

July 2013

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Recommended Citation

Tan, Allen D. (2013) "Addressing Underwater Ordnance Stockpiles in Cambodia," *The Journal of ERW and Mine Action* : Vol. 17 : Iss. 2 , Article 12.

Available at: <http://commons.lib.jmu.edu/cisr-journal/vol17/iss2/12>

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Addressing Underwater Ordnance Stockpiles in Cambodia

Cambodian rivers and tributaries contain vast amounts of munitions from sunken watercraft, and the task of locating and extracting these munitions is difficult. In response, Golden West Humanitarian Foundation designed a rigorous diver preparation course to train Cambodian nationals in advanced diving skills and basic recovery procedures needed to organize effective explosive ordnance salvage teams.

by Allen D. Tan [Golden West Humanitarian Foundation]

Ordnance in Cambodia's rivers is not a new concern but is a growing problem due to potential misuse of recovered explosives by civilians and scrap-metal collectors. Various combatants in Southeast Asia used the Mekong and Tonle Sap rivers—along with their numerous smaller tributaries—as resupply routes during the conflicts of the 1960s and 1970s. Over time, some of these resupply vessels were lost, and their cargo lies on the bottom of Cambodia's rivers.

These munitions remain mostly unfired and in shipping configuration. Because they are found in discrete locations, the term **stockpile** differentiates them from unexploded ordnance (UXO). Although Cambodia also faces the related problem of underwater UXO and individual munitions that were scattered across large areas, it is not the focus of this program. Issues of underwater UXO primarily affect infrastructure development projects such as bridges, where 100 percent clearance is required for underwater construction areas. While the submerged stockpiles provide substantial threats to the public, underwater UXO have a minimal impact on public safety and security.

Scrap Collection

In a country littered with landmines and UXO, underwater ordnance is still a major concern, even though it rests meters beneath the water's surface. In Cambodia, this ordnance does not stay underwater. Civilians collect underwater stockpiles for scrap metal and explosives, which have economic value: People generally sell them on the black market for use in quarrying or fishing.

In 2007 local authorities asked the Cambodian Mine Action Center (CMAC) to assist with the cleanup of an illicit scrap-collecting operation site in Kandal province.

Len Austin, an explosive ordnance detection technician from Golden West Humanitarian Foundation (Golden West) assisted the CMAC team. At the site, the scrap collectors had already recovered thousands of U.S.-made, 105 mm artillery projectiles and 81 mm mortars from an underwater stockpile. In typical fashion, the explosives were extracted by hand and the metal bodies sold for scrap. The extracted explosives were neatly organized by type in old rice sacks, ready for sale.

Although the public safety issues posed by UXO scrap collection are familiar to the humanitarian mine action community, the magnitude of Cambodia's river stockpiles makes most comparisons inadequate. During an underwater detection trial, Golden West located a small, 1970s-era military resupply boat estimated to contain more than 20 tons of munitions. A scrap-collection operation capable of processing this quantity of ordnance is comparable to a small demilitarization plant that operates near public roads and disregards the surrounding population. Complicating matters, authorities do not know the locations for many of these underwater stockpiles. Unlike a surface munitions bunker, which can be guarded or monitored, these underwater stockpiles are not monitored. If ordnance goes missing, no one notices.

The Historical Record

From historical records, authorities know where and when some of the larger stockpiles sank. Foreign accounts from the 1970s state "60,000 tons of civilian and military supplies were shipped every month on barges and shallow-draft freighters."¹ This refers specifically to shipments from South Vietnam, up the Mekong river to the Port of Phnom Penh in Cambodia. During the war,

SPECIAL REPORT



The discipline and attention to detail divers learn is critical to operational safety.
Photo courtesy of Nick Street.

these river convoys were a lifeline that supported Phnom Penh from 1973, when insurgent forces cut off the city, until the capture of Phnom Penh in 1975.²

The river from the Vietnam border to the Port of Phnom Penh stretches approximately 97 km (60 mi). According to a report by Kenton Clymer, this section of river is the most heavily contaminated in Cambodia, with press and historical documents suggesting that the area is contaminated with more than 2,000 tons of munitions.³

Recovered Ordnance Condition

Time will not resolve this problem. Golden West's Explosive Harvesting Program (EHP) technical staff examined the condition of the munitions firsthand in two cases where they received samples of munitions recovered from underwater stockpiles.

