
MAKE SURE YOU HAVE SOMETHING ORANGE, RED OR YELLOW WITH YOU WHEN YOU'RE BOATING, SO I CAN FIND YOU, WHEN YOU NEED HELP.
U.S.COAST GUARD
SEARCH AND RESCUE

Move Over, Lloyd Bridges

Compliments of Robert Barkin - The Washington Post

Project SEA HUNT

Story by Ensign R. E. Winter, Coast Guard Office of Research and Development

How would it feel to be rescued after drifting at sea for days? You've been waiting and watching, hoping that the next plane will see you, despairing when it doesn't. Finally, a U.S. Coast Guard helicopter sees you and turns, flying straight to the rescue, and you, you are anxious to thank your rescuer--until you find out that it's a pigeon!

That may happen. The Coast Guard is now training the birds for search and rescue. Yup! The they're the common, "statue in the park variety" pigeon, Ol' Columba livia. In Honolulu, Hawaii, with the help of the U.S. Navy and Marines, nine pigeons are being trained at the Naval Ocean System Center to spot international orange objects and to notify a human of the sighting. Project code name: Project SEA HUNT.

But why SEA HUNT? And why pigeons?

"We found in some tests we made a few years ago," says SEA HUNT project officer at Coast Guard Headquarters, LTJG Phil Sirois, "that the trained birds could detect a target on the first pass about 90 percent of the time. In about 84 percent of the runs, the pigeons spotted the target before their human pilots did."

Three trained pigeons ride in a plexiglas pod beneath a Coast Guard HH-52A helicopter, each bird having a full 180 degree view of the sea below. For the tests, the helicopter flies out to sea, drops an orange sphere, and flies away. Turning back, the HH-52A speeds the pigeons and people back toward the simulated life-jacket. When one of the pigeons spots the target, it pecks a switch, activating an indicator inside the cabin. This tells the crew both which direction to turn to find the sphere and which pigeon gets the food reward.

Pigeons

And compared to the humans' 38-percent score for first-run sightings, the pigeons tallied up 90 percent!

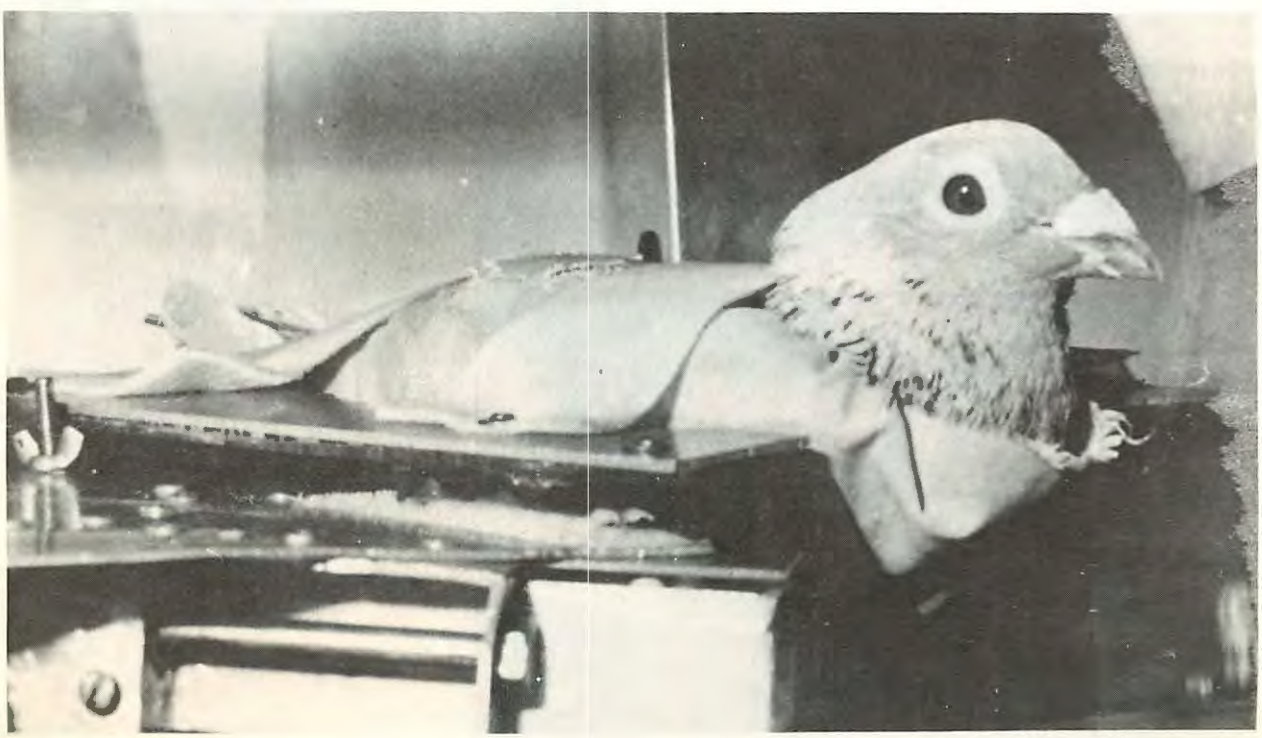
Unfortunately, the program does suffer an occasional setback or two. First, there is the mixed problem of public relations. The first reaction of most people upon hearing about SEA HUNT is a sort of humorous disbelief. --"How cute! A rescue squab!" "Rescued by a pigeon? That's funny! But seriously, now . . ."-- That attitude seems to brim over into the area of budgeting. Hence, SEA HUNT has, in the past three years, received funding from the U.S. Navy, Marines, and Coast Guard, but continued support is shaky and shifts from agency to agency. This year, the Coast Guard is carrying most of the ball.

Then, despite the fact that pigeons have been shown to have keen perception and long attention spans, few people are willing to assign the birds to important tasks. With training, the birds are able to sort through thousands of electronic parts or medicinal capsules, to spot and identify the few defects. However, there seems to be a psychological block to taking vitamins from a bottle marked "Inspected by Pigeon 14," and the same qualm seems to extend to trusting one's life at sea to the abilities of a bird, no matter how much better the pigeon scores over humans.

The final, and major, setback happened last year. As three of the pigeons and their crew were out searching for a missing boat, the helicopter ran out of fuel and made a forced landing in the water. The pigeons, encased in the pod beneath the chopper, couldn't make it out. As Jim Simmons, project director in Hawaii, commented sadly to the press, "It was a totally unexpected and definite loss."

Fortunately, interest ran high enough for the program to continue. Early in 1979, ten new pigeons were recruited from off the park statue, and training began again.

Search and rescue pigeon-in-training practices his "eagle eye".

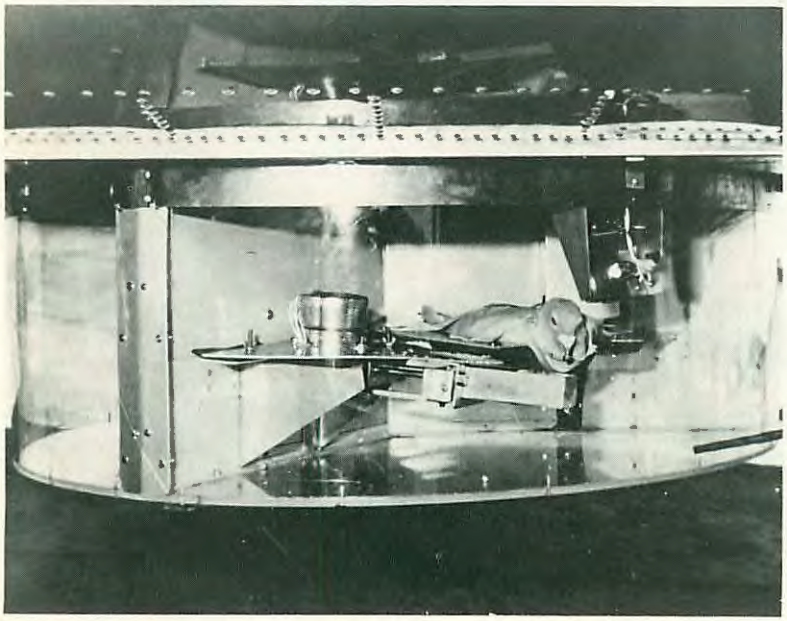


Pigeons

Training pigeons can be a long and tedious process. First, the pigeons must learn to respond in the proper way. It's a simple lesson, and soon they learn that each time they peck the response button, a little bit of corn appears in their feed cup. Next, they must get used to the small, plexiglas-fronted cubicle that will be their center of operations. The "pigeon hole" isn't quite like home, since it is subject to increasing noise and vibration in order to acclimate the birds to the helicopter.

Then comes the time-consuming task; to train the pigeons to respond to the "International Orange" color whenever it appears in front of their window. Here the training becomes more individualized, as pigeons can be as individually different as humans. Some pigeons learn faster than others, some don't learn at all; so far this year, one pigeon has been retired to the park bench.

With simple color recognition learned, a mechanical buoy is then used to show an orange flag while floating in front of the pigeons' window -- first while close, then at progressively greater distances. Slowly, the pigeons develop an eagle eye when it comes to spotting the flag, their final distances range around two thousand yards.



(Above) Pigeons are monitored by an air crewman during in-flight tests.

(Left) A close-up look at an official U. S. Coast Guard pigeonhole.

Pigeons

Finally comes the flight test. It is here that the pigeon learns that there is more to search and rescue than pecking at the sight of little flags. The targets change to surfboards, beach balls, and life preservers. The elements of motion and altitude are introduced, and then -- graduation.

"It is difficult to imagine a pigeon being useful," says LTJG Sirois, "if all you remember is the pigeons you see in the park, fighting over a piece of popcorn. But try thinking of each bird as a living microcomputer, with highly specialized vision and a programmable memory. That's closer to the truth, and it's easier to accept.

"Once a pigeon is trained to know that it won't get fed until it sees a man in the water, that pigeon will spend its life looking for a man in the water. We treat them well, keeping them healthy and hungry. And as one Coast Guardsman put it, 'They're too dumb to get bored.'"

When will you be seeing pigeons mustering with your local Coast Guard helicopter crews? "One crew of trained pigeons should be ready for SAR duty in Hawaii by April of this year," states LTJG Sirois. And so, it's just a matter of time before simple pigeons provide cheap, effective, and friendly assistance to Coast Guard search and rescue.

