International Co-operation to Improve Safety of Navigation in the Southern Red Sea

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In the late 1970s and early 1980s, under the umbrella of the Arab League Educational, Cultural and Scientific Organisation, with the assistance of the United Nations Educational Scientific and Cultural Organisation, a plan to conserve the environment of the Red Sea and Gulf of Aden was put in place. Improvement of safety of navigation in the southern Red Sea was considered to be of prime importance as a significant percentage of world shipping used these poorly charted waters on passage to and from the Suez Canal. Although, there had never been a large-scale pollution incident caused by a navigational error, studies have shown that it was a statistical probability and the potential damage to this unique, biodiverse ecosystem would be catastrophic.

Co-operative efforts by the Red Sea coastal nations brought about funding from the World Bank to improve navigation in the area. Subsequently, after extensive consultation with the United Kingdom Hydrographic Office, a plan to improve charting of the southern Red Sea and to create a Traffic Separation Scheme and recommended route through the area, was created. The Traffic Management Scheme was designed to take shipping around the dangerous and constricted waters close to the Hanish group of Islands and thence down to the Strait of Bab el Mandeb and into the Gulf of Aden. The United Kingdom Hydrographic Office was also contracted to create a scope of work for a modern hydrographic survey of the planned scheme, to oversee the tendering process and the conduct of a contracted commercial survey of the area. The final phase of the plan was to fully appraise the data before using it to improve and modernise charting of the region. To date, the data has been fully appraised and accepted and the new chart scheme will be published in early 2002.

The survey and new charting scheme will then enable PERSGA to implement the required navigational aids in the area and the new routing measures can be presented to the International Maritime Organisation. Once accepted, it is intended that the scheme be adopted by mid 2003.

Background

The development of a programme to improve the safety of navigation in the southern Red Sea can be traced back to the early 1970's when the Arab League Educational, Cultural and Scientific Organisation (ALESCO), with the assistance of UNESCO, convened a meeting in Bremerhaven, Germany to discuss interdiscipli-

nary research ideas. Subsequent meetings identified key regional concerns and proposed plans of activity which gave rise to the Programme for the Environment of the Red Sea and Gulf of Aden (PERSGA). An interim Secretariat was established in Cairo to implement the programme and which ultimately moved to Jeddah in 1980[1].

In 1982, the plenipotentiaries of the governments in the region signed the Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment. The main focus of the convention being the fight to prevent or reduce pollution. It also includes an Article directing the contracting parties to establish a regional organisation, headquartered in Jeddah, to implement the agreement. This regional organisation was established in 1995 under the Umbrella of the Arab League and, at the first council meeting in Egypt, formally announced the creation of the Regional Organisation for the Conservation of the Environment of the Red Sea and Gulf of Aden (keeping the title of PERSGA). Under the auspices of PERSGA, a Strategic Action Programme (SAP) for the Red Sea and Gulf of Aden was established.

PERSGA Administration and Funding

PERSGA is governed by a council, composed of the Ministers in charge of the environment from each of the member states (Djibouti, Egypt, Jordan, Palestine, Saudi Arabia, Somalia, Sudan and Yemen). The council meets annually to approve technical and financial policies with daily affairs being managed by the Secretariat; a small but dedicated team drawn from the countries of the region. The Kingdom of Saudi Arabia hosts the PERSGA Secretariat (Jeddah) and all Member States contribute to the budget. Specific regional programmes are assisted with grants provided by international donors.

Strategic Action Programme (SAP)

The SAP is an interdisciplinary project with eight component parts, component 2 being the Reduction of Navigation Risks and Marine Pollution (NRMP). It was developed over a period of three years in co-operation with the three Global Environment Facility (GEF) implementing agencies. These agencies were the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and the World Bank. The implementing agencies, together with the Islamic Development Bank have provided the necessary financial and technical support for the execution of the programme. The SAP was adopted by the PERSGA Council of Ministers in 1997 and issued in 1998.

SAP Component 2 – Reduction of Navigation Risk and Marine Pollution

The main objective of this SAP component is to increase the safety of navigation in order to reduce the risk of marine pollution from shipping accidents. To achieve this, a navigation risk assessment study was commissioned and was undertaken by consultants from Det Norske Veritas of Norway.

