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HYDROGRAPHIC SURVEYING AND CHARTING : THE NEED AND THE MEANS

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SUMMARY

This paper addresses the results of a preliminary analysis made of the general status of hydrographic surveying and charting in Africa. It stresses the importance of increasing hydrographic services in the interest of national maritime economic development. The paper also outlines means of establishing or improving hydrographic capabilities by participation in international cooperative programs and through receipt of formal training.

INTRODUCTION

Adequate nautical charts are an essential and integral part of the foundation upon which international trade is established and expanded into a viable maritime economy. They make it possible for today's larger ships to utilize ports and harbors that were inaccessible on the basis of old charts, thereby allowing expansion of trade, tourism, and other development. General analysis of the current status of hydrographic surveying and charting in Africa establishes a need if full advantage and involvement in today's expanding maritime trade is desired. Awareness of inadequacies in existing nautical charts and establishment or strengthening of hydrographic facilities capable of producing charts with current navigational information is imperative. The means of obtaining hydrographic facilities capable of producing adequate charts is founded upon trained personnel and sufficient equipment. This paper will discuss several

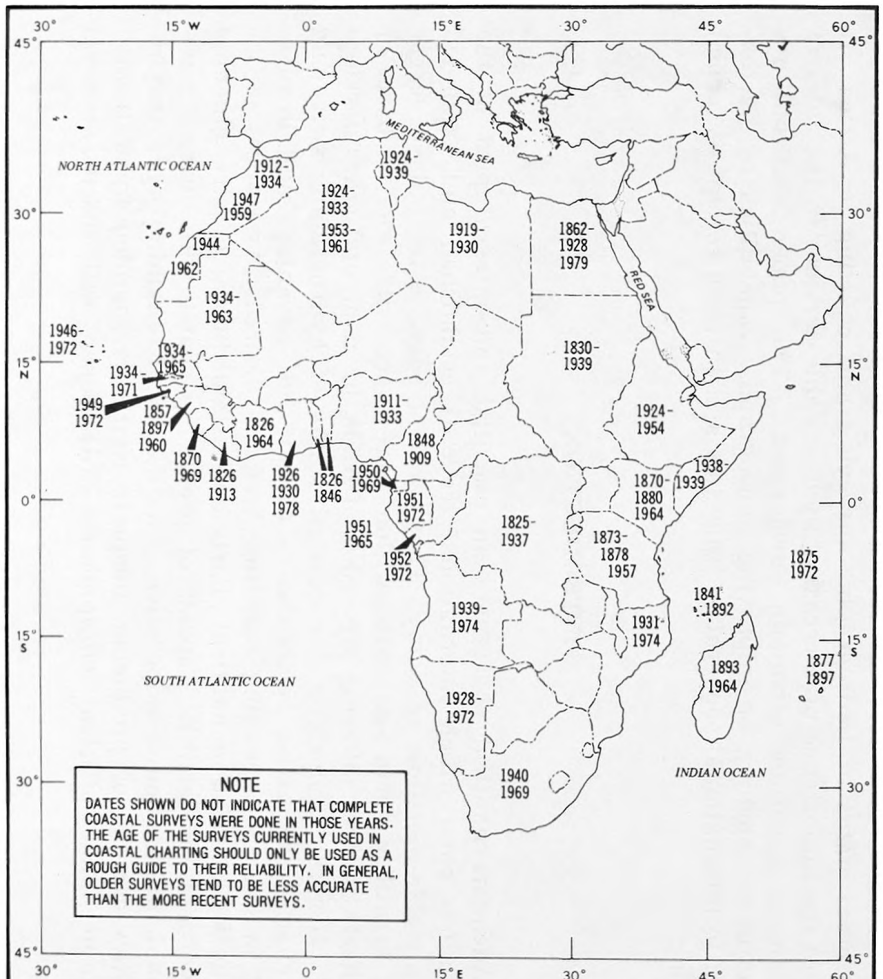


FIG. 1. — Dates of surveys used in current coastal charting.

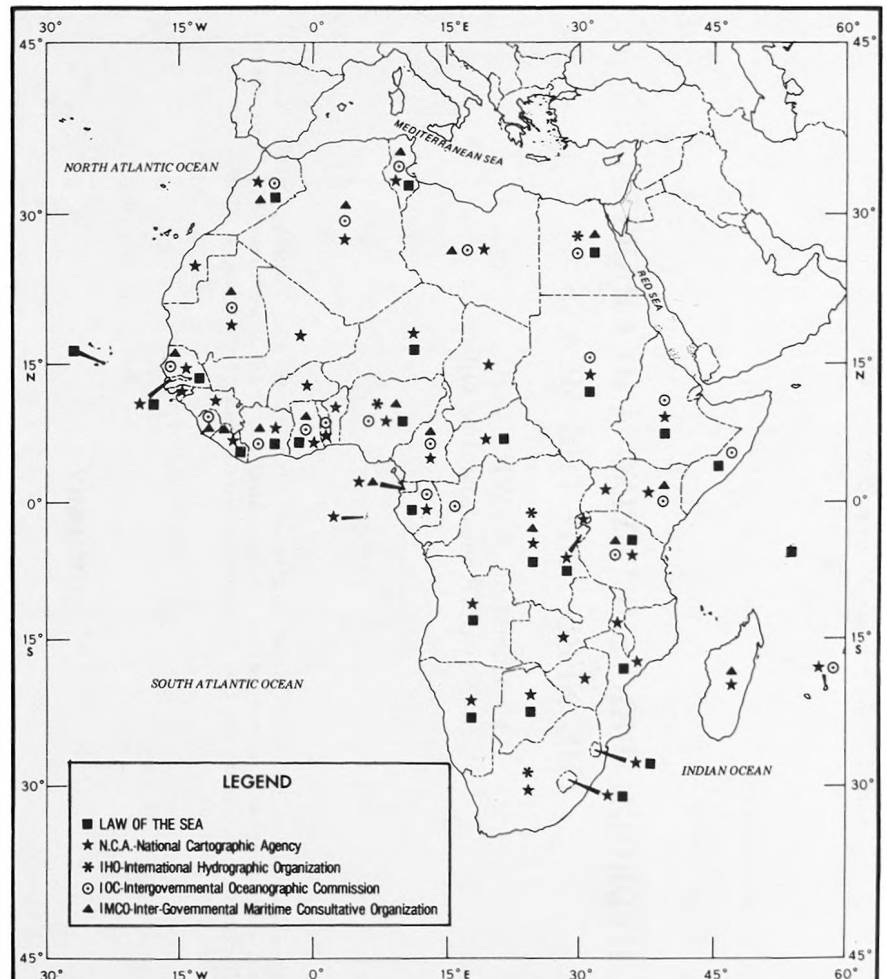


FIG. 2. — Members of hydrographic related organizations.

