PAPER 1

OPERATIONAL EXPERIENCE OF HOVERCRAFT IN THE CANADIAN COAST GUARD

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SUMMARY

The development of operational equipment, techniques and applications and also of maintenance procedures used by the ACV Units in the Canadian Coast Guard are discussed. Commencing with one SR.N5 on an evaluation basis in 1969, primarily for Search and Rescue, CCG later added an SR.N6, a Voyageur and an AP 1-88 to the operational fleet, using them in a wide variety of roles which will be described. Craft equipment and layouts have been developed and installed to improve performance in these tasks and to reduce maintenance, and personnel training programs have been developed and instituted. CCG has also evaluated other vehicles for specific roles, and is currently carrying out an in-depth study of the possible expansion of ACV activities within the Fleet. More recently, small hovercraft have been employed on rescue tasks.

INTRODUCTION

The Canadian Coast Guard (CCG) took delivery of its first hovercraft in 1968, and it became officially operational in early 1969. From that rather tentative beginning, hovercraft activities have continually expanded in scope and variety to provide a wealth of experience in operations and development. Craft routinely provide full-time Search and Rescue coverage as a primary function as well as performing many other tasks either separately or integrated with other conventional units of the Fleet.

While still only a small proportion of the Fleet resources, these craft and their crews have built up an enviable reputation of successful achievement through enthusiasm, persistence and objective development. As with any novel concept entering a well-established conventional organization, this reputation was not won easily; some of the background developments and achievements will be reviewed to illustrate a classic example of the successful exploitation of amphibious hovercraft capabilities.

THE CANADIAN COAST GUARD

First, a word about CCG. Headquartered in Ottawa, CCG is part of the Marine Transport Administration of the Department of Transport, and is headed by the Commissioner. The Coast Guard mandate may be broadly summarized as being responsible for the control and support of safe navigation of Canadian ships and of shipping in Canadian waters. Provision and maintenance of all forms of navigational aids, communications, traffic control, ice-breaking and escort, search and rescue, pollution control and safety inspections are among the more important tasks to be performed.

The detailed performance of these tasks is carried out by five Regional Directors, each with a large measure of autonomy in his own region and with a variety of resources under his control. These range from icebreakers through buoy tenders and dredging vessels to search and rescue cutters, and three hovercraft, and fixed and rotary-wing aircraft. The ships are entirely civilian in character with no armament, and many are multi-purpose to provide the most effective utilization of resources.

HOVERCRAFT IN THE CCG

Historical Review

Resulting from an internal study in 1967, it was decided to purchase one SR.N5 from UK for evaluation in the Straits of Georgia between the BC mainland and Vancouver Island. This area was chosen as one of dense and varied marine activity and one without exposure to extreme climatic conditions. Early indications of success in 1968 and 1969 quickened CCG interest in hovercraft at the time when Bell Aerospace was developing the Voyageur 20-tonne payload vehicle. CCG participated in a number of trials with this, resulting in the purchase of the second prototype which entered service in 1974. By this time the SR.N5 at Vancouver had completed the evaluation and was accepted as a prime search and rescue operational resource, but the roles for the larger Voyageur were less clearly defined. It was therefore placed under Headquarters control to determine the potential for air cushion technology across the spectrum of CCG tasks, based at Montreal. Early successes in ice-breaking and flood control led to full operational status in this role in 1976. A wide variety of other tasks was evaluated, resulting in acceptance of Voyageur as a fully operational resource earlier this year.

Meanwhile, the workload and success of the SR.N5 at Vancouver had generated the need for an additional vehicle there, and in 1977 an SR.N6 was purchased from UK, and immediately entered service in an operational role. Two non-operational SR.N6 vehicles were purchased from a previous Canadian operator, in early 1979.

In 1983 an order was placed with Westland Aerospace for an AP 1-88 to take on the duties previously executed by the Voyageur. Delivery of this craft took place in the fall of 1987.

Operational Development

The experience of CCG with its hovercraft can justifiably be said to have been highly successful. This is almost entirely due to dedicated objective initiative followed through with development of equipment and procedures to sustain the experience.

The developments can be discussed under a number of headings, and because of the many differences between the functions and equipment of the two CCG Units, it will greatly assist clarity if the discussion is further divided into two sections.

Before doing so, it might be pertinent to mention a unique feature of the CCG administration which provides and fosters a flexible development policy with the objectives of improving craft availability for operations and operating economics. The ACV Division in headquarters is responsible not only for advising on the potential and employment of hovercraft in the CCG Fleet, but it is also responsible for developing and administering national safety standards for all hovercraft in Canada.

