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NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER
Washington, D.C. 20007

DOGS FOR SWIMMER DEFENSE (u)

by

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RESEARCH AND DEVELOPMENT REPORT

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The Naval Ship Research and Development Center is a U.S. Navy center for laboratory effort directed at achieving improved sea and air vehicles. It was formed in March 1967 by merging the David Taylor Model Basin at Carderock, Maryland, and the Marine Engineering Laboratory (MEL) at Annapolis, Maryland. In November 1967 the Mine Defense Laboratory (MDL), Panama City, Florida, became a part of the Center. In November 1968 MEL was redesignated as the Naval Ship Research and Development Laboratory, Annapolis, Maryland 21402 and MDL was redesignated as the Naval Ship Research and Development Laboratory, Panama City, Florida 32401.

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ABSTRACT

(U) The use of dogs to aid in defense of fixed and floating assets against swimmer attacks has been investigated and proven effective through a field evaluation in southeast Asia. A defensive team was trained and tested at Panama City and Key West, Florida, before assuming an operational role protecting various types of targets including a pontoon bridge, an Advanced Tactical Support Base, ammunition ships alongside a pier, and a floating base anchored in the center of a river.

(U) The tests indicated that a dog works best in the swimmer defense role from a small mobile patrol boat. This allows the team to detect, localize, identify and defeat an enemy swimmer without other defensive systems (support).

(U) This report covers the tests and pertinent aspects of this unique swimmer defensive technique including operating instructions, training, and support requirements developed to date.

ADMINISTRATIVE INFORMATION

(U) The Project WATERDOG proposal was submitted by NSRDL/PC in Confidential letter serial 0781 of 20 September 1968 to the Vietnam Laboratory Assistance Program (VLAP) Coordinator. Chief, Navy Research and Development Unit - Vietnam, concurred with the proposal and established NRDU-V Project 104-68. NSRDL/PC was assigned as lead Laboratory and effort was performed under Naval Ordnance Laboratory Project Orders 9-0110 and 1-0027. Other organizations providing support included the U.S. Air Force, TEVDET, Key West, and NAVFORV.

(U) Success of this project resulted from joint cooperation of both USN and USAF personnel. Air Training Command, 3275th Tech School, and Military Working Dog School provided the dogs and handler-instructors. Their experience and capability in understanding, controlling, and training dogs were invaluable.

(C) COMNAVFORV in Confidential message 100955Z November 1970 to Commander, Naval Support Facility, Cam Ranh Bay, recommended that the operational deployment be discontinued, and concluded that "Project WATERDOG has proven during SEA evaluation and subsequent deployment to be an effective swimmer defense system."

(U) Further tests and development in areas that were not covered in the VLAP program will be performed under S2705X, Defense Against Swimmer Attack.

APPROVED AND RELEASED 17 MAY 1971

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From: Commanding Officer
To: Distribution List

Subj: NAVSHIPRANDLAB, Panama City, Confidential Report C3469 of September 1971; information concerning

1. (U) The feasibility of using specially trained dogs to detect surface and subsurface swimmers was investigated, tested, and evaluated under the Vietnam Laboratory Assistance Program (VLAP). This unique approach is another addition to the techniques needed for IUW forces concerned with swimmer defense.

2. (C) Results indicate that, for a majority of the situations, the antiswimmer dog performs best when used in a mobile small boat patrol. This enables the man-dog team to use prevailing winds and water currents to a distinct advantage in making detections by scent, sight, and hearing. A capability also exists for immediate location, identification, and, if needed, destruction of the enemy swimmer. Further development of the concept is underway under S2705X, Defense Against Swimmer Attack.

3. (U) This report presents the detailed information developed during project effort and is forwarded for distribution to interested activities.

L. O. G. WHALEY

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INTRODUCTION

(C) The continuing threat of enemy swimmers to both military and commercial assets on or near the waterways of Southeast Asian countries has prompted investigation and research to provide effective ways of countering this threat. Any technique or system must be simple and inexpensive enough for ultimate use by relatively untrained personnel in their homeland where neither support (particularly electronic) nor extensive funds are available. These were the goals when the use of dogs to detect swimmers was proposed, developed, and evaluated.

(C) Swimmer defense techniques in common usage including random scare charges, sentries, and physical barriers (underwater concertina wire, fences, etc.) have demonstrated limited capability for detecting and/or deterring enemy swimmer attacks. The attacker has a distinct advantage in being able to select the time, place, and type of attack and would normally use the natural cover of darkness and his knowledge of the defenses to increase his chances of success. Additional defensive methods are being sought to provide reliable swimmer detection and deterrence under a variety of environmental and operational conditions. Project WATERDOG was initiated to investigate one particular approach to this increasingly important problem area.

(U) The use of dogs to detect intruders is not new, German Shepherd dogs were bred in Europe especially for this purpose. Their acute sense of smell, high intelligence, durability, and trainability are suited well for detecting swimmers freely exhausting their exhaled breath. The dog sensor coupled with a small outboard-powered patrol craft is expected to provide a versatile system which is easy to transport and maintain.

SUBJECT

(U) A unique swimmer defense system using a specially trained military working dog as the detector was developed and evaluated. The dog and his handler are placed aboard a 16-foot "skimmer" patrol craft with its operator (Figure 1) and used in defense of a specific asset.

(U) This report documents the results of Project WATERDOG from feasibility tests through in-country evaluation of the system. Test results and pertinent aspects of training and use of the dogs are included.

(Text Continued on Page 3)


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TEST PROGRAM AND RESULTS

(U) The project was divided into three phases, each having specific purposes. As each phase developed, it was expanded to meet the needs of the following phase and attain the overall objective. The first phase was a determination of feasibility made through tests at Panama City and Apalachicola, Florida; the second phase tests were conducted at Key West, Florida to determine the effects of disturbances and distractions, and prepare the team members for the third phase, an operational evaluation in RVN.

FEASIBILITY TESTS

(C) USAF and Army experience had indicated that a dog on land could detect a submerged man breathing through a reed at ranges up to 40 yards. A feasibility determination was needed to define the best way to use a dog to detect swimmers, and the ranges of detection to be expected under various combinations of weather and surroundings that might be encountered.

(U) With the cooperation of the USAF Patrol Dog School, Lackland AFB, Texas and Air Training Command, Randolph AFB, Texas, the services of four patrol dogs and four USAF instructors-dog handlers were acquired and the first phase began on 8 September 1969.

(U) It was first necessary to reorient the dogs to work in, on, or near the water because their previous training had been for land patrols and sentry stations. Next, a series of detection situations were set up using a dog-handler team for defense against an attacking swimmer to determine the effectiveness of the team in detecting the swimmer. Finally, a series of field tests were conducted to determine detection ranges in the bay environment.

(C) The four dogs adapted readily to the water environment and particularly liked to ride in a 16-foot Boston Whaler (commonly called the skimmer). Results of the detection situations indicated that scent gave the longest reliable detection ranges. Therefore, to take full advantage of this capability a mobile patrol should be used to keep the dog downwind of the area or assets to be protected. The Boston Whaler provided a low bowed, relatively stable, and highly maneuverable platform for the dog. The patrolling patterns used on land patrols were then applied to the swimmer detection problem.

(C) In the open water of St. Andrew Bay, Florida, the scent of a swimmer's exhaled breath was detected up to 1000 yards downwind by the

dogs. During a four-day series of tests, the daily averages were 460, 760, 600, and 690 yards. Detection distances varied from 850 yards to 400 yards during these tests.

(C) For situations where the dog had to remain upwind of the attac ing swimmer and rely on his weaker senses of sight and hearing, the detection ranges fell below 50 yards and the probability of detecting a submerged scuba swimmer became nearly zero. A dog is nearly color-blind and cannot completely focus his eyes; hence, he is dependent upo movement for sight detection. Sound travels poorly against the wind; so when the dog is downwind scent and hearing combine to increase both the probability and the range of detection.

(C) Limited observations of the dogs' reactions to disturbances such as nearby explosions, small buoys, floating debris, gunfire, and engine noise on the patrol boat indicated an initial interest in the distraction, but with recurrence the dogs accepted it without unnecessary alerting or barking.

(U) A series of nighttime tests was performed on the Apalachicola River because of its resemblance to the Saigon River (Reference 1). Effects of the noises, smells, winds, currents, and other distractions prevalent in the area were noted while detection ranges of attacking swimmers were estimated as accurately as possible. Targets for the si lated attacks were the railroad bridge and an anchored 52-foot Navy utility boat. The utility boat and the 16-foot Boston Whalers were us to carry the dogs on patrol.

(C) After moving from the open atmosphere of a bay to the rather confining topography and vegetation of the Apalachicola River, the dogs were distracted and alerted on wild animals on the banks and floating debris in the river several times before they learned to rely on scent as the primary mode of detection. Noises and smells aboard the boat to be protected or the patrol craft itself appeared to affect the dogs very little. Every effort should be made to maintain the dog natural curiosity so they remain aware of and interested in unusual sights, sounds, and scents that could be originated by an enemy attack

(C) Sight alerts upon persons in or near the water averaged 47 yards while alerts by scent averaged 440 yards. This emphasized the need to take advantage of scent and wind whenever possible.

(C) During the operational test of protecting the railroad bridge a swimmer was successful in reaching the bridge because the Waterdog team on patrol was not aware of the actual water current direction. T team did not select the proper patrol area which allowed the swimmer t make a successful attack. The Waterdog team must be constantly aware

)f water current direction, water current speed, wind direction, and ;ind speed to effectively patrol their area. Any changes in these)arameters should be compensated for or taken advantage of.

(C) The utility craft was tried as a working platform for the teams in anchored, powered, and drifting modes with limited success. The dogs could only detect an attacking swimmer at ranges that allow time for countermeasures when wind and current directions were coincident and the swimmer approached directly upwind of the craft. Waterdog patrols using a small, fast, and maneuverable boat are more effective than patrols using larger craft in most circumstances. Additional information concerning these tests and results is contained in Appendix A.

KEY WEST TESTS

(U) Before the dogs and men could be sent to Vietnam for operational evaluation in a combat environment, further tests and refinement of operating techniques and patrols were necessary. The dogs needed to be exposed to adverse conditions where they could learn to detect swimmers amid distractions. A measure of their effectiveness under these conditions was also desired. Key West, Florida, was selected as the test site because the area afforded a warm climate similar to that of southeast Asia in February. This also helped the dogs in adapting to a warm climate.

(U) All of the tests used an anchored inhabited craft as the asset to be protected from attack by swimmers. The effects of interfering scents, such as those from the protected asset and the surroundings, upon the ability of the dog to resolve a swimmer scent from the extraneous smells were noted. The effects of wind velocity upon detection ranges were also determined during the test period.

(C) Computer analysis of the data indicated that day and night, swimmer type, approach angle, air temperature, and separation between swimmer and protected asset were statistically insignificant. Significant factors affecting the performance of the dogs were disturbances, differences between the dogs themselves, and wind speed. The average detection range for nondisturbance conditions was 143 yards. When a disturbance was introduced, the detection ranges averaged 106 yards, a decrease of about 25 percent; average detection ranges of the dogs ranged from 166 yards to 125 yards for no disturbance levels, and 122 yards to 92 yards for high disturbance levels. The least scent sensitive dog of the four tested was about 25 percent less sensitive than the best dog. Most of the range figures were restricted in magnitude by the physical limitations of the test area. All runs began at a maximum range of 200 yards downwind.

(C) Test results supported the intuitive hypothesis correlating wind speed with detection ranges. A wind speed of 11 knots was found to provide maximum detection range while higher and lower wind speeds decreased the range. At speeds greater than 11 knots, the scent cone becomes narrower and more concentrated making it easier to pass throu without a detection. (The scent cone can be defined as the general shape of the concentrated scent area as it is carried away from the source by the wind). At lower speeds, the scent cone becomes broad a: diffused making the scent concentration weaker and more difficult to detect. Therefore, worst case conditions are those having very light winds or high winds. High winds can also cause unsafe sea states tha: affect the safety of the patrol craft.

(C) An observation of the dog's retention of their specialized training was made when the tests began at Key West. Prior to this, t dogs had not been near the water or exposed to swimmers since the conclusion of the tests at Apalachicola; a time lapse of 2-1/2 months. dogs reacted immediately to seeing a swimmer with barking, jumping, and straining at their leashes as if there had been no period of inactivity. Virtually no retraining was necessary before tests could beg: Additional information is contained in Appendix B.

VIETNAM OPERATIONAL EVALUATION

(C) The Waterdog team consisting of four dogs, their four instructor-handlers, one diver-boat operator, evaluation coordinator, and equipment arrived in-country on 19 March 1970. Refresher training exercises and shakedown tests were performed during the period require for acclimatization of the dogs. Initial daytime tests made on the Saigon River using U.S. scuba-equipped swimmers produced detection ranges of 150 to 200 yards under very light wind conditions. Nighttim tests in the vicinity of the POL Tank Farms with Vietnamese surface swimmers indicated strong scent alerts and demonstrated a strong swimming capability of the Vietnamese. Opposing wind and water current co ditions created surface waves on the wide river that made operations c the 16-foot skimmer boat difficult.