Bulk explosives recovered in the 2007 Kandal province scrap collectors' raid were tested and found to be completely functional. In 2010 EHP disassembled complete projectiles from a small boat found on the bottom of the Tonle Sap. The ordnance was in exceptional condition and still exhibited fully intact factory safety stickers on the projectile bodies after having been submerged in 10 m (11 yd) of water for more than 30 years. In both cases, the explosives were in such good condition that EHP used them to produce humanitarian demining charges.

Locating Stockpiles

Regarding containment, the first challenge involves stockpile location. Once located, two principal options exist: full recovery or site monitoring (which prevents unauthorized recovery). While site monitoring is



Wearing blackout masks, students rig training ordnance for recovery, tying knots using only their sense of touch.
Photo courtesy of the author.

theoretically possible due to the visible footprint that even makeshift dive operations present, the lack of police manpower, cost and other challenges in implementation make this approach untenable. Full recovery is the best solution.

Scrap collectors find underwater stockpiles through several methods known to authorities, none of which involve sophisticated equipment. The first method involves offering monetary incentives to locals living in riverside villages who witnessed the watercrafts sinking. These riverside residents also may have recovered a few items themselves for scrap when times were tough. Similarly, local fishermen know where sunken vessels are located because fish congregate around these wrecks.

In Cambodia, Golden West developed a systematic survey-based approach that incorporates a variation of the low-tech methods described previously with technology that increases the productivity and reliability of

results. Much like the scrap collectors, the Golden West team relies on locals for information about the ships and underwater obstructions. In Golden West's experience, references to sightings can be off-target by several hundred meters, which is substantial when divers enter a zero-visibility environment. When directed by local fishermen, the locations tend to be more exact.

In either case, reports do not automatically warrant the deployment of a dive team, particularly when precise locations are unknown. This is when advanced technology is applied. Using sonar, Golden West can survey large areas of river very quickly. Any protruding anomaly will be immediately apparent.

Once the sonar locates an anomaly, teams must determine whether the anomaly has sufficient metal content to indicate the possibility of large quantities of ordnance. Due to the dynamic environment presented by Cambodia's rivers (such as unregulated river traffic,

