U.S. NAVAL OCEANOGRAPHIC OFFICE HARBOR SURVEY ASSISTANCE PROGRAM

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Abstract

The Harbor Survey Assistance Program (HARSAP) was initiated by the U.S. Naval Oceanographic Office in late 1964 to assist the Latin-American countries in developing their hydrographic capabilities.

The HARSAP Program has a dual purpose of (1) obtaining late-date technical information for the publication of accurate nautical charts and sailing directions and (2) providing on-the-job technical training and guidance to personnel of various participating governments.

This report not only deals with the over-all accomplishments of the HARSAP Program, but it also details the various operational phases, problems encountered, and results obtained in the seven Latin-American countries which have, so far, participated in the program.

PROGRESS OF THE HARBOR SURVEY ASSISTANCE PROGRAM

Introduction

The rapid increase in maritime trade in recent years between nations has brought to light serious deficiencies in the nautical chart coverage for the navigable waters of the world. Responsibility for this increase in trade can be attributed directly to the world's population explosion and to the accompanying economic development whereby demand is created for a greater and greater amount of goods. As this demand continues upward, new methods and techniques have to be developed to accommodate the ever-increasing sea trade. Large containers which can be quickly loaded and off-loaded, and the construction of ships in excess of 300 000 tons, are good examples of recent advancements in this field.

As a result of these developments, the maritime ports are constantly pressured to provide better, larger, and faster facilities to accommodate the ever-growing merchant fleet calling at these ports. Needless to say, the safe movement and navigation of commercial and military shipping, in addition to the development of modern and adequate harbor facilities, greatly depends on the availability of up-to-date large-scale charts of ports, harbors and their approaches. Unfortunately, approximately 80 % of the port and harbor charts presently in use are based on data gathered over 30 years ago by extremely primitive methods compared with present day techniques and equipment.

Realizing the pressing need for updating existing charts and, in some instances, publishing entirely new charts of important areas for which none previously existed, the U.S. Naval Oceanographic Office (NAVOCEANO) in late 1964 initiated the Harbor Survey Assistance Program (HARSAP).

Background

HARSAP is designed primarily to assist Latin American countries, which so desire, in planning and executing hydrographic and basic oceanographic surveys of their harbors and the approaches thereto; it has the dual purpose of (1) obtaining information for the publication of accurate nautical charts and sailing directions, and (2) providing technical training and guidance to personnel of the various participating governments.

The accepted procedure for countries interested in participating in HARSAP is for the host country to initiate liaison through the Commander in Chief, U.S. Southern Command, with headquarters in Panama, who is coordinating all U.S. mapping and charting programs within Latin America. After it has been determined that NAVOCEANO has the necessary resources available for a requested project, and engineer from NAVOCEANO visits the requesting country and conducts a reconnaissance of the proposed survey area. During this visit, the in-country resources are evaluated, and a preliminary agreement is prepared defining the responsibilities of all participants. Host nation resources are utilized to the maximum at all times. As host nation personnel become experienced, the NAVOCEANO effort is gradually diminished, both in personnel and equipment, until eventually NAVOCEANO participation is reduced to the role of providing a technical advisor when requested by the host government. To date, Ecuador, Guatemala, Nicaragua, Colombia, El Salvador, Costa Rica, and the Dominican Republic, in that order, have participated in this program. Assistance rendered by NAVOCEANO has been pointed toward developing in the host nation a permanent capability of conducting a complete hydrographic survey. In some countries, this has encompassed not only the sounding operations, but also the establishment of geodetic control, positioning of aids and dangers to navigation, collection of tide and current data, establishment of photogrammetric control and collection of bottom samples so the area could be adequately described on charts and sailing directions. Some assistance has also been provided to the host country in the compilation of the resulting nautical charts.

Accomplishments

a. *Ecuador*

The first country to request and receive assistance under HARSAP was Ecuador. Because of the many groundings in the Estero Salado, the Guayaquil Port Authority, which is responsible for the administration and maintenance of Puerto Maritimo de Guayaquil, requested the assistance of the U.S. Navy in conducting a complete hydrographic survey of this port and its approaches. The survey of Estero Salado was conducted during the period 1964-1967. NAVOCEANO personnel assisted in this operation from the initial positioning of the hydrographic signals in 1964 until 1966, after which Port Authority personnel continued unassisted until completion of the work in 1967. Presently, the Port Authority is continuing with check and post-dredging surveys to maintain current information on changes to ensure the safe navigation of visiting ships.