(U) A standard 30 ft by 90 ft ammibarge was fitted with two 16 ft by 32 ft frame buildings (Figure 2) to provide a mobile Waterdog support platform for men, animals, and operations. The kennel was enclos with screen wire and had a concrete slab floor. The second building w the living quarters for the team members.

(C) Protecting a pontoon bridge across the Van Co Dong River at G Dau Ha was the team's first assignment (Figure 3). It was a strategic military target which, if destroyed, would have adversely affected the Cambodian offensive in April 1970. A dusk to dawn patrol was maintain

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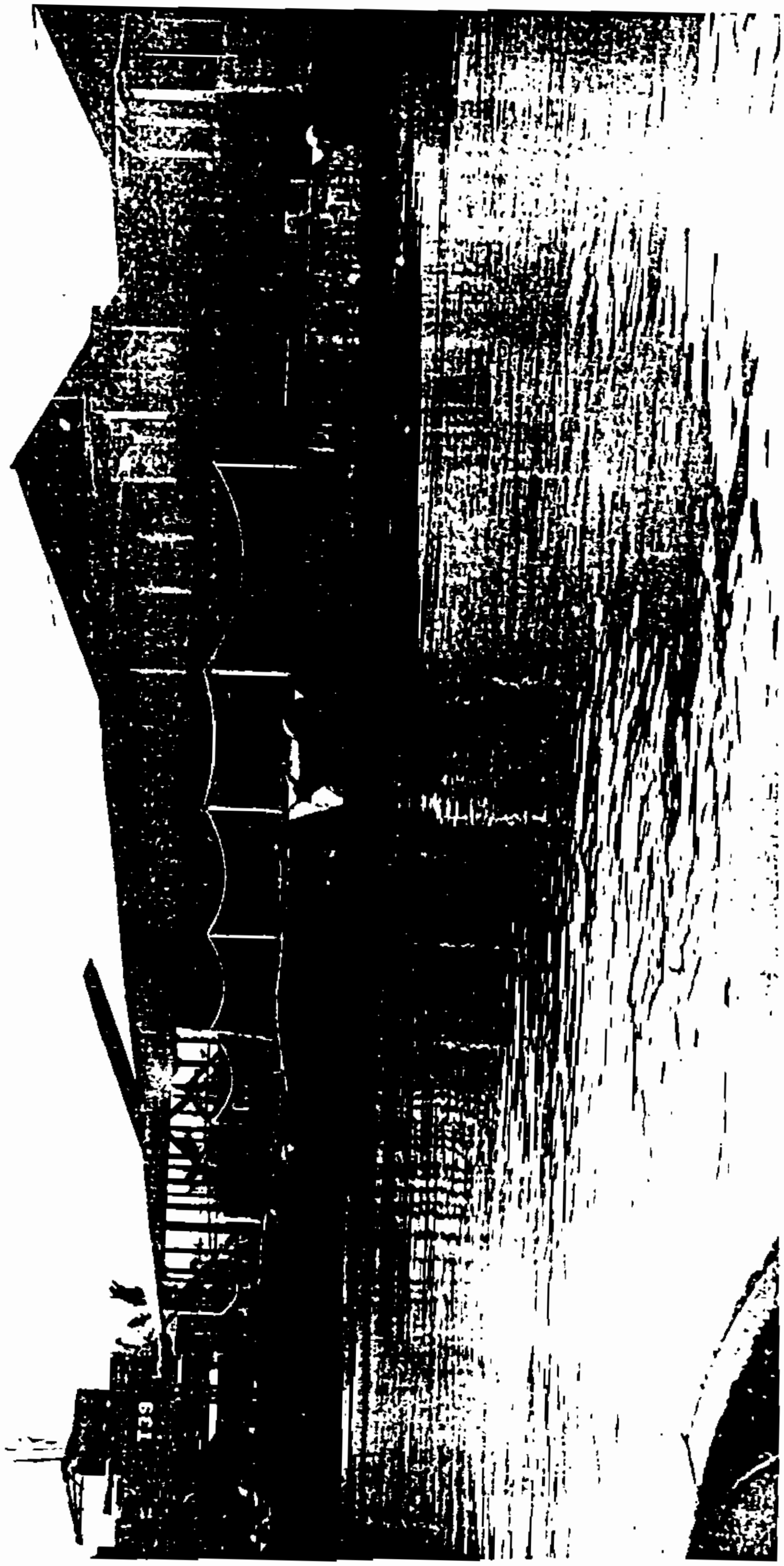
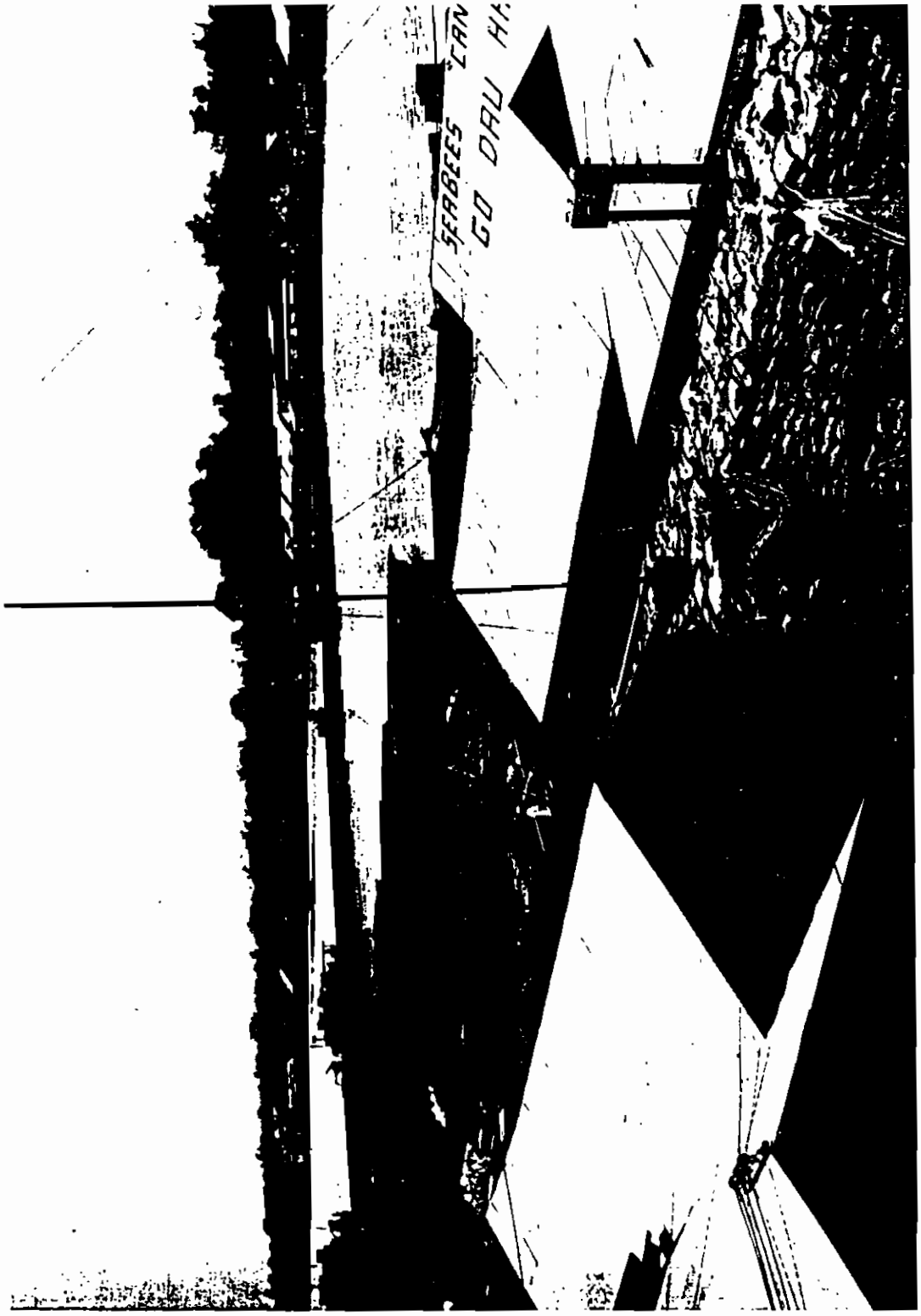


(U) FIGURE 2. WATERDOG KENNEL-BERTHING AMMI BARGE



(U) FIGURE 3. PONTOON BRIDGE AT GO DAU HA

for four nights working each dog an average of 2-1/2 to 3 hours. During these patrols, four Vietnamese were detected, located, and identified as friendly in or near the water. These individuals were detected at ranges from 50 to 150 yards.

(C) Operationally, it was not possible to insert friendly swimmers into a hostile environment for controlled tests. Swimmers were not available and their safety could not have been assured. As it was, the Waterdog antiswimmer patrols were discontinued at Go Dau Ha when the risk of injury from friendly small-arms fire became significant.

(C) Following a move to Advanced Tactical Support Base (ATSB) Ben Keo, nightly patrols were resumed protecting the ATSB (Figure 4) itself. Six consecutive nights were worked before taking a night off for rest of the dogs and men. Maintaining an all-night patrol with teams of three men and a dog aboard the craft for 10 to 12 consecutive hours was a problem when only five men and four dogs were available. This situation was alleviated by the arrival of Navy replacement dog handlers; the work load per man was reduced and the transition to new handlers was easier. The overlap provided more time for the dogs to adapt to their new handlers. The USAF dog handlers were on loan to the Navy and returned to CONUS.

(C) While patrolling in the vicinity of the ATSB Ben Keo, scent alerts from individuals on land and in the water were made. Experienced dog handlers could usually differentiate between the two. Several sight alerts pinpointed unauthorized movement by natives within the village surrounding the ATSB. A Vietnamese nighttime bather was found. Scent from unidentified sources in the fields across the river from the ATSB prompted several alerts when it was suspected that Viet Cong on reconnaissance missions were present. Harassment and interdiction gunfire was usually used to follow up an alert of this nature to discourage possible further activity or an attack.

(U) In addition to their swimmer defense duties, the Waterdog patrol team also guarded the assets against floating mines. Several unoccupied sampans, unusual floating boxes, and suspicious clumps of water hyacinth were intercepted, investigated, and fired upon, if necessary. Further information is contained in Appendix C.

WORLD PORT SURVEY

(U) Data accumulated and compiled under the Port Categorization Study of Project S2705X, Defense Against Swimmer Attack (U) were analyzed to determine the average mean wind velocities for the 42 types of ports (Reference 2). The information, presented in Table 1, is useful in determining possible areas of use for Waterdogs.

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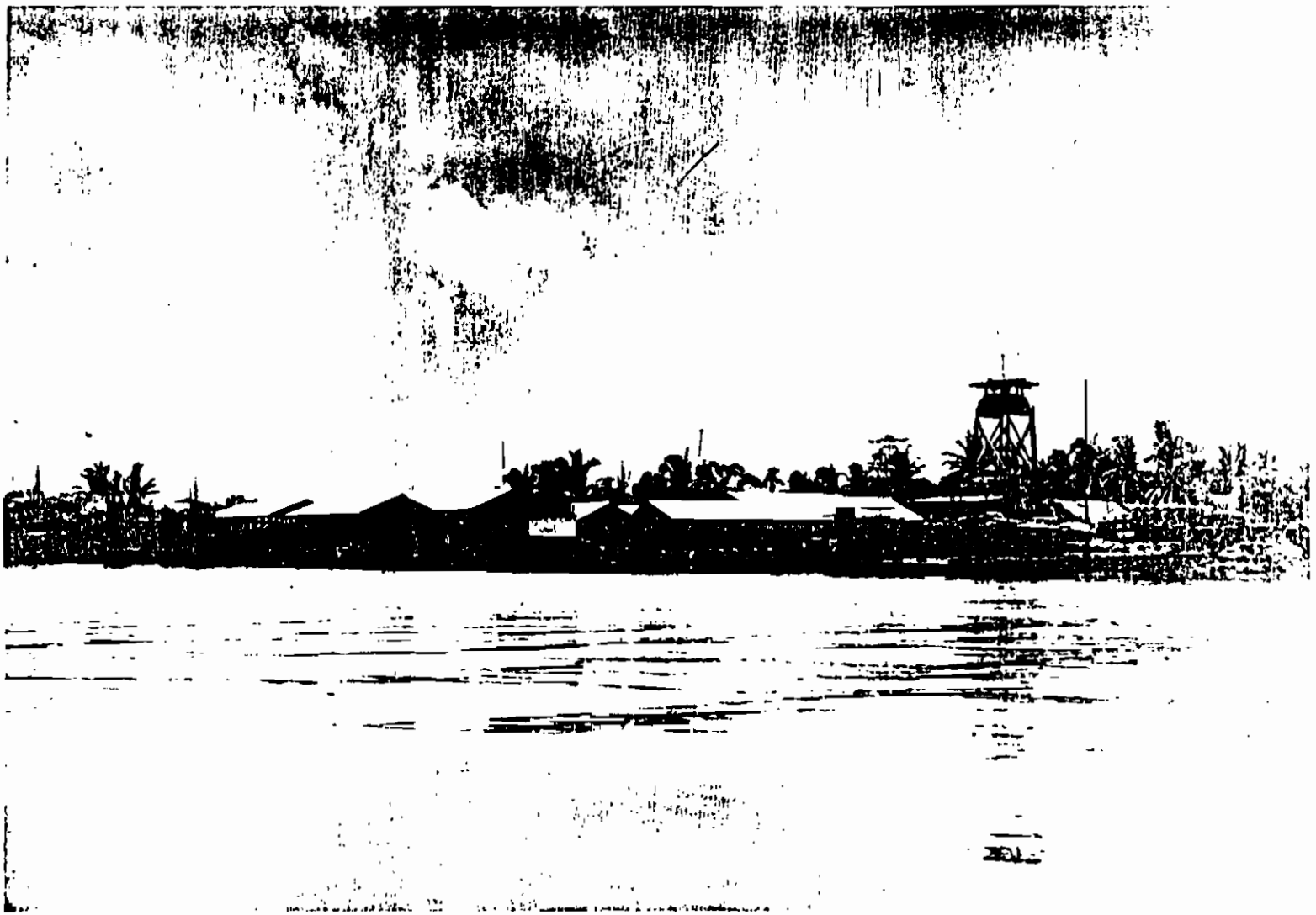

