The case *for* an obligation on designers to provide UMS with the capacity to conduct search and rescue operations begins by emphasizing the strength and importance of the existing duty of rescue. The moral case for a duty of rescue has been made at length above, so we shall simply assume it here.

It is possible to argue directly for the existence of such an obligation on designers of UMS by interpreting the claim that parties are obligated to take "all possible measures" expansively, and insisting that this injunction itself requires them to, wherever possible, use weapon systems that facilitate the location and rescue of shipwrecked personnel, as well as to design this capacity into these systems themselves. One problem with this line of argument, however, has already been pointed out: the history of the development and use of torpedoes and naval mines in war at sea provides little evidence for the existence of such an obligation.[54]

Clearly, the fact that a weapon doesn't possess the capacity to conduct search and rescue operations does not rule out its use being ethical. Nevertheless, there are two important ways in which (some) UMS differ from such weapons systems. First, by their nature, torpedoes and mines are destroyed when they attack a target. This may also be true of some UMS, but many of the systems being developed are themselves armed with weapons with which they can attack targets, and will remain in the area after the attack has been carried out. It would

54 It might be argued that because mines tended to be deployed near coasts and at choke points, and thus were never far from observation, manned systems have always been available to conduct rescue operations for those whose vessels were sunk by mines – with the consequence that the question of the ethics of the use of naval mines in relation to the duty of rescue did not arise. Similarly, torpedoes have a limited life when launched. The fact that free-floating mines are required by IHL to render themselves (or be rendered) inert after one hour and that torpedoes are expected to become inert at the end of their run might further be adduced in support of this claim. See Hague Convention (VIII) Relative to the Laying of Automatic Submarine Contact Mines, 18 October 1907, Art. 1. However, we believe the legal expectations when it comes to the use of free-floating mines and torpedoes are better explained as arising from a concern for distinction, and that the empirical claim about the availability of manned systems is disputable. See, generally, Howard S. Levie, "Submarine Warfare: With Emphasis on the 1936 London Protocol", *International Law Studies*, Vol. 65, 1993; Dale Stephens and Mark Fitzpatrick, "Legal Aspects of Contemporary Naval Mine Warfare", *Loyola of Los Angeles International and Comparative Law Journal*, Vol. 21, No. 4, 1999; David Letts, "Naval Mines: Legal Considerations in Armed Conflict and Peacetime", *International Review of the Red Cross*, Vol. 98, No. 902, 2016; US Navy, *US Navy Commander's Handbook on the Law of Naval Operations*, NWP 1-14M, 2017, section 9.2.

therefore not be impossible for this latter class of systems to be required to have some capacity to conduct – or at least facilitate – search and rescue operations. Second, until very recently it wasn't possible for anything other than a vessel (or aircraft) under the command of a human being on board to conduct search and rescue operations. It is hardly surprising, then, that the question of whether previous weapons and/or weapons systems should be provided with this capacity did not arise. Yet the current military enthusiasm for UMS has arisen precisely because these systems are now capable of carrying out relatively complex operations. An issue therefore arises regarding our expectations of these systems where it does not for previous generations of systems. Moreover, the question is *not* whether it would be ethical to deploy an unmanned system without the capacity to conduct search and rescue operations once such a system exists, but rather whether there is an obligation on designers to provide the systems they design with the capacity to conduct search and rescue operations, or, at the least, to enable UMS to provide a link in the chain enabling other assets – such as aircraft – to respond. The argument that this obligation flows directly from parties' ethical and legal obligations under GC II therefore has, we believe, some force, at least in relation to the design of systems that are persistent and over a certain tonnage.[55]

We imagine that some readers will balk at the idea that an ethical – let alone a legal – obligation can be derived from existing IHL. Another way of approaching the matter, then, is to observe that all of the arguments supporting the existing ethical *and* legal obligation also support the claim that it would be beneficial if UUVs and USVs were provided with the capacity to conduct search and rescue operations. That is to say, an obligation to design future UMS so as to be able to conduct search and rescue operations might instead be thought of as a new obligation arising as a result of the rapid increase in the capacities of UMS and supported by the same considerations as support the historical obligation.