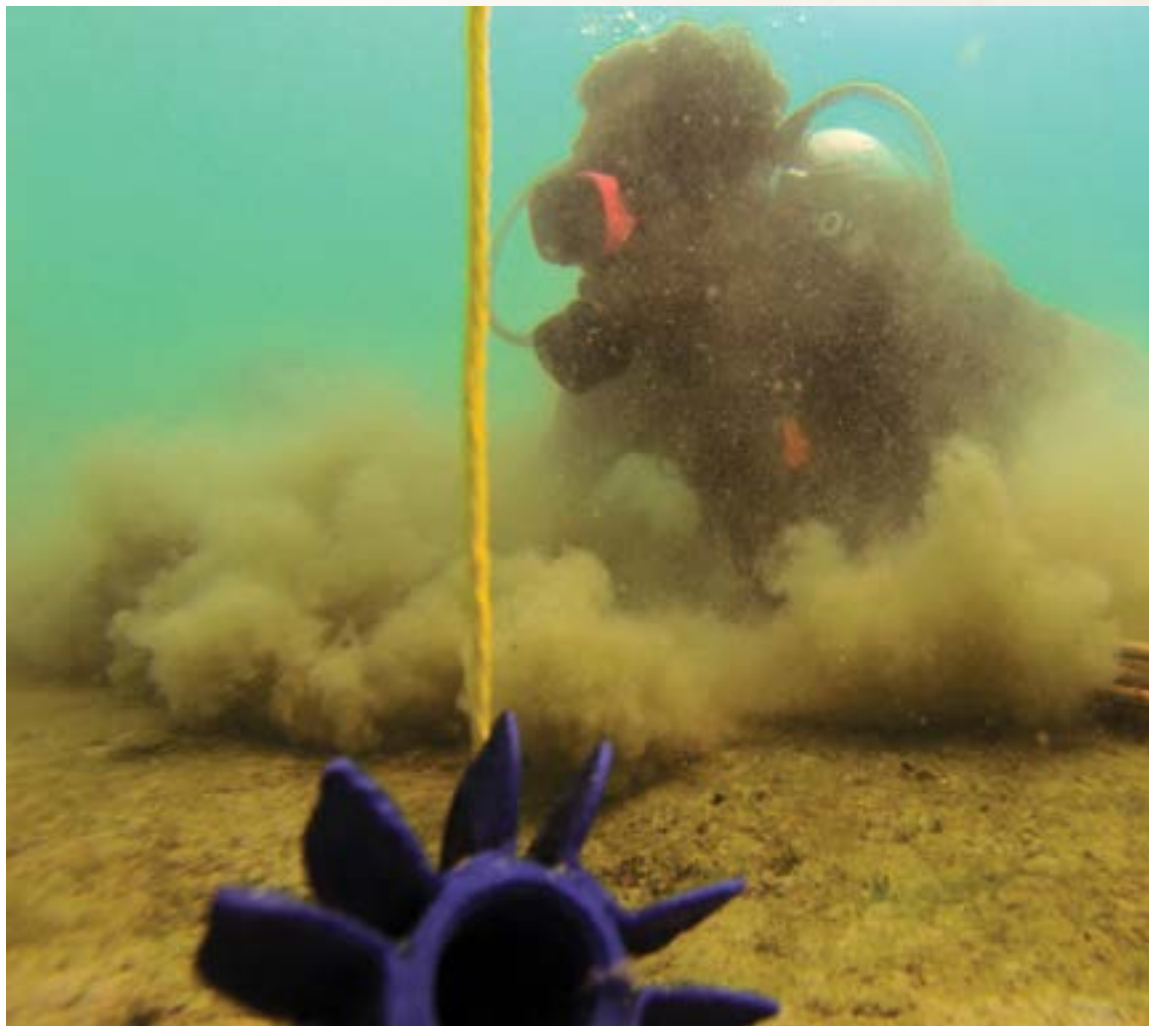
masses of floating vegetation and a high density of fishing nets), towing a conventional subsurface magnetometer is impractical. Golden West accomplishes underwater demining with a custom-designed sensor, based on the Ebinger UPEX 740 and mounted on a towed surface platform. With an array measuring 5 m by 5 m (5.47 yd by 5.47 yd), this pulse-induction detector can see large metal targets as deep as 30 m (33 yd).

The final component to this system involves verification, or reconnaissance divers. When a target with a significant metal signature is identified, divers are the only way to determine if that signature is attributable to ordnance. Other possible causes include engines or metal objects such as hulls or wheeled vehicles. If the diver investigation is inconclusive, the site is marked for possible salvage.

Building Cambodian Salvage Capacity

The unavailability of Cambodian assets capable of safely recovering underwater stockpiles prevents progress on this issue. Without the means to recover stockpiles, a systematic survey of the river bottom would be irrelevant. Working with CMAC, the U.S. Department of Defense (DOD) Humanitarian Mine Action (HMA) Program and the Office of Weapons Removal and Abatement in the U.S. Department of State's Bureau of Political-Military Affairs (PM/WRA), Golden West developed a strategy to build a national salvage dive capability.

Golden West's first challenge was the lack of suitable Cambodian candidates to undergo dive training. Among host-nation nationals, insufficient swimming abilities and minimal-to-nonexistent formal education in math and science presented unique challenges. With this in



A student wearing a blackout mask searches the bottom of the ocean by touch. A training 60 mm mortar is in his search path.

Photo courtesy of the author.



Wearing blackout masks that completely obstruct their vision, students perform a circle-line search, simulating the type of work they will do in Mekong, Cambodia.

Photo courtesy of the author.

mind, Golden West developed the Diver Preparation Course, an intense physical and academic regiment intended to identify and train suitable candidates for advanced dive training. PM/WRA funded the course; it began 28 January 2013 in Phnom Penh.

Separated into two phases, Phase I of the Diver Preparation Course started with the basics of how to swim. Over a two-week period, candidates spent more than 30 hours in the pool learning basic strokes, snorkeling and other exercises designed to teach operational safety in an underwater environment. When not in the pool, students learned scuba vocabulary, physics, history, hand signals and underwater rigging. Forty applicants were accepted for Phase I; by test day, 34 candidates remained.⁴

From those 34 candidates, 20 students were selected during a formal selection process by a board comprised of all the instructors for Phase II based on their competence in and out of the water. Since all the students were already employees of CMAC and came from other jobs

(mostly as deminers), those not selected to continue returned to their previous jobs.

