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Mine warfare and clearance diving in the Royal Australian Navy: strategic need and future capability

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The Australian Navy Mine Warfare and Clearance Diving Group was formed in 2001 from the Australian Mine Warfare and Clearance Diving Forces as part of a reorganisation of the Royal Australian Navy (RAN). The group's function is to manage all inputs, services and resources needed to deliver the mine warfare and clearance diving capabilities required to fight and win at sea and to contribute to military support operations. In this paper, Martin Brooker outlines the strategic need for a mine warfare and clearance diving capability in the RAN, the history of the capability and future requirements.

> *"We have lost control of the seas to a nation without a navy, using pre-World War I weapons, laid by vessels that were utilised at the time of the birth of Christ"*
>
> – Rear Admiral Alan E. Smith, Commander of the United States Amphibious Force, following D-day off Wonson, Korea, October 1950

Mine warfare is one of the less 'glamorous' or 'high profile' warfare areas in any navy[3]. Yet the threat of sea mines, if you are not prepared to deal with them, can have devastating effects on your freedom of manoeuvre and sea control. In this paper, my aim is to impress on you why mine warfare and clearance diving are an integral part of any maritime warfare capability and the strategic importance of this capability for Australia. I will also provide you with a brief overview of the history of the RAN's mine warfare and clearance diving capability and make some comments on future requirements.

Australia's Strategic Need for a Mine Warfare Capability

The sea mine poses a viable threat to Australia, an island continent with over 35,000 km of coast line, open sea approaches, choke point passages, and major sea ports that are pivotal to the economy. The closure, by mining, of any one of our ports or waterways would have a potentially crippling effect on our economy. The ability to counter this potential threat requires an effective mine warfare capability incorporating a balanced combination of mine hunting, mine sweeping, clearance diving and, potentially, mining capabilities.[4]

Indeed, mines would be a particularly effective method of interdicting our sea lines of communication in the archipelagic choke points to our north and in South-East Asia. Accordingly, a mine warfare capability is needed to: ensure the lines of communication can be kept safe from offensive mining; maintain the mobility of maritime forces; and maintain commerce and trade, which are strategically important to Australia's diplomatic, economic and social interests.[5]

Australia's economy relies heavily on sea transport. Of our total exports and imports, 99 per cent (by volume) is transported by sea. This represents 86 per cent (by value) of exports and 78 per cent (by value) of imports; with 96 per cent of this trade carried under a foreign flag. Hence, it is essential that we maintain freedom of manoeuvre in our sea lines of communication. To this end, the maintenance of maritime capabilities (air and naval forces) that can ensure freedom of passage in Australia's air and sea approaches is essential, including an ability to detect, prosecute and remove the threat of sea mines in the approaches to Australia and its ports.

Australia's most recent strategic guidance, *Defence 2000,* recognises this need. It states that Australia's maritime forces must provide *"an assured capability to detect and attack any major surface ships, and to impose substantial constraints on hostile submarine operations, in our extended maritime approaches",* and *"the ability…… to protect Australian ports from sea mines".* While a new Defence white paper is expected shortly, I am sure this will be an enduring requirement.

In fact, this is not a new concept. Nearly 150 years ago, Admiral David Farragut became famous for his "damning torpedoes"[6] [mines] at the entrance to Mobile Bay during

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[3]Rear Admiral C. Bennet (Retd) (1988). Mine warfare at sea. *African Security Review* **7** (5), 1.

[4]http://www.navy.gov.au/pub:Semaphore_-_Issue_7,_2004

[5]ibid

[6]M. S. Davis (2000). David Glasgow Farragut. In *Encyclopedia of the American Civil War: A Political, Social, and Military History* (W. W. Norton & Company: University of Michigan) p. 682.

the American Civil War. From the North Sea mine barrage in World War I to the mining of Japanese harbours in World War II, from Wonson in Korea to Haiphong Harbour in Vietnam, sea mines have been used to great effect and have led to a mine warfare capability becoming a critical element of a nation's maritime warfare capability.