Moreover, the arguments *against* providing systems with the capacity to rescue may all be contested. Whether the principles of just war theory – or of morality more generally – could ever be understood as applying "to", or making demands of, UMS themselves, or only of the human beings who design and deploy them, is the topic of ongoing controversy in the larger debate about the ethical issues raised by the development of military robotics. Some authors have held that robots may, at some stage in the future, become sufficiently

55 UMS that destroy themselves in the course of an attack *cannot* make any contribution to search and rescue operations. Where systems are operated remotely by personnel on board manned vessels nearby, it is less important that the unmanned system is able to contribute to search and rescue operations because presumably the manned vessel would have the capacity to do so. However, where UMS are capable of extended operations and travelling long distances, it increases the chance that they might be the only vessel in the vicinity of people in need of rescue, which in turn increases the force of the case that they should be provided with the capacity to contribute to search and rescue operations. Similarly, larger vessels have more of a capacity to carry life rafts and/or take seamen aboard, so it would be especially egregious if they were not provided with such functionality. For further discussion of the extent to which it is reasonable to expect that different sizes and sorts of UMS should be provided with the capacity to contribute to search and rescue operations, see the section "Designing UMS for Rescue", below.

autonomous as to create a "responsibility gap", such that it becomes difficult to hold any human being responsible for the consequences of the actions of the machine.[56] Some authors have even argued that at this point our best option would be to hold the machine itself responsible for what it does.[57] At this point it would presumably also make sense to blame the machine if it failed to meet its obligations under just war theory, including the obligation to conduct search and rescue operations.

Another line of argument which might support the claim that at least some UMS should be held to be under an ethical obligation to conduct search and rescue operations draws on the idea that, in the context of war at sea, the legal obligations on the belligerent parties devolve, in the form of ethical obligations, to vessels in the immediate area of operations rather than individuals.[58] It is extremely difficult for individuals to ply the oceans by themselves, and even more so for them to make an effective contribution to a military effort conducted in this domain. The vast majority of those who go to sea do so alongside others, as crew or passengers of boats, ships or submarines. Once on board a vessel, though, individuals have very little opportunity to act without the cooperation of the other people on board. For this reason, it makes little sense to hold each and every combatant individually to be under a duty (for instance) to conduct search and rescue operations. Instead, the burdens of this obligation fall on vessels and their captains. "Vessels" (and aircraft) are, for the most part, the actors in naval conflict and thus the appropriate subject for the immediate practical obligations deriving from the legal obligations of the belligerent parties under Article 18 of GC II. As the updated 2017 ICRC Commentary on GCII states:

> If a ship is close to the place where the obligations of Article 18 are to be implemented, and depending on such factors as the temperature of the water, it may be the only entity in a position to save those in need, notably shipwrecked persons.[59]

There are independent reasons why some scholars have wished to categorize at least some USVs and UUVs as vessels.[60] For example, classing systems as vessels (thus

56 Andreas Matthias, "The Responsibility Gap: Ascribing Responsibility for the Actions of Learning Automata", *Ethics and Information Technology*, Vol. 6, No. 3, 2004; Heather M Roff, "Killing in War: Responsibility, Liability, and Lethal Autonomous Robots", in Fritz Allhoff, Nicholas G Evans and Adam Henschke (eds), *Routledge Handbook of Ethics and War: Just War Theory in the 21st Century*, Routledge, Milton Park, 2013; Robert Sparrow, "Killer Robots", *Journal of Applied Philosophy*, Vol. 24, No. 1, 2007.

57 Thomas Hellström, "On the Moral Responsibility of Military Robots", *Ethics and Information Technology*, Vol. 15, No. 2, 2013.

58 R. Sparrow and G. Lucas, above note 3. See also the discussion in I. Papanicolopulu, above note 4, pp. 495–497, 504, on the references in the 1989 International Convention on Salvage and the 1910 Salvage Convention to the duties of the masters of vessels, which, Papanicolopulu argues, persist in wartime.

59 ICRC Commentary on GC II, above note 4, para. 1630.

60 B. Gogarty and M. Hagger, above note 3, pp. 114–116; A. H. Henderson, above note 3, p. 66; R. McLaughlin, above note 3, p. 112; A. Norris, above note 3; Wolff Heintschel von Heinegg, "Submarine Operations and International Law", in Ola Engdahl and Pål Wrange (eds), *Law at War: The Law as It Was and the Law as It Should Be*, Koninklijke Brill, Leiden, 2008, p. 146.

requiring that they have a nationality[61]) provides them with an organic sovereign status – unconnected to a parent "unit" – in terms of sovereign immunity. This is important in that this status carries with it an expectation and obligation, in peacetime, of non-interference in almost all situations, but also an expectation of direct sovereign accountability (in that such vessels are assumed to be engaged solely in the bidding of their sovereign) which is greater than that linked to a non-sovereign immune vessel of the same nationality.[62] If such UMS are vessels, then, they have the same obligations to conduct search and rescue operations as other vessels. Those who design them are in turn under an obligation to provide them with the capacity to do so, or at the minimum, with the capacity to contribute to such operations.