On the job -- suspended from the bottom of the HH-52A helicopter, the three-pigeon observer team prepares for another day of testing. *U. S. Coast Guard Photo*

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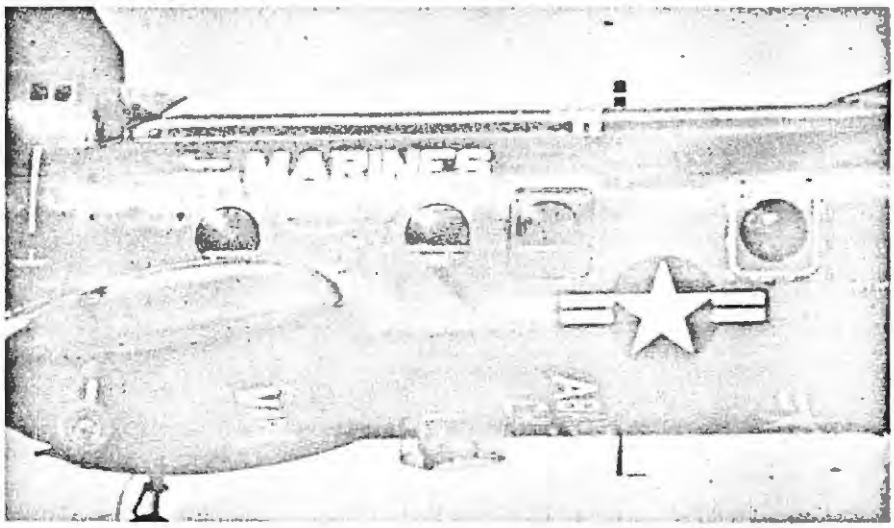
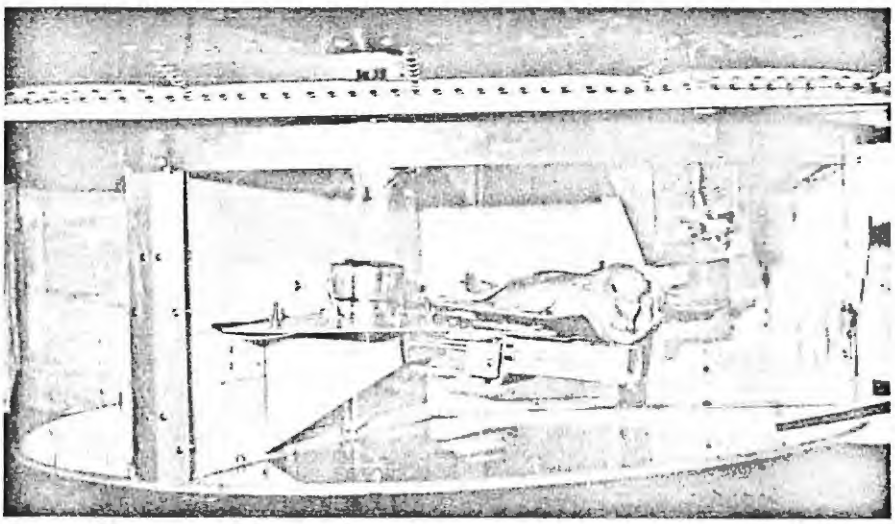
Project Sea Hunt

Overall view of the plexiglass pod attached to the bottom of a helicopter.

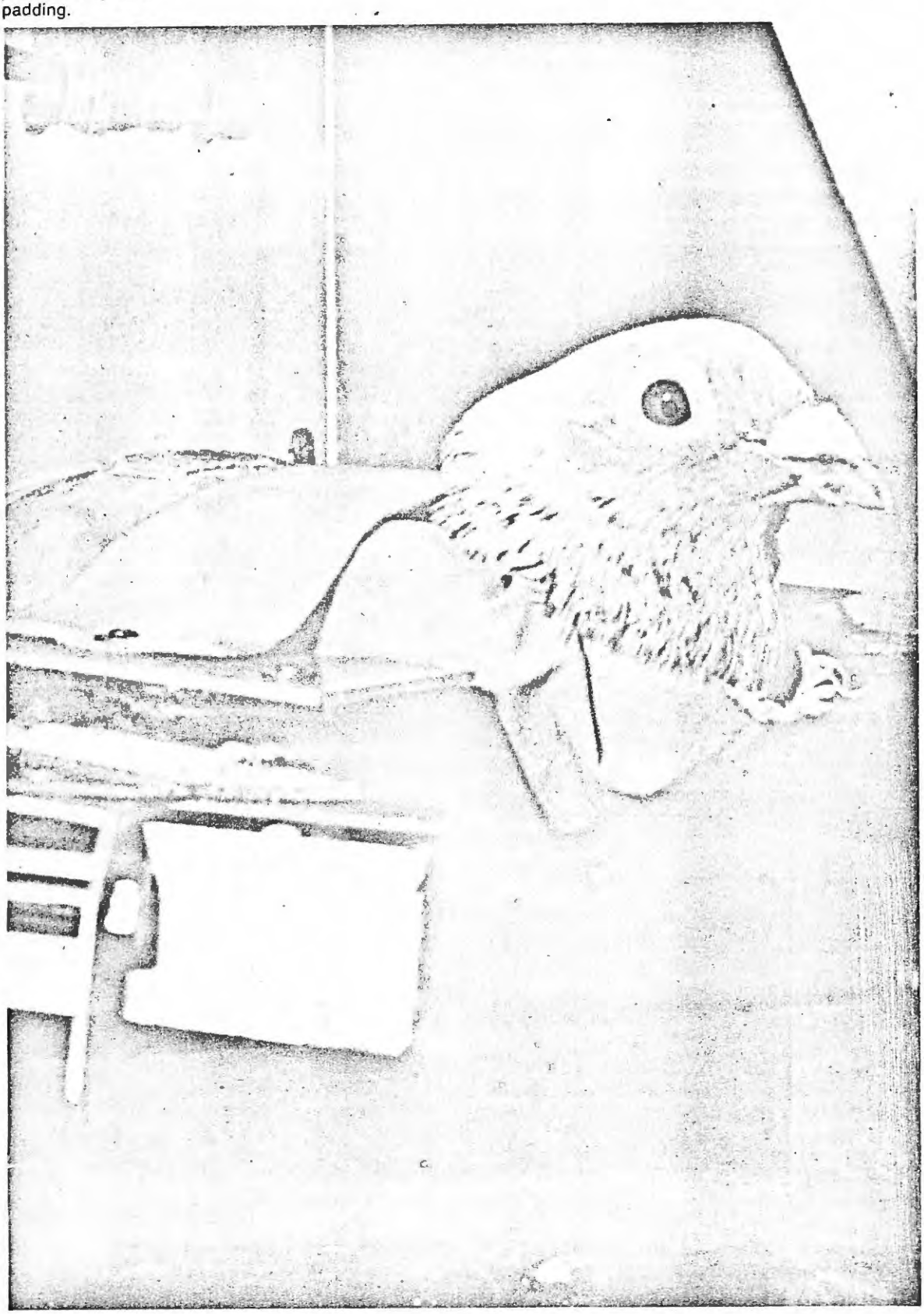


Closeup showing how the pigeon is situated in the pod so he can have a 180° field of vision.



Project Sea Hunt is a research and development program being examined by the U.S. Navy (Naval Ocean Systems Center) and the Coast Guard for search and rescue applications. The concept utilizes trained pigeons in the reconnaissance mission. The pigeons are placed in a plexiglass pod which is attached to the bottom of a helicopter. The pod is divided into three sections that limits the field of view of each bird to about 180°. This allows overlap for complete coverage of the visual field and vectoring of directional information. The pigeons are trained to peck a response key when they sight an orange sphere which is approximately 16 inches in diameter. This training target simulates a life-jacketed man in the water. The responses of the pigeons and human observers are recorded as the helicopter flies various approach distances toward the practice target at an altitude of 350 to 500 feet. Training to date in U.S. Marine Corps helicopters has shown that the pigeons have a long attention span and good search rates compared to man.

Note how the pigeon is protected against harm by being wrapped in protective layers of padding.



In both the Marine Corps and Coast Guard flight tests the pigeons scored way ahead of the humans on first-pass probability of detection (POD). The pigeons obtained a POD of 90% to the human POD of 38%. On first-pass detection trials the pigeons saw the target first 84% of the time, the humans saw it first 15% of the time and both saw it at the same time 1% of the time.

More sophisticated testing and analysis of this promising system are expected during the coming year.

DOES YOUR WET SUIT FIT?

During a recent rescue mission the rescue swimmer was hampered in his attempt due to his wet suit's poor fit. Not only did this poor fitting suit restrict his swimming ability, but it would not have provided adequate protection for the swimmer if required. This problem jeopardizes both the person in distress and the wearer. For this reason every unit must issue relatively good fitting wet suits to their crewmembers. However, fully custom fitted wet suits are not recommended for many reaons. Only individuals with unusual shapes should be considered for custom fitting.

The primary purpose of the wet suit is to provide hypothermia protection to the wearer. This is achieved by the millions of tiny bubbles in the neoprene foam providing insulation from the cold water. Small amounts of water entering the suit have no serious effect. Loose fitting suits allow relatively large amounts of water to enter or pool inside the suit and almost any movement results in flushing of the suit with cold water which reduces the wearer's body temperature. The wet suits that we recommend for crewmembers are especially designed to allow for constant wear (out of the water) with acceptable discomfort. This is accomplished with a slightly looser fit (than a diver would prefer) plus expansion zippers and velcro closures. With the zippers in the open position they provide approximately three (3) inches of expansion in the torso, arms and legs, which allows for some air to circulate under the suit. Before or after water entry the zippers and velcro closures must be closed. Once the necessary steps have been taken to tighten and seal the suit it must fit relatively snug if it is to be effective.

We do not recommend custom fitting of wet suits for many reasons. Only individuals with unusual shapes should be considered for custom fitting.

IMCO ISSUES NEW MERSAR MANUAL

The Inter-Governmental Maritime Consultative Organization (IMCO) has issued the second edition of the Merchant Ship Search and Rescue Manual (MERSAR).

The edition contains a new chapter on "Assistance by SAR Aircraft" and a revised chapter on "Communications." Minor changes and up-datings have been made to other chapters. The basic instructions for ships to assist in a search and rescue operation (including special search patterns) remain pretty much the same.