Currently, there are over 40 countries possessing mining capabilities, of which at least 30 have demonstrated a mine production capability and 20 have attempted to export these systems. This has compounded the challenge for nations wishing to maintain a credible mine counter-measures capability.

Further, mining is unique in maritime warfare to the extent that mines developed over a hundred years ago remain effective weapons today. Contact mines designed in 1908 continue to be used because they are inexpensive and simple to manufacture and maintain. While they may have a shorter lethal range than newer mines, their mere existence poses a potential threat, the psychological nature of which is one reason why mine warfare is so effective.[7] Indeed, the low cost and effectiveness of mines allows economically-constrained countries and non-state actors to employ mines which have a destructive power that far outweighs their cost (Table 1).

Table 1: Cost of the weapons used to attack United States warships on four separate occasions in the Persian Gulf compared to the value of the damage caused.

Ship	Date of attack	Cost (weapon) ($USD)	Impact ($USD)
USS *Stark* (FFG-31)	May 1999	$1,000,000 (2 Exocet missiles)	$100 million to repair out-of-action for 15 months
USS *Samuel B. Roberts* (FFG-58)	April 1988	$1500 (moored contact mine)	$96 million to repair out-of-action for 18 months
USS *Tripoli* (LPH-10)	February 1991	$1500 (moored contact mine)	$3.5 million to repair out-of-action for 3 weeks
USS *Princeton* (CG-59)	February 1991	$22,000 (ground mine)	$17.6 million + to repair out-of-action for 2 months

History of RAN Mine Warfare Capability

The sea mine has been used in Australian waters for both offensive and defensive purposes. Minefields were an important part of port defences during the colonial era and, during World War II, they were used to seal off many of the passages through the Great Barrier Reef.

In both world wars, German surface raiders laid offensive minefields that sank a number of Allied merchant ships in Bass Strait and off the east coast.[8] The Japanese also conducted a limited offensive mining campaign in Australian waters. During 1942-43, their submarines laid mines off Darwin and Brisbane, and in the Torres Strait. Most of the fields consisted of moored contact mines that required a ship to physically strike the chemical horn in the mine. Off Brisbane, however, the Japanese laid influence ground mines that detonated in response to either the noise or magnetic field produced by a passing ship. Fortunately, the Japanese fields were all cleared before they could claim a victim.[9]

During World War II, RAN minesweeping squadrons were based at Sydney, Melbourne, Hobart, Adelaide, Fremantle, Darwin, Brisbane and Newcastle. HMAS *Bathurst* (I) was the first of sixty Australian minesweepers (Table 2), commonly known as 'corvettes', built during World War II in Australian shipyards as part of the Commonwealth Government's wartime shipbuilding programme. Twenty (including *Bathurst* (I)) were built on Admiralty order, but were manned and commissioned by the RAN. Thirty-six were built for the RAN and four for the Royal Indian Navy. Australia also had a mining capability with the HMAS *Bungaree*, which laid approximately 10,000 mines in Australian and New Zealand waters during the war. Additional minefields were laid to defend the main Australian ports. After the war, the RAN's mine counter-measures capabilities were engaged in clearing mines from Australian and regional coastal areas continuously from 1945 until 1950.[10]

Table 2: Characteristics of the Bathurst-class minesweepers

Type	Australian Minesweeper (Bathurst class)
Builder	Cockatoo Docks and Engineering Co Ltd, Sydney
Displacement	733 tons
Length	186 feet (56.693 metres)
Beam	31 feet
Draught	8 feet 6 inches
Armament	1 x 12-pounder gun 2 x Oerlikons 1 x Bofors
Main Machinery	Triple expansion, 2 shafts
Horsepower	2000
Speed	15 knots

In 1950, with the clean up complete, the RAN operation of mine counter-measures vessels effectively ceased, although the Clearance Diving Branch was established in 1951 with officers and sailors of from the Render Mine Safe Branch.