The survey of the Guayaquil area presented some unique field problems to the hydrographic group. The lack of adequate geodetic control in the area necessitated the establishment of better than 30 supplemental control stations along both sides of the Estero Salado from the coast to Puerto Maritimo de Guayaquil, a distance of approximately 50 miles. Due to the nature of the surrounding terrain, 20′ towers had to be constructed as observation platforms to control the hydrographic survey.

The abnormal currents and tides encountered in the Estero Salado created a great deal of problems for the hydrographers. Strong currents restricted the sounding operations mostly to periods of slack tide. Differences in tidal range within the survey area required the computation of tidal gradient to obtain sounding reducers rather than obtaining these reducers from a common tidal plane.

As a result of the extensive survey conducted in the Guayaquil area, NAVOCEANO published, in March 1968, H.O. Chart 5964 at scale of 1/50 000.

b. *Guatemala*

Guatemala indicated its interest in the hydrographic development of Puerto Barrios/Matias de Galvez, and in December 1964 an engineer from NAVOCEANO, accompanied by the Oceanographic Consultant of the U.S. Naval Southern Command, visited the country and made the initial reconnaissance, prepared preliminary specifications, and finalized details of the operation. The Instituto Geografico Nacional (IGN) agreed to establish the geodetic control prior to NAVOCEANO participation in field operations. The hydrographic survey began in March 1965 when two NAVOCEANO engineers with equipment arrived in Guatemala. In addition to completing the sounding operations in late 1965, a total of 134 bottom samples were taken, all navigational aids were positioned, and two 48-hour current stations were observed. Tidal information was obtained from a permanent gage located at the Marine Base in Mathias de Galvez.

The mapping agency of Guatemala, the IGN, as a result of this joint survey project, developed an improved hydrographic capability. Through this survey, personnel of the IGN became familiar with U.S. Navy harbor survey techniques, and, with proper equipment, could apply these same techniques on future projects.

As in the case of all field operations, several minor problems were encountered during the course of the survey. High seas and strong winds are the worst enemies of any hydrographic project, especially when the work is conducted in a small 28′ boat such as the one used in the Puerto Barrios/Matias de Galvez project.

In November 1967 NAVOCEANO published H.O. Chart 1575, at 1/12 500, and H.O. 1576, at 1/50 000 scale, of the Puerto Barrios/Matias de Galvez area, using the results obtained during the hydrographic survey. In addition, Spanish language versions of these two charts were also published by NAVOCEANO. These were identified as IGN-GUA 1575 and IGN-GUA 1576.

c. *Nicaragua*

The third HARSAP operation began in Corinto harbor, Nicaragua, in 1965 with the signing of an agreement between the Nicaraguan and the United States governments. NAVOCEANO participation began in September 1965 with the arrival of two engineers and the technical equipment required for geodetic/hydrographic operations. The collaborating agencies in Nicaragua were the Direccion General de Cartografia (DGC) and the Corinto Port Authority. Twenty-one geodetic stations were positioned for the hydrographic signals, and soundings in the port and its approaches were completed in January 1966. Photo coverage of the area was obtained through the combined effort of DGC, the Corinto Port Authority, and the Inter-American Geodetic Survey (IAGS). A total of 61 bottom samples were obtained, eight 24-hour current stations were observed, and all aids to navigation were positioned.

Tidal information was obtained from a permanent tide gage installed and maintained by the Inter-American Geodetic Survey (IAGS). The gage was very conveniently located on the main Corinto pier.

An extension of the previously signed agreement between Nicaragua and the United States made possible the next HARSAP Project in Bluefields, Nicaragua. The Bluefields Project was undertaken, not only to gather up-to-date information for the publication of Nautical Charts and Sailing Directions, but also to determine the feasibility of constructing a major port on the Atlantic coast of Nicaragua. Fourteen new geoodetic stations were positioned for control of the hydrographic operations. In addition to completing the soundings in Bluefields and its approaches, reconnaissance sounding lines were run on the Escondido River, extending some fifty miles from Bluefields to Rama. A portable tide gage was established and operated throughout the survey period. Seventy-nine bottom samples were taken, and two current stations were observed for twenty-four hours each.

On completion of the Bluefields survey, Nicaragua personnel were fully familiar with U.S. Navy harbor survey procedures. Specialized sounding equipment remained in-country on loan, and the Nicaraguan Government is continuing with a hydrographic survey of Puerto Somoza, with minimum technical assistance from NAVOCEANO.