The study highlighted the fact that the Red Sea and Gulf of Aden form part of a major shipping route that carries approximately 7 per cent of total world trade. This shipping is dominated by tankers and combination carriers carrying crude oil and products between the Middle East and Europe/North America, bulk and combined carriers between Australia and Europe, container ships, car carriers, RoRo and general cargo ships using the Suez Canal route and passenger cruise liners. As an example, over 100 million tons of oil are transported annually through the area with approximately 14,000 ships passing through the Gulf of Aden each year[2].

[1] UNEP Web site – www.unep.ch
[2] Strategic Action Programme for the Red Sea and Gulf of Aden, PERSGA

Whilst a large part of the Red Sea requires uncomplicated navigation by transiting ships, there are a number of exceptions. The two streams of traffic (northbound to the Suez Canal and southbound from it) are constrained at the northern end by the Gulf of Suez and at the southern end by the Hanish group of islands and the Strait of Bab el Mandeb. Traffic on this 1,200 nautical mile (nm) route is, for the most part, unregulated and these constraining points are high-risk zones for potential navigation accidents. Because of the general depths in the area of the Hanish Islands, shipping has to pass close to the islands thus any error in navigation could very rapidly become a serious grounding incident. A collision, grounding or other incident involving a large tanker causing a major oil spillage is a statistical probability and could give rise to large-scale pollution. Such an event in this relatively ecologically undisturbed enclosed body of water could have a catastrophic effect on the bio-diverse ecosystem. Large-scale pollution would have serious effects on the coastal mangrove and seagrass ecosystems where fish spawn thus affecting local fishing industries. Long-term pollution effects are also likely to have an adverse effect on regional tourism. The report concluded that, in respect of the southern Red Sea, implementation of traffic management measures on the routes around Jabal Zuqar Island and the Hanish Islands down to the Strait of Bab el Mandeb, would significantly reduce the risk of navigation induced accidents.

Component 2 of the SAP therefore designed a Traffic Separation Scheme (TSS) to take traffic around the Hanish Islands and thence southwards to link up with the scheme already in place in the Strait of Bab el Mandeb. The scheme, however, could not be implemented without full and unambiguous knowledge of the bathymetry of the area. This key requirement was not available at the time due to a lack of modern survey information in the area.

Charting in the Southern Red Sea and Gulf of Aden

At this time, charting in the southern Red Sea consisted of a series of charts at differing scales as can be seen in Figure 1. The four main charts used for navigation through the Strait of Bab el Mandeb and around the Jabal Zuqar and Hanish Islands are:

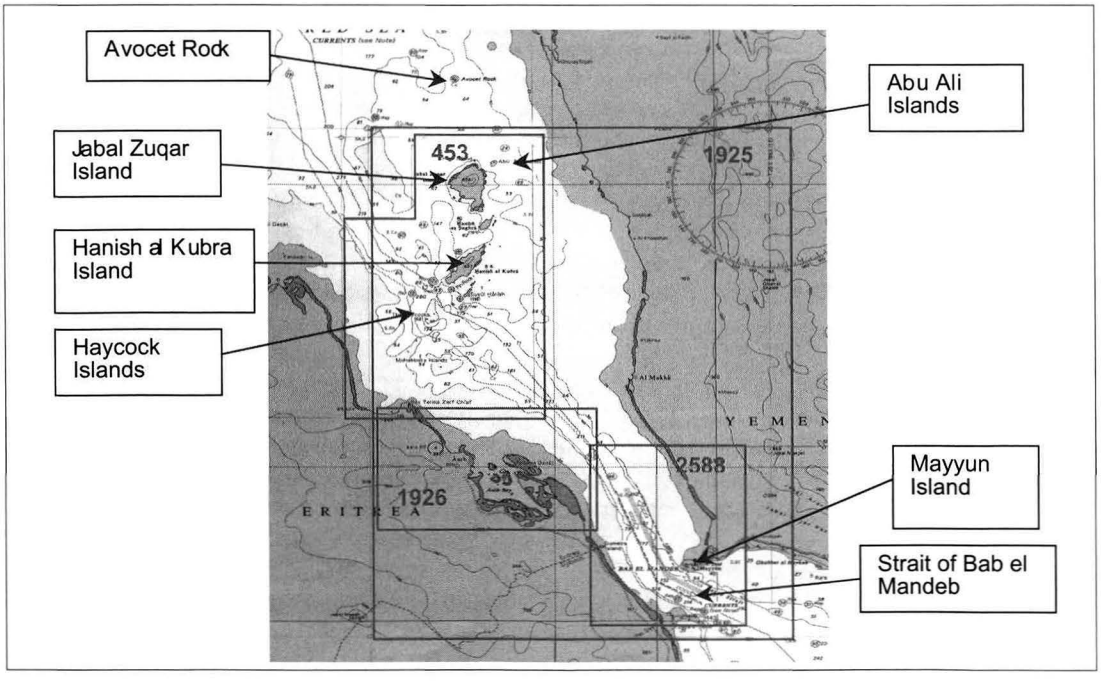

Figure 1: Current charting scheme in the Southern Red Sea

BA 1925	Jabal Zuqar Island to Bab el Mandeb, 1:200,000 (1985)
BA 2588	Straits of Bab el Mandeb, 1:75,000 (1984)
BA 1926	Aseb Bay, 1:75,000 (1984)
BA 453	Islands in the Southern Red Sea, 1:100,000 (1985)

These charts lack modern hydrographic surveys and the source data used to compile these charts is varied in both age and quality. Sources range from various Admiralty surveys conducted between the 1830s and the 1960s to soundings from ships on passage. They also include information from French and Italian government charts and a number of commercial seismic surveys. Therefore, much of the data in fact comes from old lead-line surveys of the area.

These lead-line surveys, while being old, provide the navigator with useful information. The measured depths are mostly very reliable but, because of the nature of these surveys, the data tends to be quite sparse. Also, whilst the depths may be reliable, this type of survey does not provide any information about the depth of water in between the soundings. Thus, the navigator gets only a general impression of the topography of the seabed – not a precise picture.

More modern surveys that utilise echo sounder technology provide a great deal more information. The survey vessel is able to provide long lines of depth information and thus, a series of 'profiles' of the seabed can be built up to provide a much more detailed representation of the seabed topography. However, as with lead-line surveys, no information in-between the lines of soundings is gathered. To overcome this 'inadequacy', sideways looking sonars were developed in the 1960s and 1970s to 'look' at the seabed between the lines of soundings. This did not provide the surveyor with depth information between the lines of soundings, but it did allow him to check whether there were any obstructions or features either side of the lines of sounding. Thus, with the introduction of side scan sonars, the surveyor was able to plan his survey line spacing such that the side scan sonars provided 100 per cent coverage of the seabed. This enabled the cartographers to produce charts with soundings that not only represent the general topography, but with certain knowledge that no dangers exist between the soundings shown on the chart.

It can also be seen when looking at charts of poorly surveyed waters such as these, that there often 'shoal soundings' shown in otherwise deeper waters. These soundings are shown with a date and a short descriptor such as, position doubtful or even existence doubtful. Such depths occur because they have been reported to the charting authority by vessels on passage through the area. All such reports are scrutinised by the charting authority for reliability and accuracy before being shown on the chart. However, it is often the case that, these soundings are the product of 'spurious information'. The vessel's echo sounder may have locked on to a semi-buoyant but submerged object, shoals of fish, possibly a highly reflective layer of water or, the depth may be 'true' and a pinnacle of rock does exist in that position. The charting authority has a responsibility to show these depths on the chart (unless they can positively disprove them) to allow the navigator to make an informed assessment of the safety of his planned track.