It was not until 1962 that the RAN re-acquired a surface-ship mine counter-measures force, with six Ton-class minesweepers of which two were converted into mine-hunters. These ships were capable of mechanical and influence sweeping, a speed of 16 knots, an armament of 40/60 Bofors (two prior to 1968), radar and sonar. They served as patrol vessels in the Indonesian Confrontation in 1964 and were decommissioned in 1990.

With an on-going requirement for a surface-ship mine counter-measures capability, the RAN explored innovative ways in which to maintain it. Two key projects in the mid-1980s were the Mine Hunter Inshore (MHI) and the Craft of Opportunity. MHIs, HMAS *Rushcutter* and *Shoalwater* were commissioned in 1986 and 1987 respectively. Built to a catamaran design for operations in sheltered waters and with a displacement of 170 tonnes, they were not suitable for mine-hunting operations beyond the immediate area of ports and waterways. The ships also fulfilled a vital training

[7]Captain A. Du Toit and Lieutenant Commander M. Brown (2001). The future of mine warfare: a small to medium navy perspective. *Maritime Warfare in the 21st Century* (RAN Sea Power Centre: Canberra) p. 263.

[8]The first RAN ratings killed by enemy action in the Australian theatre in World War II were Able Seamen Danswan and Todd on 14 July 1941 – they died in an attempt to render safe a German mine that had washed up at Beachport, South Australia (www.ww2australia.gov.au/waratsea/lost.html).

[9]*ibid*

[10]http://www.navy.gov.au/RAN_in_the_Second_World_War#Awards

role, maintaining practical mine-warfare skills in the RAN, thereby retaining a core-level of expertise on which to build when the coastal mine hunters were introduced. The two MHIs were decommissioned in August 2001.

In August 1994, the RAN embarked on a major acquisition of larger coastal mine counter-measures surface vessels with greater endurance, improved mine-hunting and neutralisation systems. The first of the new Huon-class Mine Hunter Coastal (MHC) were delivered in May 1999 with the last, HMAS *Yarra*, commissioning in September 2002. Since entering service, the Huon-class MHCs have provided a solid base from which to develop a credible and meaningful surface mine counter-measures capability. Operational commitments in recent years for the MHCs have included activities not related to mine counter-measures in deployments to the Solomon Islands and providing additional surface surveillance and response capability to border protection operations in northern Australia.

While the surface-ship mine counter-measures capability has waxed and waned over the years, the clearance-diving team capabilities have grown and matured. The Clearance Diving Branch in 1951 had the primary role of *"location, identification and disposal of mines underwater"* with a secondary role of *"underwater maintenance, training of the Fleet in ship defence against saboteurs, beach reconnaissance and minor salvage"*.

Although explosive ordnance disposal remained a primary function, it soon became apparent that navy divers were suited to an ever expanding variety of tasks. In 1966, the RAN introduced the concept of the Australian Clearance Diving Team (AUSCDT). AUSCDT THREE was formed and trained[11] in all aspects of explosive ordnance demolition, small arms and jungle survival, before going to Vietnam, where it was highly commended by the United States on its success in fighting the world's most committed and resourceful guerrilla soldier.

After Vietnam, the roles of the Branch and the Teams were refined. As well as serving with the fleet in sea-going ships, additional clearance-diving teams were formed in Sydney and Western Australia. These teams have continued to provide personnel in support of a number of significant military operations, including deployments to: Kuwait in 1991 and Iraq in 2003 in support of port mine-clearance operations; East Timor in 1999 to clear and secure a safe entrance into Dili and demolition of ex-Indonesian munitions left behind; and the Solomon Islands in 2003 to assist the Regional Assistance Mission to conduct explosive ordnance clearance and underwater search. Today, clearance divers are deployed in Iraq and Afghanistan supporting Coalition efforts to counter the threat of improvised explosive devices to its forces.

Current Capability

The RAN mine warfare force-in-being is designed to fulfil the Defence of Australia strategic guidance on mine counter-measures. The force comprises two clearance-diving teams, six coastal mine hunters, a mine-sweeping drone unit, two auxiliary mine sweepers, seven Reserve diving teams, and the Australian Minesweeping and Surveillance Command Support System.