A consequential revision to CG-421, Part 1 - Merchant Ship Search and Rescue Manual is expected to be issued to SAR units early in 1979. Until that time, the IMCO publication may be purchased at the following outlets:

New York Nautical Instrument and Service
140 West Broadway
New York, NY 10013
Price: $7.50

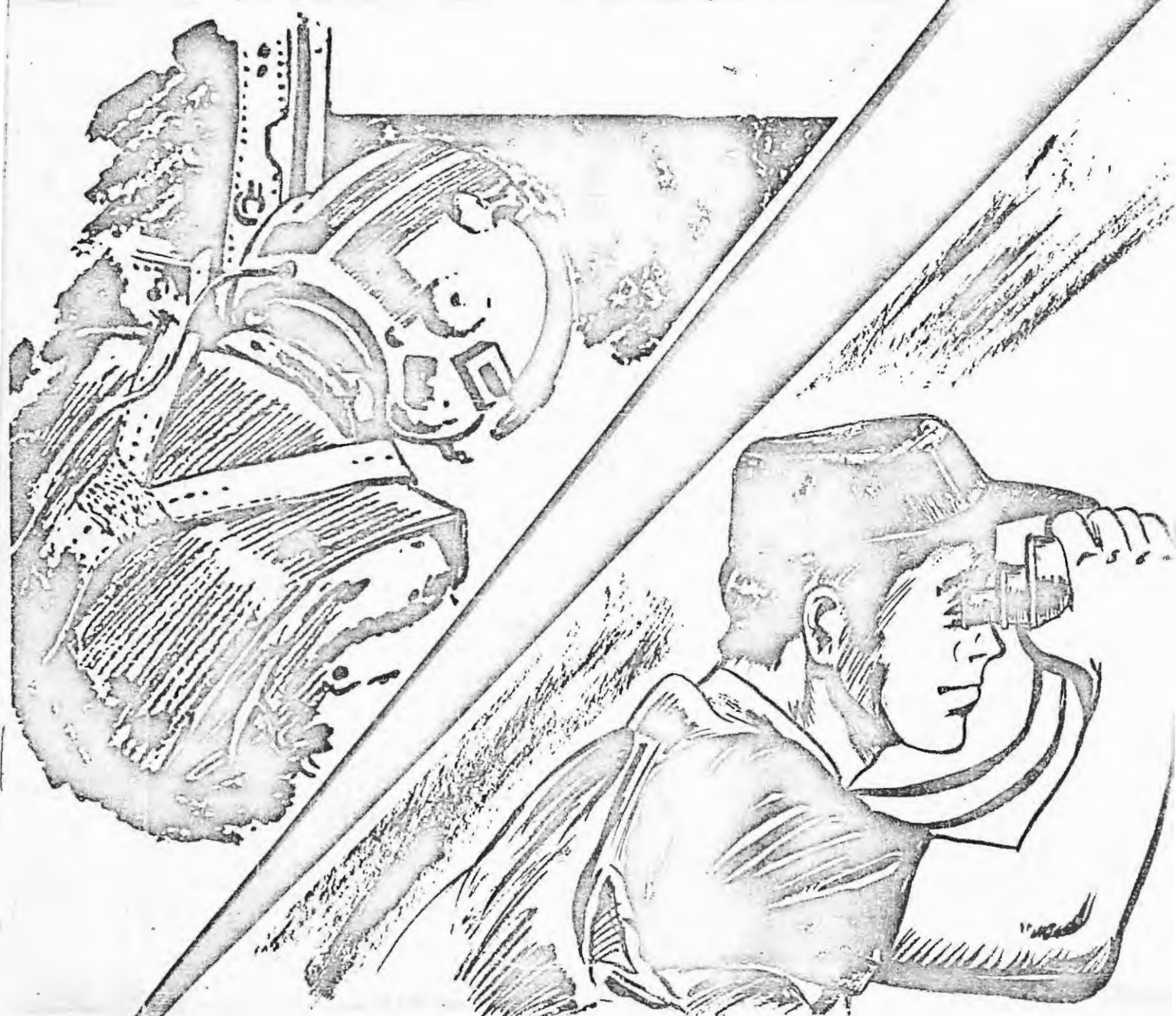
Southwest Instrument Co.
235 West 7th St.
San Pedro, CA 90731
Price: $4.70

Inter-Governmental Maritime Consultative Organization
101 - 104 Piccadilly
London W1V OAE
England
Price: 1 Pound 50 pence (approximately $2.50)

ON SCENE

4/3/79

THE NATIONAL MARITIME SAR REVIEW



DEPARTMENT OF TRANSPORTATION

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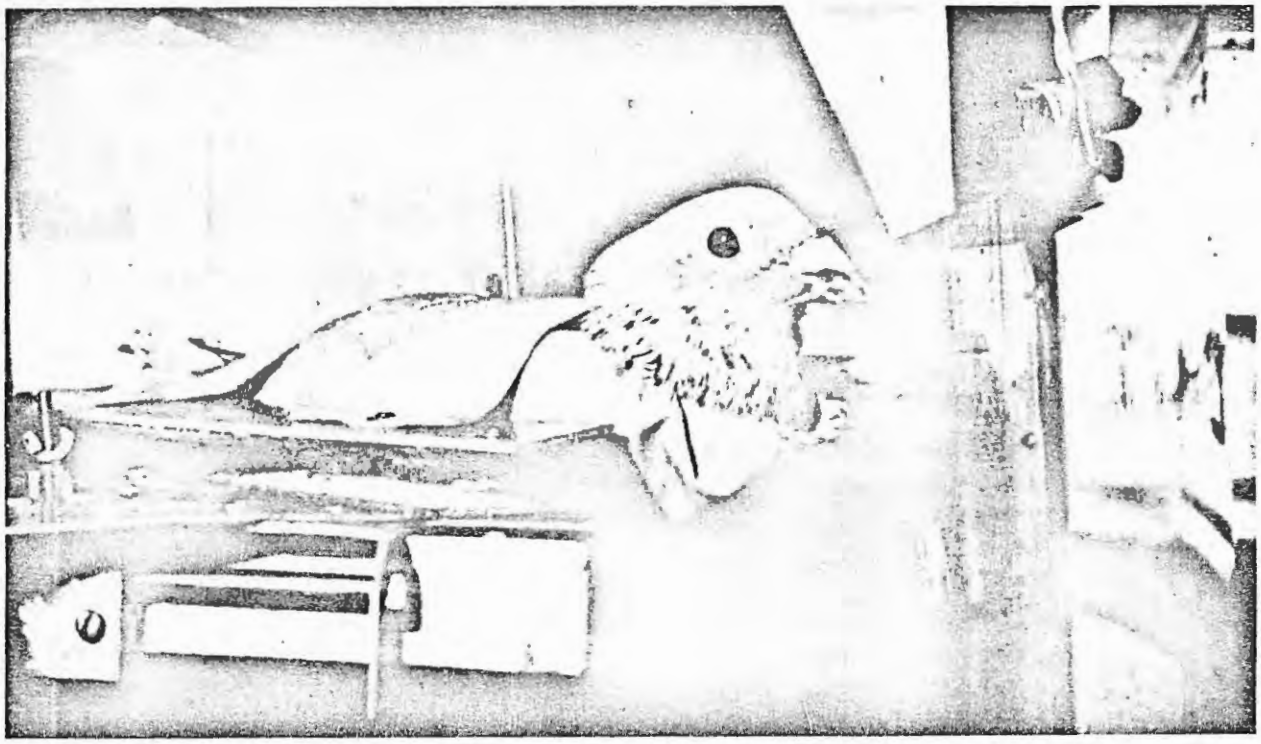
SEARCHING BY MARK II EYEBALL

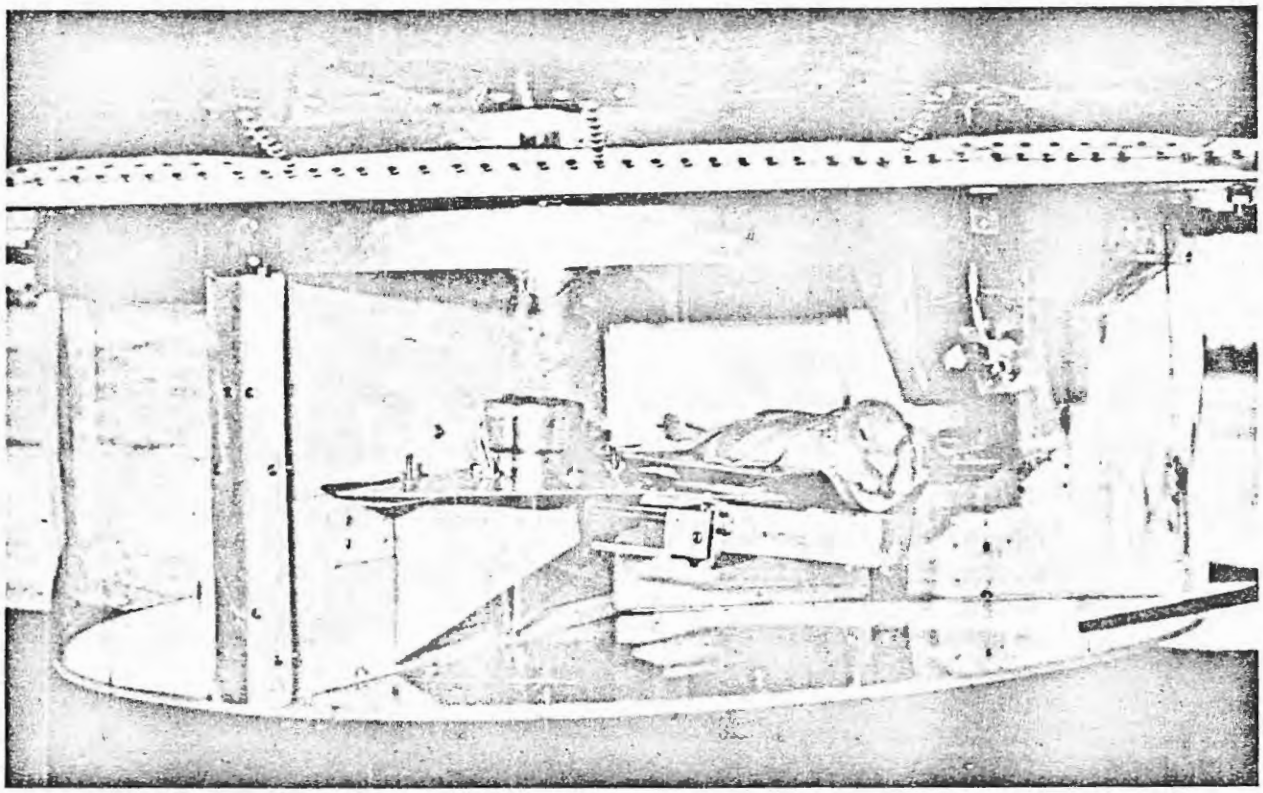
We've all been complaining for years about the deficiencies of the Mark I (human) eyeball. Now along comes an R&D project which seems to be showing that visual searching is literally "for the birds" with the advent of the Mark II (pigeon) eyeball.

Project SEA HUNT was proposed to the Navy in 1976. It was based on the assumption that trained pigeons could be used as an aid to the crew of an aircraft on a daylight search mission because of the pigeon's superior visual search rate ability. The pigeon is able to process acutely a much larger proportion of a visual field than man in the same amount of time.