(U) FIGURE 4. ATSB BEN KEO

(U) TABLE 1

AVERAGE MEAN WIND SPEEDS FOR 4124 WORLD PORTS GROUPED BY PORT CHARACTERISTICS AND CLIMATIC CONDITIONS

(U) FIGURE 4. ATSB BEN KEO

(U) TABLE 1

AVERAGE MEAN WIND SPEEDS FOR 4124 WORLD PORTS GROUPED BY PORT CHARACTERISTICS AND CLIMATIC CONDITIONS

Port Characteristics		Average Wind Speeds for January/July (kt) Port Climatic Conditions						
Type	Depth	Tropical Rain Forest	Steppe	Desert	Mild Subtropical	Temperate Coniferous Forest	Continental Forest	Tundra-Glacial
River	<40 ft	9.1 / 8.4	10.6 / 9.4	10.6 / 11.7	13.8 / 10.4	0 / 0	12.2 / 9.1	0 / 0
	>40 ft	9.0 / 11.9	12.2 / 15.2	21.5 / 26.0	12.5 / 10.4	0 / 0	12.4 / 9.4	10.0 / 10.0
Bay	<40 ft	9.4 / 8.8	10.4 / 12.8	12.4 / 9.8	14.0 / 9.1	0 / 0	13.5 / 8.8	12.1 / 12.9
	>40 ft	9.4 / 8.8	10.2 / 14.9	9.1 / 9.2	13.6 / 8.6	0 / 0	13.9 / 10.0	10.0 / 9.0
Offshore	<40 ft	8.7 / 8.8	10.8 / 11.0	8.6 / 8.1	14.6 / 10.1	0 / 0	12.8 / 8.2	0 / 0
	>40 ft	9.4 / 8.6	10.3 / 9.1	8.5 / 7.2	12.8 / 10.7	0 / 0	12.0 / 11.9	11.0 / 10.0

(U) Of all the world ports, 85 percent may be classed as river and bay ports. Surface water conditions in these ports are the most favorable for small patrol craft operations.

(C) Essentially all of the ports (99 percent) included in the survey have average mean wind velocities of less than 15 knots all year long; 44 percent have average mean wind velocities of less than or equa to 12.5 knots year around. Because maximum detection ranges are obtain when wind speeds are about 11 knots, it appears that Waterdogs could be used to an advantage at 50 percent or more of all world ports where a swimmer threat could exist.

CONCLUSIONS

(C) All of the tests performed to date have demonstrated and proven the ability of the specially trained Waterdog to detect swimmers by scent, sight and sound. Persons near the water's edge can also be detected by the same senses. Because the scent from a person in the water tends to remain low and more concentrated near the water-air interface, the Waterdog can discriminate between sources on land and in the water.

(C) Use of the Waterdogs in a small, highly mobile patrol boat (skimmer) to secure an area or specific asset has been proven advantageous. The boat becomes the dog's "feet" on water, an area of otherwise restricted movement for standard sentry and patrol dogs. The skimmer is a stable, maneuverable, and low-profile boat ideally suited for Waterdog patrols. It provides the mobility needed to (1) keep the dog downwind from the swimmer threat area, (2) permit coverage of a large area, and (3) immediately localize, identify, and counter the enemy swimmer.

(C) Protection of a floating or fixed asset cannot be assured when using the Waterdog as a sentry aid from the asset itself because the scent of the swimmer hangs close to the surface of the water; therefore, the Waterdog must patrol no more than a few feet above the water surface.

(C) For an efficient patrol using a Waterdog team, all factors affecting the swimmer, dog, patrol boat, and the asset to be protected must be considered. These factors are outlined in the Waterdog Operating Instructions (Appendix D). The most significant factors are: water current speed and direction, wind speed and direction, asset location relative to swimmer water entry points, clearance and water depth around

the asset permitting patrol boat movement, and existing defenses that could assist or hinder the Waterdog patrol teams.

(C) In addition to their swimmer detection duties, a Waterdog patrol team can protect against floating mines if the amount of float debris to be investigated does not inhibit the team in swimmer defens Because swimmers sometimes use a clump of debris for camouflage of th snorkel or charge, these two functions are related.

(C) The number of Waterdogs needed is dependent upon the nature size of the asset to be protected, its location, characteristics of t environment, and the total time a dog can patrol each day. A Waterdo can patrol effectively for 2-1/2 to 3 hours before he must be removed for exercise, and relief of his bladder and bowel. Because sentry an patrol dogs are used on land posts for periods up to 7 hours, it woul appear possible to use a Waterdog on a second 3-hour patrol after exe cise and an hour's rest. This has not yet been proven, but if it is feasible it would reduce the number of dogs and handlers needed by on third.

(C) Waterdogs can operate from skimmers whenever water surface c ditions allow safe operations. The dogs can maintain an effective patrol through steady light rain and heavier showers of short duratio

(U) Because a dog learns from experience and his handler, he can operate in the presence of scent, sight, and noise distractions. He learns which are significant and ignores the rest as much as possible. The dog and his handler work together closely and must understand each other much as two persons would in the same situation.

(C) Detection ranges may be as great as 850 yards under ideal con ditions. For more usual conditions, detection ranges are most often 150 to 250 yards when scent is used primarily. Swimmer detection by sight averages less than 50 yards. Because both scent and sound are carried by the wind, the Waterdogs should be patrolled downwind of the swimmer approach area.

(C) The use of dogs as sentries offers a significant psychologica benefit. Most people are aware of a dog's ability to detect animals including man by scent and unless they believe that they can enter the area guarded by the dog without detection, there is a natural reluctan to press an attack and risk an encounter with the dog.

(U) Waterdogs must have adequate exercise to maintain their physi cal condition at a high level. They do not receive this exercise riding in a small boat. Daily exercise over an established obstacle course of at least 1 hour's duration is desirable. A periodic rotatio

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o sentry or patrol duties on land for several weeks would also be eneficial to the dog's physical well being and could also prevent the og from losing interest in his work.

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APPENDIX A

WATERDOG FEASIBILITY TESTS

TEST PROGRAM

(C) While determining feasibility of using dogs to detect swimmers, other parameters affecting the utility and usefulness of the concept were defined and studied. These parameters were:

1. Establish alerting range for underwater and surface swimmers. Determine strongest alerting stimuli (bubbles, splash, wake, scent).

2. Determine optimum patrol platform and relative effectiveness of other platforms; i.e., rafts, barges, boats, piers.

3. Determine reactions of dogs to unfamiliar personnel on same boat, sounds of the boat engine, nearby explosions and gunfire, etc.

4. Determine effects of various disturbance factors that might be encountered in an operational situation. False alarm rate is one measure. (A false alarm is defined as an alert in which the handler reads his dog as alerting on a bona fide contact and finds something other than a swimmer.)

(C) The feasibility tests and demonstration consisted of four phases: first, the dogs had to be adapted to the water environment so they would work comfortably and effectively from boats, piers, etc.; next, they had to be trained to seek out and detect persons in or very near the water; third, working modes had to be determined; and last, expected detection ranges under near ideal conditions were determined.

ADAPTATION TO THE WATER ENVIRONMENT

(C) In adapting the four land patrol dogs to work around water, their previous field-type training was continued until a good dog-handler relationship was firmly established. Human decoys were then planted in trees, behind bushes, and under natural cover for the dogs to locate. These decoys were gradually moved from land cover into the water. Patrol routes began on roads and moved progressively from land to the waterline and finally to a small boat. Detections using all three modes, sight, sound, and scent, were made while studying the dogs' effectiveness and reactions to working near, in, and on the water.

CONDITIONING TO DETECT SWIMMERS

(C) Continuous nighttime operations were begun using scouting exercises with the swimmer near the water's edge in shallow water alternating head profile and snorkel positions to determine if detection by the dog was primarily visual or scent. The dogs were patrolled on the beach to detect offshore swimmers at a medium distance (50 yards) downwind in the scent cone. When the dogs showed some promise at detection of surface swimmers and swimmers using snorkels, the tests were expanded to include distances of 100 yards for detection of surface swimmers and snorkelers both upwind and downwind. Tests were run from various stationary platforms; e.g., piers, beach, skiff, and pontoon float.

(C) Following work on stationary platforms the dogs were taken on patrols in a 16-foot Boston Whaler. Patrol patterns were run to detect surface and snorkel swimmers upwind and downwind using search patterns much like the quartering patterns used in field work. At this time the scuba swimmer was added as a new type of decoy. The boat/dog patrol then worked in relatively open water to determine the effectiveness of the patrol against all three type decoys and the approximate detection ranges to be expected on each type.

WORKING MODES

(C) After establishing that the dogs were effective in controlled tests against surface and subsurface swimmers, tests were begun using an unmanned target (skiff, float, pier, etc.), an attacking diver, and the defending boat/dog patrol in an effort to determine effective patrolling or working modes. The diver was instructed to approach the target using scuba, snorkel, or no aids in his attacks. The time and methods used by the swimmer were unknown by the dog handlers, but were coordinated by the task leader so that the data gained would reflect a fair sample of loincloth, scuba, or snorkel swimmers approaching from both upwind and downwind at an unknown time. During these tests the effects of explosives, other noises, objects floating in the water, and miscellaneous disturbance factors were noted. Any false alarms were noted and recorded. The tests were moved from St. Andrew Bay to the Apalachicola River to conduct tests for comparison of bay and riverine environments on the dogs' detection capabilities. Three test configurations were used: (1) the utility boat was anchored and dogs placed on the bow to detect swimmers approaching with the current; (2) the utility boat was allowed to drift downriver to allow the dogs to detect swimmers hidden on the river banks; and (3) the dogs were patrolled in the 16-foot Boston Whaler with a railroad bridge as the target and with divers approaching with the current.

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RESULTS

ADAPTATION TO WATER ENVIRONMENT

(C) The dogs adaptation to the water environment was accomplished with no problems. The dogs showed no behavioral differences when confronted with problems in the water environment. Decoys located by the dogs along the banks or in shallow water were viewed with even more suspicion and alertness than those located in the brush.

(C) The dogs appeared to be unaffected by water motion, speed, or sounds produced by the boat's motor, and appeared to undergo no changes in temperament except for an almost human tendency to be exhilirated by the boat traveling at speed. While moving at over 8 knots the dogs would face the wind and hold their muzzles high; at lower speeds, however, they were alert to any scents or other strange objects in the area. It was noted from the start that the dogs were locating the decoys primarily by scent, and they were only moderately effective in detecting slow movements, profiles, bubbles, or other anomalies in a background of ripples and waves. The water environment seemed to mask sounds made by a swimmer. In order for the dog to visually detect a swimmer, a relatively rapid movement was necessary. The detection mode involving scent was by far the most effective.

CONDITIONING TO DETECT SWIMMERS

(C) The dogs were able to detect snorkeling and surface swimmers by smell at 400 to 800 yards from the downwind position. However, swimmers of all types approaching from the leeward side were able to approach very close to the dogs without being detected. This was the case when the dogs were on stationary platforms on the water (skiff, raft, beach, pier) where they had to use sight and sound detection the greater part of the time because they were either out of the scent cone because of wind directions or above it. Overall, stationary platforms produced erratic results: long detection ranges by scent when the swimmer was in the scent cone but poor results when, through lack of mobility, the dog was limited to using his two weaker senses.

(C) The 16-foot Boston Whaler was found to be an ideal patrol craft, providing mobility, speed, and maneuverability. The dog, stationed in the bow on short leash to his handler, showed his "alert" (interest in a strange scent) by lowering his head, closing his mouth, lifting one paw, etc., and was "read" by his handler. The dog, on a long distance alert, leaned from one side of the bow to the other to get the strongest scent which allowed the boat operator to steer the boat

by watching the dog and home-in on the swimmer. The dogs were able to detect scuba swimmers (at a depth of 30 feet) and snorkel swimmers at ranges exceeding 800 yards. In some cases the detection range was much less due to wind shifts or dead calm. The optimum patrol speed for the patrolling Boston Whaler was found to be 2 to 4 knots.