Huon-class Mine Hunter Coastal

Originally designed in Italy as the Gaeta class for the Italian Navy, the RAN Huon class has been modified to suit Australian conditions, including improved accommodation and mine-hunting capabilities. It features a unique hull design, outstanding shock resistance and an inherently low magnetic signature, allowing the ships to operate in hostile mine environments. The single-skin monocoque hull has no ribs, frames or stiffeners, thus avoiding local stress points that could separate under shock conditions.

For their mine-countermeasure operations, the ships are fitted with a variable-depth sonar able to detect mines more than 1000 metres ahead of the ship. When a mine is detected in a water column or on the seabed, the ship will 'hover' about 200 metres from the contact. A mine disposal vehicle or clearance divers will then be sent to investigate and neutralise the mine threat.

Each ship has a pair of electrically-powered Bofors Underwater Systems Double Eagle mine-disposal vehicles equipped with a searchlight, a closed-circuit low light television camera and an on-board close range identification sonar. Commands are relayed via a fibre-optic link inside the vehicle's tether, which also relays sensor images for display on the ship's multifunction console in the operations room. Each Double Eagle vehicle is fitted with either a disposal charge slung beneath or an explosive or mechanical cutter designed to sever the wire rope or chain holding moored mines.

The Huon-class coastal mine hunter, HMAS *Yarra*

Clearance Diving Teams

Australian clearance divers have always been the Australian Defence Force's (ADF) specialist divers and have, since the inception of the Branch, operated all in-service diving equipment to the full extent of its operational capacity. Nevertheless, the primary focus of a clearance diver is to perform explosive ordnance disposal. This role is conducted at sea in ships, in the oceans (particularly the vulnerable approaches to ports and anchorages), and onshore in port facilities, installations and the littoral environment (associated with amphibious operations). The Australian clearance diving community represents the

[11]The diving school was initially located at HMAS *Rushcutter* on Sydney harbour and remained there until 1968 when it was relocated to HMAS *Penguin*, also on Sydney Harbour.

largest single ADF organisation with a direct, primary interest in the conduct of explosive ordnance demolition.[12]

Currently, there are two identically-organised clearance diving teams; one in Sydney and the other at HMAS *Stirling*, in Fremantle, Western Australia. Each team is a self-contained, highly mobile unit consisting of about sixty personnel. Within each team there are three distinct elements: Underwater Battle Damage Repair, whose personnel are trained in the use of pneumatic and hydraulic tools and carry out salvage and emergency repair work in wartime situations; Mine Counter-Measures, who dispose of and disarm mines, explosive ordnance and improvised explosive devices; and Marine Tactical Operations, who conduct very shallow water mine counter-measures and amphibious reconnaissance. Team members receive instruction in all three disciplines.

Mine Sweeper Auxiliaries

The two Mine Sweeper Auxiliaries, *Bandicoot* and *Wallaroo*, were originally built in 1982 as commercial tugs and operated in Singapore. The RAN acquired both vessels in August 1990 to support visits to Australia by nuclear-powered warships on the eastern seaboard and provide an auxiliary mine counter-measures capability. Both vessels have a ship's complement of 10 personnel and, apart from the technical sailors onboard, are crewed predominantly by mine warfare sailors.

These ships provide an excellent capability in their primary role of support to visiting nuclear warships from Hobart to north Queensland ports. Both vessels also have a secondary role as mine-sweeping platforms, towing mechanical and influence sweeps; they are also used as training mine-sweeping vessels; and they occasionally conduct route survey operations. They are limited by speed and weather (less than sea state four) and, due to age, will most likely be removed from the RAN inventory in the next few years.

Naval Reserve Diving Teams

There are seven Naval Reserve diving teams located around Australia (Brisbane, Hobart, Melbourne, Sydney, Cairns, Adelaide and Perth). The teams are made up of Reserve clearance divers and Reserve diver-category sailors. Their principal role is to provide a surge/force multiplier for the AUSCDTs and provide Fleet support in their local port/state. They also deploy in support of the Mine Clearance Diving Task Group and provide exercise support (*e.g.* mine laying and recovery).