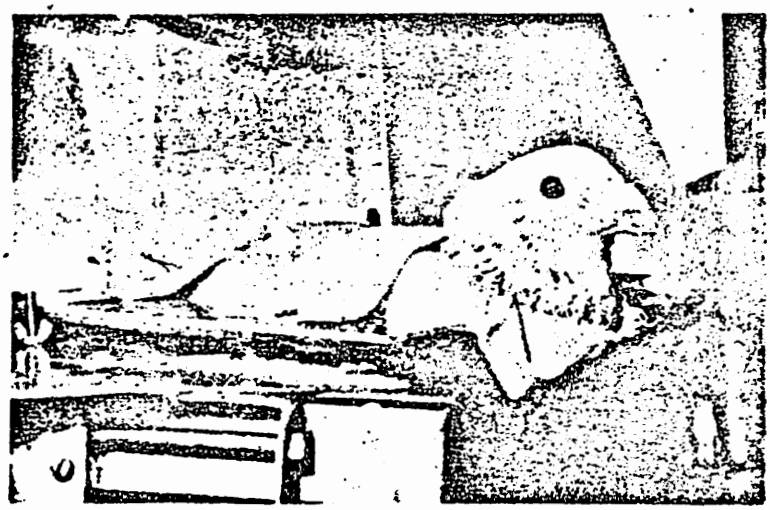
The prototype system consisted of three birds harnessed in separate compartments in an observation chamber attached to the underside of a helicopter. (See photos). The birds had been trained to detect orange objects on the ocean surface, and signal their prsence by pecking a response key. The key sends an aural signal to alert the crew to look at the visual display which is also triggered by the key. The display shows the direction in which to concentrate the search.

Four birds were trained and, after initial flight tests with Marine Corps helicopters, the Coast Guard joined in the project.





As you can see from the photos, the birds are harnessed in a 360° viewing compartment, each having a 120° scanning sector. When a bird signals a target sighted, the pilot can tell from his display in which sector the target is located.



EAGLE-EYED pigeons outperformed Coast Guard flight crews on test search and rescue missions.

Rescue aid birds go down with copter

By JEAN WALLER

A promising search and rescue experiment utilizing the "eagle-eye" of pigeons to spot floating debris ended abruptly when a Coast Guard helicopter carrying the birds had to ditch in the ocean off the island of Hawaii.

The pigeons had the ill fortune to be strapped to the underbody of the only one of seven planes on a Feb. 15 search mission to run out of gas.

They were presumed drowned at sea but the four-man crew escaped unhurt.

Trained by the Naval Ocean Systems Center in Honolulu, the birds reportedly were better at locating an orange colored object resembling a life jacket than the Coast Guard flight crews carrying the pigeons on test runs.

The birds, of the common park species, would "just sit there fat, dumb and happy with nothing else to do but look," said Capt. Tom Lutton, chief of the Coast Guard Operations and Environmental Technology Division.

"I'm a pilot and I've spent a lot of time in planes looking for people," said Lutton.

"The chance of a crew blinking or dozing is much greater than for a bird that doesn't have to fly the plane."

When flight teams were first asked to participate in Operation Sea Hunt, their attitude

corn sufficient to keep their concentration keen.

When a bird spots the orange buoy it presses a lever and is treated to a morsel of corn.

The level in turn activiates a signalling device telling the Coast Guard crew where to look for the buoy.

During test passes the sharp-eyed pigeons found the target first 86 percent of the time.

Navy researchers who spent two years developing the pigeon training program are undecided whether to seek funding to train another feathered search team.

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"The chance of a crew blinking or dozing is much greater than for a bird that doesn't have to fly the plane."

When flight teams were first asked to participate in Operation Sea Hunt, their attitude was one of bemusement, according to Lt. Cmdr. Kenneth Williams of the Coast Guard Research and Development Branch.

However, after a few passes over a test area where the pigeons significantly outperformed their human counterparts, the flight crews were "really quite impressed," said Williams.

The pigeons also are easy to please with a mere kernel of corn sufficient to keep their concentration keen.

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EVALUATION OF THE DETECTION CAPABILITIES OF THE SEA HUNT SYSTEM

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Enclosure (1)

BACKGROUND

During the period 4-17 December 1982, a field team from the Coast Guard R&D Center conducted a performance evaluation of the Sea Hunt System (see reference 2 for a description of the system). Data collection occurred on a total of six experiment days off the coast south of San Francisco (see Figure 1). Weather and aircraft mechanical difficulties precluded experiments on three of the nine days scheduled for tests. Air Station San Francisco provided a HH-52A helicopter and crew for all sorties. USCGC POINT HEYER served as a platform for setting and recovery of targets, weather observations, and on-scene coordination of the exercise. Mr. Bob Gisiner, a contractor to Naval Ocean Systems Center (NOSC) Hawaii, was the observer and data recorder on board the Sea Hunt-equipped HH-52. Target deployment positions and helicopter tracks were monitored and recorded at the San Francisco Vessel Traffic System (VTS) Center on Yerba Buena Island using the Point Bonita radar.

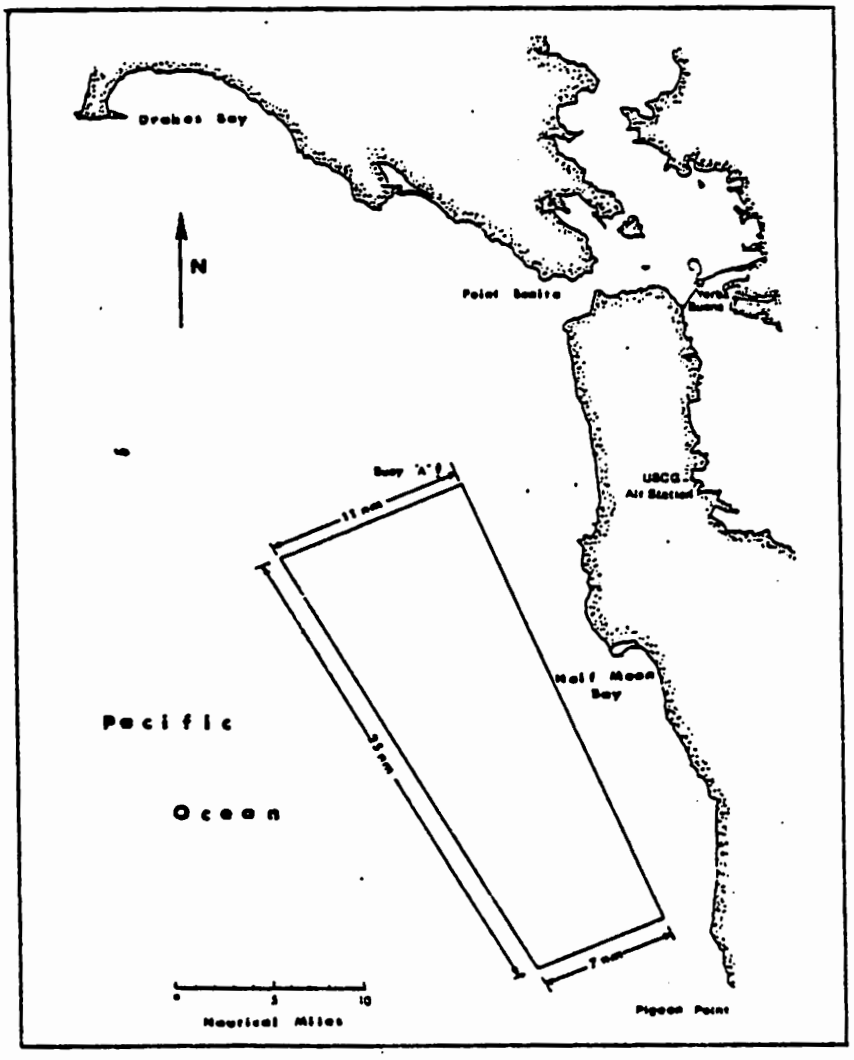


FIGURE 1. Exercise area for Sea Hunt System evaluation

DATA COLLECTION

The test was designed to provide a limited comparison between the detection performance of the Sea Hunt system and human lookouts. To maximize use of time available for data collection, all primary controllable parameters were held constant. Search speed for all tests was 60 knots, search altitude was 500 feet, and only one target type was used. The targets were fabricated to simulate an overturned boat with a lifejacketed survivor hanging on. The 4 by 8 foot targets were painted reddish brown and one life jacket was attached to each. The underside of the target was covered with foam insulation to provide it with some freeboard (see Figure 2).

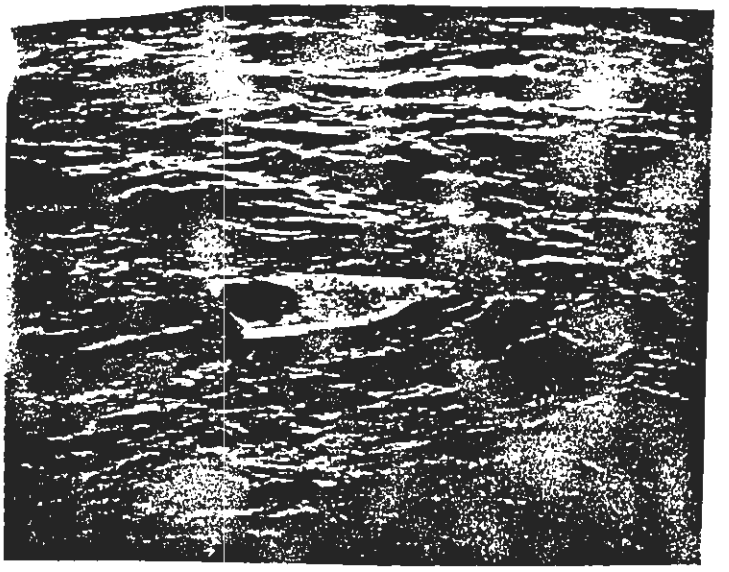


FIGURE 2. Photograph of one of the targets used during this Sea Hunt evaluation.

All sorties were trackline searches with the targets moored along the assigned tracks. Normally, in experiments of this type, position information would have been gathered using the R&D Center's microwave tracking system (MTS). Unfortunately, time and funding restrictions placed on this project did not permit use of the MTS. Position data were obtained using the radar at VTS San Francisco, and the LORAN-C's on board the CGC POINT HEYER and the Sea Hunt helicopter. The VTS was unable to maintain contact with the helicopter in the extreme southern portions of the exercise area. For this reason, search tracks were moved to the northern portion of the exercise area during the latter part of the experiment.

For the purpose of this test, the responses of the pigeons were monitored by the on-board observer only, the helicopter crew received no information from the Sea Hunt System. The on-board observer also served as the in-flight pigeon trainer creating a very heavy workload for him. Weight limitations prevented the assignment of an additional person to run the Sea Hunt System during the test flights. A strip chart record of the pigeon's responses was automatically produced by the Sea Hunt system and served as a check on the observer's records. Though the speed of the strip chart varied, the observer made frequent time marks on the chart making this record accurate to within $\pm$ 10 seconds.