In September 1967, NAVOCEANO published a new edition of H.O. Chart 2604 at 1/10 000 scale of Corinto Harbor and its approaches. H.O. Chart 1858 at 1/20 000 scale, covering the Bluefields area, was published by NAVOCEANO in September 1968. Work conducted under HARSAP made the publication of these charts possible.

d. *Colombia*

Although there appears to be some doubt as to whether the Buenaventura Survey Project should be included as a HARSAP project, this survey followed all the guidelines set forth for HARSAP. The survey support furnished by NAVOCEANO during the Buenaventura survey, however, exceeded that of any other survey involving U.S. Navy participation in Latin America in recent years.

Two U.S. Navy survey ships, a large one and a small one, completely equipped with electronic control systems, together with four soundboats, were used to accomplish the hydrographic phase of the Buenaventura project. In addition, one ship, the *Boca de Cenizas* of the Colombian Port Authority, was used to accomplish the geodetic phase of the operation. A helicopter from the large U.S. Navy survey ship was also available in support of the survey operations.

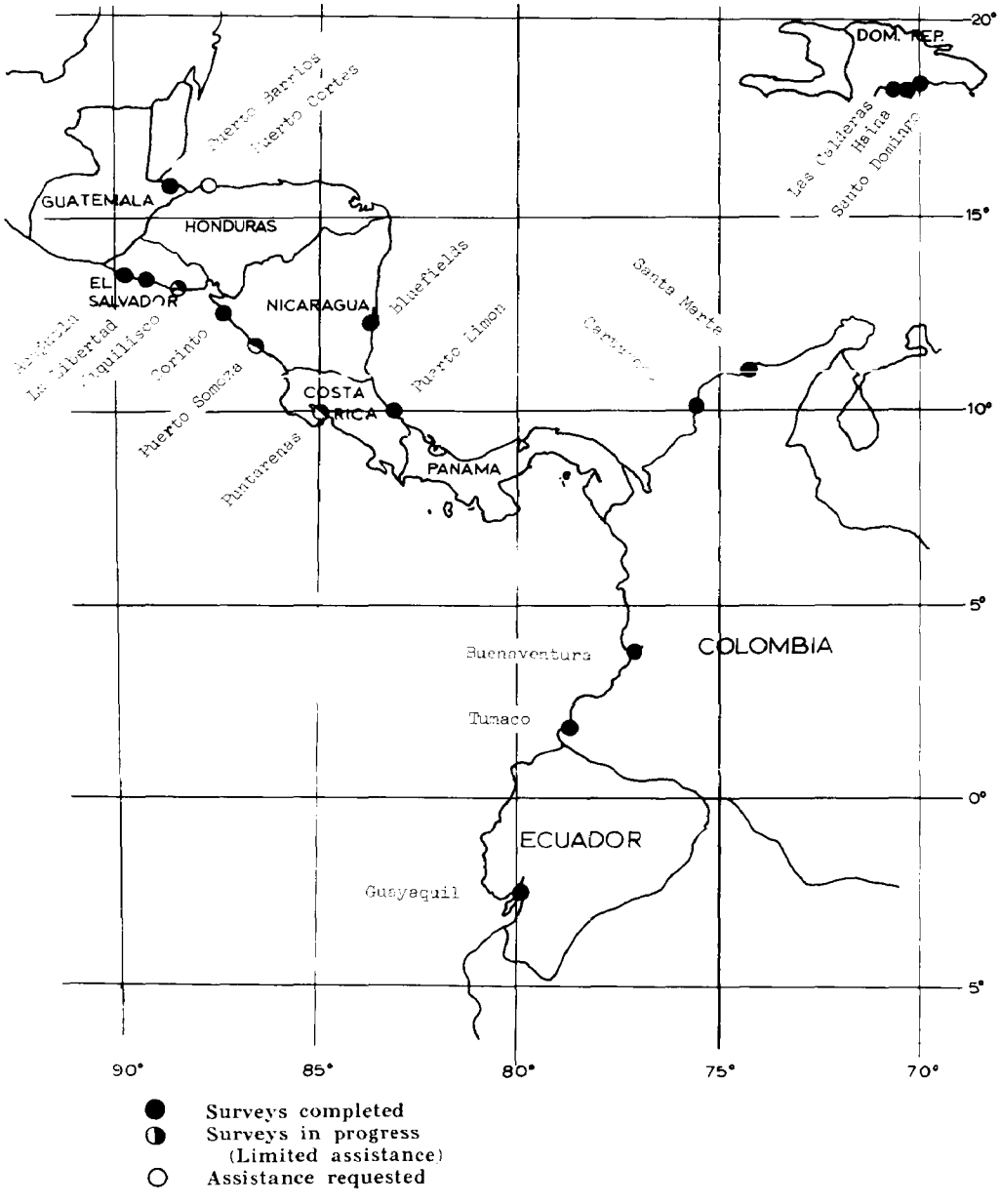
Altogether, over 19 000 miles of sounding lines were obtained by the survey task group, 69 bottom samples were taken, and two tide gages were established in the survey area. A permanent type tide gage installed and operated by IAGS was also used as a reference for sounding reducers. In addition, 43 geodetic stations were established, observed, and computed, and 1 200 aerial photographs taken.