However, one does not need to treat UMS as "autonomous" in some strong sense to believe that there might be an obligation on the designers of such systems to provide them with the capacity to conduct search and rescue operations. One can insist that even if, in the future, battles were to come to be fought entirely between robots, the real combatants would remain the human beings who ordered the robots into combat, and still hold that the designers of military robots for use in naval combat should ensure that these robots have some capacity to facilitate search and rescue operations. By emphasizing the moral responsibility of the human user, this argument essentially treats autonomous systems as though they were tele-operated systems. The reason for providing both sorts of systems with the capacity to facilitate search and rescue operations is simply to allow human combatants to meet *their* obligations. In the future, as wars come to be fought increasingly by UMS, unless robots have this capacity, human beings won't be able to search for survivors and for human remains after a combat engagement has ended.

Furthermore, the countervailing considerations that might be cited by the opponents of an obligation to provide UMS with the capacity to facilitate search and rescue are arguably weak. As noted above, the fact that meeting an obligation posed by just war theory might make it harder to win a particular battle or even a war is not in itself an objection to it. The *raison d'être* of such obligations is to motivate us to do things we would otherwise not be inclined to do. It would not be unreasonable to expect designers to provide UMS with the capacity to facilitate search and rescue operations, even if this would make the systems more expensive or larger or less reliable. Importantly, the main consideration that sometimes excuses manned vessels from attempting rescue – that doing so would pose a grave risk to the lives of those on board, and the military capability they represent – has reduced force in cases involving UMS. If an unmanned system endangers itself in carrying out a rescue, it remains the case that it risks no lives (although it does risk capability). Insofar as UMS are more expendable, there is arguably *more* of an obligation on UMS than on other vessels to come to the aid of seamen in peril. Even if there might be circumstances in which it *would* be reasonable to hold that risking the

61 Law of the Sea Convention, 1982, Arts 91 ("Nationality of Ships"), 92 ("Status of Ships").
62 R. McLaughlin, above note 3.

destruction of an unmanned system by ordering it to participate in search and rescue operations would jeopardize human lives (or a morally significant military capability), this is compatible with the existence of a general moral obligation on such systems to participate in such operations. As such, an exception could be made in this case, as is currently done for manned vessels.

The importance of rescue to those who require it, the role that acknowledging an obligation to rescue has in civilizing war more generally, and the relative weakness of the case against the proposal inclines the present authors to conclude that designers of UMS are indeed, at the very least, morally obligated to provide UMS above a certain size with at least some capacity to facilitate search and rescue operations.[63]

Designing UMS for rescue

Should the designers of UMS wish to provide them with the capacity to conduct or at least facilitate search and rescue operations, either because they are convinced by the argument above or because they are concerned with being able to assist their own personnel in the event of their becoming sick, wounded or shipwrecked, then there are three different capabilities that might be provided to particular UMS.

First, UMS might be provided with the capacity to recognize the post-engagement presence (or at least the likelihood thereof) of sick, wounded and shipwrecked persons, and to communicate their location (or suspected location) to other forces nearby, either friendly, neutral or enemy, who might then conduct rescue and recovery operations. Indeed, we presume that all UMS – even the most autonomous systems – will have some capacity to communicate with a controller in order to be tasked with their missions, and that some of them are likely to possess sensors capable of detecting (some) objects in the water.[64] The cost of notifying other vessels of the location of sick, wounded and shipwrecked persons will then generally be low, although in some cases this will alert the enemy to the presence of a particular military asset in the area. Of the ways in which UMS might contribute to search and rescue operations that we survey here, this is the only role that it is plausible to think that UAVs could be required to be able to play.

63 Insofar as "ought implies can", the obligations on UMS to conduct search and rescue obligations – or, more precisely, on the designers of UMS to provide them with the capacity to contribute to search and rescue operations – is a function of the capacity of systems to facilitate search and rescue operations. Our reasons for thinking that larger systems have a greater capacity to contribute to search and rescue operations are provided immediately below.