Table 1

Country	Coastline (km)	Number of major ports	Number of minor ports
Algeria, Democratic and Popular Republic of	1 183	9	8
Angola, Peoples Republic of	1 600	3	15
Benin, Peoples Republic of	1 963	1	1
Botswana, Republic of	0	0	0
Burundi, Republic of	0	0	0
Cameroon, United Republic of	402	1	3
Cape Verde, Republic of	965	1	3
Central African Republic	0	0	0
Chad, Republic of	0	0	0
Comoros Islands	340	0	1
Congo, Peoples Republic of	169	1	0
Djibouti, Republic of	314	1	0
Egypt, Arab Republic of	2 450	3	8
Equitorial Guinea, Republic of	296	2	3
Ethiopia	1 094	2	0
Gabonese Republic	885	3	2
Gambia, Republic of the	80	1	0
Ghana, Republic of	539	2	4
Guinea, Republic of	346	1	3
Guinea-Bissau, Republic of	274	1	2
Ivory Coast, Republic of	515	2	3
Kenya, Republic of	536	1	3
Lesotho, Kingdom of	0	0	0
Liberia, Republic of	579	3	4
Libyan Arab Republic	1 770	3	4
Madagascar, Democratic Republic of	4 828	4	0
Malawi, Republic of	0	0	0
Mali, Republic of	0	0	0
Mauritania, Islamic Republic of	754	1	2
Mauritius	177	1	0
Morocco, Kingdom of	1 835	8	10
Mozambique, Peoples Republic of	2 470	3	2
Niger	0	0	0
Nigeria, The Federal Republic of	853	2	10
Réunion, Overseas Department of	201	1	0
Rhodesia, Zimbabwe	0	0	0
Rwanda, Republic of	0	0	0
Sao Tome & Principe, Democratic Republic of	209	1	0
Senegal, Republic of	531	1	2
Seychelles	491	0	1
Sierra Leone, Republic of	402	1	2
Somali Democratic Republic	3 025	3	0
South Africa, Republic of	2 881	5	6
Territory of South-West Africa (Namibia)	24	1	1
Sudan, Democratic Republic of	853	1	0
Swaziland, Kingdom of	0	0	0
Tanzania, United Republic of	1 424	3	0
Togolese Republic	56	1	1
Tunisia, Republic of	1 143	4	8
Uganda, Republic of	0	0	0
Upper Volta, Republic of	0	0	0
Western Sahara	690	2	2
Zaire, Republic of	37	2	1
Zambia, Republic of	0	0	0

(*Note :* The figures quoted above are approximate).

training programs available to help nations develop their surveying capabilities, but will not address equipment, vessels or other surveying aspects.

Information presented in this document deals mainly with coastal African nations. (See figure 1 and table 1). Land-locked African countries have their own hydrographic considerations that are unique to their environment. Due to their individual requirements they will not be discussed in this paper.

DISCUSSION

As nations realize the economic importance of accurate nautical charts, the demand for hydrographic surveys becomes greater. Many of the hydrographic charts covering Africa are based on surveys carried out by other nations. Many of these charts, based on surveys carried out more than a century ago by methods that are completely outdated, are dangerously inadequate for insuring the safety of navigation for present day shipping. However, because the charts based on such surveys are the only ones available, mariners must depend upon them for navigating the harbors or along the coasts of these countries. Given up-to-date charts, international shipping would be encouraged to enter harbors or navigate along the coasts without fear or reservation.

Marine Economy

There is a direct correlation between the marine economy of a nation and the state of nautical charts covering its ports and coasts. For ships of today to make speedy, safe, and economic voyages it is essential that adequate modern nautical charts be available for navigation along coasts and into and out of ports. Data acquired through modern hydrographic surveys may reveal that it is possible for the larger ships of today to enter ports formerly thought to be inaccessible and thereby free a nation from the costly process of transhipment. Modern charts also provide information needed to establish sea lanes and traffic separation schemes compatible with international requirements and the interests and economy of the coastal state. The availability of modern charts may also promote international tourism by encouraging large cruise ships to visit formerly inaccessible areas.

Coastal Zone Management

Shorelines are one of the most rapidly changing landforms on earth, and make it essential that precise large-scale surveys be updated whenever ocean engineering subjects are being considered. These surveys provide the primary data essential for projects involving all phases of coastal zone management, including construction of new ports and enhancement of existing ones; construction of training works to control coastal erosion;

reclamation of land from the sea; dredging operations to establish and improve channels; establishment and monitoring of dumping grounds for industrial wastes; exploration of the feasibility of tidal power; the extraction of inshore mineral deposits, including sand and gravel; desalination projects and aquacultural activities. The African continent has over 39 184 kilometers of coastline with approximately 258 ports. Of these ports only 15 % are estimated to have accurate nautical chart coverage. This incomplete coverage undoubtedly impairs maritime trade for most of the African nations. Marine insurance becomes a problem to ships using ports with poor or non-existent nautical charts. Marine law considers a ship unseaworthy if it does not have adequate charts covering the area it is transiting.