As stated before, in order to implement any Traffic Management scheme, a full and unambiguous knowledge of the bathymetry of the area is required. Clearly, in these waters, this is not the case. Old lead-line survey data and soundings from ships on passage characterise this area. There were also a number of 'reported' shoal depths. PERSGA had, therefore, to address this situation and commission a modern hydrographic survey of the area before they could proceed any further with their plans. They also needed to look at the current chart scheme itself to ensure that it adequately met the needs of a Traffic Management Scheme. For this reason the lead specialists from Component 2 worked closely with the Red Sea charting specialists at the UKHO to create a practical scheme, that would not only suit the requirements of modern shipping, but that could also be adequately depicted on a practical series of charts of the region.

Chart Scheme

The proposed Traffic Management Scheme called for a TSS close north east of Jabal Zuqar Island, through the Abu Ali Channel and thence south eastwards down the eastern side of the island groups to join up with the scheme already in place in the Strait of Bab el Mandeb. A second, complementary TSS was also designed to take shipping around the south-western limits of the island groups. This scheme was therefore, extensive and would have a significant impact on the three larger scale charts of the area, BA Charts 453, 2588 and 1926.

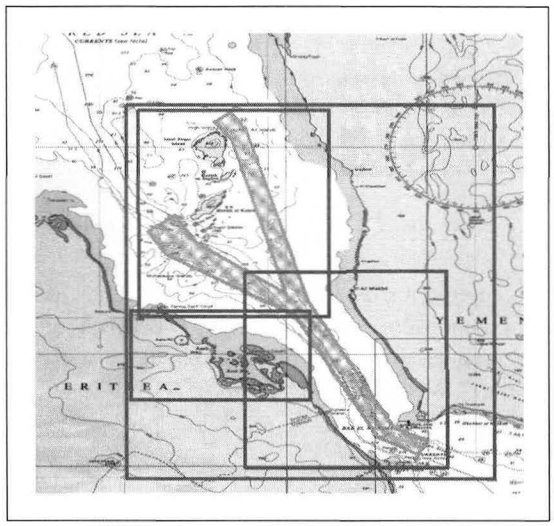

Figure 2: New chart scheme for the Southern Red Sea and proposed limits of the traffic management scheme

It can be seen that, if a TSS were to be introduced to the east of Jabal Zuqar Island, BA chart 453 would not provide sufficient sea room for the navigator within its current limits. It can also be seen that, any scheme running south from these islands to the Strait of Bab el Mandeb would have to pass through the north eastern corner of BA chart 1926 for a short distance before entering BA chart 2588. Again, this situation is less than ideal for safe navigation. It was decided, therefore, to redesign some of the charts in order to create a more efficient scheme. Figure 2. shows the proposed new scheme of charts and the proposed limits of the Traffic Management Scheme.

The new scheme will consist of unchanged BA charts 1925 (1:200,000) and 1926 (1:75,000), a New Edition of BA 453 (1:100,000) with limits extended to the east and a New Chart BA 452 (1:100,000). BA 2588 is to be abolished. The limits of New Chart 452 have been designed to encompass the Strait of Bab el Mandeb and to overlap the southern limit of BA 453.

Hydrographic Surveying Plans and Overseeing Services

The next phase of the plan called for the commissioning of a hydrographic survey to cover the entire area of the proposed scheme. PERSGA opted to utilise the expertise within the UKHO for planning, overseeing and verifying extensive area-surveys conducted to internationally approved standards for charting purposes.

In 1999, a contract was raised by PERSGA and funded by the World Bank for the UKHO to create the technical specifications for a survey of the area based on the plans created by the SAP Component 2 specialists. The contract called, not only for the UKHO to raise the technical specifications and the scope of work for the survey, but also to oversee the commercial tendering process needed to ensure that a suit-

able survey organisation was found to undertake the survey. Further to this, the UKHO was also contracted to provide a survey overseer who would be required to monitor the progress of the survey to ensure that the laid down standards[3] were being followed and to act as a liaison point between the survey organisation and the UKHO. The final aspect of the contract was for the UKHO to fully appraise the survey data to ensure that it was fit for purpose before being adopted into the published charts.

Once the technical specifications for the survey were completed and sufficient funding secured from the World Bank, the proposed survey was advertised and interested companies were invited to tender for the contract. These proceedings were initiated early in 2000 and by the end of August 2000, the tenders had been scrutinised by UKHO and PERSGA personnel and a shortlist of companies with suitable plans was drawn up. After this stage, a special meeting of PERSGA and UKHO personnel was convened (the survey companies were invited to attend) and the financial bids opened. The winning company (Gardline Surveys Limited of Great Yarmouth, UK) was invited to enter into negotiations with PERSGA to create a contract to undertake the survey.