Held in the seaside town of Sihanoukville, Phase II also lasted two weeks. Grueling 14-hour days were split between the classroom, the pool and the ocean. Students were instructed how to use scuba equipment in the pool and learned scuba theory in the classroom.⁵ Four hours of daily, strenuous, ocean-based confidence training tested the students' physical conditioning and mental discipline. This training introduced them to the rough conditions that professional divers experience, instilling the mental strength needed to deal safely with exhausting conditions. Their performance was remarkable, given this was the first time many individuals had ever seen the ocean.

The second week of Phase II consisted of 18 working dives over six days at sea. During these dives, the students learned how to run a working dive station, conduct underwater searches and perform basic recovery procedures under blackout conditions. The main aim of Phase

It was to graduate divers capable of continuing to more advanced training. From the group of 13 students to complete this course, 10 graduated with the CMAC Second Class Diver rating and will form the first CMAC Salvage Dive Unit when funding becomes available.

Graduates from the Diver Preparation Course are not salvage divers. The next steps for the newly formed CMAC Salvage Dive Unit will be to continue building their capacity over the next one to two years. This will be accomplished through daily intra-unit trainings that maintain skills and periodic, short-duration training sessions from outside experts to build new skills. This new skills training regimen will be supported by the U.S. DOD HMA program, and the first Light Salvage Course is scheduled for June 2013. The U.S. Army's 7th Engineer Dive Detachment from Hawaii will conduct this course.

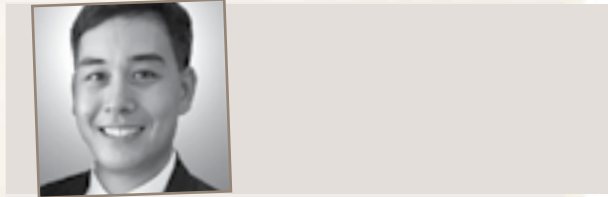
The Future of Salvage Diving

Golden West currently seeks adequate funding to sustain the CMAC Salvage Dive Unit through its infancy and begin the systematic survey of the river system. The goal is to provide the CMAC Salvage Dive Unit with the tools to sustain readiness and perform operations without outside guidance. This process will take two to three years, including developing standard operating procedures for equipment maintenance, mission planning, recruitment and training.

The Cambodian Diver Preparation Course was initiated as a pilot program designed to test the validity of this training model. In order to refine the model for future iterations, considerable effort was made to record lessons learned. Operating as a mobile training program, this course could be applied in countries considering the development of a national dive capability. Golden West plans to extend this course to other countries looking to build their own dive program.

Golden West is the first nonprofit nongovernmental organization to partner with a national mine action agency and U.S. governmental agencies to address this new area of humanitarian mine action in Cambodia. One of Golden West's key guiding principles is unity of effort, and this project fully supports the whole-of-government approach, bringing together PM/WRA, the U.S. DOD HMA Program, the U.S. Army, CMAC and the Cambodian Mine Action Authority. Golden West is pleased to have the opportunity to conduct this project and looks forward to making the region safer for the Cambodian people. ©

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Allen Tan is the general manager of Golden West Humanitarian Foundation in Southeast Asia and is based out of its regional office in Phnom Penh, Cambodia. Tan was the course director and manager for the Diver Preparation Course. He is a former U.S. Army explosive ordnance disposal team leader and has served in Iraq and Afghanistan. He holds a Bachelor's of Science in business administration and is a Master of Science candidate in organizational continuity and risk management at Boston University (U.S.). Tan was awarded the Royal Order of Sahametrei by the Kingdom of Cambodia in recognition of his efforts.

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1. Isaacs, A.R. *Without Honor: Defeat in Vietnam and Cambodia*. John Hopkins University Press, 1984.
2. Batchelder, C.S. and M.D. Quinlan. "Operation Eagle Pull." *The Marine Corps Gazette*, May 1976. <http://tinyurl.com/bqkpsjm>. Accessed 1 April 2013.
3. Clymer, Kenton. *United States and Cambodia, 1969–2000*. Taylor & Francis 2004, 66.
4. Participants who did not continue either self-selected to return to their jobs or were asked to leave because they were slow to acquire the skills.
5. Scuba theory is the knowledge base of physics and physiology necessary for successful underwater diving.