At first sight, this dual function might be seen to be a conflict of interest, but provided that they retain their separate identity, the functions can be co-ordinated and integrated to mutual benefit, as long as a flexible attitude is maintained. Thus, we can administer safety regulations and procedures, study their effects almost at first hand upon operations, and develop them so as to have least impact without

compromising safety standards. We can also appreciate the needs of the operators, and modify or develop procedures without the pressure of a commercial operation.

Programmes were developed to improve engine maintenance; amongst these are engine health monitoring in-service; monitoring engine condition at overhaul to negotiate extended overhaul periods, and the development of quick-change units to reduce the time required for powerplant changes.

It was also the ACV Division which was responsible for Voyageur ice-breaking research, and anti-icing investigations which led to development and use of the spray suppression apron on the Voyageur and subsequently the US Army JEFF-A and the LCAC.

WESTERN REGION - SR.N5 AND SR.N6

Craft Equipment

These were essentially standard production craft when they were purchased, and needed to be equipped to perform the primary role of search and rescue in an area where boats may be stranded or capsized; aircraft may crash on mud flats; and people may be stranded on cliffs day or night.

They were therefore provided with a full range of radio communication and navigation sets, a marine radar, doppler speed-meters and powerful searchlights.

Enlarged deck areas were fitted for working over the side during many operations, and form support for long range fuel tanks to provide additional search endurance. Other external features include a permanently fitted and stowed towing bridle, led from the stern to one side deck from which it can easily be attached to a boat.

Internally the cabin layout has been modified by moving the radar from the port bow to behind the pilot, and providing lockers and work space for medical equipment and first-aid treatment, which includes stretchers and an oxygen tent.

Maintenance and Operating Facility

The Base is located at Vancouver International Airport, with two ramps leading directly into the Fraser River. At the head of the ramp is a hangar into which either craft can be taken for maintenance. Adjacent to this is a comprehensively equipped engine overhaul workshop, and on the second deck is a large storage area and space for laying out skirt components.

Unit personnel are certified to carry out partial overhauls of the Gnome gas turbine, and overhauls of the transmission gearbox. They also carry out major repairs to skirt components, and on two occasions have had major structural repairs to perform on the SR.N5, one of which involved replacement of a complete section of the hull following a fan pintle support failure.

Operations

The average craft utilization is about 1000 hours per year - after 10½ years, the SR.N5 had just 10,000 hours, while in the first full year of the

SR.N6 the craft logged 1200 hours. The normal crew is three - craft captain, first officer and crewman; and crews are provided to give 24 hours coverage, with an average response time of three minutes.

Search and Rescue

This is the primary dedicated task of the Unit, which was officially assigned on 1 April 1969. To date over 6000 SAR missions had been carried out, at an increasing annual rate as early figures show:

1969	-	69	1974	-	202
1970	-	146	1975	-	68
1971	-	122	1976	-	357
1972	-	164	1977	-	355
1973	-	239	1978	-	591

SAR missions are characterized by their variety, from the supply of gas to a drifting run-about on a calm day, to a cliff rescue or survivor search in a gale at night. Of the 1303 incidents in 1976-78, 105 of them were in winds of over 25 knots, and 148 of them involved towing vessels. The average distance towed was just under four miles, and the largest tow was a 50-foot pleasure boat; in addition, an aircraft was towed off a sandbank. The workload is very variable, the maximum number of calls responded to in one day is 11.

Some examples extracted from mission reports illustrate not only the Unit's capabilities but also some strange reasons for distress. One incident 18 months ago involved a 35-foot fishing boat which had run hard aground on a rocky shore and damaged the hull. The hovercraft crew pumped water out, patched the holes and towed the boat to a safe beach. It transpired that the only person onboard had fallen asleep.

Before the Unit was officially operational, a dramatic rescue was made. With the craft in maintenance, a call was received at home on the weekend of New Year's in late 1968 to rescue a 65-foot pleasure boat aground on a rocky island 40 miles distant. In under an hour, the craft was away; the mission report quotes conditions as wind 35 knots, air temperature 10 degrees F, sea rough with 50 per cent ice pan cover. An hour later, the hovercraft was removing the five people onboard and they were transferred to a cutter which could not approach the scene.