As a result of this operation, which lasted from January to May 1965, NAVOCEANO published the following navigational charts :

Chart No.	Scale	Publication Date
HO 1781	1/25 000	May 1968
HO 1786	1/50 000	February 1968
HO 1787	1/250 000	March 1968

A second Colombian HARSAP operation was initiated in Cartagena, in August 1966, when two NAVOCEANO engineers arrived in country to assist personnel from the Colombian Navy and the Colombian Port Authority in the geodetic and hydrographic survey of the area. Interest for a new survey in Cartagena lay in the fact that, besides being the major commercial shipping port on the Atlantic Coast of Colombia, it is also an important Colombian Navy base.

HARBOR SURVEY ASSISTANCE PROGRAM



Survey operations were constantly delayed during the Cartagena project by problems such as the survey boat sinking while moored to the pier, damage to the sounding equipment due to unexpected, uncharted shoals in the survey area, and the almost-daily rainfall which occurred during the early stages of the survey. Nevertheless, the HARSAP group was able to accomplish, by March 1967, when the operation was completed, a detailed hydrographic survey of the Cartagena area including 32 bottom samples and two current stations, establishment of 14 geodetic stations

with semi-permanent towers erected over five of the stations, and the correct positioning of all aids to navigation in the survey area.

In two separate occasions, from June to September 1967, and from November to December 1967, a NAVOCEANO nautical cartographer was assigned to the Instituto Cartografico "Agustin Codazzi" in Bogota to collaborate with the personnel of that organization in the compilation and publication of a nautical chart of the surveyed area. In addition to the Colombian chart to be produced from the survey, NAVOCEANO plans to publish its own chart, H.O. 978, for Cartagena.

An additional project of interest in Colombia is the survey of the Santa Marta area. The entire project was conducted by the personnel of the Colombian Port Authority and technical assistance was furnished by NAVOCEANO only during the planning phase of the project.

As a result of the interest created in Colombia by the two projects conducted in the country, the Colombian Navy has established a fully operational Hydrographic Department presently known as the "Departamento De Litorales". With newly purchased hydrographic equipment, the recently converted hydrographic ship *Quindio*, a very limited technical assistance furnished by NAVOCEANO, and the professional skills of several Colombian Naval Officer graduates of the NAVOCEANO Hydrographic Course, the Departamento De Litorales has recently completed a full hydrographic survey of the Tumaco area. A new edition of NAVOCEANO chart H.O. 1540 will be published, utilizing these data, for Tumaco Harbor and approaches.

e. *El Salvador*

In response to a request of El Salvador, a HARSAP operation was begun in that country in April 1967. Two ports, La Libertad and Acajutla, were selected for development.

Following a reconnaissance of the area in January 1967 by representatives of the Commander, U.S. Naval Forces, Southern Command (COMUSNAVSO), the Direccion General de Cartografia, San Salvador (DGC), and NAVOCEANO, it was determined that a total of 23 hydrographic control points would have to be established prior to beginning of the survey operations. These required stations were established and computed by the DGC personnel in May 1967.

The ports of La Libertad and Acajutla and their approaches were surveyed on two sheets at 1/5 000 scale, and an additional survey in the vicinity of the Acajutla pier was conducted at 1/2 500 scale. Ten bottom samples were obtained and a temporary tide gage was established in the port of La Libertad. Data obtained from a permanent tide gage, installed and maintained by IAGS in Acajutla, were used to reduce all soundings to Mean Low Water Springs.

During the course of the survey, from April until September 1967, aerial photographs of the survey areas were flown by DGC personnel at both high and low tides at 1/10 000 and 1/22 000 scale. These photographs, together with all the other data gathered, will be used for the publication of NAVOCEANO chart H.O. 1365. The chart will consist of two plans, La Libertad at 1/18 000 scale and Acajutla at 1/25 000 scale.

f. *Costa Rica*

At the request of the government of Costa Rica, NAVOCEANO initiated HARSAP operations in Puerto Limon on the east coast of that country in March 1968. A visit to Costa Rica by representatives from NAVOCEANO and COMUSNAVSO in December 1967 resulted in a preliminary agreement between the host country and the United States. A reconnaissance of the Puerto Limon area, also conducted during the visit, indicated that a total of 35 hydrographic control points would be required to accomplish the survey. These stations were established by both the personnel of the Instituto Geografico Nacional (IGN) and the HARSAP group.