WORKING MODES

(C) During the working mode tests using a target, the boat/dog patrol, and scuba, loincloth, and snorkel swimmers, it was found that the detection percentage and range was a function of relative position to the wind and not swimmer type. Thus, when the swimmer's scent was windblown to the dog a detection was almost assured. On upwind patrols, where the swimmer was always on the leeward side of the boat, the detection probability decreased and ranges fell to below 50 yards. In those tests where no restrictions in tactics were placed on either swimmers or the patrol, the probability of detection was nearly 100 percent in open water and somewhat less as the target was moved shoreward.

(C) During these tests, the dogs were exposed to underwater explosions of concussion grenades at distances of 10 yards or more, artillery simulators, and gunfire in the area. During a heavy concentration of such fire, the dog could be drawn off an alert, but as with other types of disturbances, the dogs adjusted to the fire in proportion to the amount of exposure they were subjected to. The noise did not incapacitate the dogs, but rather drew their attention as it would with a human. On some occasions the dogs were attracted to objects floating in the water, such as crab trap buoys, cans, and other debris. The dogs adjusted to the debris in the water the longer they were exposed to it, and came to depend primarily on their sense of smell to locate swimmers while on the boat patrol. To break the dogs of alerting on trash in the water, they were allowed to approach it and investigate closely. After finding the debris to be without live scent or movement of its own, the dogs paid less and less attention to it, and in several weeks their interest, if shown at all, was cursory. The tests demonstrated that the dogs would tolerate unfamiliar personnel on the patrol boat with no loss of effectiveness.

(C) Miscellaneous disturbances consisted of stray animals, changes in wind pattern caused by natural or man-made breakwinds, and movement, sounds, and scents coming from inhabitated areas. Due to the variety of these disturbances it was impossible to isolate each one and analyze it. However, it was noted that the dogs had a tendency to adjust quickly to the background environment. There was a relatively high percentage of spurious alerts which were recognized by the handlers, but very few false alarms (defined in item 4, page A-1). Most of the lost contact situations was caused by wind shifts or wind distortions caused by breakwinds.

(C) The results of nighttime river exercises and tests were very similar to those made during the day.

(C) The working mode exercises and tests also showed that the boat personnel and dog handlers must be as attentive as the dogs. In one case a bridge target was attacked successfully by swimmers because the men in the boat failed to notice that the direction of the river current had changed.

ALERTING RANGE TESTS

(C) The average maximum alerting ranges for the dogs were determined during the tests using surface and scuba swimmers. The tests were made to determine the maximum average alerting range and range differences between surface and scuba swimmers.

(C) The dogs were patrolled in the Boston Whaler starting about 1200 yards downwind of the swimmer and gradually moved closer to the swimmer until the dog alerted. This was considered to be the maximum range. The tests were conducted using four dogs on four days, working the dogs equally. Thus, the four dogs worked two patrols each day for four days against a surface swimmer and a scuba swimmer. This produced 32 detection ranges from which the average maximum detection range was determined to be 610 yards against the scuba swimmer and 645 yards for the surface swimmer (Tables A1 and A2). The maximum detection range against the scuba swimmer was 850 yards and 800 yards against the surface swimmer.

(C) TABLE A1

WATERDOG DETECTION RANGE DATA (U)

Day	Run No.	Dog	Swimmer	Wind Speed (knots)	Time	Detection Range
1	1	Topper	Snorkel	6	1300	500
	2	Bear	Snorkel	6	1400	450
	3	Pete	Snorkel	5	1430	500
	4	Jet	Snorkel	6	1530	400
	5	Topper	Scuba	6	1600	500
	6	Bear	Scuba	6	1620	400
	7	Pete	Scuba	6	1655	500
	8	Jet	Scuba	5	1730	450
2	1	Topper	Snorkel	5	0800	700
	2	Bear	Snorkel	5	0825	640
	3	Pete	Snorkel	5	0900	800
	4	Jet	Snorkel	5	0930	750
	5	Topper	Scuba	2	1000	850
	6	Bear	Scuba	2	1030	800
	7	Pete	Scuba	2	1100	800
	8	Jet	Scuba	3	1130	750
3	1	Topper	Snorkel	5	1330	700
	2	Bear	Snorkel	6	1400	650
	3	Pete	Snorkel	6	1430	700
	4	Jet	Snorkel	6	1500	600
	5	Topper	Scuba	5	1530	500
	6	Bear	Scuba	5	1600	550
	7	Pete	Scuba	5	1630	600
	8	Jet	Scuba	6	1700	500
4	1	Topper	Snorkel	6	1330	750
	2	Bear	Snorkel	4	1400	700
	3	Pete	Snorkel	5	1430	800
	5	Jet	Snorkel	4	1500	700
	5	Topper	Scuba	5	1530	800
	6	Bear	Scuba	5	1600	600
	7	Pete	Scuba	6	1630	600
	8	Jet	Scuba	6	1700	600

(C) TABLE A2

SUMMARY OF DETECTION RANGE DATA (U)

	Average Detection Ranges (Yards)	
Day	Scuba	Snorkel
1	460	460
2	800	720
3	540	660
4	650	740
Average	610	645

Minimum Detection Range - 400 Yards

Maximum Detection Range - 850 Yards

me	Detection Range
00	500
00	450
30	500
30	400
00	500
20	400
55	500
30	450
00	700
25	640
00	800
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APPENDIX B

CONUS EVALUATION AT KEY WEST

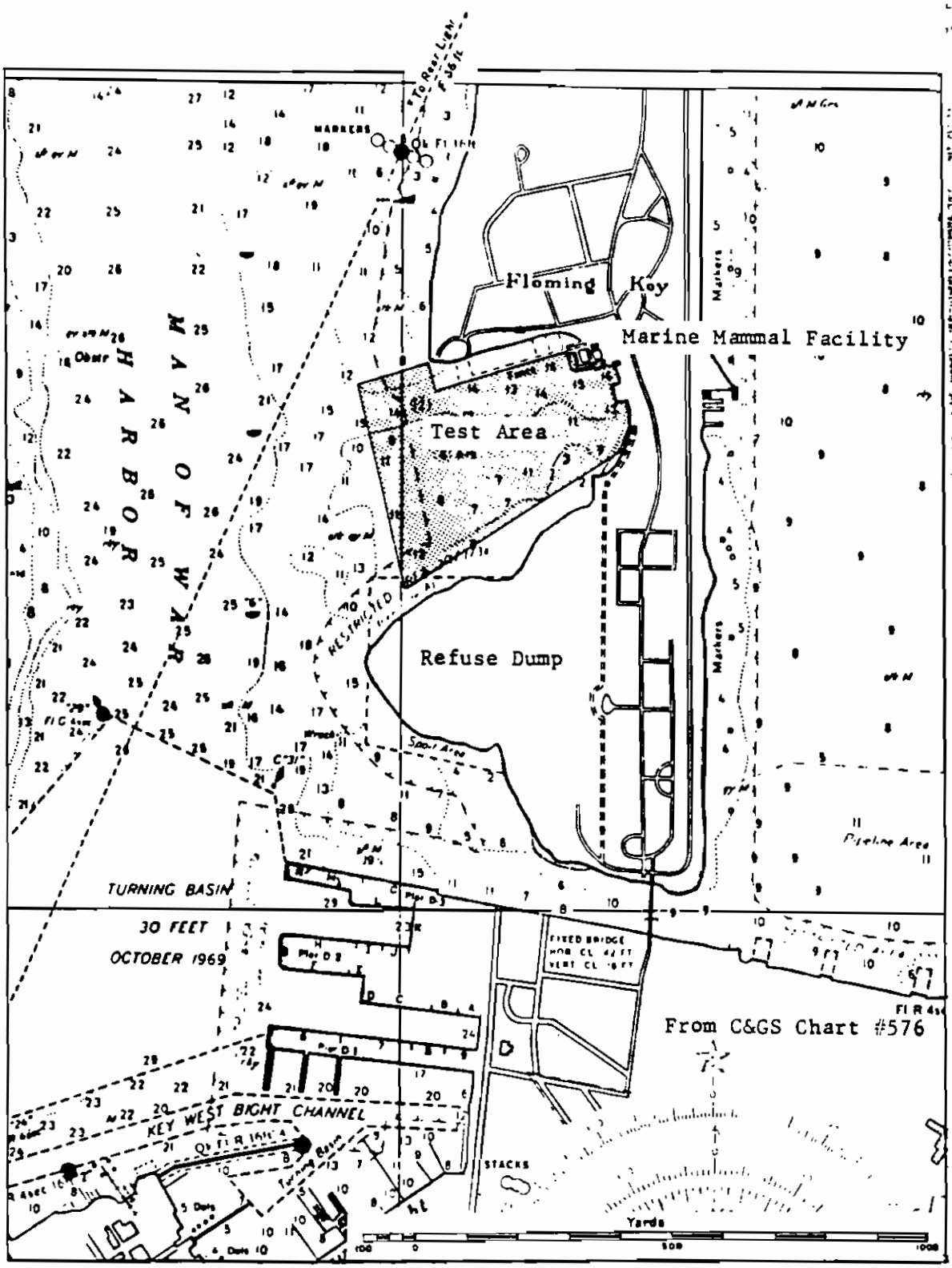
(U) Based upon the promising results of the preliminary feasibility tests (Appendix A), NRDU-V concurred with the recommendations for an in-country evaluation after completion of an additional series of tests in CONUS. The purpose of the CONUS tests was twofold: (1) prepare the dogs and team members for the in-country evaluation through refresher training and development of patrol techniques, and (2) determine the effects of distractions upon the dogs, especially those found around inhabited ships, shipping piers, and docks.

(C) Working with the Mathematical Analysis Division, a test plan was formulated to obtain a statistical measure of sight, sound, and scent distraction taken separately and collectively. A determination of maximum detection ranges was not repeated. Surface snorkel and open-circuit scuba swimmers were used for the runs.

(U) Key West, Florida, was chosen as the test site because the climate and water temperatures were mild in February. Water depths in the test area of 30 feet or less permitted the divers to remain submerged as long as needed or their air supply exhausted. With the cooperation of the U.S. Naval Station, the tests were conducted in restricted waters off Flemming Key. The nature of the system and the tests required that they be free of observation and interference by civilian boaters.

(U) Figure B1, a section of C&GS chart No. 576, shows the test area. A refuse dump to the south provided many distractions: truck and personnel traffic, fires, smoke, and the typical dump-type smells. An abundance of natural wildlife including pelicans, ducks, seagulls, and a porpoise, added many uncontrolled distraction factors. Crab and lobster pot buoys were also plentiful. The test area was not ideal because it was not large enough to permit equal maximum patrol ranges for all wind directions. Detection ranges were therefore shortened. Original plans called for use of an isolated offshore key but this was not feasible due to the distances and transit times involved. The then unused Marine Mammal Facility docks and buildings were almost ideally suited as a base of operations.

(U) Other support for the tests included a 65-foot utility craft for a target to be protected, divers, and compressed air provided by the Test and Evaluation Detachment, Key West, and divers from the Diving School for a night of tests using multiple attacking swimmers whose scents were strange to the dogs.



(U) FIGURE B1. KEY WEST TEST AREA

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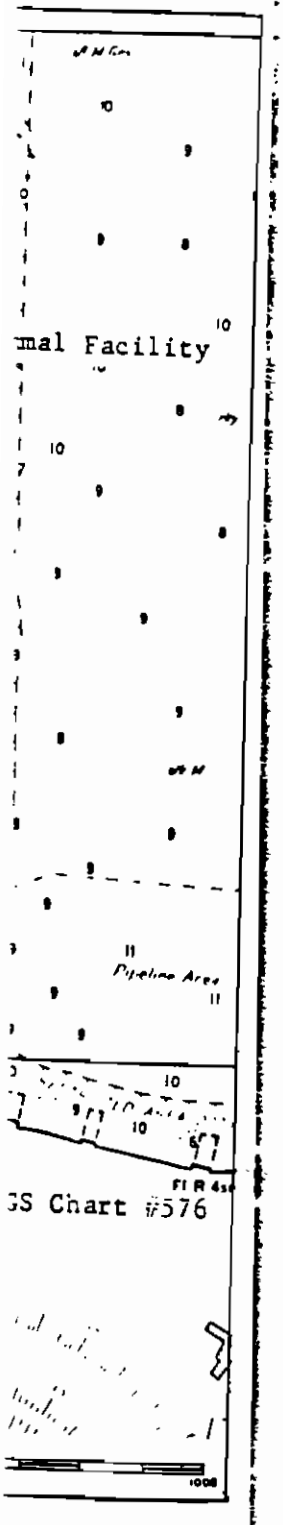