Environmental conditions were recorded by the R&DC field team members aboard the CGC POINT HEYER and on board the helicopter. The ranges of environmental conditions encountered during data collection are listed in Table 1. Significant wave height (H_S), as used here, is defined as the average height of the upper third of the waves and swells and represents the wave/swell height that would normally be reported by an experienced observer. The number of white caps was estimated and recorded as either none, some or many.

TABLE 1 - Range of environmental parameters encountered during data collection.

Parameters	Range
Wind speed (knots)	3-30
Cloud cover (tenths)	0-2 and 10
Visibility (nm)	12-20
Significant wave height (ft)	0-0.5 and 2-6
White caps	none to some

ANALYSIS

The first step in the data analysis was the reconstruction of the experiment. Reconstruction is the process of plotting all of the position information and extracting all the valid sighting data from the logs and data sheets. Whenever possible, the reconstruction of a detection opportunity was done using only those positions determined from the VTS radar. For those areas where VTS positions were not available, Loran-C positions were used. A data file was then created using all detection opportunities including those for which position accuracies could not be confirmed. This file was used for all analyses except for developing cumulative detection probability (CDP) curves. A separate file containing all position data determined to be accurate to better than a third of a nautical mile (nm) was used for the CDP analysis.

Only three of the five environmental parameters listed in Table 1 were considered in this study. Since no targets were detected at greater than 3 nm and the minimum visibility encountered during the experiment was 12 nm, the effect of visibility could not be determined using the available data set. The effect of wind speed was assumed to be adequately represented by the white cap and significant wave height (H_S) parameters.

To identify which system (i.e., Sea Hunt or lookouts) displayed the best detection performance under the range of environmental conditions encountered during this test, a non-parametric matched-pair statistic known as the "sign test" was used (reference 1). Matched pairs were formed by grouping a detection opportunity for Sea Hunt with the corresponding detection opportunity for the lookouts for each target. Credit for better detection performance was given for either detecting a target first or detecting a target that the other system missed. The sign test produced levels of significance for each range of environmental conditions and for the entire data set considered as a whole. In this case, level of significance is defined as the probability that the data set as collected misrepresents the conclusion that the Sea Hunt System outperforms the lookouts. For this

analysis, the criteria for accepting the conclusion that the Sea Hunt System outperforms human lookouts was taken to be the 0.05 level (i.e., better than a 95% probability that this conclusion is correct).

RESULTS

Table 2 lists the results of the sign tests performed on the Sea Hunt data. In all of the categories, the pigeons detected the targets first more times than the lookouts. These statistical tests show that the Sea Hunt System is statistically superior (i.e., exceeds the 0.05 level of significance) to human lookouts for the detection of small orange targets in a moderate sea state. The test also indicates that the Sea Hunt System probably outperforms lookouts under the range of white cap and overcast conditions encountered although there was insufficient data to substantiate this conclusion. The low level of significance for the no white cap and totally overcast conditions are most likely due to contamination from the effect of the 2-6 foot H_S (i.e., all the overcast and 60% of the no white cap conditions occurred during 2-6 foot H_S). The same is true for the "all conditions" category.

TABLE 2 - Results of the sign test for difference in detection ability. N is the number of matched pairs for which a difference could be discerned, R is the number of times the Sea Hunt System either detected a target missed by the lookouts or detected the target first.

Environmental Conditions	N	R	Level of Significance
White caps			
None	12	9	0.0730
Some to many	6	4	0.3437
Cloud cover (tenths)			
0-2	11	8	0.1133
10	7	5	0.0625
Significant wave height (H_S)			
0-0.5 feet	5	3	0.5
2-6 feet	13	10	0.0461
All conditions	18	13	0.0481

Table 3 summarizes the percentage of target opportunities detected as a function of H_S. The number of detections and detection opportunities were evenly distributed through the 2 to 6 foot H_S range (i.e. 6 opportunities in both the 2-3 foot range and the 5-6 foot range). A difference in performance within the 2-6 foot H_S cannot be determined from this limited data set. These results are similar to those achieved by NOSC. In the NOSC experiments, the Sea Hunt System achieved an 83% detection rate compared to 58% for lookouts in searches for a life raft and a large orange buoy, 71 inches in diameter and having a 22-inch freeboard (reference 2).

TABLE 3 - Percent detected as a function of significant wave height (H_S) for Sea Hunt System and lookouts.

Hs (ft)	# Opportunities	Sea Hunt	Lookouts	Combined
0-0.5	8	100%	100%	100%
2-6	16	75%	50%	81%
Combined	24	83%	67%	87%

In this experiment, the Sea Hunt system and the lookouts achieved maximum detection ranges of 2.8 nm and 1.5 nm respectively. Not only did the Sea Hunt system detect the targets at longer ranges than lookouts for 0-0.5 H_S, the Sea Hunt system continued to make detections at longer ranges in rougher seas (see Table 4).

TABLE 4 - Distribution of detections by Sea Hunt and lookouts. Detections are binned by significant wave height (H_S) in feet and detection range (x) in nautical miles (nm). No detections occurred at the range of 3nm or greater.

H_S	Sensor	# of detection binned by range (x) in nm. $0 \leq x < 1$	$1 \leq x < 2$	$2 \leq x < 3$	Total Detection
0.0-0.5	Sea Hunt	5	2	1	8
	Lookouts	7	1	0	8
2.0-6.0	Sea Hunt	6	3	3	12
	Lookouts	8	0	0	8

During the experiment, several large ships passed within the detection envelope of the Sea Hunt System. Even though a few of these ships displayed significant amounts of red and orange and one ship came within 400 yards of the Sea Hunt helicopter, the pigeons did not respond to these nuisance targets. This suggests that the pigeons are capable of being trained to ignore many nuisance targets. Unfortunately, no detection opportunities coincided with the occurrence of large vessels close aboard. Whether or not the pigeons will respond to a target in close proximity to a nuisance target remains unknown.

The cumulative-detection-probabilty (CDP) versus range curves for Sea Hunt and lookouts in 0-0.5 foot H_S are presented in Figure 3. Positive ranges represent the helicopter closing on the target, and negative ranges represent the helicopter moving away. There were detection opportunities up to 10 nm but no detections beyond 3 nm. The CDP curves were calculated with the smaller data set, therefore the curves represent only 3 opportunities for Sea Hunt and 5 for the lookouts. While both groups achieved 100% detection, the pigeons had the largest detection range.

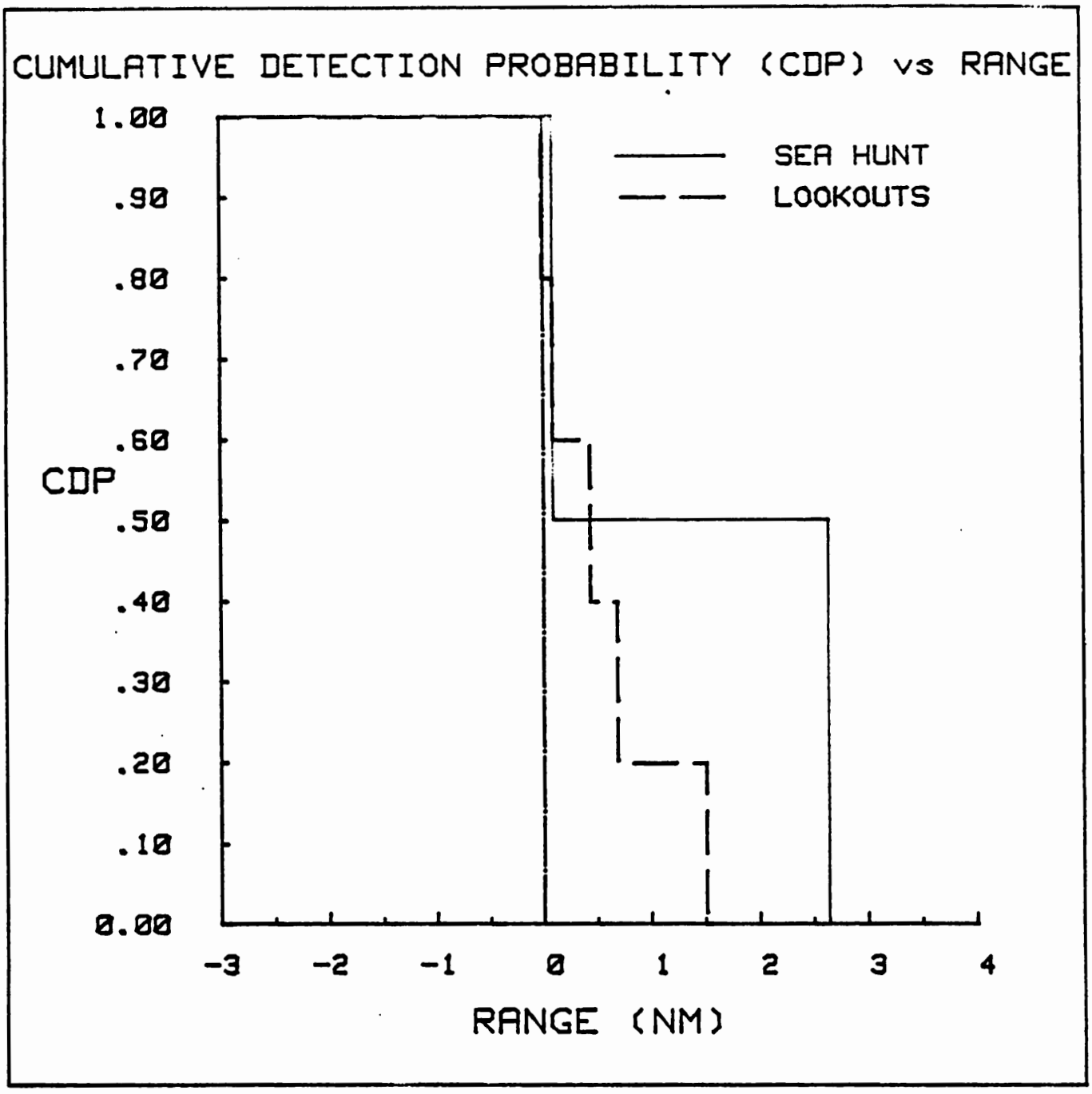


Figure 3. Plot of Cumulative Detection Probability (CDP) vs. Range for Significant Wave Heights (H_S) between 0.0 and 0.5 feet. The solid green line was drawn through 3 analysis points for the Sea Hunt System. Each point represents 1 or 2 detection opportunities. The dashed red line was developed from 5 analysis points for human lookouts on the Sea Hunt equipped platform with each point representing 1 to 5 detection opportunities.

Figure 4 presents the CDP curves for 2-6 foot H_S. Although both pigeons and humans obtained a final CDP of approximately 80% in this range of sea states, first detection of the targets by the human lookout were all at less than 1 nm. The Sea Hunt System, by comparison, had obtained a CDP of 40% by 1 nm indicating again that it was able to detect the targets at a greater range.