By September 1968, when the project was terminated, the HARSAP group, consisting of personnel from IGN, Direccion de Obras Portuarias (DOP) and NAVOCEANO, completed a controlled hydrographic survey of Puerto Limon and Bahia Moin areas and their approaches. In addition, a reconnaissance survey of Puerto Vargas was conducted. Approximately 100 bottom samples were obtained, four current stations were observed, and correct geodetic positions for all aids to navigation were determined.

Under the direction of a NAVOCEANO photogrammetrist, the field group accomplished the establishment of a secondary net of horizontal and vertical photo tie points and the field classification for all aerial photographs in addition to the photo-identification of all control stations.

The successful completion of the project and the experience gained by the host country personnel encouraged the Costa Rican Government to request that a second HARSAP operation be undertaken in Puntarenas, on the west coast of Costa Rica.

After formal approval of the Puntarenas project was received in Costa Rica, a reconnaissance party visited the area in order to select the location of the required hydrographic control. The hydrographic phase was started in Puntarenas in October 1968 with Costa Rican personnel performing all the field operations without the assistance of a NAVOCEANO engineer, but utilizing NAVOCEANO's hydrographic equipment.

The results of the Costa Rica surveys will be reflected in planned new editions of H.O. 1293 at 1/20 000 scale, of Puerto Limon, and H.O. 1060, at 1/25 000, of the Puntarenas area.

g. *Dominican Republic*

In February 1968, NAVOCEANO received, through the Commander, U.S. Naval Forces, Southern Command/Commandant Fifteenth Naval District, an official communication from the Dominican Republic Government requesting assistance under the HARSAP program. The request listed a number of ports which, in the opinion of the Dominican Republic officials, required new or updated charts, and therefore needed immediate attention.

Two representatives, one from COMUSNAVSO/COMFIFTEEN and one from NAVOCEANO visited the Dominican Republic in May 1968 for the purpose of conducting a reconnaissance of the areas selected for the initial

survey and to finalize a memorandum of understanding between the Dominican Republic and the United States. The memorandum of understanding briefly outlines the responsibilities of both countries concerning the survey operation and the support required by each cognizant agency within the country.

A group consisting of personnel from the Dominican Navy Hydrographic Department, NAVOCEANO, COMNAVSO/COMFIFTEEN, U.S. Naval Mission Dominican Republic, and IAGS, conducted a two-day reconnaissance of the Las Calderas, Haina, and Santo Domingo areas. During the course of the reconnaissance, 14 sites were selected for the positioning of the required hydrographic control stations in Las Calderas area. These stations were established and computed by the Instituto Cartographico Universitario (ICU) in July 1968.

In August, three NAVOCEANO representatives, two engineers and a photogrammetrist, departed Washington together with all the necessary technical equipment for the Dominican Republic. The HARSAP field party, which in this case consisted of the officers and enlisted personnel from the Hydrographic Department of the Dominican Navy, and the NAVOCEANO representatives, arrived in Las Calderas in early September to begin the first phase of the hydrographic survey.

By early November, when the Las Calderas project was completed, the survey group had accomplished a detailed survey of the area on three sheets, one at 1/5 000 and two at 1/10 000 scale. The correct positions for all aids to navigation were obtained, 95 bottom samples were taken, 2 current stations were observed, all shoals in the area were investigated, one tide gage was established, 43 miles of differential levels were run, a secondary net of horizontal photogrammetric points was established, and 104 points for the orientation of the aerial photographs were developed.

Immediately upon the completion of the Las Calderas area, surveys were conducted in the Haina and Santo Domingo areas. The approaches to both of these ports were surveyed, at 1/25 000 scale, between November 1968 and January 1969.

The information gathered during these surveys will be used by NAVOCEANO to publish new editions of Las Calderas chart H.O. 2664, Santo Domingo chart H.O. 2283, and a Haina chart with a yet-to-be-assigned H.O. number.

General comments

Similar to any other scientific program of such magnitude, HARSAP has suffered some unfortunate set-backs and delays since its beginning. In the majority of the cases, these can be directly attributed to circumstances beyond human control, such as breakdown of equipment, and national emergencies in the host countries. Further difficulties stem from lack of funds and the limited resources of NAVOCEANO for this purpose. Nevertheless, the program can be considered a total success in view of the results obtained since HARSAP became a reality in 1964.