Exploration and Exploitation of Undersea Resources

In recent years it has become more evident that inadequate hydrographic services not only restrict the growth of maritime trade but also lead to costly delays in resource exploration. The emerging Law of the Sea is likely to confer upon coastal states sovereign rights to the resources in a 200-mile wide Exclusive Economic Zone, and it will probably contain provisions which will place an obligation on the part of the coastal states to show baselines, the outer limits of the territorial sea, exclusive economic zone, and continental shelf on charts of adequate scale. Hydrographic Services are the only agencies with the technical competence to prepare such charts. Nations will therefore have strong economic incentives to develop their ocean resource potential. To realize the full benefits they must first conduct surveys and provide charts which are a prerequisite to exploration and exploitation of the resources in these coastal areas. Coastal sedimentary areas have a vast potential for containing rich mineral deposits, particularly hydrocarbons, which need to be identified by surveys. The data acquired from these hydrographic surveys can prove to be extremely valuable to the coastal nation by providing an informational advantage when considering contracts for exploration and resource recovery.

INTERNATIONAL ORGANIZATIONS

Countries can benefit greatly by affiliating themselves with international organizations that deal with the science of hydrography. Members of these international organizations are kept abreast of international standards and requirements of hydrographic surveying and charting. They are also informed about international training programs such as the Hydrographic Survey Assistance Program (HYSAP) that will benefit them in setting up or strengthening their own hydrographic facilities. (HYSAP is discussed later in this paper). Figure 2 indicates three international organizations of which African nations are already members; the International Hydrographic Organization (IHO), the Inter-Governmental Maritime Consultative Organization (IMCO), the Intergovernmental Oceanogra-

phic Commission (IOC). It also shows nations which have participated in the Law of the Sea Conference.

Also included in figure 2 is a list of countries which already have national cartographic agencies. According to the data presented in the 1977 Study of the World's Surveying and Mapping Manpower and Training Facilities by Dr. A. J. BRANDENBERGER, 44 African nations already possess a National Cartographic Agency (N.C.A.) of one type or another. (Hydrography is a basic adjunct to cartography). It might seem natural then, that establishment of hydrographic services would be developed as an outgrowth of existing cartographic facilities.

IHO

The objectives of the International Hydrographic Organization (IHO) are to consider the advisability of all maritime nations adopting similar methods in the preparation, construction, and production of their nautical charts and hydrographic publications; to render the results in the most convenient form to enable them to be readily used; to institute a prompt system of mutual exchange of hydrographic information between all countries and to provide an opportunity for consultations and discussions by the hydrographic experts of the world.

IMCO

The Inter-Governmental Maritime Consultative Organization (IMCO) is the specialized agency of the United Nations concerned solely with maritime affairs. Its interest lies mainly in ships used in international services. Its objectives are: (1) to facilitate cooperation among governments on technical matters affecting shipping and particularly from the angle of safety of life at sea; (2) to ensure the achievement of the highest possible standards of safety at sea; (3) to support efficient navigation. These objectives entail providing an extensive exchange of information between nations on technical maritime subjects and concluding international agreements.

IOC

The purpose of the Intergovernmental Oceanographic Commission (IOC) is to promote scientific research with a view of learning more about the nature and resources of oceans through concerted action of its members. The IOC is under the direction of the United Nations and is also an affiliate of Unesco.

N.C.A.

This abbreviation indicates countries that have an established National Cartographic Agency of one type or another.

Law of the Sea

The Conference on the Law of the Sea is held under the direction of the United Nations. Topics discussed at these international conferences include international solutions to questions of territorial waters, navigation, fishing, mineral rights, and shipping.

DEVELOPING A HYDROGRAPHIC CAPABILITY

In order for a nation to establish or strengthen its hydrographic capabilities four aspects should be treated; they are : trained personnel, adequate equipment, survey vessels, and cartographic facilities. All four aspects are basically of equal importance; however, the only one dealt with in this paper is that of trained personnel.

TRAINING

Trained personnel are the foundation upon which national hydrographic capabilities are established. For nations lacking hydrographic training facilities, there are several countries which make the training programs conducted within their charting agencies available to personnel from other nations. These programs vary greatly from the work/training type in which the students receive a basic working familiarization with hydrography to comprehensive programs which provide indepth knowledge of all aspects of hydrography and cartography.

Training not only benefits countries without hydrographic services but also helps strengthen capabilities of nations having existing services. Advanced courses provide a more detailed study of survey procedures, instrumentation, and modern technological developments. These courses also furnish hydrographers from various countries with the opportunity to exchange knowledge and ideas.

Personnel selected for international training programs should have academic backgrounds that will enable them to absorb the training being offered, as well as being competent in the language of the training program.

Countries interested in establishing their own hydrographic facilities should avail themselves of the programs being offered by established hydrographic organizations as opposed to developing their own facilities immediately. The training programs outlined here are just a sampling of many available and should not be construed to advocate any preference or level of competence. Countries interested in obtaining more information could contact such organizations as the IHO or the United States Naval Oceanographic Office (NAVOCEANO) who will advise them of programs appropriate to their national needs (*). The IOC, IMCO, and the Law of the Sea Conference are also good sources of maritime information.

HARSAP/HYSAP

In 1963 NAVOCEANO initiated the Harbor Survey Assistance Program (HARSAP) to assist Latin-American countries in developing the hydrogra-

(*) *Editor's Note :* The IHB's Special Publication No. 47 : Training and Technical Assistance in Hydrography (1st Edition, 1980) gives details of training programmes and technical assistance in hydrography provided by Member States of the IHO.

phic and cartographic capabilities necessary to produce accurate, up-to-date, and large-scale charts of their harbors and approaches. The HARSAP program that existed between 1963 and 1971 was for the most part a technical assistance program in which NAVOCEANO, at the request of a country, would provide advisors to assist in that country's survey operations. This served a two-fold purpose whereby the survey was conducted and personnel were trained simultaneously. Student hydrographers received lectures and on-the-job training in the techniques, procedures, and instrumentation necessary to conduct the hydrographic survey.

In 1971 the program expanded to include the Defense Mapping Agency (DMA) Inter-American Geodetic Survey (IAGS) School which offers a six week course in cartography offered in the Panama Canal Zone. In this part of the program the student receives training in the cartographic techniques, procedures, and standards used in the construction and reproduction of nautical charts. All cartographic training is based on methods used by the United States Defense Mapping Agency Hydrographic/Topographic Center (DMAHTC). These standards also meet or exceed those set by the International Hydrographic Organization.