CONCLUSIONS

1. In 0-0.5 foot H_S, no statistically significant difference was identified in the detection performance of the pigeons and the human lookouts for small orange targets that pass within .5 nautical miles. However, the Sea Hunt System does make detections at greater distances under these conditions.

2. In seas of 2 to 6 feet, the Sea Hunt System is significantly better than the human lookouts at detecting the test targets. Under these rougher conditions, the Sea Hunt System has a greater detection range than human lookouts for the test targets, indicating that the system would most likely have a larger sweep width. This is the first system that the R&D Center has tested with detection performance superior to the human lookout in searches for very small targets during daylight hours in good visibility.

3. The Sea Hunt System did not respond to yellow, orange, or red located on very large nuisance targets. This suggests that the pigeons may be trained to ignore a variety of large nuisance targets.

SUGGESTIONS FOR FUTURE WORK

If the decision is made to continue with Sea Hunt evaluations, then:

1. Additional detection data will be necessary to complete a statistically valid evaluation of this system over the range of environmental conditions that may affect its performance. This test was simply a rough evaluation of Sea Hunt and should not be considered a definitive statement of the system's performance.

2. Future tests should also be conducted to determine the performance of Sea Hunt and the human crew as a single system. Two helicopters, one with the Sea Hunt System, should be tested simultaneously for detection performance. The search area should be swept clear of all man-made objects and then seeded with typical search objects and nuisance targets. With the data collected, system performance under more realistic conditions could be evaluated, and the issues of false alarms and nuisance targets could be addressed.

3. The possibility of training the pigeons to ignore nuisance targets should be investigated.

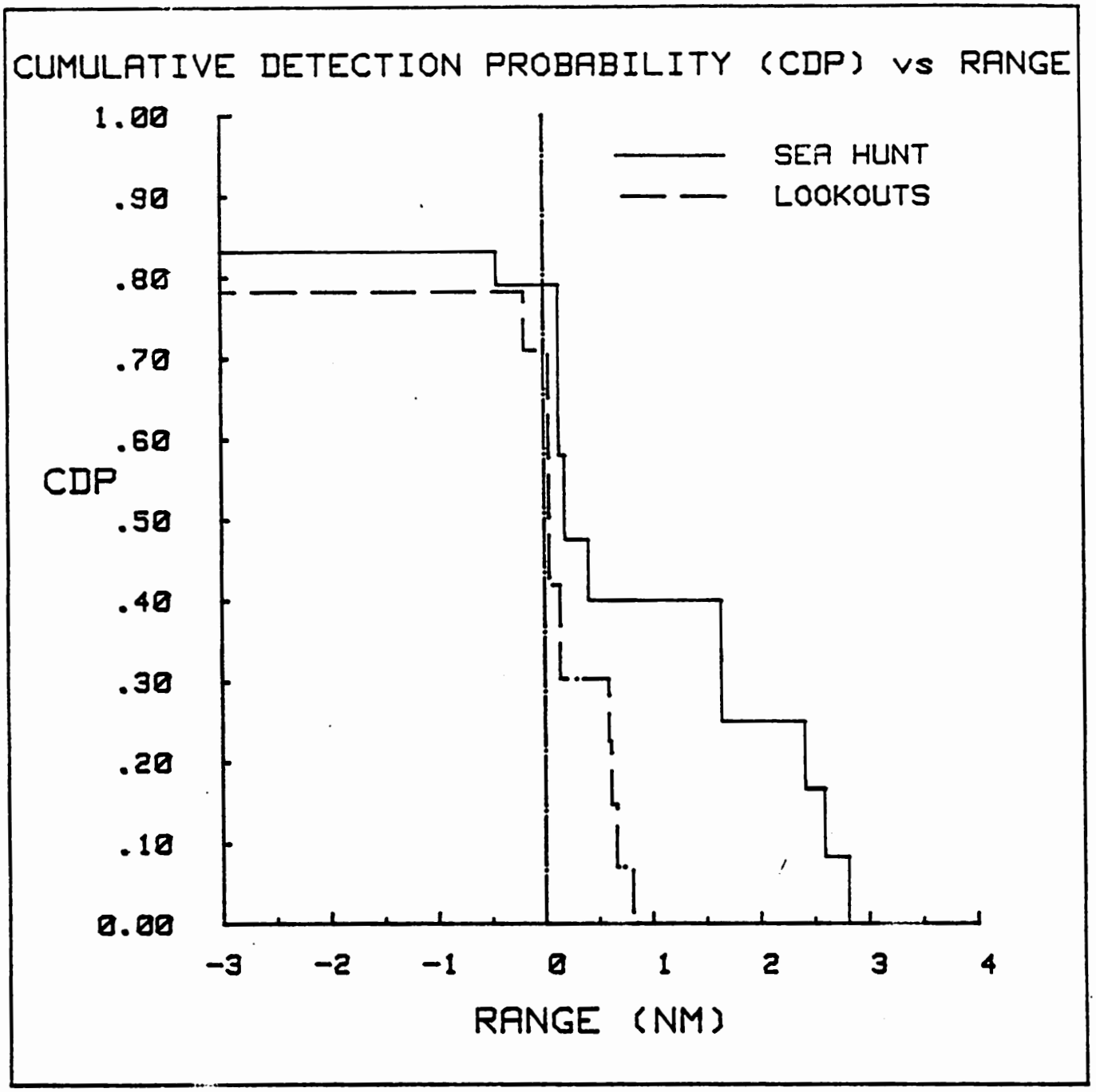


Figure 4. Plot of Cumulative Detection Probability (CDP) vs. Range for Significant Wave Heights (H_S) between 2 and 6 feet. The solid green line was drawn through 19 analysis points for the Sea Hunt System. Each point represents 7 to 12 detection opportunities. The dashed red line was developed from 20 analysis points for human lookouts on the Sea Hunt equipped platform with each point representing 1 to 14 detection opportunities.

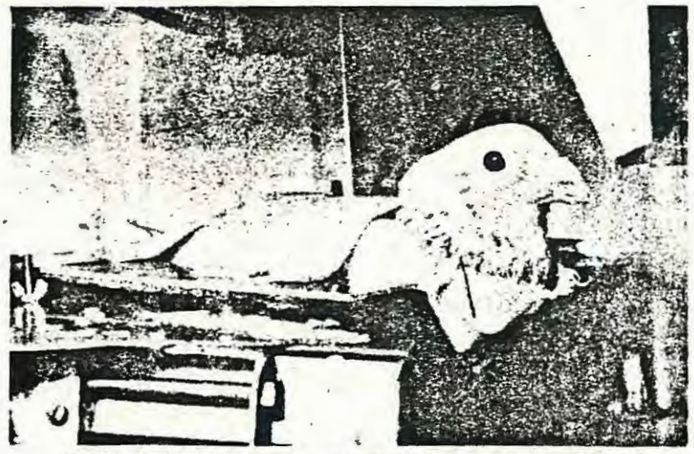
APPENDIX A

LETTERS OF APPRAISAL

REFERENCES

1. Lapin, Lawrence L. STATISTICS, MEANING AND METHOD, Harcourt Brace Jovanovich, Inc., New York. 1975.

2. Simmons, J.V., Jr., PROJECT SEA HUNT: A REPORT ON PROTOTYPE DEVELOPMENT AND TESTS. NOSC TR746, Naval Ocean Systems Center, San Diego, California. July 1981.



EAGLE-EYED pigeons outperformed Coast Guard flight crews on test search and rescue missions.

Rescue aid birds go down with copter

By JEAN WALLER

A promising search and rescue experiment utilizing the "eagle-eye" of pigeons to spot floating debris ended abruptly when a Coast Guard helicopter carrying the birds had to ditch in the ocean off the island of Hawaii.

The pigeons had the ill fortune to be strapped to the underbody of the only one of seven planes on a Feb. 15 search mission to run out of gas.

They were presumed drowned at sea but the four-man crew escaped unhurt.

Trained by the Naval Ocean Systems Center in Honolulu, the birds reportedly were better at locating an orange colored object resembling a life jacket than the Coast Guard flight crews carrying the pigeons on test runs.

The birds, of the common park species, would "just sit there fat, dumb and happy with nothing else to do but look," said Capt. Tom Lutton, chief of the Coast Guard Operations and Environmental Technology Division.

"I'm a pilot and I've spent a lot of time in planes looking for people," said Lutton.

"The chance of a crew blinking or dozing is much greater than for a bird that doesn't have to fly the plane."

When flight teams were first asked to participate in Operation Sea Hunt, their attitude was one of bemusement, according to Lt. Cmdr. Kenneth Williams of the Coast Guard Research and Development Branch.

However, after a few passes over a test area where the pigeons significantly outperformed their human counterparts, the flight crews were "really quite impressed," said Williams.

The pigeons also are easy to please with a mere kernel of corn sufficient to keep their concentration keen.

When a bird spots the orange buoy it presses a lever and is treated to a morsel of corn.

The level in turn activiates a signalling device telling the Coast Guard crew where to look for the buoy.

During test passes the sharp-eyed pigeons found the target first 86 percent of the time.

Navy researchers who spent two years developing the pigeon training program are undecided whether to seek funding to train another feathered search team.

NOSC NEWS

Naval Ocean Systems Center San Diego, California 92152
Joel T. Meriwether Public Affairs Officer, (714) 225-7805

For Further Information Contact Pat Polakowski September 20, 1978
For Release: AT WILL

Project Sea Hunt

Homing pigeons, widely known to have excellent vision and unique behavioral abilities, are being trained by the Naval Ocean Systems Center, San Diego, to search the ocean surface for lost personnel or objects.

The program, titled Project Sea Hunt, is underway at NOSC's midocean base at Kaneohe Bay, Oahu, Hawaii.

Four birds have been trained to report the sighting of orange targets by pecking a response key. Results to date indicate that pigeons can reliably detect objects at distances greater than 2,000 feet, according to James V. Simmons, Jr., project director.

Simmons points out that Navy, Coast Guard and civilian search and rescue activities would be likely beneficiaries of the abilities of the trained pigeons. Search and rescue helicopter crews often must search vast expanses of the ocean looking for personnel. Limited fields of view, competition of other duties and optical problems such as sun glare make if difficult to see objects on the surface of the ocean. The trained pigeon, with its superior visual system, appears to offer an effective, inexpensive aid to search activities.

In early training, pigeons are placed in an observation chamber that simulates the vibration and noise environment of a helicopter. An orange target

-more-

is anchored close to the observation chamber and intermittently exposed to the pigeon's view. The pigeon is presented food for pecking the key while the target is exposed. As training progresses, the distance between the target and the observation chamber is gradually increased until it is more than 2,000 feet away. Despite the increasing target distance, the pigeon's search and report behavior remains high. It responds within ten seconds and despite infrequent target presentations, detection failures and false reports are low.