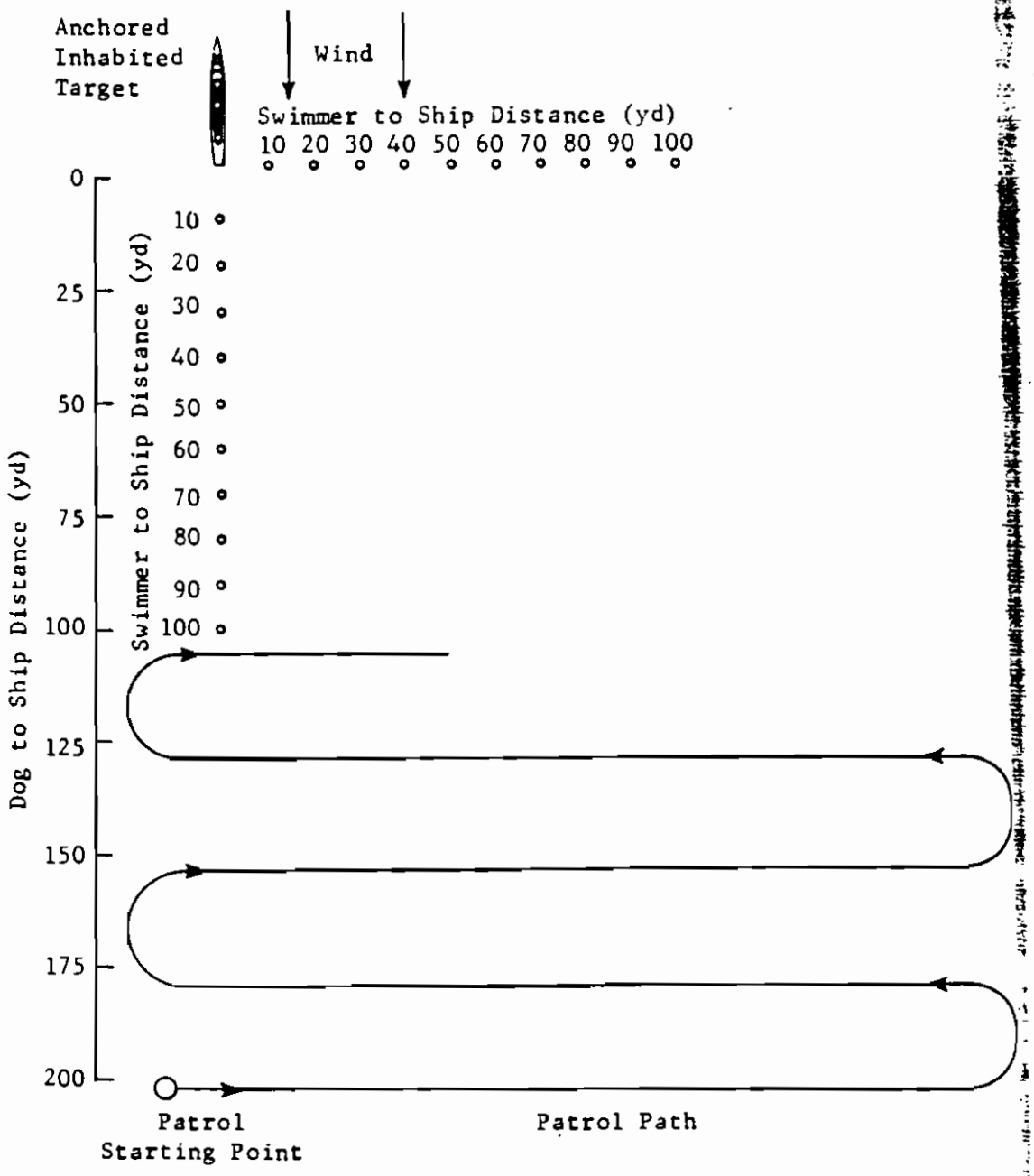
(U) Environmental conditions throughout the test period varied considerably. Air temperatures ranged from 57°F to 86°F with an average of 68°F. Average water temperature was also 68°F and ranged from 60°F to 73°F. A drastic water temperature drop of 10 degrees was recorded when a cold front moved through the area and brought high winds, rain, and rough seas. Surface fog occasionally reduced visibility to several hundred yards.

(C) The test area layout and a patrol pattern used for the tests is shown in Figure B2. The 65-foot utility craft was the reference point for the tests. Because the tests and operations were in a relatively small cove, the craft was usually anchored as near the shore as possible. Controlled distracting noises, smells, and activities on the beach could be inserted into the problems. Two 100-yard lengths of shot line marked at 10-yard intervals were laid at a right angle to the target on the bottom and anchored at each end. The inside ends were placed directly beneath the anchored craft. The marked lines provided 20 possible locations for the submerged scuba divers, 10 locations to the side of the craft, and 10 downwind of the craft. This arrangement was to help in determining the dog's ability to resolve smell from the inhabited target craft and the smell from the swimmer at right-angle and downwind displacements. For each set of runs (one run per dog for four dogs) the diver started from one of the 20 locations. When he was detected, he was signaled to come to the surface where he agitated the dog by splashing and shouting as a "reward" to reinforce the dog's training.

(C) After the unobserved swimmer took a position on one of the lines, the team consisting of a dog, his handler, a boat operator, and the test observer began a patrol pattern at least 200 yards downwind of the target craft. The Waterdog patrol boat followed a patrol pattern as shown in Figure B2 moving closer to the swimmer and target in 25-yard increments until the dog alerted. The distance from the dog to the swimmer was estimated, recorded, and the patrol team followed up the alert to localize and identify the source.

(C) One of the characteristics that must be considered when working with animals and humans is that they learn from experience and their level of performance may be better or poorer than any previous time; this is dependent upon what they have learned, how they feel at the moment, and environmental conditions. Therefore, it is more difficult to run a repetitive series of tests over a short time and compare those results with what might be obtained in the field. In an operational environment, the dogs are not going to find a swimmer within a half-hour after beginning a patrol every time. They may go for weeks without an alert unless a friendly swimmer is used periodically as a decoy to reinforce a dog's training; this is necessary and must be done during operational use of dogs.

(Text Continued on Page B-5)



(C) FIGURE B2. TEST CONFIGURATION INCLUDING PATROL, SHIP, AND SWIMMER RELATIONSHIPS (U)

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(C) Beginning on 28 January 1970, a total of 159 runs using four dogs were made. Various disturbances were used and included gunfire, firecrackers, shouting on beach, vehicular traffic, low altitude jet aircraft, helicopters passing overhead, debris and gasoline on water, smoke, engine exhaust, noises and smells from inhabited target craft, birds swimming and diving, and small buoys. Besides being necessary for the tests, exposure to these disturbances prepared the dogs for similar encounters during the in-country evaluation. Last runs were made on 12 February 1970.

(C) To analyze the data by computer, a mathematical model was established to determine the influence levels of the various parameters. These included disturbances, dogs, day and night, swimmer type, approach angle, wind speed, air temperature, and swimmer to target craft distance. At the 95 percent confidence level, the results indicated that the disturbance level, individual dogs, and wind speed were the only statistically significant factors. The average detection ranges in yards for the eight combinations of four dogs and two disturbance levels are presented in Table B1.

(C) TABLE B1

AVERAGE DETECTION RANGES (U)

	No Disturbance		Disturbance		Total	
Dog	Average Detection Range (Yards)	Sample Size	Average Detection Range (Yards)	Sample Size	Average Detection Range (Yards)	Sample Size
Pete	166	23	122	18	144	41
Topper	154	22	109	18	131	40
Bear	125	22	101	17	113	39
Jet	125	22	92	17	109	39
Total	142	89	106	70	124	159

(C) These figures indicate that the effect of disturbances is about equivalent to the differences in sensitivity between the four dogs; i.e., the addition of a disturbance reduced the average detection range about

PATROL,

25 percent and the average detection range of the least sensitive dog (Jet) was about 25 percent less than that of the most sensitive dog (Pete).

(C) Even in the presence of disturbances the dog always detected the swimmer, even though the range of detection may have been shorter. This does give the enemy swimmer a better chance to make a successful attack but the patrol team is flexible and can modify their patrol pattern as necessary to compensate for most conditions as they occur.

(C) A measure of the effects of wind speed was obtained during the evaluation to support earlier suppositions. Detection ranges increased with increasing wind speed up to about 11 miles per hour at which time the range began to decrease as wind speed increased. This is logical because as wind speed increases, the scent cone of the swimmer becomes more concentrated and stronger, and hence easier to detect at longer ranges. Above 11 knots, the scent cone becomes narrower so that it is easier to miss by passing through it.

OTHER RESULTS

(C) The dogs always alerted on a porpoise that surfaced in the are It was a new and unusual event caused by a swimmer (animal) that the dogs were not familiar with. Their suspicious nature is useful and should be encouraged.

(C) There is apparently a characteristic odor associated with the compressed air released from scuba gear. During one run, the scuba-equipped swimmer remained in the boat lying on the bottom not breathing the compressed air from his bottles. Naturally the dogs could not find a swimmer. When the swimmer began breathing air from his tanks, the do alerted immediately upon the man inside the boat.

(C) The dogs will alert on personnel in boats at distances of 700 yards or more at night over open water. On one night patrol, a dog alerted at this range on a small unlighted fishing boat containing two men. This characteristic of Waterdogs could probably be utilized by coastal and harbor patrol craft interested in interdicting illicit nighttime boat traffic.

(C) The dogs retained their previous training well. After being away from water and swimmers for over 2 months, they immediately knew what their job was and little additional training was necessary to get them working efficiently.

(C) In a situation where the target craft to be protected was down wind of the swimmer and between the swimmer and the dog, the dog could

still detect the swimmer even though the scent would be split in passing around the craft and mixed with other scents coming from the craft itself. Localization of the source is more difficult but it can be done.

(U) The time that a dog can remain on patrol in the boat is limited to about 3 hours. Space is not available in the skimmer for the dog to get much exercise and he cannot relieve himself normally. After this period of time the dog's sensitivity has also declined due to nasal fatigue and his effectiveness is reduced. Before a dog is put on an extended patrol, he should be exercised where he can relieve himself naturally.

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APPENDIX C

VIETNAM OPERATIONAL EVALUATION

(U) The four Waterdogs, their handlers, a boat operator, and the coordinator arrived in-country on 19 March 1970 and remained in the Saigon-Nha Be area for acclimatization of the dogs, refresher training, preevaluation efficiency tests, final check-out of equipment, and supplies. Following agitation of the dogs, initial scuba swimmer detection trials were made during the early morning hours while it was still relatively cool. Nighttime trials were conducted near the POL Tank Farms using Vietnamese surface swimmers. All work and tests were supported by and coordinated through NAVSUPPACT SAIGON, NAVSUPPACT DETACHMENT NHA BE, RSSZ TOC, and Nha Be District Advistory Group TOC.

(U) A preliminary visit to the operational evaluation sites of ATSB Go Dau Ha and ATSB Ben Keo revealed that there was no adequate land area on which a temporary kennel facility could be established. However, a combination kennel-berthing ammi barge was provided as a portable support base for the WATERDOG system. It could be moved wherever the swimmer defense system was needed and would be especially suited for use in the delta area. A suitable barge was built at Nha Be for the system's use. Two standard 16 ft by 32 ft hooches were constructed on a standard fuel ammi barge. The kennel hooch was modified to have a concrete slab floor and screened in sides to facilitate cleaning and allow sufficient air circulation.

(U) Before the kennel-ammi barge was completed and moved to Go Dau Ha, the Waterdog team was sent to the ATSB Go Dau Ha. For a makeshift kennel the dogs were staked to the perimeter fence and a canvas shade erected. Since November 1969, there had been three swimmer attacks in the immediate area of the ATSB. The last attack dropped two spans of the bridge crossing the Song Vam Co Dong River on Highway QL-1 leading to Cambodia. While the main bridge was being repaired a pontoon bridge was constructed upriver to carry vehicular traffic prior to and during the Cambodian offensive. This bridge was critical and a likely target for an enemy swimmer attack. Project WATERDOG was assigned to protect this installation.

(C) Patrol operations were conducted four nights from 1930 to 0530 under very trying conditions. Finally, the local situation deteriorated to the point where it was not safe to be on the river at night due to friendly small arms fire and the patrols were stopped. The Waterdog ammi barge arrived soon thereafter so the system was loaded aboard and moved to ATSB Ben Keo on 16 April 1970.

(U) ATSB Ben Keo consisted of six ammi barges (including the Waterdog barge) and a very limited waterfront area to which the barges were anchored. The barges extended into the river a distance of 180 feet and their combined width was 90 feet. Most of the time there were river patrol craft (PBR's and ATC's) tied alongside the barges. The Vam Co Dong River at this point was 125 to 150 yards wide.

(C) One month before WATERDOG arrived, the ATSB was attacked by three surface snorkel swimmers each carrying a 50-pound charge of C-4. Fortunately they were seen and countered before they could plant their explosives. It is believed that the swimmers made their entry into the river through the village which surrounds the Navy base.

(C) WATERDOG patrols were maintained on a 1930 to 0530 basis for six consecutive nights before taking a night off to rest. The teams remained on site until 5 May and operated a total of 16 nights. Averag time on patrol per dog each night was 2-1/2 hours. Until the four Navy dog handlers arrived on 21 April the four original dog handlers and one boat operator were very busy. One off-duty dog handler filled the gunner poisition and a second off-duty handler relieved the boat operator. The handlers also had to feed, exercise, and care for their dogs.

(U) During virtually all of the operational evaluation period at Ben Keo, intelligence reported that the Navy base was targeted for rocket and mortar fire attack. On the third night the base was hit by a 107-mm CHICOM rocket fired from a range of 500 meters. It very narrowly missed severely injuring the WATERDOG personnel and dogs. Shrapnel and blast effects damaged the WATERDOG barge. The next night the base went to General Quarters when a total of ten 122-mm rockets were seen launched towards the base and impacted in the Vietnamese Army Training Center less than 1 kilometer away. General enemy and friendly activity in the area was high.