Thus far the HARSAP cooperative program has been extremely effective in assisting Latin-American countries in developing their hydrographic surveying and nautical chart construction capabilities. As a result of the program over 104 hydrographers have been trained, seven hydrographic facilities have been established, and more than 55 nautical charts have been published, nine of which have been the direct result of engineering projects related to port expansions.

The Hydrographic Survey Assistance Program (HYSAP) is an outgrowth of the HARSAP Program. The primary purpose of HYSAP is basically the same as that of HARSAP : to assist participating nations in developing the capabilities necessary to conduct hydrographic surveys and to produce nautical charts complying with international standards. These efforts would also be accomplished by an on-the-job, in-country training program. Assistance can be tailored to the particular needs of each individual country.

Given below is an outline of the typical formal arrangements for training in hydrography and nautical charting under the HYSAP program.

International Training Program at NAVOCEANO

In 1957 NAVOCEANO, in response to foreign requests for on-the-job training in hydrography, cartography, and oceanography, initiated the International Training Program with major emphasis on coastal hydrography. The purpose of this program is to provide a formal structured training program to assist maritime nations in developing their hydrographic/oceanographic capabilities in the realm of nautical charting.

Since its inception 22 years ago over 357 students from 43 nations have received technical training in hydrographic surveying and oceanography. This includes 20 students from the African nations of Nigeria, the Arab Republic of Egypt, and Ethiopia. (See figure 3 and table 2).

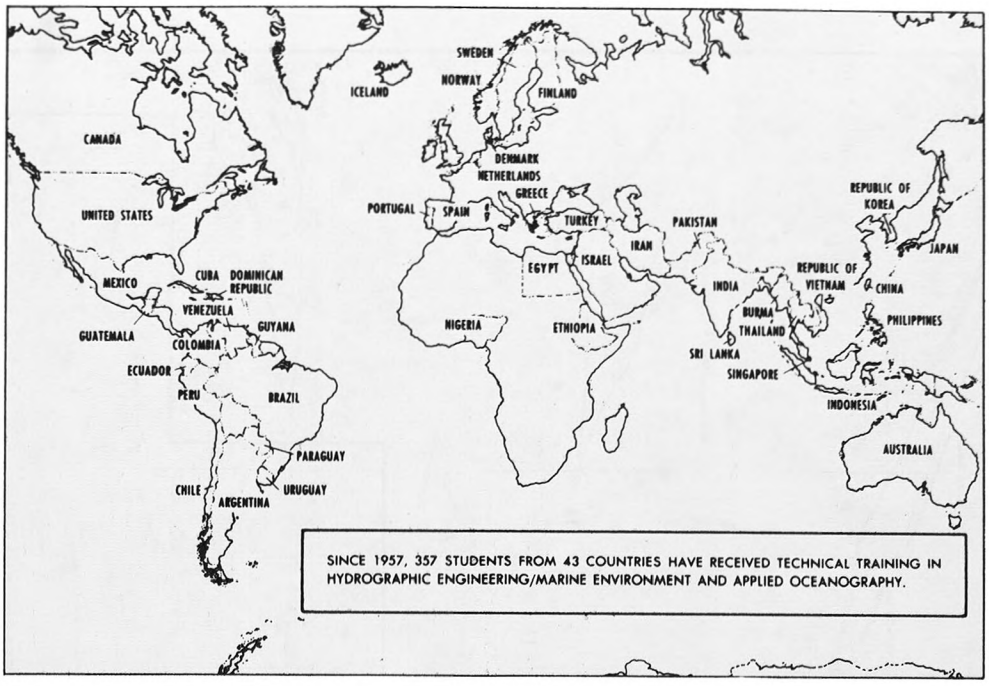


FIG. 3. — Foreign officer training.