Conduct of the Survey

The contract between Gardline Surveys Limited and PERSGA was signed in December 2000 and survey operations were commenced very shortly thereafter. Gardline Surveys opted to use one of their own survey vessels, the 80 metre MV Ocean Seeker (Figure 3). Precise positioning was to be obtained from Global Positioning System (GPS) satellite signals corrected for differential errors (DGPS), with depth measurements obtained from single beam echo sounder supplemented by total side scan sonar coverage at a scale of 1:25,000.

Figure 3: MV Ocean Seeker

Survey operations commenced in late December 2000 and continued through to early June 2001. The first phase of the survey took place in the topographically challenging area to the south of the Hanish islands. This area is characterised by a number of small, steep sided islands and rocks known as the Haycock Islands and the South West Rocks and also numerous steep underwater sea mounts. The plan called for the ship to conduct the majority of the data gathering phase but to utilise a small twin-hulled survey motor launch (sub-contracted from Titan Surveys Limited of Swansea, UK) for the hazardous inshore work.

The second phase of the survey took place in the northern section of the area close to Abu Ali Island. Although this area is more intensively used by vessels on passage, it was not as topographically challenging as the first area. The survey was progressed southwards and finally, the last phase was conducted in the Strait of Bab el Mandeb.

In order to ensure that the sounding data was corrected for tidal height, tide gauges were set up at Hodeidah, Abu Ali Island, Hanish al Kubra Island, Al Mukha and Mayyun Island. Continuous observations

[3] IHO Special Publication No 44, 4th Edition, April 1998

were taken throughout the survey period. This enabled analysis of the data and subsequent updating of the information published in the appropriate tidal publications for the area. At the same time as surveying was being conducted, the vessel laid four Acoustic Doppler Current Profile (ADCP) stations. These stations were situated south of Mayyun Island, south of Hanish Island, at the junction of the two branches of the scheme and south of Abu Ali Island. The ADCPs were laid to record tidal flow data at the surface, mid-water and close to the seabed. This type of information is vital for marine authorities when planning how to contain pollution caused by vessel accidents and groundings.

In addition to the main survey, one important investigation was included in the scope of work. Approximately 18 miles to the north of Abu Ali, a shoal of 4.6 metres in a general depth of 60 metres known as Avocet Rock exists. This shoal lies in the general path of vessels exiting and entering the TSS. The shoal was known to exist, but its precise location and extent have remained uncertain for many years. It was first 'discovered' by HMS AVOCET in 1887 when the vessel reported having struck the rock. Over the years, there have been several attempts to locate the rock and there have been several reported positions from merchant shipping. This survey provided the ideal opportunity to conduct a definitive search and thereby remove any doubt about its location.

Survey Appraisal

On completion of the survey data gathering phase, the data was processed by Gardline Surveys Limited at their head office and final 'Fair' data and supporting reports were rendered to the UKHO in two batches. The first, covering the northern half of the survey area, was rendered at the end of July 2001 and the southern half in late August 2001.

Once received in the UKHO, the data undergoes a rigorous appraisal process. This process is used to ensure that all the data supplied is of the highest possible quality and has been gathered in accordance