(U) On 5 May, the WATERDOG project moved to Cam Ranh Bay to complete the turnover of the dogs to the Navy handlers. Within 2 weeks the turnover was completed and operations were begun patrolling in the vicinity of the Army ammunition piers. No problems were experienced.

(U) An unfortunate event occurred on 17 May when one of the four original Waterdogs died probably of overheating. To continue the project, a dog handler's former sentry dog was transferred from NSA Danang to the team and retrained at Cam Ranh Bay. The training provided additional information to refine the initial training lesson plans and schedule.

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RESULTS

(C) Over 200 hours of patrol time were logged during the operational evaluation in a typical riverine combat environment. Two types of assets were successfully guarded: a pontoon bridge and a moored floating ATSB. Although no enemy swimmers were detected and friendly swimmers were used only in a limited way, the working ability and usefulness of the Waterdogs in the field was demonstrated. At both ATSB Go Dau Ha and ATSB Ben Keo it was impossible to use friendly swimmers to simulate an attack situation because there was no possible way to assure their safety and yet protect the base from enemy swimmers. This prohibited making an assessment of the effectiveness in terms of detections made versus misses from swimmer runs, but a good estimate could be made based on the detections of indigenous bathers, swimmers, and people near the water, and on the dogs other general performance. A total of eight indigenous Vietnamese persons were detected in or very near the water. Two were bathing, one was swimming, and the other five were found while they were checking fish traps, defecating, performing sentry duty, or just moving around after dark on the bank. Ranges at which these detections were made varied from 25 yards to 150 yards. Six were detected by scent and two by sight. The setting of the evaluation area limited the ranges at which detections could be made. Friendly surface swimmers were used to make one nighttime run each for three of the four dogs at Ben Keo to test the dogs' efficiency after 14 days of patrols and reinforce their skill of swimmer detection by scent. An attempt to determine the maximum range of detection was not made. All three dogs alerted on the first pass at an estimated 100 yards range under very light wind conditions. During the first daytime scuba detection runs made at Nha Be, the dogs alerted at between 175 and 200 yards in similar wind conditions.

(C) An average of one alert per night was made by the dogs on sources that could not be pinpointed or identified. These always originated from the land surrounding the base. Supposedly there were no people in these areas after dark unless they were the enemy. The dogs' alert to a person on land is different than that of a waterborne source and the handler can usually tell the type of alert and react accordingly. When an alert of this nature was made, the local NOC was informed by radio so they could check the area for enemy activity. Normal patrol was resumed as quickly as possible after these alerts because the enemy could use such tactics to pull the Waterdog team away from its assigned patrol area and insert a swimmer behind them.

(C) There is a considerable psychological factor in using dogs. During the entire time in-country, it was observed that everyone, and especially the Vietnamese because of their small physical size, have a great deal of respect for a large, noisy, biting dog. In most cases it was not necessary to tell anyone to stay clear of the kennel area or of the dogs a second time. No one was ever bitten but several were badly scared. If the enemy reacts in the same way, just the presence of a trained team of dogs, whether they are trained for sentry or WATERDOG duties, may be a significant deterrent to attack. It is possible that the 107-mm rocket attack at ATSB Ben Keo was intended for the WATERDOG teams and equipment.

(C) All three senses of the dog, smell, sight, and hearing, are used but smell is predominant. A properly trained dog will observe floating objects but not alert on them unless there is a human scent associated with it. Therefore, the boat must pass downwind of such objects so this check can be made. The dog handler can visually check the object when it is illuminated. As long as the number of suspicious floating objects is not excessive (2 to 4 per hour) the WATERDOG patrol can check these objects in addition to protecting against swimmers.

(C) The effects of distractions while on patrol were minimal. The dogs adjusted well to recurring events. The first time anything happened with which the dog was unfamiliar, he would alert; but once he identified it, he accepted it as normal.

(C) The weekly use of concussion grenades at ATSB Ben Keo was noted before and after the arrival of the WATERDOG project. Before the WATERDOGS arrived, there was an average expenditure of 900 grenades per week. During the evaluation this dropped to 200 or less. Most of these 200 went to the river divisions who used them away from the ATSB. Project WATERDOG personnel used an average of four grenades per night.

(C) Before the WATERDOGS arrived, the random use of concussion grenades was the standard means of swimmer defense. The effectiveness of this technique is mainly in the fear and scare that is induced. The noise and shock from the grenades makes it difficult for personnel living on the ships and barges to get any rest. Frankly, it makes sleeping difficult. When the dogs were working and only four or five grenades were used during the night, everyone slept and felt better. Many unsolicited comments were received during the evaluation to support this observation.

LIMITATIONS

(C) There are three main limitations to the WATERDOG system: size of the area that can be patrolled, effects of certain weather conditions,

and support requirements. These factors must be considered when contemplating the use of the WATERDOGS.

(C) Primary factors affecting the size of the area that can be adequately patrolled are the number of WATERDOG patrol teams and equipment available, type and nature of the protected asset, location of the asset, and the water current conditions in the area. Assuming that adequate dogs, men, equipment, and support are available to maintain one WATERDOG team on patrol throughout the desired period, the maximum linear frontal area that can be secured under ideal conditions is approximately 250 yards. An example would be an anchored seagoing freighter in a bay or protected harbor at least 500 to 1000 yards away from the nearest uncontrolled land area from which a swimmer could enter the water. The patrol team has unrestricted access to all sides of the ship at all times.

(C) When the enemy swimmer has a point to enter the water that is close to the target, the WATERDOG patrol team has restricted freedom of movement, or unfavorable wind and current conditions prevail, the area that can be adequately patrolled is reduced accordingly. Figures 4 and 5 illustrate two shoreline situations where a swimmer could conceivably enter and/or swim along or under buildings, etc. in an attempt to avoid detection. These situations will require special consideration and patrol time and therefore reduce the total area that can be secured. A summary of swimmer's capabilities and limitations necessary for the proper deployment of an antiswimmer program is in Appendix D. The appendix also contains guidelines for determining the techniques, areas, and methods of patrol for most conditions that might confront the WATERDOG team.

(C) Limitations of WATERDOG patrols due to adverse weather conditions are natural. Sea states that make the normal 16-foot outboard skimmer uncomfortable or unsafe for humans affect the dog similarly. When he has to concentrate on remaining upright and inside the boat, his effectiveness as a swimmer detector is diminished. Very calm wind conditions make an area more difficult to secure because the scent of a swimmer diffuses quickly and shortens the scent detection range. When there is calm water along with the very calm wind the dog's sight and hearing capabilities are enhanced and partially make up for the decreased scent detection range. A hard rain will distract the dog to some extent, make him uncomfortable, and shorten the detection range but he can still work in the rain and be more effective than most other antiswimmer systems developed to date. Because patrols are usually maintained at night, the tropical heat does not affect the dog's performance unless it prevents him from resting properly during the day. In the area of RVN where the tests were made it was found best not to work the dogs excessively between 0900 and 1700. The German Shepherds are

susceptible to overheating and subsequent death, so care must be taken in their use.

(C) When a Waterdog is used in the normal 16-foot Boston Whaler, his freedom of movement and opportunity for exercise are very limited. Also, he cannot relieve himself in the boat as he could on a land patrol. The result is that his effectiveness is reduced after about 3 hours on patrol.

(U) Because the opportunity for exercise in the patrol boat is very limited, each Waterdog should be exercised at least 1 hour daily. This should be done on an established obstacle course. A physically sluggish dog does not have the physical endurance and efficiency that is required. In the tropical environment of RVN the physical exercises should be conducted in the early morning or late evening hours to prevent overheating.

(U) The long-term effects of using dogs continuously in a boat have not been determined but it was observed that they did become physically weaker after 4 weeks of boat work. The instructors from the USAF Patrol Dog School who were the original dog handlers believe that it would be advisable to periodically alternate the Waterdogs to land type sentry or patrol dog positions. This would give them a chance for physical reconditioning and also stimulate their interest by providing a change in surroundings and work. Minor retraining would probably be necessary before making the change, but the overall result would extend their working life and increase their efficiency. The change in the type of patrol work should be done at least once every 3 months. It could be done by working two nights on the boat and one night on land. If the Waterdogs were originally sentry or patrol dogs, there should be no problem to rotating the patrols.

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APPENDIX D

WATERDOG OPERATING INSTRUCTIONS

1.1 INTRODUCTION

(U) 1.1.1 The information and instructions contained herein apply to the operational use of WATERDOGS for defending fixed and floating assets from attacks by swimmers.

1.2 DESCRIPTION OF THE SYSTEM

(U) 1.2.1 A military working dog specially trained to detect persons in or very near the water is the basic sensing device. Usually this animal will be a German Shepherd or of similar stock having the characteristics of a typical German Shepherd. He is very adaptable to different climatic conditions, strong, alert, fearless, agile, and well muscled. Normally the dog must meet the characteristics and specifications set forth in Air Force 125-5 and U.S. Army FM 20-20.

(U) 1.2.2 For optimum performance and effectiveness, the dog and his handler are placed aboard a patrol boat, usually a 16-foot Boston Whaler. This craft, commonly known as a "skimmer," is normally powered by an outboard engine of at least 40 horsepower. It is a stable, seaworthy, maneuverable, and fast boat. As such, it makes an excellent patrol craft in rivers, canals, harbors, docking, and anchorage areas. Other larger patrol craft can be used but with an attendant decrease in operating efficiency.

(C) 1.2.3 Capabilities. A WATERDOG team consisting of a dog, his handler, and an outboard operator using a Boston Whaler equipped with an 85 hp engine can secure and protect an area or specific target from sneak attacks by surface, snorkel, or open-circuit scuba equipped enemy swimmers. Detection by scent provides the longest ranges. Sight and sound detection complements scent at shorter ranges. The maximum area that can be secured is dependent upon prevailing wind and water current conditions, configuration of the area, accessability to enemy swimmers, accessability of the area by the patrol craft, and the type of target to be protected. For a 95 percent probability of detection, the maximum linear frontal distance perpendicular to the wind that can be protected is about 200 to 250 yards. A combination of unfavorable wind conditions and slack tide may reduce this area because a swimmer can approach from any direction and the patrol team may not be able to maneuver rapidly enough to detect and intercept him.

1.3 SWIMMER CAPABILITIES

(C) 1.3.1 Primary Controlling Factors. A swimmer making an attack on a traget is influenced in his mission planning and execution by three primary controlling factors. These are the requirements for concealment throughout the mission, navigating from the water entry point to the target, and the swimming range as determined by his swimming endurance and speed. There are other factors to be considered for the mission but all are subordinate to these three.

(U) 1.3.1.1 Concealment is important because the element of surprise is the key to success. When covertness is lost, the swimmer must either escape or gamble with his life to complete the mission. Only in rare instances when he is highly motivated will the latter course of action be selected.

(U) 1.3.1.2 Concealment can be attained by either swimming beneath the surface using scuba gear, swimming just below the surface with a breathing tube, or swimming unaided on the surface. Periods of low light levels provided by dim moonlight, cloud cover, rain, and fog may be used to an advantage in making the swimmer less visible to sentries.

(U) 1.3.2.1 Navigation. Without the aid of sophisticated navigational equipment or unusual circumstances favoring him, a swimmer must rely on periodic visual surface sightings to avoid missing his target. Test results obtained using highly trained personnel navigating only by wrist compass in daylight conditions indicate a lateral error of 150 yards per 1000 yards swam. The error under less optimum conditions by a poorly trained swimmer would be much larger.

(C) 1.3.2.2 An example situation where a scuba swimmer could attack and retreat completely submerged from a considerable distance is that where several targets of opportunity are docked across a relatively shallow body of water (less than 30 feet). He could swim along the bottom using a wrist compass until he found the dock, find a target by feel, plant his charge, and swim away.

(U) 1.3.3 Swimmer Range. The distance a swimmer can traverse is determined by the physical condition of the individual, his swimming ability, water temperature, water currents, navigational requirements, and whether or not he has an aid to propulsion such as a swimmer delivery vehicle.

(C) 1.3.3.1 An individual's physical condition varies from person to person, the time he has to practice swimming, and how he lives before an attack. Swimming speed and endurance limits of men are placed at 3.4 knots for a short burst and an average 1.2 knots for 20 hours.

These are world records and it is improbable that a swimmer having these speeds and endurance capabilities would be encountered. Average swimmer speed and endurance, assisted by currents, have generally been set at 1 knot sustained for 4 hours with a resulting range of 4 nautical miles. These figures assume that the swimmer times his approach to coincide with slack tide so he can approach from any side, work easier alongside his target, and use the reversed current direction to carry him to his original water entry point.

(U) 1.3.3.2 A swimmer's endurance and range is affected by the water temperature. Best conditions for the loincloth or unprotected swimmer exist when water temperatures are between 70 and 85°F. At temperatures between 70 and 40°F, some type of protective clothing or wet suit is required unless total time in the water is 3 hours or less.