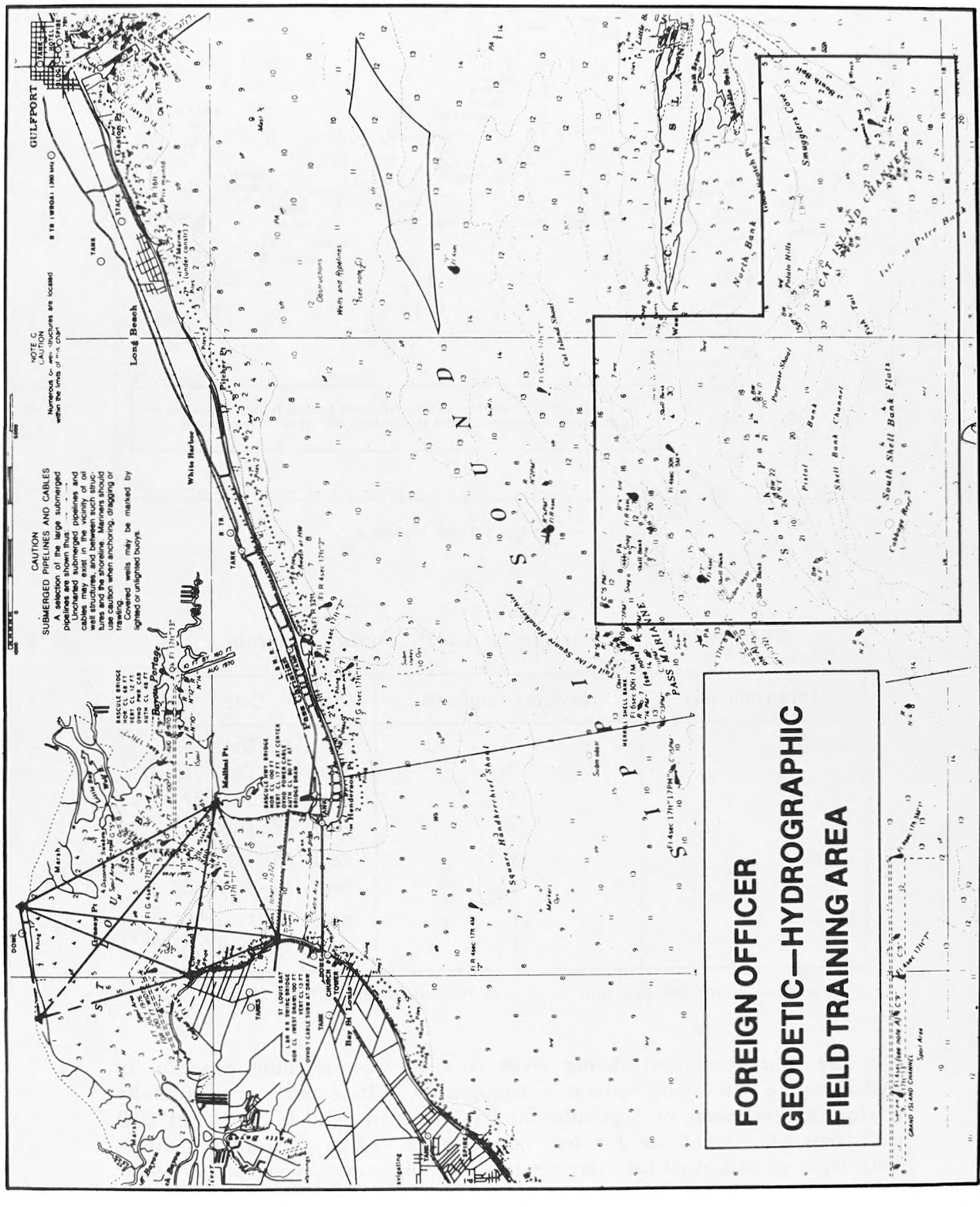
Table 2

NAVOCEANO — Foreign Officers' training program

African country(*)	Number of students	Date
Nigeria	2	Sept. '74 - Dec. '75
	3	Sept. '75 - Dec. '76
	1	Sept. '78 - July '79
	2	Sept. '79 - July '80
Egypt	5	Sept. '78 - July '79
	5	Sept. '79 - July '80
Ethiopia	1	Sept. '64 - Sept. '65
	1	Sept. '75 - Dec. '76

(*) Inquiries about the program have also been made by Liberia.

The course currently being given is a 48-week training program in hydrographic surveying/coastal oceanography. It commences annually during the first week of September and is designed to meet or exceed IHO standards of competence for hydrographic surveyors. Training includes both lectures and practical exercises in the disciplines that are of particular interest to cartographers, oceanographers, and the geodetic and hydrographic surveyor. The curriculum also includes the latest technology, procedures and techniques of acquiring and processing hydrographic/oceano-