64 Unless they can communicate with a human controller, UMS cannot be switched to "active" mode at the beginning of a conflict and risk continuing to engage in combat after a conflict has ended. The capacity to detect objects in the water is essential to most of the roles for which naval UMS are intended, and especially to combat operations in and under the water. Detecting individual persons in the water is a formidable challenge, but detecting objects such as life rafts or the presence of life jackets that emit light or signals may well be plausible for a sophisticated unmanned system located nearby. UAVs could presumably transmit video footage to a human controller who could assess the nature of the post-conflict environment and the likelihood that it contains persons in need of assistance.

However, simply broadcasting the location of people who are sick, wounded and shipwrecked will do them little good if there is nobody available to assist them. Second, then, USVs and UUVs might be provided with the capacity to launch life rafts, flotation devices and other resources that would help shipwrecked sailors to survive until they can be rescued by other forces. In theory, it is even possible for UUVs to be provided with the capacity to launch flotation devices while remaining submerged so as to reduce the risk of revealing their precise location. These resources would greatly increase the chance of shipwrecked seamen surviving until they can be rescued by other forces. Admittedly, they would likely also increase the size of the USV or UUV, but the same is true of providing this capacity to manned ships, which must by regulation carry such equipment.

Finally, and most ambitiously, USVs and (perhaps) UUVs might be designed so as to be able to conduct rescue operations and to take the sick, wounded and shipwrecked on board, if necessary as prisoners of war. This would presumably only be an option for very large USVs, of the sort that are intended to replace a corvette, or UUVs that are intended to replace a medium-sized submarine.[65] Such systems would need to be engineered so as to rule out the possibility of them then being commandeered or sabotaged by those they take on board, and, more problematically, to facilitate medical care to the wounded and sick (an almost impossible task unless the unmanned system leverages the rescued personnel to provide the care). For the moment this last option remains, we suspect, beyond the bounds of technological feasibility. However, the dynamics pushing towards the development of UMS should eventually be expected to lead to the development of corvette-class systems capable of a wide range of independent operations, in which case it is not unreasonable to expect that these operations should also include search and rescue.

Conclusions

The way in which wars are fought has, inevitably, evolved alongside the weapons that are used to fight them. The increasing introduction of unmanned systems into warfare is likely to prove no exception to this rule. While this process is not itself to be regretted, all those with an interest in war – and, in particular, those who might fight wars – are well advised to pay close attention to it. New technologies may shift the burdens and benefits of different roles during wartime, and not always for the better. We have argued that, although the introduction of UMS to war at sea might reduce the risk to active combatants, unless concrete

65 It is possible that UUVs should be held to have a limited *obligation* to conduct search and rescue operations by analogy with the case of manned submersibles. However, as suggested in the section "The Case for a Duty of Rescue for UMS" above, it is also plausible to think that they are under *more* of an obligation to do so than manned submersibles insofar as they are more expendable than manned submersibles. In any case, if there are *any* circumstances in which they have such an obligation, the issues discussed here will arise.

steps are taken now, this may be achieved at a significant cost to those who have been rendered *hors de combat* by virtue of being shipwrecked, wounded or sick, as well as civilians in these perilous circumstances. Absent a capacity to undertake search and rescue operations, belligerent parties with only UMS fielded in the area of operations may ultimately have no obligation to do so in practice. Because the shipwrecked, wounded or sick pose no military threat, this transfer of the burdens of war cannot be justified by military necessity.

Any erosion of the expectation that belligerent parties will conduct search and rescue operations between engagements will be disastrous for all those who go to sea during wartime. It would also undermine the commitment to reciprocity that currently underpins military practice regarding the treatment of those who are shipwrecked, wounded or sick and which, we have argued, plays an important role in civilizing war more generally. We therefore believe that the international community should quickly move to establish an expectation that nations developing and fielding UMS intended for use in naval warfare will ensure that these systems are provided with some capacity to conduct or contribute to search and rescue operations. In particular, this means that the designers of early UUVs and USVs should provide these systems with this capacity and publicize the fact that they have done so. In order to motivate this policy, we would strongly encourage those who are responsible for the design of these systems to imagine that they might be fighting alongside them – or might at least have to go to sea during wartime – and thus might one day find themselves in need of rescue.