Advanced training is performed from an observation chamber mounted on a helicopter. The chamber, designed to be portable, light-weight and easily attached to Navy and Coast Guard helicopters, provides the pigeons a safe, unobstructed view of the ocean. The birds learn to perform during searches for a target which simulates a life-jacketed man in the water. A control panel enables the trainer to determine when the target is detected, together with its approximate location. As in early training, the pigeon is presented food for reporting the presence of the orange target.

On training flights, the birds report sighting the practice target about 30 seconds before the flight crew on nearly sixty percent of the approaches to the target at ranges exceeding half a mile. The trained pigeons have even spotted lost orange surfboards and other orange debris on the ocean surface. These results indicate that the Sea Hunt system can assist in the detection of objects or personnel on the surface of the ocean.

3 Trained Pigeons Lost In Helicopter Ditching

HONOLULU, Feb. 16 (UPI)—Three pigeons trained to aid in ocean search and rescue were lost Thursday when a Coast Guard helicopter they were riding was forced to make an emergency landing in the ocean. the pigeons were trained by the Naval Octon Systems Center to peck a buzzer if they spotted lifejackets or other ocean gear.

They were being used in a Coast Guard-Coordinated Search in Hawaiian waters for a missing 17-foot Boston Whaler, the Sarah Jo, with five men aboard. The boat disappeared Sunday afternoon.

The three birds were housed in a plastic bubble beneath the helicopter. A Coast Guard spokesman said all four crewmen aboard the helicopter were unhurt in the ditching.

Honolulu Star-Bulletin, Wed 14 Feb 1979

Pigeons Used in Search for 5 Missing Fishermen

For the first time in an actual search operation, three Navy-trained spotter pigeons set out in a helicopter today to help in the aerial hunt today for a 17-foot power boat missing off Maui since Sunday.

The Naval Ocean Systems Center, near the Kaneohe Marine Corps base, has been training the birds since last fall.

Coast Guard spokesman Jim Gillman said the three pigeons were to fly over the search area in a special "bubble" container fixed underneath the helicopter.

Using their sharp eyesight they can spot objects invisible to humans and they are trained to peck on a buzzer when they see anything orange, the common color of life jackets, floats and many other items associated with disabled or sunken vessels.

Gillman said the three birds used today were arranged to view a complete circle, with each bird given a 120-degree viewing angle.

The helicopter crew would know what direction to go when any bird sends them a signal.

IN ADDITION, 15 aircraft from the Coast Guard, the Navy, the Air Force, the Civil Air Patrol and the Coast Guard Auxiliary were searching an area of 14,400 square miles of ocean today.

The boat, the Sarah Joe, left Hana for a fishing trip Sunday morning and radioed a distress call at about 5 p.m. the same day, in heavy seas and high winds, apparently with a disabled engine.

The search since the distress call failed to find any trace of the Sarah Joe or its crew.

Hana police said a large group of volunteers combed the rugged Maui coast yesterday between Hana and Kipahulu looking for traces of the boat and a team of Marines checked the shoreline of Kaboolawe in case the crew had made it to shore.

The missing men are Ralph Malaikini, Benjamin Kalama, Peter Hanchett, Scott Mooreman and Patrick Woesner.

COAST GUARD

PUBLIC AFFAIRS DIVISION PRESS CLIPPINGS DATE 22 JUN 79

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Bird-brained idea? No; pigeons may save lives

Washington (AP)—In this age of laser and sonar and other sophisticated wizardries, the Coast Guard has hit on a new way of finding people lost at sea.

Hungry pigeons.

Pigeons of the plain, park-bench, statue-sitting variety.

A man at the Naval Oceans Systems Center, in Honolulu, has taken five pigeons under his wing, training them to spot the color orange. When the bird sees orange, it pecks at a switch and is rewarded with food.

After graduating from land-training with an orange flag that pops up randomly, the pigeons are strapped into a plexiglass pod attached to the underside of a helicopter and taken for a ride over the sea.

"We found in some tests last year that the birds would detect the target about 90 per cent of the time on the first pass," said Douglas Conley, who runs the project. "The pilots and crews would detect it about 40 per cent of the time and they know where to look."

The pigeons ride three to a pod, each facing a different direction. Lights in the cockpit tell the pilot which bird spots the target and from that he knows which way to look. The winning bird gets food.

Do they cheat? "As far as I know, we haven't had many false alarms at all," said Mr. Conley, who is in the Coast Guard's Office of Research and Development.

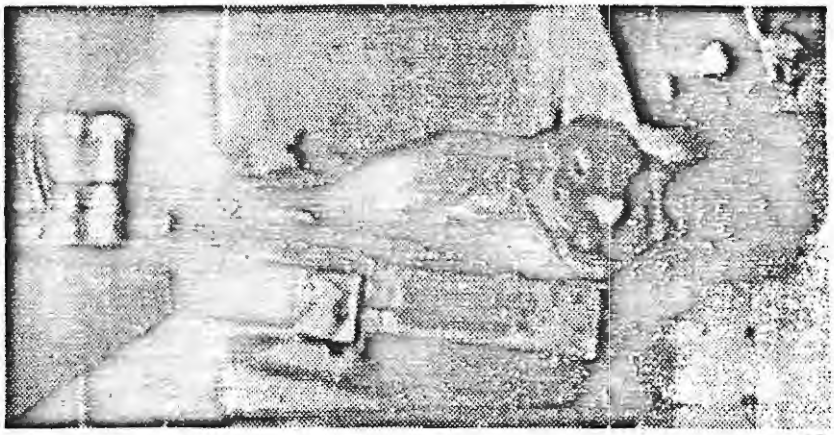
At first, chopper captains thought flying co-pilot with pigeons was for the birds, but changed their minds with the results.

"The birds seem pretty happy about it," Mr. Conley said. "We haven't had any complaints."

It took 18 months to train the first set of three. They were used to look for a small motorboat off Hawaii in February, but the helicopter crashed and the birds were lost. Five birds are in training now and are expected to be flying by the end of September and October.

If it works out, the Coast Guard hopes to use simulators to train the birds. Right now the target color is orange; later they'll be trained on yellow—the color of most liferafts—and red. And, who knows, eventually pigeons may be trained to peck when they see anything man-made on the water.

This year, the Coast Guard is spending $73,000 on the project, which pays for bird-training, a new observation pod and better electronic components.



AP

School's out for almost everyone except this pigeon and others like it, which are being trained by the Coast Guard to spot and respond to the color orange. When the birds graduate, they will take to the sky not on their own wings but in helicopters from which they can spot colored rafts, potentially helping find people lost at sea.

SAR is for the Birds – or Project Sea Hunt

One of the most helpless feelings in man's experience is to be lost at sea. The accepted method of searching for someone in the vast expanse of ocean is to use as many aircraft as possible with human lookouts. The aircraft follow a pattern of search which is, hopefully, in the area of the lost person. Whether or not the observer is successful depends on many factors – alertness, fatigue level, interference with other essential duties, sun angle, weather, altitude, the list goes on. The main drawback, sometimes, is the capability of the observer's eyes.

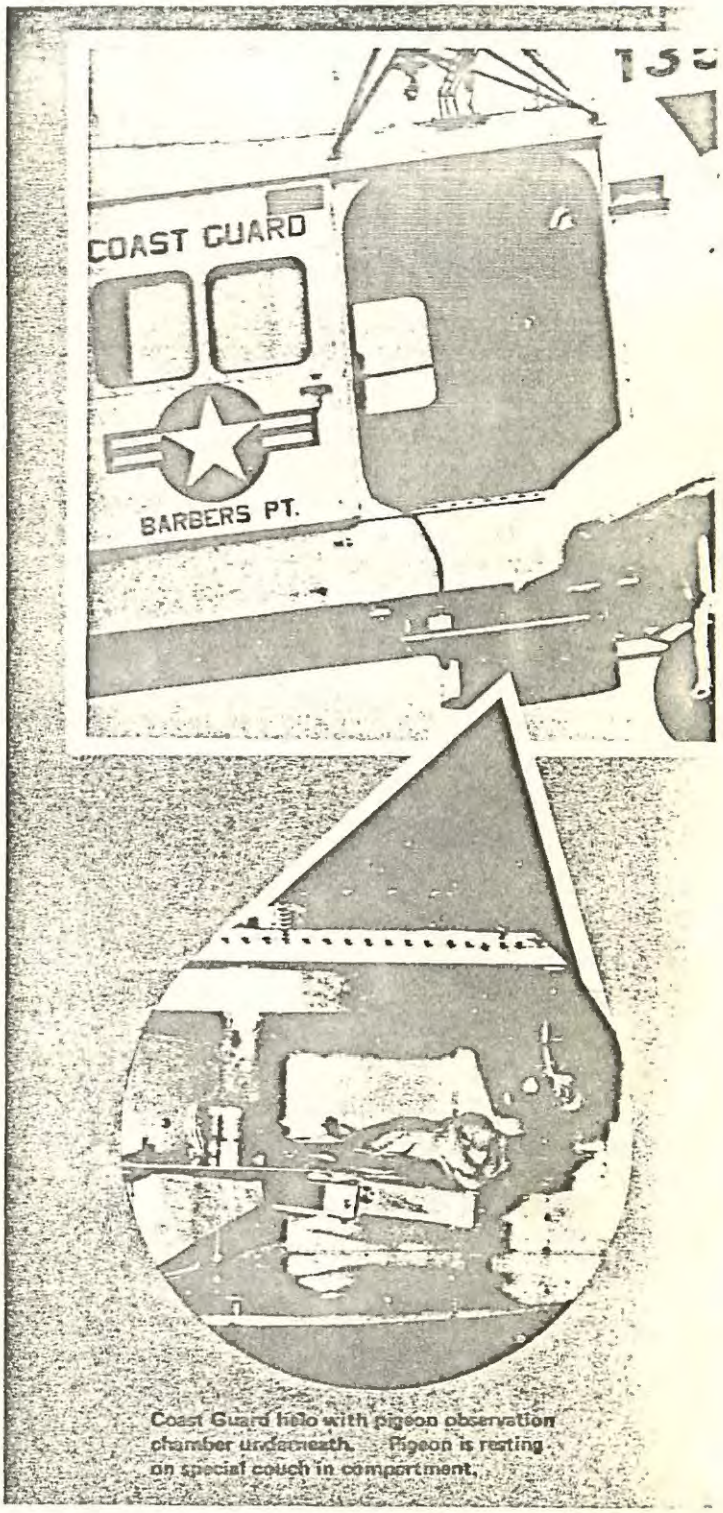
Since search and rescue is the core of the Coast Guard mission, that service has been looking for ways to increase the probability of detecting a person or object on the earth's surface.