FOREIGN OFFICER
GEODETIC—HYDROGRAPHIC
FIELD TRAINING AREA
GULFPORT
Long Beach
CAUTION
SUBMERGED PIPELINES AND CABLES
A selection of the large submerged pipelines are shown thus
Numerous other structures are located within the limits of this chart
Covered wells may be marked by lighted or unlighted buoys.
Obstructions
Wells and Pipelines
Cat Island
CAT ISLAND CHANNEL
North Bank
Potato Hills
Smugglers Cove
South Shell Bank Flats
Shell Bank Channel
Pistol Bank
Porpoise Shoal
Square Handkerchief Shoal
PASS MARIANNE
Ship Island
Mississippi Sound
Bay St. Louis
Pass Christian
Henderson Point
Marsh
Pier
Wharf
Tank
Stack
Dome
Church
Tower
Radio Mast
Radio Tower
Water Tower
Fish Haven
Submerged Pipeline
Submerged Cable
Spoil Area
Anchorage
Quarantine Station
Coast Guard Station
Yacht Club
Boat Ramp
Fishing Pier
Bridge
Ferry
Ferry Landing
Ferry Slip
Ferry Terminal
Ferry Terminal Building
Ferry Terminal Pier
Ferry Terminal Slip
Ferry Terminal Wharf
Ferry Terminal Yard
Ferry Terminal Office
Ferry Terminal Waiting Room
Ferry Terminal Ticket Office
Ferry Terminal Baggage Room
Ferry Terminal Restroom
Ferry Terminal Parking Lot
Ferry Terminal Access Road
Ferry Terminal Entrance
Ferry Terminal Exit
Ferry Terminal Signage
Ferry Terminal Lighting
Ferry Terminal Security
Ferry Terminal Maintenance
Ferry Terminal Operations
Ferry Terminal Management
Ferry Terminal Staff
Ferry Terminal Customers
Ferry Terminal Vehicles
Ferry Terminal Boats
Ferry Terminal Schedule
Ferry Terminal Fare
Ferry Terminal Ticket
Ferry Terminal Reservation
Ferry Terminal Cancellation
Ferry Terminal Refund
Ferry Terminal Complaint
Ferry Terminal Lost and Found
Ferry Terminal First Aid
Ferry Terminal Emergency
Ferry Terminal Evacuation
Ferry Terminal Drill
Ferry Terminal Training
Ferry Terminal Certification
Ferry Terminal Inspection
Ferry Terminal Audit
Ferry Terminal Report
Ferry Terminal Record
Ferry Terminal Archive
Ferry Terminal Library
Ferry Terminal Museum
Ferry Terminal Gift Shop
Ferry Terminal Restaurant
Ferry Terminal Cafeteria
Ferry Terminal Snack Bar
Ferry Terminal Vending Machine
Ferry Terminal Telephone
Ferry Terminal Internet
Ferry Terminal Wi-Fi
Ferry Terminal Computer
Ferry Terminal Printer
Ferry Terminal Scanner
Ferry Terminal Fax
Ferry Terminal Email
Ferry Terminal Website
Ferry Terminal Social Media
Ferry Terminal Advertising
Ferry Terminal Marketing
Ferry Terminal Public Relations
Ferry Terminal Community Outreach
Ferry Terminal Volunteer
Ferry Terminal Donation
Ferry Terminal Fundraising
Ferry Terminal Grant
Ferry Terminal Budget
Ferry Terminal Finance
Ferry Terminal Accounting
Ferry Terminal Payroll
Ferry Terminal Human Resources
Ferry Terminal Recruitment
Ferry Terminal Hiring
Ferry Terminal Training
Ferry Terminal Development
Ferry Terminal Performance
Ferry Terminal Evaluation
Ferry Terminal Promotion
Ferry Terminal Retirement
Ferry Terminal Pension
Ferry Terminal Benefits
Ferry Terminal Insurance
Ferry Terminal Safety
Ferry Terminal Health
Ferry Terminal Wellness
Ferry Terminal Fitness
Ferry Terminal Nutrition
Ferry Terminal Diet
Ferry Terminal Exercise
Ferry Terminal Sports
Ferry Terminal Recreation
Ferry Terminal Entertainment
Ferry Terminal Culture
Ferry Terminal Art
Ferry Terminal Music
Ferry Terminal Dance
Ferry Terminal Theater
Ferry Terminal Film
Ferry Terminal Photography
Ferry Terminal Video
Ferry Terminal Television
Ferry Terminal Radio
Ferry Terminal Newspaper
Ferry Terminal Magazine
Ferry Terminal Book
Ferry Terminal Author
Ferry Terminal Publisher
Ferry Terminal Editor
Ferry Terminal Reporter
Ferry Terminal Journalist
Ferry Terminal Photographer
Ferry Terminal Artist
Ferry Terminal Musician
Ferry Terminal Dancer
Ferry Terminal Actor
Ferry Terminal Director
Ferry Terminal Producer
Ferry Terminal Writer
Ferry Terminal Poet
Ferry Terminal Playwright
Ferry Terminal Screenwriter
Ferry Terminal Novelist
Ferry Terminal Short Story
Ferry Terminal Essay
Ferry Terminal Poetry
Ferry Terminal Drama
Ferry Terminal Comedy
Ferry Terminal Tragedy
Ferry Terminal Romance
Ferry Terminal Mystery
Ferry Terminal Thriller
Ferry Terminal Horror
Ferry Terminal Science Fiction
Ferry Terminal Fantasy
Ferry Terminal Historical Fiction
Ferry Terminal Biography
Ferry Terminal Autobiography
Ferry Terminal Memoir
Ferry Terminal Travel
Ferry Terminal Guidebook
Ferry Terminal Cookbook
Ferry Terminal Recipe
Ferry Terminal Food
Ferry Terminal Drink
Ferry Terminal Wine
Ferry Terminal Beer
Ferry Terminal Coffee
Ferry Terminal Tea
Ferry Terminal Juice
Ferry Terminal Soda
Ferry Terminal Water
Ferry Terminal Milk
Ferry Terminal Cream
Ferry Terminal Butter
Ferry Terminal Cheese
Ferry Terminal Yogurt
Ferry Terminal Egg
Ferry Terminal Meat
Ferry Terminal Poultry
Ferry Terminal Fish
Ferry Terminal Seafood
Ferry Terminal Shellfish
Ferry Terminal Crab
Ferry Terminal Lobster
Ferry Terminal Shrimp
Ferry Terminal Oyster
Ferry Terminal Clam
Ferry Terminal Mussel
Ferry Terminal Scallop
Ferry Terminal Squid
Ferry Terminal Octopus
Ferry Terminal Eel
Ferry Terminal Catfish
Ferry Terminal Bass
Ferry Terminal Trout
Ferry Terminal Salmon
Ferry Terminal Tuna
Ferry Terminal Swordfish
Ferry Terminal Shark
Ferry Terminal Ray
Ferry Terminal Skate
Ferry Terminal Flounder
Ferry Terminal Sole
Ferry Terminal Halibut
Ferry Terminal Cod
Ferry Terminal Haddock
Ferry Terminal Pollock
Ferry Terminal Whiting
Ferry Terminal Mackerel
Ferry Terminal Herring
Ferry Terminal Sardine
Ferry Terminal Anchovy
Ferry Terminal Smelt
Ferry Terminal Perch
Ferry Terminal Sunfish
Ferry Terminal Crappie
Ferry Terminal Bluegill
Ferry Terminal Pumpkinseed
Ferry Terminal Redbreast
Ferry Terminal Warmouth
Ferry Terminal Rock Bass
Ferry Terminal Largemouth Bass
Ferry Terminal Smallmouth Bass
Ferry Terminal Spotted Bass
Ferry Terminal White Bass
Ferry Terminal Striped Bass
Ferry Terminal Hybrid Bass
Ferry Terminal Walleye
Ferry Terminal Sauger
Ferry Terminal Saugeye
Ferry Terminal Northern Pike
Ferry Terminal Muskellunge
Ferry Terminal Tiger Muskie
Ferry Terminal Chain Pickerel
Ferry Terminal Redfin Pickerel
Ferry Terminal Grass Pickerel
Ferry Terminal Muskellunge
Ferry Terminal Tiger Muskie
Ferry Terminal Chain Pickerel
Ferry Terminal Redfin Pickerel
Ferry Terminal Grass Pickerel