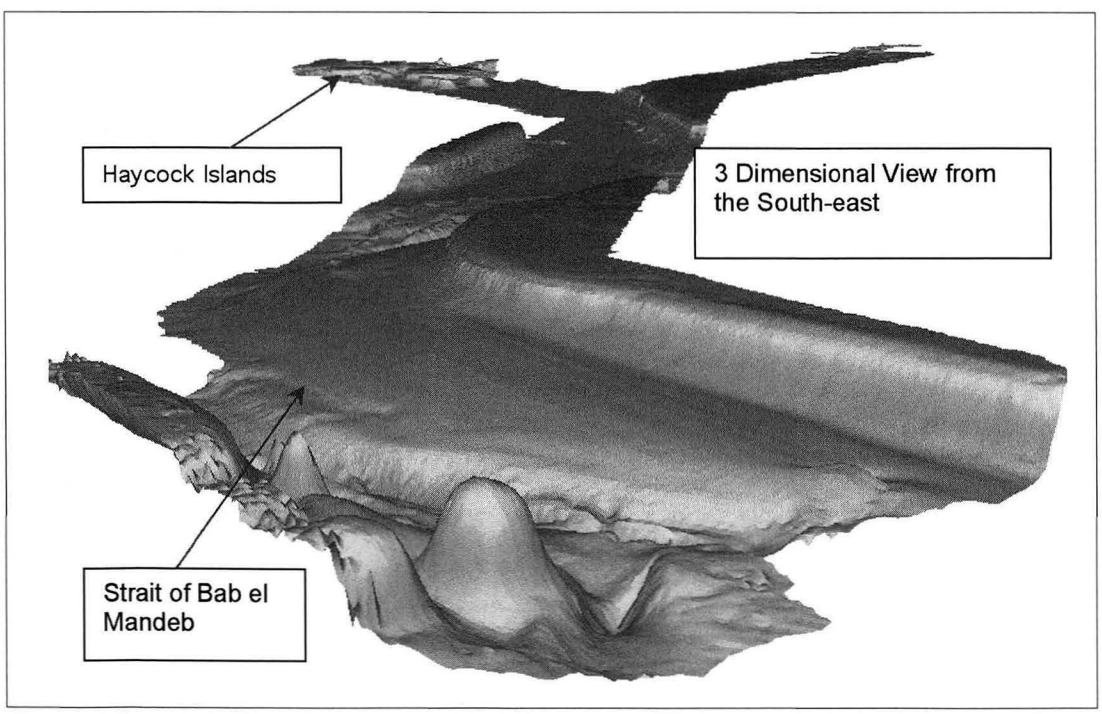

Figure 4: 3-Dimensional view from the South-east

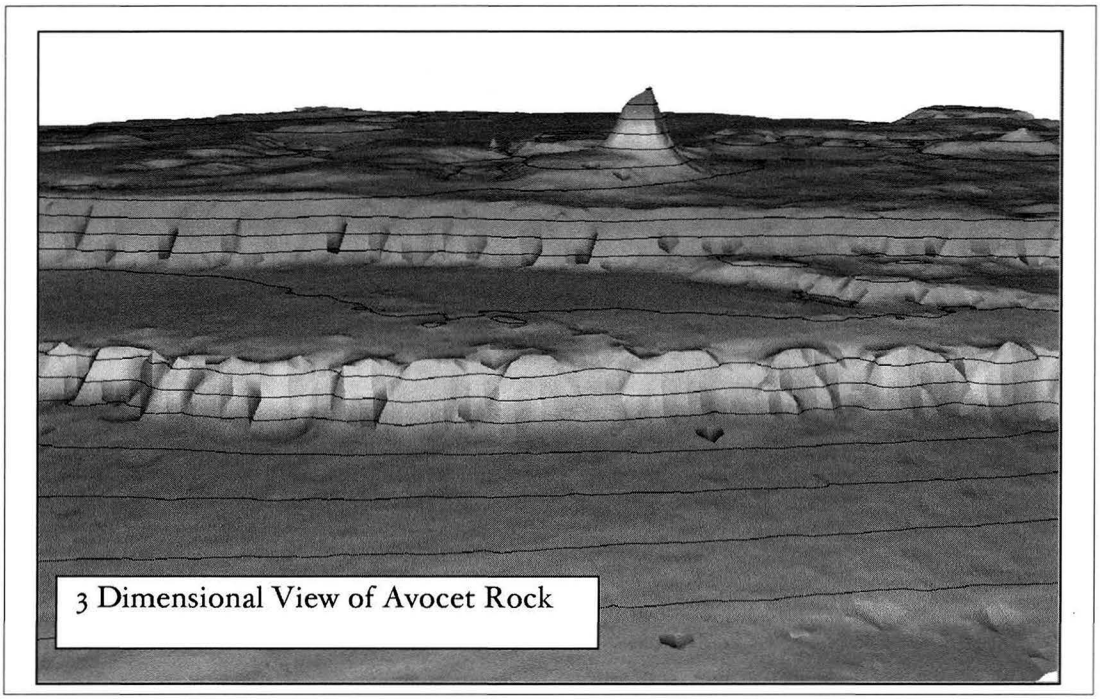

Figure 5: 3-Dimensional view of Avocet Rock

with the exacting standards laid down in the technical specifications before it is utilised in the published chart. Checks range from confirmation that the tidal information has been correctly gathered and connected to the charting datum and applied to the soundings, to detailed analysis of the digital sounding data to ensure all spurious data has been removed. Echo sounders have also to be calibrated and the correct parameters such as speed of sound in the water column applied. The satellite navigation system data is checked for correct operation and to verify that the system has been correctly validated before usage.

Once these technical checks have been satisfactorily completed, the data is scrutinised from a charting perspective. Side scan sonar coverage of the area is checked to ensure complete insonification; sounding coverage of shoals and features is checked to ensure that S44 standards have been met and that the area has been thoroughly and systematically investigated.

Having completed all the validation and appraisal checks and having resolved any queries about the data with the survey company, the data is then compared with the existing charted information. In particular, comparisons are made between originally charted shoals and the new data to see whether the shoal soundings are supported or fully disproved. This process is particularly important in the areas of 'reported' shoal depths.

The full appraisal process for this survey has now been completed, the data has been accepted and is ready for inclusion in the new charts. Most importantly for PERSGA, all of the 'reported' shoals within the survey area have now been either confirmed or disproved and there are no new dangerous shoal depths within the proposed TSS that could pose a danger to navigation. Disproved shoal depths have been removed from the charts by Notice to Mariner action. In addition, the location of Avocet Rock was entirely successful and a final definitive position and depth determined. Figure 4 shows a 3 dimensional representation of the entire area and Figure 5 shows a 3 dimensional representation of Avocet Rock.

Conclusion