Birds generally have eyesight far superior to man's. This is not strange since survival requires them to identify food, find prey or detect danger at great distances. The pigeon in particular is much better suited to visual search than man. It has a superior search rate ability, being able to process a much larger proportion of the visual field in the same amount of time.

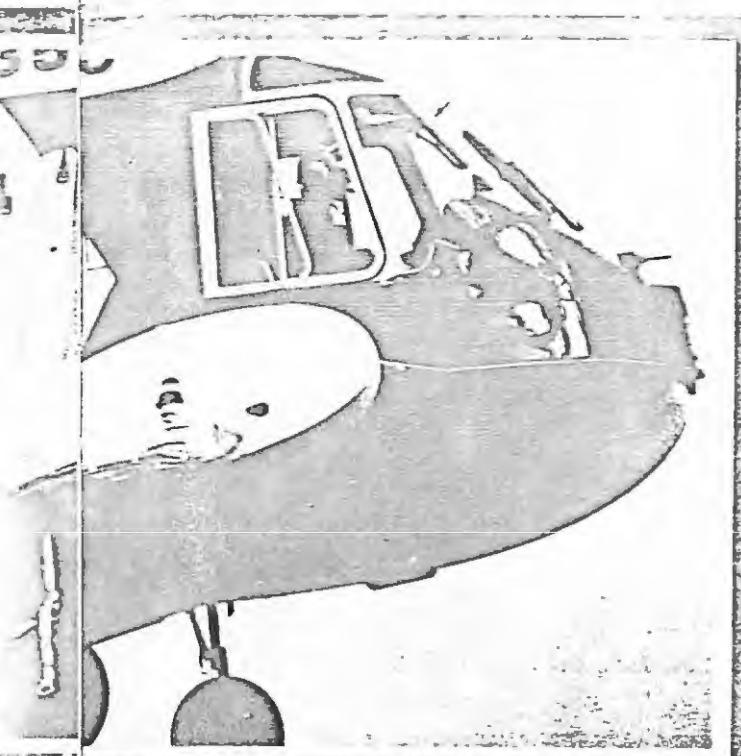
The Coast Guard began a study to determine whether the unaided visual abilities of the pigeon could be used to detect the presence of an object on the surface of the ocean at the distances required during aerial searches.

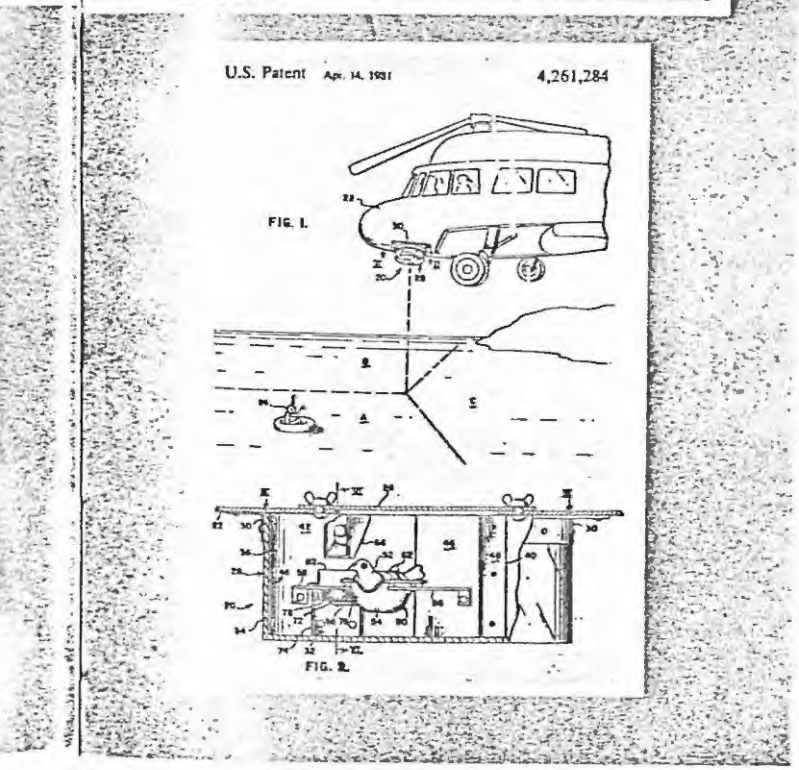
A prototype system was designed in July 1976 in which three birds were comfortably positioned in separate compartments in an observation chamber attached to the underside of a helicopter. Each of the three compartments was fitted with a peck key, feeding mechanism and pigeon couch.

The pigeons were trained to detect orange (the conventional color of emergency equipment) and to indicate the presence of such an object by pecking a response key, which alerted the observer with an auditory signal. Responses by the pigeon were displayed by counter and panel lights. A four-channel strip-chart recorder was used to record the pigeons' responses and detection of the target by the human observer. The target used during the heli-



Coast Guard helo with pigeon observation chamber underneath. Pigeon is resting on special couch in compartment.





copter training and testing was a spherical orange fishing float. The pigeons were trained to peck the response key when the target was presented and were also conditioned to perform their visual task in an environment which simulated the noise and vibration characteristics of a helicopter.

When the pigeons were ready for flight testing, the Station Operation and Maintenance Squadron at Marine Corps Air Station, Kaneohe Bay, one of whose primary duties is SAR for all airfield operations, and Coast Guardsmen at Barbers Point conducted the tests. The Marines flew HH-46As and the Coast Guard H-52s.

The helos would fly to the work area, usually 7 to 10 miles north of MCAS Kaneohe Bay or 5 to 10 miles southwest of the Coast Guard station at Oahu. The target, an 18-inch-diameter international orange buoy, was thrown out of the aircraft and a tacan fix was taken to mark its location. The aircraft then flew further out to sea and the pigeons were placed in the observation chamber. Minutes later the aircraft turned and flew back towards the target. Four to six approach trials were conducted in each one to two-hour flight. The pilot would try to fly the aircraft on a course that would place the buoy to the left or right of the flight path, and the aircrew members would begin visually searching for the buoy. The pigeons sighted the buoy 97 percent of the time on the first pass, compared to 30 percent by the crew members. In 77 percent of the passes, the pigeons were the first to acquire the target. It was frequently necessary for the helos to orbit the area indicated by the pigeons several times before the crewmen saw the buoy. The trainer monitored the pigeons' performance and gave direction information to the crew when there was a detection by the pigeons.

At the end of each session, the practice target was recovered by the hovering helo, using a grappling line to snag a floating line attached to the target.

Not only did the pigeons detect the target on the first pass at a higher probability than the human observers, but the information supplied by the pigeons helped the crewmen concentrate their search in the proper direction.

By 1979, three of the four pigeons had been successfully trained to detect not only orange but also red and yellow. Then, in early 1979, a Coast Guard helicopter carrying the Sea Hunt pigeons was involved in a real-life drama, searching for five men missing on a fishing trip. The crew was forced to make an emergency landing off the North Kona Coast of Hawaii. The observation chamber carrying the birds was torn from the helo and lost along with the birds, martyrs to the cause of SAR.

Both the Marine Corps and Coast Guard pilots involved in the testing agreed that pigeons are much more efficient than humans in searching for small objects of a specific color and will be of great aid in search missions. And so, although there was a break in the testing after the first pigeons were lost, Project Sea Hunt is on again with a new group of "volunteers."

The search aparatus for the Sea Hunt system has been patented and is believed to be only the second U.S. patent granted where a living being is a basic part of the patented item.

It is planned to use the pigeons at a Coast Guard air station for actual search missions in the not too distant future and, in the years to come, many downed pilots may owe their lives to concerned men and women of the Coast Guard and their feathered friends.

NOVEMBER, 1980

Trained rescue pigeons cooped in by budget cut

Despite the fact that they're "superior, expert observers who work for chicken feed," the Coast Guard has laid off its trained pigeons as lookouts for search and rescue missions.

In what is strictly an economy move, the program was dropped Oct. 1, as the Coast Guard began its new budget year. Scientists emphasized the move had nothing to do with the birds' effectiveness.

Scientists claimed trained pigeons, with an 80-degree angle of acute vision, compared to two and one half degrees for humans, can see objects the size of a life jacket floating in choppy water up to three-quarters of a mile away.

"The pigeon is better suited to visual searches than man," said James V. Simmons, research scientist in charge of Project Sea Hunt, at Barbers Point Air Station, Hawaii. The birds can see floating objects faster and more consistently than Coast Guard lookouts, he said.

Pigeons in the program had a year of intensive training as Simmons taught them to peck an electrical switch when they sighted international orange, the widely used color of emergency equipment. When they did, the birds got a kernel of corn.

On the missions, three pigeons were stationed in separate compartments of a plexiglass bubble beneath a helicopter. By observing which pigeon was doing the pecking, the pilot learned the direction of an object.

The Coast Guard used the pigeons in a search mission only once. The rescue effort was successful, but the pigeons were killed when the helicopter lost power and had to make an emergency landing off the Kona Coast of Hawaii.

A new set of pigeons was recruited, but it took another year to train them, and money for the program has run out.

US Department of Transportation
United States Coast Guard

Commandant
United States Coast Guard

Washington, DC 20593
Staff Symbol: (G-DST-2)
Phone: (202) 426-1013

3970/1736P.
3 JAN 1983

From: Commandant
To: Commanding Officer, U. S. Coast Guard Air Station San Francisco, CA
Via: Commander, Twelfth Coast Guard District (o) W.P. Merlin 1/7/83

Subj: Completion of Operational Evaluation of the Sea Hunt Project

1. As of 1 January 1983, the operational evaluation of Sea Hunt will be terminated. After that date, the Naval Ocean Systems Center will suspend maintenance of the system as an operational resource for SAR and there will no longer be a need for the Air Station to provide flights or personnel support to maintain the Sea Hunt system.

2. If you have no objection, Mr. Giezner will continue working in the trailers at their present location through March 1983. During this time, he will be evaluating the data collected and writing a final report. After completion of the report, the Naval Ocean Systems Center will make arrangments for shipping the trailers back to Hawaii.

3. At this time, I wish to thank you for your cooperation with the Sea Hunt evaluation. I was particularly gratified by the support you provided for our intensive two week December testing conducted by the R&D Center probability of detection team. It was a short notice effort that required a great deal of work. Your Air Station provided helicopter flight time when needed, even though two of the three helicopters were down due to maintenance problems. The pilots accomplished the difficult, demanding task of precise navigation in the target area that allowed us to obtain the necessary data. Your spirit of cooperation under these difficult conditions is greatly appreciated and makes our task easy. Please extend my sincere appreciation to all your personnel who supported the Sea Hunt testing.

K. G. WIMAN
Rear Admiral, U. S. Coast Guard
Chief, Office of Research and Development

Copy: G-OSR
R&DC