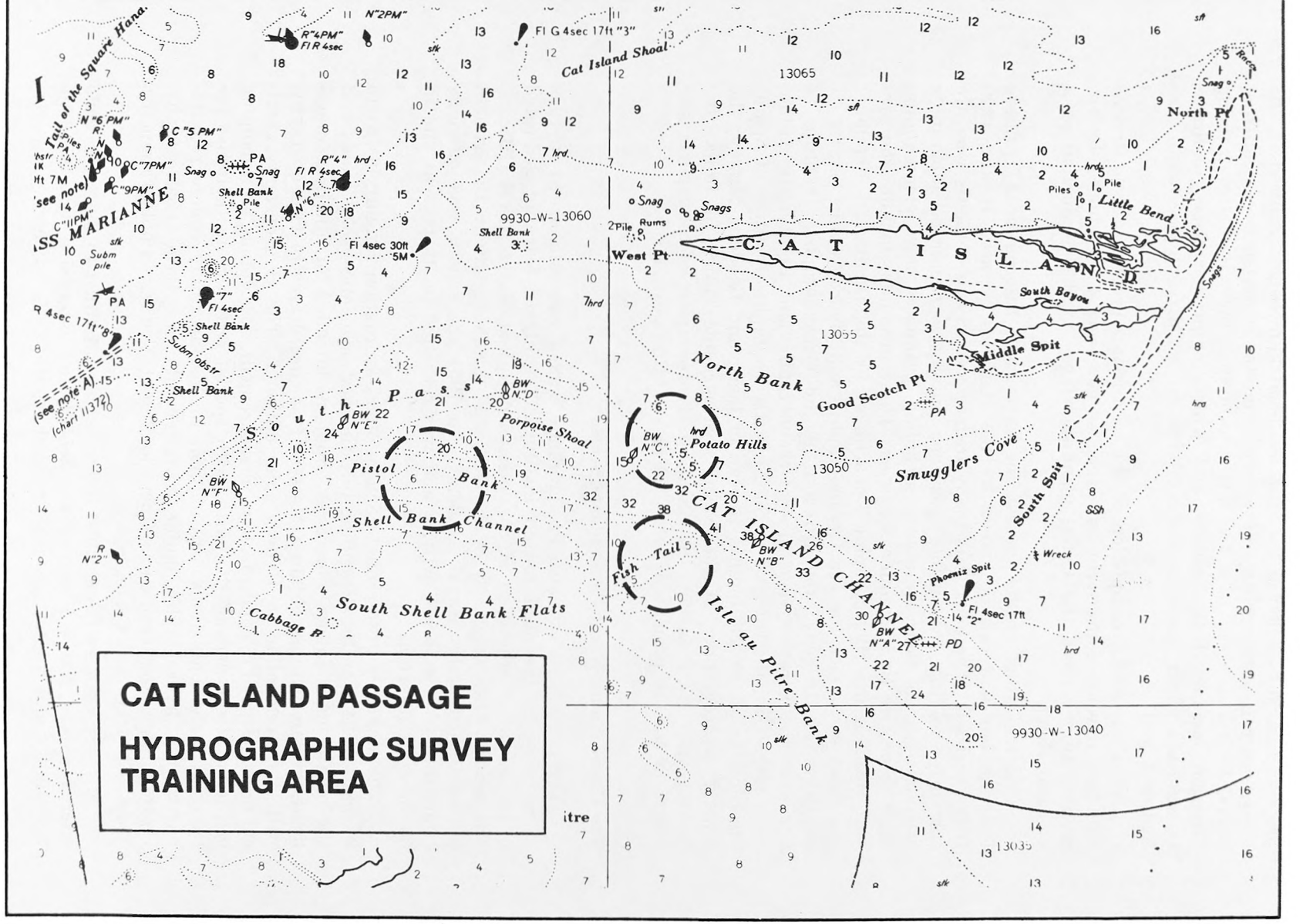

CAT ISLAND PASSAGE
HYDROGRAPHIC SURVEY
TRAINING AREA
Cat Island Shoal
13065
North Pt
Little Bend
West Pt
C A T I S L A N D
South Bayou
Middle Spit
13055
North Bank
Good Scotch Pt
Smugglers Cove
South Spit
13050
Potato Hills
Porpoise Shoal
Pistol Bank
Shell Bank Channel
CAT ISLAND CHANNEL
Fish Tail
Isle au Pitre Bank
South Shell Bank Flats
Phoenix Spit
Wreck
9930-W-13060
9930-W-13040
13035
Tail of the Square Hana.
Shell Bank
Subm pile
Subm obstr
Snag
Snags
Piles
Pile
Rums
Fl 4sec 30ft 5M
Fl G 4sec 17ft "3"
R"4PM" Fl R 4sec
N"2PM"
C "5 PM"
C"7PM"
C"9PM"
C"11PM"
N"6 PM"
R"4" hrd Fl R 4sec
"7" Fl 4sec
Fl 4sec 17ft
Fl 4sec 17ft "2"
BW N"A"
BW N"B"
BW N"C"
BW N"D"
BW N"E"
BW N"F"
N"2"
PA
PD
SSh
stk
hrd
(see note A)
(chart 11372)

FIG. 5

graphic data. It is believed that the technical knowledge acquired in the classroom can only be fully developed from the experience gained from actual field exercises. It is for this reason that the NAVOCEANO training program includes both geodetic and hydrographic exercises conducted by students under actual field conditions in the Mississippi Sound. (See figures 4 and 5).

After successful completion of the NAVOCEANO program, each student will have developed the technical expertise necessary to conduct a hydrographic survey from the initial planning stages to the production of a nautical chart.

One indication of the success the NAVOCEANO International Training Program has had can be shown by the statistics released in the 1979 IHO Yearbook. The book lists many former NAVOCEANO students who are currently holding responsible positions in hydrographic/oceanographic organizations in their countries, including graduates now commanding their respective Hydrographic Agencies. These graduates include the present Head of the Hydrographic Department of the Dominican Republic; the Head of Service for the Oceanographic and Hydrographic Service of the Navy of Uruguay; the Director of the Oceanographic Institute of Ecuador; the Director General of Oceanography and Lighthouse Authorities in Mexico; the Director of the Navy Hydrographic Institute of Spain; the Director of the Philippines Bureau of Coast and Geodetic Survey; the Deputy Hydrographer of the Naval Hydrographic Office in India; the Hydrographer of Pakistan; the Assistant Hydrographer of Singapore; and others in equally prominent technical or scientific positions.

The United States Naval Postgraduate School

The United States Naval Postgraduate School was established in 1909 in response to the need for an institution of higher learning dedicated to the advanced education of commissioned United States Naval Officers. The school, when originally established, was the Postgraduate Department of the United States Naval Academy. In 1951 the school was officially established as a separate activity and was relocated to its present site in Monterey, California.

The Monterey Postgraduate School offers a program ranging in length from 18 to 24 months, depending on students' academic backgrounds and the sponsoring countries' objectives. Students intended for middle management assignments can obtain a Master of Science degree in Oceanography, with a concentration in Hydrography optional. The Hydrography curriculum is designed to concentrate on measurement, description, and mapping of the surface waters of the earth, with special reference to their use for navigation and operations. In addition to Oceanography course requirements, the hydrography option requirements are Basic Hydrography, Hydrographic Measurements, Operations and Cruises, Photogrammetry, Tides, Geodesy, and Cartography.

Military Officers from allied countries are admitted to most curricula offered at the Naval Postgraduate School, but admission is subject to availability and quotas assigned to each country. Candidates must also

satisfy academic standards established for each curriculum and exhibit a fluency in English.

The Naval Postgraduate School occupies a multi-million dollar campus, graduates an average of 800 students a year, and offers a range of curricular programs specifically tailored to impart the scientific, engineering, operational, and administrative knowledge required to meet the present and projected professional needs of the United States Department of Defense.