(C) 1.3.3.3 Both river and tidal currents can be and are used to increase swimmer speed and ranges. While decreasing the mission length and effort required to move to and from the target, use of the currents can increase the problems of navigation and make it more difficult to work at the target itself. Employment of a magnetic limpet mine will minimize working time required at the target. A survey of all world ports and anchorages shows that river or tidal currents generally do not exceed 2.5 knots. Only 25 percent of world-wide dockside currents are greater than 1.5 knots and the same percentage applied to the number of open anchorage areas having currents in excess of 0.5 knots.

1.4 SWIMMER TACTICS

(U) 1.4.1 Water Entry Point. A swimmer chooses his water entry point to provide concealment and a range to the target within his swimming capabilities. A bank covered by vegetation or buildings with water at least 3 feet deep are preferred locations. Another desirable site would be near the mouth of a small tributary where he could enter the water unobserved. The swimmer could also use an indigenous surface craft to carry him to an appropriate drop-off point nearer his target than could otherwise be obtained. A skilled swimmer may also use an underwater cave or tunnel to execute his attack from and retreat to for hiding.

(C) 1.4.2 Approach Sectors. As with other guerrilla and insurgent attacks, the swimmer can usually choose his own time, place, direction, and mode of attack. Extensive study and observations will precede most attacks to learn all possible facts about the target, approach conditions, security measures in effect, escape routes, and guard personnel habits. Analyses of incidents in Vietnam indicate that 65 percent of the swimmers used slack tide and nights having little or no moon illumination. Use of slack tide permits the swimmer to approach from any side where a sentry is not alert and makes it easier for him to attach his charge to the target.

(U) 1.4.2.1 For a target in rivers or waters strongly influenced by tide, most of the time there is a current running that will limit the direction from which a swimmer can approach his target. Figure D1 illustrates the swimmer approach sectors for various water current speeds and swimmer speeds of 1.0 and 1.5 knots. Swimming speeds greater than 1.5 knots would most likely be noisy due to splashing of hands and feet and therefore not useful to a swimmer who needs to remain covert.

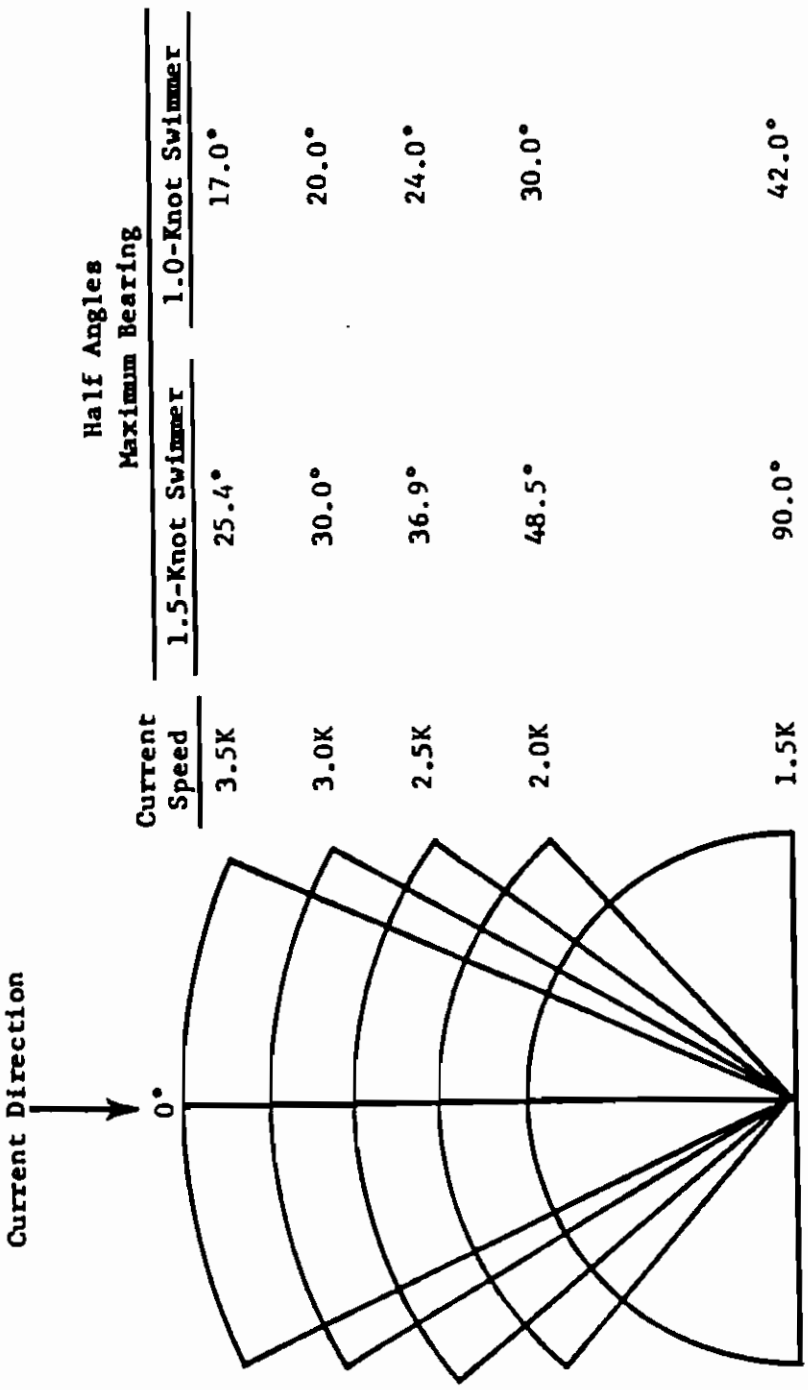
(C) 1.4.2.2 It should be noted that the figures given in the table of Figure D1 are half-angles. The full sector widths are double the half angles given. It is important to note that a 1-knot swimmer can approach the target anywhere in a relatively wide angle. When currents are 1 knot or less this swimmer can approach from any angle, so a full 360-degree surveillance capability is needed at times for any swimmer defense system.

(C) 1.4.2.3 The sector widths given in Figure D1 may seem unnecessarily large at first. However, further study substantiates their need. A swimmer sapper is not restricted to swimming with the water current. He can vector himself at an angle into the current, enter the stream at the right point, and can get to his target even though both his transit time and total effort will be increased. It may also make it possible for him to defeat a narrow sector scan antiswimmer device by avoiding it's search sector. Figure D2 presents a mathematical analysis of swimmer water entry points and time to transit for various vectors he may take in reaching the target. It assumes a sustained swimming capability equivalent to water current. When (1) a better swimmer is encountered or (2) water current is decreased, the patrol sector must be widened; i.e., if a swimmer can average 1 knot swim speed and current is 1/2 knot the water entry point is 1/2 the distance upcurrent required for a 1-knot current. For a given swimmer speed, the time of transit will remain the same.

(C) 1.4.3 Swimmer Approach Pattern. Figure D3 is an illustration of what an average snorkel equipped swimmer's path might look like. The presence of a patrol boat, certain weather conditions, or personal preference would modify this path. An average swimmer must remain on the surface from 5 to 20 seconds to clear his vision, take a compass or visual sighting, and correct his course. This allows opportunities for visual detection. Any swimmer defense must examine all possible modes, types, and directions of attack and be prepared to counter any threat regardless of how little it may seem to promise success to an attacking swimmer.

Current Direction

(Text Continued on Page D8)



(U) FIGURE D1. SWIMMER APPROACH SECTORS

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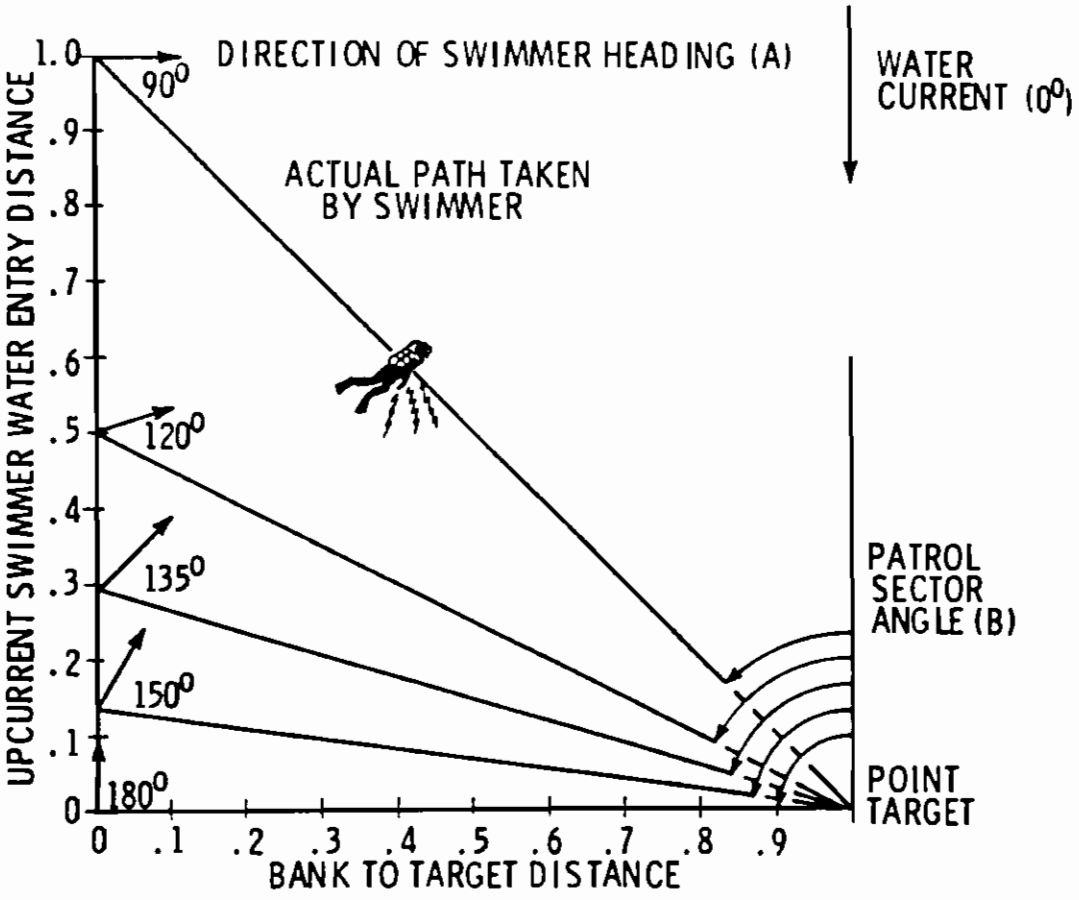
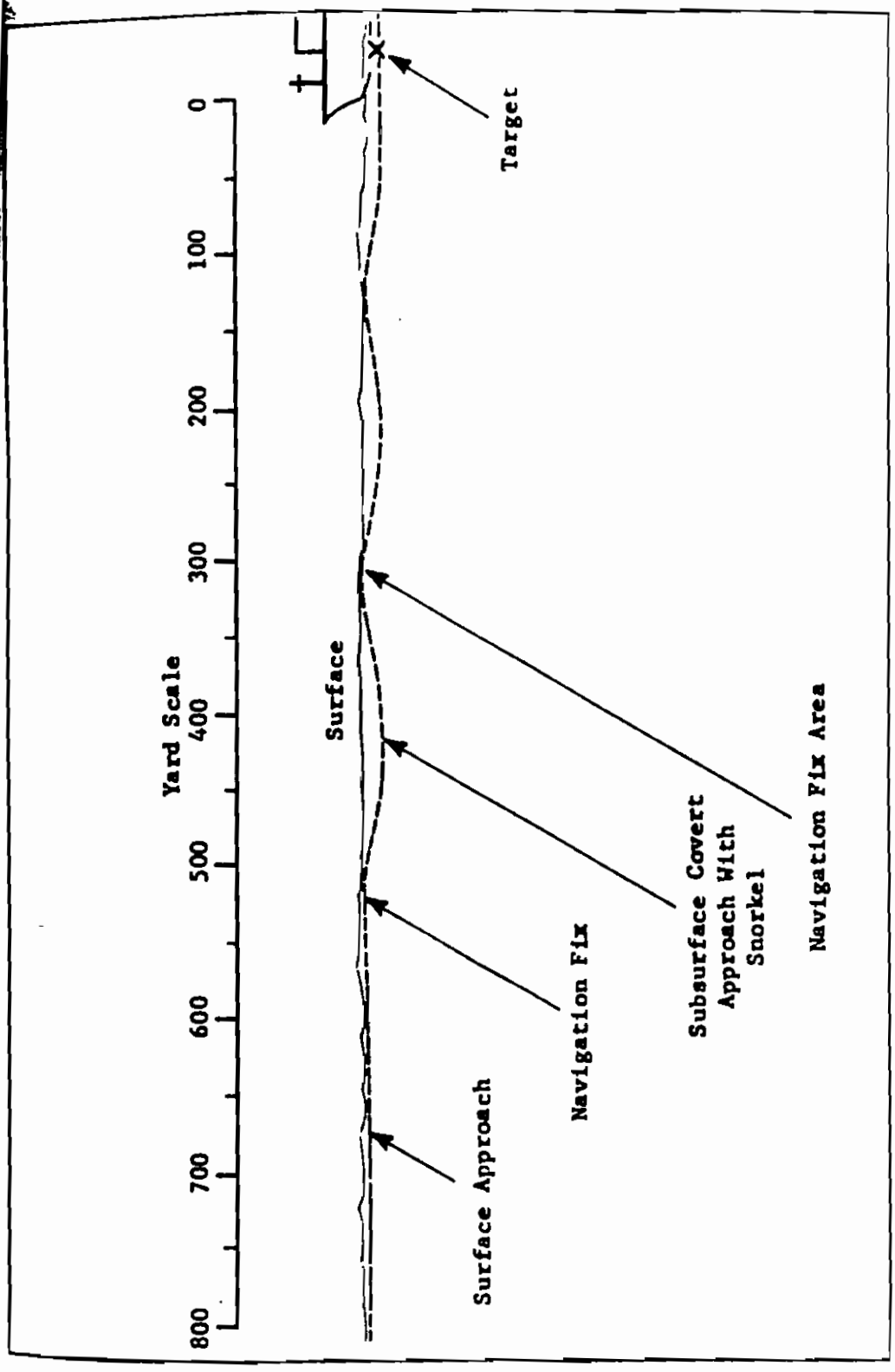