Mine Warfare Command Support System

To assist operational and tactical commanders with mining operation planning, tactics and analysis, the Mine Clearance Diving Task Group operates a mine warfare command support system. The system can provide automated planning tools and is deployable in containerised modules with clearance diving teams and the Mine Clearance Diving Task Group.

Future Requirements

The undersea domain will remain the most opaque area – mine technologies (along with submarines, fighter aircraft and missile technologies) are the key areas of concern for the future maritime force. Given an increasingly lethal and transparent battle space, there is a need for new technologies, accurate and timely intelligence and rapid assessment of the environment to ensure maximum safety of personnel and, where practicable, to keep the man out of the minefield.[13]

Range of adversaries

Intelligence and awareness of the enemy is an essential component to countering any warfare threat, including mine warfare. Potential adversaries range from sophisticated to non-state players (asymmetric threat) and our navy needs to be adaptable to meet both the littoral and open-ocean adversaries in mine warfare.

While the ADF's current mine counter-measures capability is good in regional terms, the changing nature of ADF operations and the evolving regional mine threat will require ongoing assessment to ensure the capability is maintained at an appropriate level to meet the Government's future strategic directives.[14]

Sophisticated mines

Rocket mines, already in some inventories, cannot be hunted and thus need to be avoided. Therefore, one must rely on superior intelligence as to who has them and where they are, so as to avoid them, or better still, to prevent them being laid in the first place.[15]

These mine systems provide a unique anti-submarine capability. Their distinguishing feature is that they attack targets themselves. They detect and classify an underwater target, determine its course and running depth, optimise the target intercept trajectory and generate a command to launch either a rocket (which runs at a speed of about 80 metres per second) or a torpedo. The warheads (rockets or torpedoes) are accommodated in sealed launchers laid at depths from 40-600 metres. Operation of the target detection, classification and dynamic parameter determination systems is based on acoustic principles. The attack lasts only seconds, which obviates counter-measures or evasive manoeuvre.

Other new technologies

Developments in mine technology, especially stealth technology, will make future mine clearance operations increasingly hazardous for crewed mine counter-measures vessels. The ADF will need to transition to systems that enable remote detection and clearance, with a greater use of remotely-operated or airborne vehicles for high-risk operations.[16]

To meet future requirements, Navy requires a mine warfare force with deployable and advanced mine counter-measures capabilities. This force must provide commanders with sufficient assurance of its capacity to counter mines for them to be able to provide maritime forces to meet the mission requirements, maintain sea

[12]http://www.navy.gov.au/Australian_Clearance_Diving_Team_1

[13]Future Maritime Operating Concept 2025 – Maritime Force Projection and Control (Defence Publishing Service: Canberra) p9.

[14]http://www.navy.gov.au/Publication:Semaphore_-_Issue_7,_2004

[15]*ibid*

[16]*ibid*

lines of communication, protect maritime trade and expand the manoeuvre area for the stabilisation phases of operations. An ability to conduct mine laying for offensive, protective and defensive purposes may also be needed.[17]

The geographic dispersion and number of vital ports in Australia, as well as the potential threat facing deployed forces, requires a more flexible solution than just dedicated coastal mine counter-measures vessels. Rapidly deployable airborne sensors, both land-based and organic to a task group as part of an overall rapid environment assessment capability, are technologies that exist now. Autonomous underwater vehicles with sensors and disposal weapons, surface drones (and possibility helicopters) towing emulation minesweeping equipment that can be deployed and operated from shore camps or afloat parent platforms, present significant capability advantages and should be considered.[18]

Whilst being mindful that old mines remain just as potent, new capabilities and issues that should be considered for current and future mine warfare include:

- ***Uninhabited underwater vehicles*** present opportunities to meet area surveillance and denial challenges and to develop a rapid understanding of the under-sea domain – an element of rapid environmental assessment.
- ***Remote-control mine disposal systems:*** One-shot mine disposal uses a remote-controlled underwater vehicle to locate and destroy mines. The vehicle is easily portable, is designed to be expendable, and carries its own warhead. These systems have the potential provide all ships with an organic mine counter-measures capability.
- ***Unmanned surface vessels*** – fast, with low acoustic, magnetic, pressure and seismic signatures – could deploy remotely-operable sensors ahead of the main force and possibly reduce the need for increased numbers of coastal mine hunters, particularly if self-deployable and equipped for a dual hydrographic role.
- ***Sea mining:*** Sea mining can shape the battle space. Sea mines are a relatively inexpensive force multiplier that can be used offensively to inhibit an enemy's freedom to operate, by closing their ports or sea routes; or defensively to protect sea lines of communication, our own ports and off-shore resource installations. Sea-mining operations assist in the dislocation of an adversary's efforts; and contribute to the security of sea communications by threat of destruction of hostile naval forces.[19] Depending on tasking, the majority of vessels and aircraft hold the potential to be minelayers.
- ***Realism within exercises – own forces:*** Even with sophisticated equipment and trained mine warfare personnel, the wider Fleet needs to experience the time it takes to clear mines and the limitations that mines place on manoeuvre. Often mine warfare/clearance is allotted too short a timeframe in exercises and is disregarded increasingly as exercises progress. Units need to have visual reminders and real time penalties when they have been affected by a mine to ensure mission commanders factor mine warfare aspects into all scenario planning. This is an issue that the Mine Warfare and Clearance Diving Group keenly pursues at planning conferences.
- ***Budgetary constraints:*** Vision without funding is an illusion. Mine warfare is in competition for finances and personnel with other programmes and work places. Mine warfare is cost effective and a deadly force multiplier that needs professional expertise and ongoing development as the capability cannot be bought off-the-shelf when an enemy lays/threatens to lay a minefield.

Conclusion

Australia is an island continent that relies heavily on commercial shipping and the Navy is tasked with maintaining sea lines of communication. Australian waters are suited to defensive and offensive mining – hence, the RAN needs to maintain a credible mine counter-measures force to fulfil the government's maritime warfare capability requirements and maintain our critical lines of communication.

Sea mines are effective, low-cost force multiplying weapons of choice. Yet mine warfare is often neglected until the need is recognised too late (*e.g.* Wonson and Kuwait). Mine warfare requires specialised, professional military people. It is a skill that takes time to acquire and develop to a high standard; and requires sustained application of resources and focus to maintain that capability.

Our ability to counter the sea-mine threat increases our maritime manoeuvre in the battlespace. Increases in technology notwithstanding, the humble mine will remain a potent, cost-effective weapon that cannot be ignored in our strategic capability planning. Current strategy and doctrine is driving the RAN to continue traditional mine counter-measures and, additionally, to provide an organic mine counter-measures capability in all classes of ship and develop an ADF sea-mining capability. This augurs well for the ADF to maintain an effective mine warfare capability into the future.

I trust that I have combated the common perception that sea mines are a low threat. Any ship can be a minesweeper ONCE. Hence, there is an ongoing need to maintain a credible mine warfare capability.

The Author: Captain Brooker is commander of the Australian Mine Warfare and Clearance Diving Group in Sydney. His extensive career both at sea and ashore in key command and leadership positions has included command of HMAS *Manoora* during the Iraq war and of the Maritime Task Group in the Solomon Islands in 2003, for which latter service he was awarded the Conspicuous Service Cross. He also served as Commander Operations in Fleet Command during the war on terror. He is a graduate of the Queensland University of Technology's Graduate Business School and the RAN Staff College.
[Photo of Captain Brooker: Department of Defence]

[17] *The Navy Strategy – Charting the Course to 2025* (Defence Publishing Service: Canberra) p.21.
[18] *ibid*
[19] Future Maritime Operating Concept 2025, *op cit*, p. 12.