Many incidents involve medical assistance; all crew members are trained in resuscitation and first aid. Some, unfortunately, involve fatalities resulting from capsizes during storms. Many lives however are saved by the speed of response. The SR.N5 was patrolling one Saturday afternoon when a large ferry and a freighter were in collision in very narrow waters nearby.

Within minutes of hearing the distress calls, the craft was at the scene, radioed ashore for ambulance and transferred the injured persons ashore directly to the waiting doctors.

Low visibility does not prevent operations - a floatplane got lost in fog attempting to take-off and ran on to a mudbank. Within 15 minutes, the hovercraft was alongside, secured the aircraft and towed it out to deep water. Heavy weather does not deter the crews either, but it very nearly spelled the end of SR.N5 in March 1975. A freak storm with winds gusting to 85 mph had the harbour littered with drifting ships and wrecks by midnight. The SR.N5 was called out at 2.30 in the morning to go to the

assistance of two fishing boats some 25 miles away. In 15 foot seas, they made good progress at about 22 knots until they hit what turned out to be a dismasted, unlit trimaran. Both craft were severely damaged; the trimaran was eventually lost, but the SR.N5 was towed ashore and returned to base on a barge. That was the reason for the low number of rescues in 1975 - the illustration indicates the damage and also gives a measure of the Unit's maintenance capability. Within seven months, the craft was back in service completely repaired and with new electrical and electronic systems.

Other Tasks

While the SAR role tends to overshadow the Unit's activities, many other tasks are performed - re-supply or servicing light stations and buoys; taking ship inspectors or police officers out to ships or wrecks; hydrographic and shoreline surveys, and numerous exercises and demonstrations. On rare occasions, ice hampers the fishing fleet, and the craft have been used to help vessels leave harbours.

While the majority of time is spent based at Vancouver, craft are deployed to other areas for specific tasks. The SR.N5 has visited Alaska while on deployment to Prince Rupert in Northern BC. The distance from Vancouver to Prince Rupert is just 500 miles, and typically the journey takes 15 hours averaging about 33 knots.

Before leaving the Vancouver Unit, mention should be made of a very successful exercise one summer when the SR.N6 demonstrated its capability in oil pollution control. It very quickly streamed a 1000 foot oil boom direct from a truck to an off-shore simulated spill and then took an inflatable boom from a ship and encircled the spill at high speed before finally towing a small oil skimmer into the area. Throughout, with the comprehensive radio installation, the craft was also able to maintain communication links between land, sea and air units taking part in the exercise. Sea-trucks originally detailed for the exercise could not leave their base due to local sea conditions there.

In summary, the Unit at Vancouver is a highly professional and versatile unit which exploits the characteristics of amphibious ACVs to the full in the particular environment. All the personnel are dedicated proponents of the technology, and the craft they operate are well suited for the tasks which they are called upon to perform. Capabilities have increased with the basing of an SR.N6 at Parksville, 80 km north of Vancouver on Vancouver Island.

VOYAGEUR

Voyageur's role in CCG was not so clearly defined as the SR.N6 and N6; she did not have a tailor-made role, but rather her function was originally to determine the potential roles for air cushion technology in CCG, which she had to do in direct competition with established resources. Without the extensive user experience background, some engineering development of the craft itself has been necessary. .Entering service in early 1974, she has now completed the task originally set; the roles are defined and Voyageur based at Montreal is now an operational Unit performing those roles, until superseded by the AP 1-88.

Operational Equipment

Basically, Voyageur was equipped with a comprehensive radio and navaid communication system, marine radar and searchlight. Efforts to find a successful Doppler speed meter installation have so far failed.

The craft also has removable accommodation and storage trailers and a self-powered hydraulic crane which can be fitted on deck.

Spray Suppression

Much of the craft's time was spent ice-breaking and the techniques involved generate large volumes of spray which not only load the craft up with ice but also rapidly eroded the propellers. The degree of icing can be severe - and caused a major maintenance workload in removal. Propeller blade life in winter has been around 300 hours.

In 1977, a spray suppression apron based upon those developed for high pressure air cushion platforms was fitted experimentally and is still on the craft. Its effect was immediate and the spray reduction is dramatic.

Craft icing is greatly reduced and propeller blade life is now in excess of 700 hours.

Engine Life Improvements

In the five years during which CCG operated Voyageur, the engine life was extended from 1250 hours to 2250 hours between overhauls, and we anticipate that we may be able to go further. Frequent monitoring of standard engine instruments is being used for engine health monitoring using a small computer programme, which we hope will give early warning of internal malfunctions, and also confidence that engine life can be extended.