The school has had a number of African students in many of their programs. For example between 1975 and 1979 the International Program in Resource Management Education graduated a total of 30 students from the countries of Ethiopia, Ghana, Kenya, Liberia, Nigeria, Senegal, and Togo. The Oceanography (Hydrography) program, however, is a relatively new program at the Naval Postgraduate School and has not had any African students in attendance thus far.

The National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration (NOAA) offers a six week hydrographic program entitled "Fundamentals of Combined Operations". The primary purpose of this program is to give new NOAA Corps Junior Officers the hydrographic training necessary to perform more efficiently when assigned to duty stations that require a basic knowledge of hydrographic technology. Although the NOAA program is geared toward a curriculum that benefits its own junior officers, it has proven to be an excellent hydrographic training program for civilians and foreign officers alike.

The NOAA program is broken down into three sections : classroom instruction, field work, and data processing. The classroom instruction and field work are combined in such a way as to enact an actual hydrographic operation. The operation includes training in survey planning, initializing and conducting the survey, and data acquisition.

The first phase of the course, geodetic field work, teaches the student the technical skills necessary to go from setting up horizontal control points to tide gage installation. In the next phase students are trained in the art of field editing. This involves the location and verification of hazards to navigation by combining photogrammetric techniques and actual field observations. The field editing phase is followed by training in three types of positioning systems: Range/Range, visual hydro, and Range/Azimuth. Students are also taught to utilize a PDP 8 computer in order to process data received.

The above NOAA program is offered twice a year at the Pacific Marine Center in Seattle, Washington, and has experienced much success. Attendance, however, is somewhat restricted, and foreign students' applications would be studied and approved on a case-by-case basis.

LANGUAGE

Figure 6 delineates the distribution of official languages used throughout Africa. This type of information could be used to analyse and determine the location of training facilities, and the language that could be used at each facility to benefit the greatest number of students.

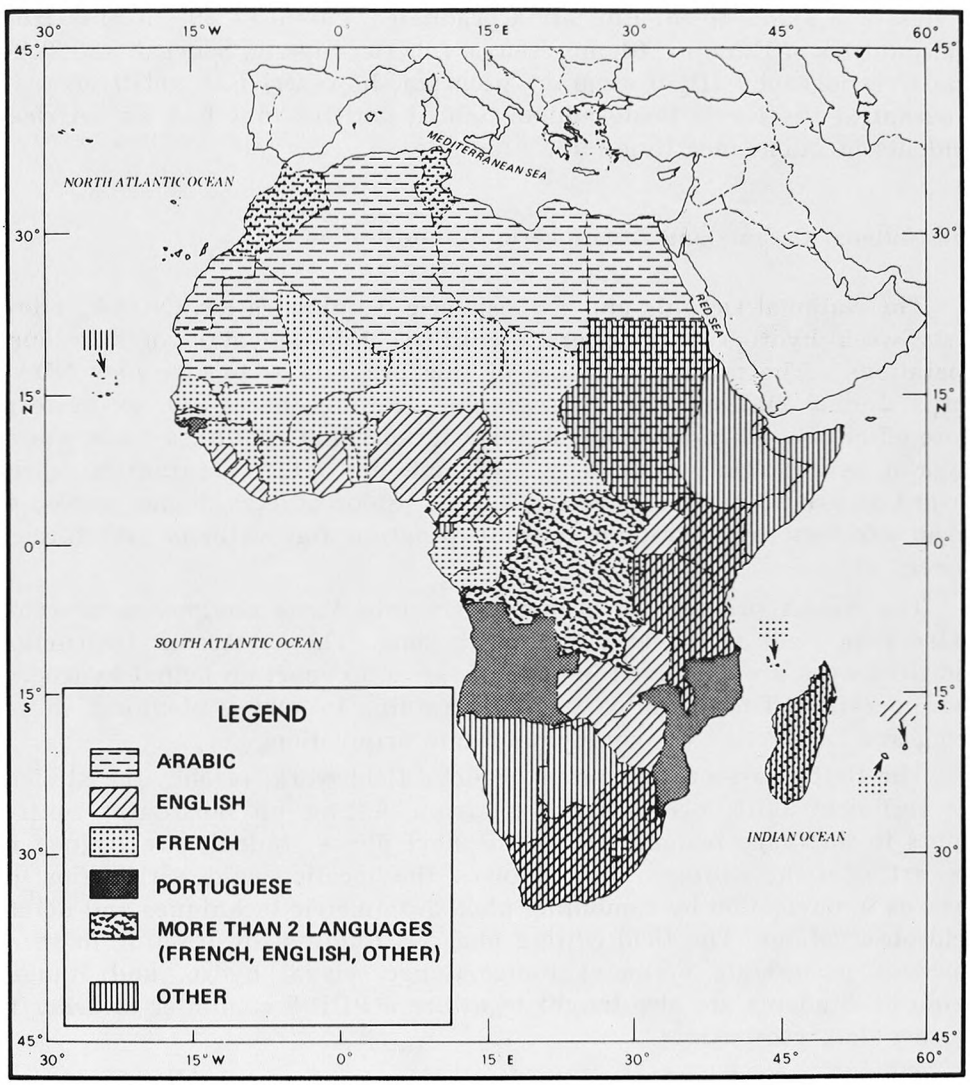


FIG. 6. — Language breakdown.

CONCLUSION

Africa is the second largest continent in the world with approximately 18 924 229 square kilometres, and has a total of nearly 40 000 km of coastline. Of its 53 countries, 39 border on one of five seas and oceans. This vast predominantly maritime continent has virtually unlimited potential in all ocean-related fields.

Technology and the production of improved hydrographic charts will open the door to increased maritime economy and the exploration and exploitation of undersea resources. It also will benefit projects in coastal zone management and keep a watch on environmental concerns.

Trained personnel are the key to a strong, efficient hydrographic service that is necessary for a nation to produce the type of charts needed to improve its maritime economy. The many hydrographic training schools can give personnel from other nations the types of training needed to produce these services.

Improved hydrographic surveying and charting would benefit not only the African nations themselves but the maritime world at large.

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