SWIM ANGLE (A)	90°	120°	135°	150°	165°	180°
TIME TO TRANSIT (RELATIVE TO SHORTEST TIME POSSIBLE)	1.0	1.15	1.40	2.0	3.86	
PATROL SECTOR ANGLE (HALF-ANGLE) (B)	45°	63.5°	73.5°	82.5°	88°	90°

(C) FIGURE D2. APPROACH PATHS, TRANSIT TIMES, AND PATROL SECTOR ANGLES FOR SWIM CAPABILITY EQUAL TO CURRENT SPEED (U)



(C) FIGURE D3. TYPICAL SWIMMER APPROACH PATTERN (U)

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1.5 SEA EXPERIENCE

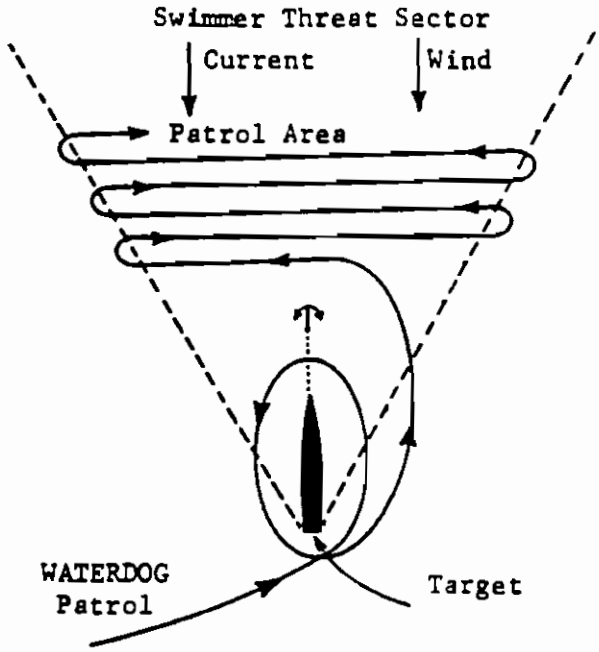
(C) South Vietnam has ideal conditions for swimmer activities and much has been learned by experience there. The swimmer/sapper team consists of a leader and three or more men who usually operate in cells of three men during an attack. The leader is experienced in guerrilla tactics and is well trained in reconnaissance techniques, explosives, and other pertinent subjects. The swimmers are usually given about 40 hours of formal training but this may be increased to include semi-closed and closed circuit scuba. They are typical guerrillas, living off the country, dependent upon some local support, and will usually obtain the larger items such as explosive charges near the site of the attack. They are patient and careful in observing defensive measures and in planning their attack to take advantage of any weakness. Diversionary tactics such as civilian disturbances, fires, intentional swimmer exposures, and small arms firing, are used to draw attention away from the real effort. Advantage is taken of the dark of the moon, rain, fog, cloud cover, choppy water, floating debris, and normal movements of indigenous personnel and water craft near or through their operating area. Targets are chosen near favorable water entry points and where currents will assist the swimmer approach to and withdrawal from the target. The approach is usually made on the surface using homemade snorkels. The hours of darkness are most often used with 2300 to 0400 hours being the most frequent choice. Lights on the target or dim moonlight back lighting are used to guide the swimmer. A well lighted ship, especially at the waterline, with alert sentries will be avoided. The explosive charge is usually a crude homemade expedient detonated by command wire and battery but delay fuse and chemical detonators are also used. The attacks are not suicidal in nature.

2.1 OPERATING PROCEDURES

(U) 2.1.1 Applications. Waterdogs can be used to protect almost any asset, fixed or floating, against attacks by all swimmers except those equipped with closed circuit scuba gear. The number of patrol teams required is dependent upon many factors unique to each particular site and variable from day to day. Section 1.3, Swimmer Capabilities, presents what the swimmer can be expected to do. Other parameters affecting the patrol team and the dogs are wind speed and direction, current speed and direction, amount of debris and other distractions in the area and restrictions of patrol craft maneuverability affected by area configuration. All these factors must be considered in setting up Waterdog patrols and patterns.

(C) 2.1.2 Optimum Patrolling Situation. A large asset, such as a single ship or assemblage of barges, is easiest to protect if anchored

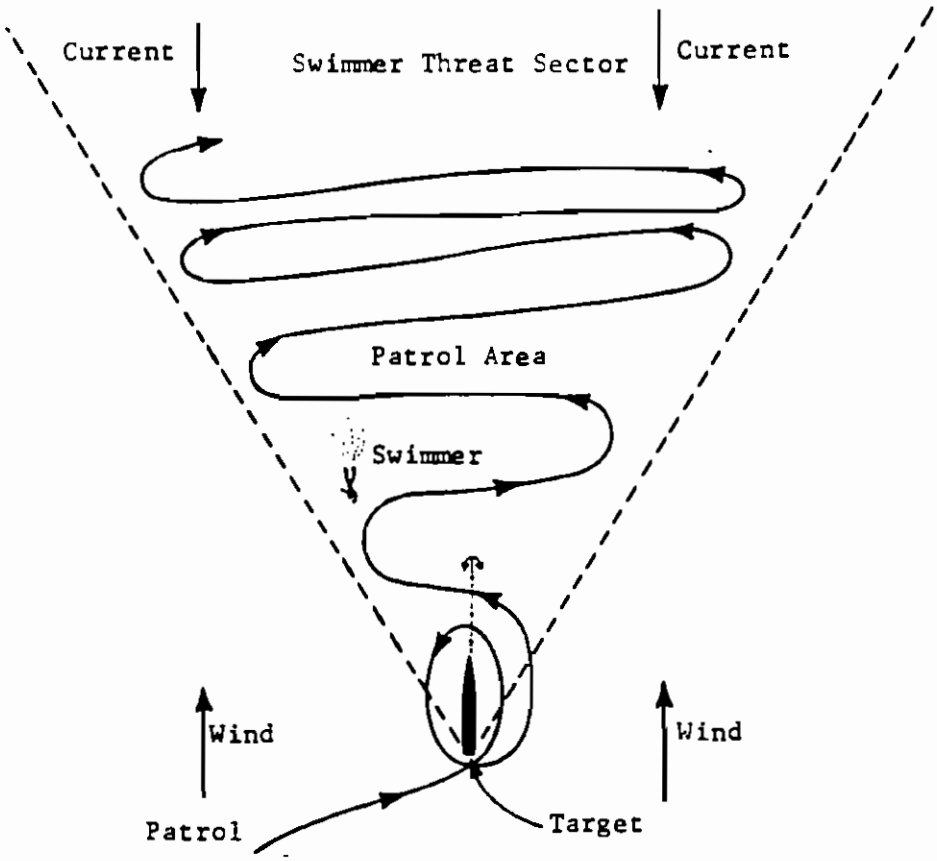
r moored in a bay or large river at least 500 yards from land areas
r indigenous traffic lanes that might serve as swimmer water entry
oints. The presence of a current of 1 knot or greater and a steady
ind of 5 to 10 knots in the same direction as the water current will
lso make swimmer detection easier. A patrol should begin by a pass
round the target to clear the target itself; i.e., make sure there
re no swimmers already there. This also allows the dog to get used
o and identify whatever distractions that might be there. After
learing the target, the patrol boat should move upcurrent approximately
00 yards and begin a back-and-forth patrol pattern making sure that the
attern is wide enough to periodically place the dog downwind of an
pproaching swimmer wherever he may decide to transit in swimming to
he target. This patrol width is dependent upon the width of the asset
and the water current speed (Figure D4). See Figure D1 for the effect
of water current upon swimmer approach sector width. A normal patrol
peed of 3 to 5 knots is recommended.



(C) FIGURE D4. AN OPTIMUM PATROL SITUATION (U)

(C) 2.1.3 Less than Optimum Situations.

(C) 2.1.3.1 Wind Direction Opposite Water Current Direction. Begin the patrol by clearing the protected asset. This should always be performed first and can be repeated periodically during a patrol. The patrol area for this situation is enlarged and moved upcurrent farther because the swimmer must get between the protected asset and the Waterdog team before he can be detected by scent (Figure D5). The swimmer must also be

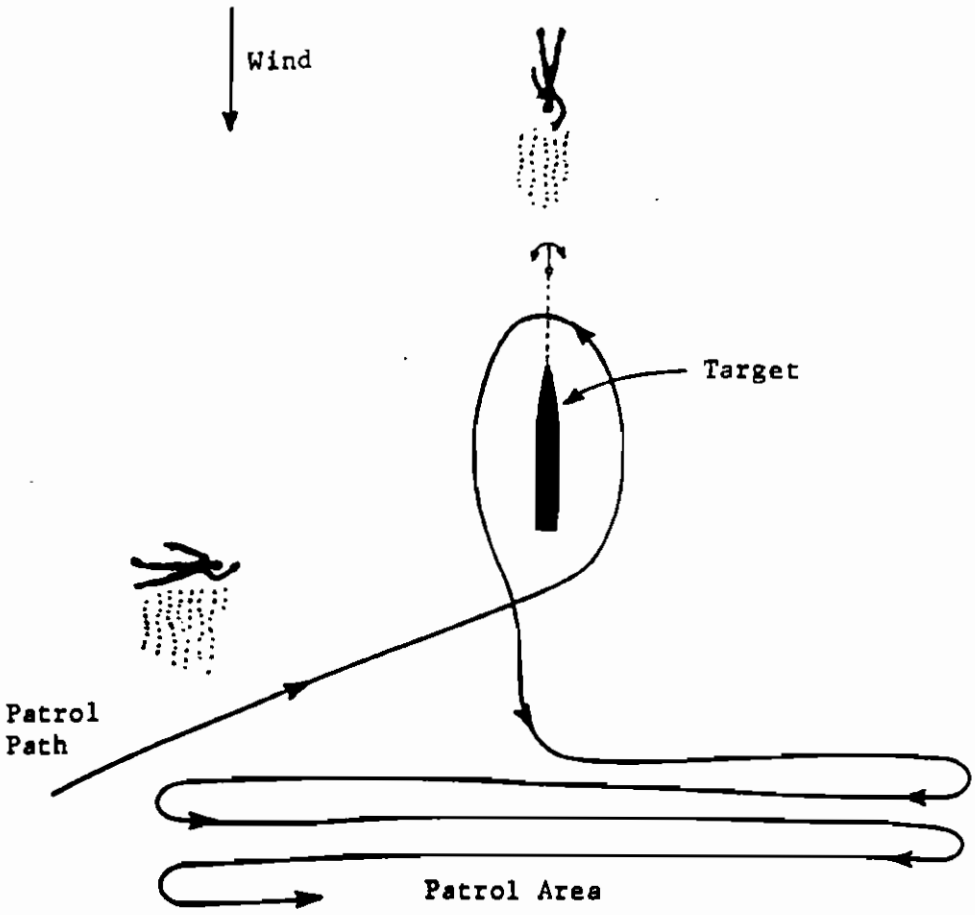


(C) FIGURE D5. A PATROL SITUATION WITH OPPOSING WIND AND CURRENT DIRECTIONS (U)

detected far enough away to permit localization and countering before he reaches the asset. The Waterdog team also has a chance to detect the swimmer by sight or hearing when he passes through the patrol area.

(C) 2.1.3.2 Water Currents Less than 1 Knot. The swimmer has access to the protected asset from all sides. Begin patrol by clearing asset. Move downwind of asset no more than 100 yards and begin patrol (Figure D6). It may be necessary to increase patrol speed slightly. Avoid setting up a pattern of movement by varying speed and direction occasionally. Periodic re-clearing of asset may be necessary.

(C) 2.1.3.3 Protecting Other Assets. Each situation must be carefully studied to determine where a swimmer could come from. No possibilities should be excluded, no matter how remote. Determine the closest water entry points for a swimmer to approach by land and enter water. A friendly village might not be so "friendly." Study and, if possible, measure water currents and directions. Determine when slack tide occurs so the patrol pattern may be adjusted accordingly. When on



(C) FIGURE D6. A 360-DEGREE PATROL SITUATION (U)

patrol, be aware of wind conditions at all times and correct patrol pattern for changes immediately. Restrict indigenous boat traffic in the area so a swimmer cannot approach from them.

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