Payload Increase

With much of Voyageur's operation being in sheltered waters, based near Montreal, a re-evaluation of the structure was requested, with the result that we can now operate in low sea-states at up to 101,000 lbs - a useful increase of 13,000 lbs or approximately 25 per cent payload increase.

Craft Lifting

As with all large hovercraft, Voyageur needs special consideration when looking at the means of lifting for underside inspection and repair. Each end requires a heavy crane and lifting sling and the lifting operation is time-consuming. We have investigated air lifting bags, but the only acceptable proposal was very expensive. A single-point lifting sling and associated ground jacks were developed.

AP 1-88

The Voyageur performed a useful role in the St Lawrence Seaway, including the support and supply of navigational aids, pollution control, search and rescue and particularly in flood control by means of ice-breaking.

However, by the early 1980s, the limitations of the Voyageur were becoming increasingly apparent and a replacement was sought. In 1983 the CCG approached BHC, Westland Aerospace, for a hovercraft which could carry out

a range of missions on the St Lawrence Seaway. The resulting design was a half well deck version of the aluminium hulled, diesel engine powered, ducted twin propellered AP 1-88.

The craft was delivered in the fall of 1987, ready for the winter season, and in particular the ice break up period in the spring of the following year.

Craft Description

In the CCG AP 1-88 the lift and transmission systems remain the same as on the basic craft but the cabin has been removed from the forward end of the craft, leaving a well deck in which a variety of equipment can be carried.

The craft has a bow ramp and a hydraulic crane, mounted on a wheeled chassis, can be drawn up onto the deck and bolted into position. The crane has a lift capacity of 5000 lbs and together with a capstan on the port side foredeck and a winch on the starboard side foredeck (all of which are driven from an auxiliary hydraulic system) provides the 'muscle' power needed to handle the navigation buoys, and off-load heavy items. The lift system is then run at just above idle speed to provide the necessary power requirements. In the re-supply role, the crane is removed from the deck and diesel fuel and drinking water carried in large flexible bag tanks.

The cabin provides day time accommodation for up to 10 personnel complete with galley and toilet and 4 bunks are available for long range sorties. Stretcher facilities are also included to cover the medivac and search and rescue requirements.

Because the craft is required to operate at long distances from its base at Montreal, it is equipped with a fuel system capable of taking up to 6000 litres of fuel. It is also required to operate from unprepared beaches and to be able to take on extra fuel trucked in to the nearest convenient point.

The craft is designed to operate in temperatures down to -40 degrees C and for cold weather operation is equipped with an anti-spray skirt. In addition, electrical de-icing of the propeller ducts and the fan air intakes is provided and because of the high power requirements, an auxiliary power unit is supplied providing ac current. Heating is also provided in critical area to prevent waxing of the fuel.

The control cabin is positioned above the main cabin and has been enlarged to include the necessary equipment for all the roles for which the craft is designed. Because of the wide range of equipment and roles, the craft weight has been increased to 44 tonnes and up-rated versions of the Deutz air-cooled engines have been fitted to maintain performance.

CANADIAN COAST GUARD AUXILIARY UNIT

The CCG has also put small hovercraft to good use in rescue and emergency situations, using a SCAT Hovercraft HP12. This craft is used by a unit of the CCG Auxiliary - volunteers who respond to marine distress calls.

This unit, based some 20 km west of Montreal, two winters ago took part in about 15 missions; on one occasion it returned 7 km over broken ice with a stranded snowmobile (weighing at least as much as itself) strapped across it. They also towed back a 'tin' fishing boat carrying two outboards, and

then rescued the passengers and their dog.

The SCAT HP 12 is 3.7 m long, with a grp upper hull, foam filled deck and high impact ABS bottom. The skirt segments are made from neoprene coated nylon fabric. A 503 cc Rotax two stroke engine drives an axial-flow fan, two thirds of the efflux providing thrust and one third cushion air for lift. Handlebar steering operates twin rudders at the rear of the fan duct.

The Auxiliary Unit operations have attracted attention, and several municipal authorities have expressed interest in using small hovercraft for SAR; so far three cities have each purchased a Hoverguard - a modified, stretched Hoverstar, produced by Hovertechnics in Michigan - and five or six other authorities are watching. Amongst them is Ottawa, and Ron Fishlock (ex Hovermarine) has developed what appears to be a very good craft, with full reverse thrust capability, which must be a strong contender. Ron is based just outside Ottawa.

CONCLUDING REMARKS

The Canadian Coast Guard Hovercraft Unit has been operational for 20 years and is the oldest (and possibly the only) non-commercial operator of ACVs in the work dedicated to Search and Rescue, and their experience and knowledge is unparalleled.

The Unit's capabilities have increased with the addition of new craft to their Fleet, including the use of small hovercraft by an Auxiliary Unit. There are many people who have cause to be extremely grateful to the CCGHU, either for rescues or for the prevention of flooding by moving ice-jams, particularly in the St Lawrence Seaway area.

Whilst the Canadian experience of hovercraft in this role is unique, it is by no means exclusive, for there are similar situations around the world where hovercraft of all sizes could play an effective and similar role.

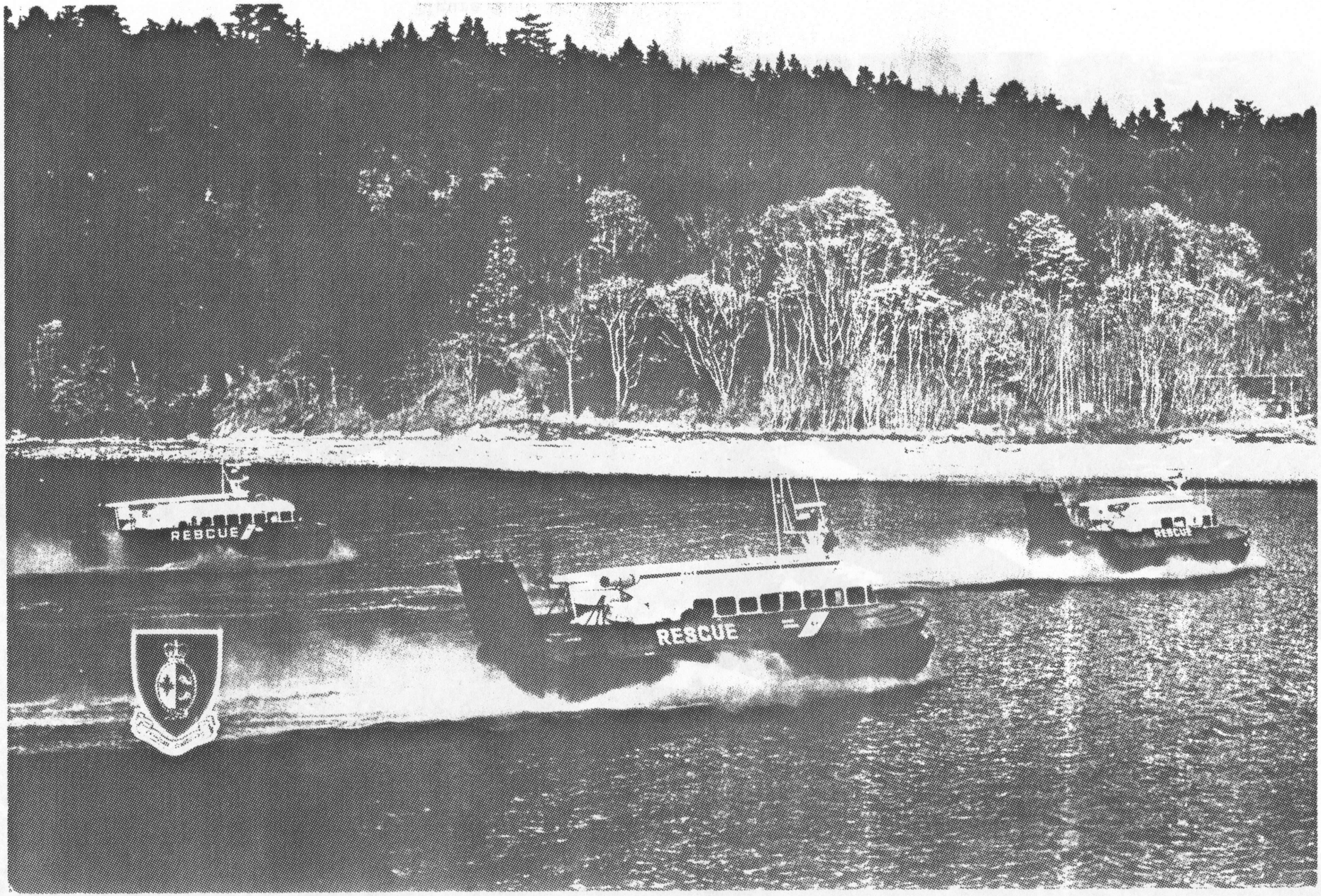

Figure 1

Canadian Coast Guard SR.N5 AND SR.N6 Hovercraft

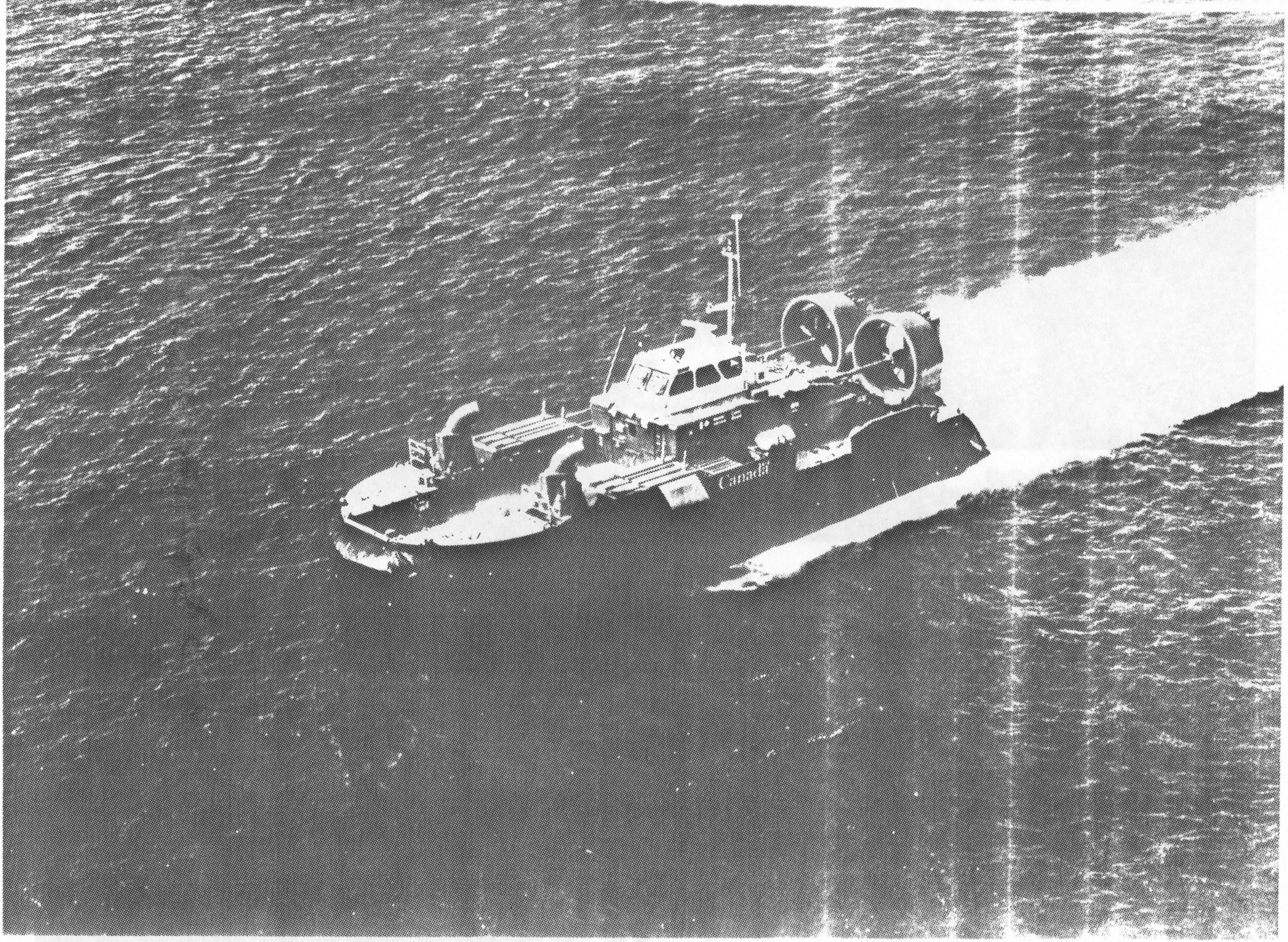

Figure 2
The CCG AP 1-88

Figure 3

The CCG SCAT HP12 Carrying a Skidoo

Figure 4

The SCAT HP12 Towing a Boat