The PERSGA survey project has shown that, concerted action by regional groups of countries in conjunction with international donor agencies can, with suitable hydrographic expertise brought in from competent agencies, undertake hydrographic surveys which help to protect the environment through improved safety of navigation. In the case of the UKHO, although it has a long history of survey supervision in UK waters, this was the first time that this type of consultancy work has been undertaken on such a scale.

Coastal nations undoubtedly benefit from modern charting of their waters. For example, the state of charting can affect the success of port operations especially if detours around un-surveyed waters causes increased voyage time; tourism prospects can be improved by adequate modern charting and, as in this project, safety of navigation is improved, thereby having a positive environmental impact. The success of this project has set a standard for the future. The UK believes that this type of co-operative effort between coastal nations, international donor agencies and major hydrographic offices is in the long term interests of coastal nations and is a vital tool in ensuring important sea routes are adequately charted to modern standards.

References

A. International Hydrographic Organisation Special Publication No 44 (IHO Standards for Hydrographic Surveys), 4th Edition, April 1998

B. Strategic Action Programme for the Red Sea and Gulf of Aden (Navigation Risk Assessment and Management Plan, August 1998

C. General Instructions for Hydrographic Surveyors (NP135), 17th Edition, 1996

Acronyms

ADCP	Acoustic Doppler Current Profiler
ALESCO	Arab League Educational, Cultural and Scientific Organisation
BA	British Admiralty
DGPS	Differential Global Positioning System
GEF	Global Environment Facility
GPS	Global Positioning System
IHO	International Hydrographic Organisation
IMO	International Maritime Organisation
nm	Nautical Mile
NRMP	Reduction of Navigation Risks and Marine Pollution
PERSGA	Regional Organisation for the Conservation of the Red Sea and Gulf of Aden
RoRo	Roll-on Roll-off
SAP	Strategic Action Programme for the Red Sea and Gulf of Aden
TSS	Traffic Separation Scheme
UKHO	United Kingdom Hydrographic Office
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational Scientific and Cultural Organisation

Biography

Lieutenant Commander Dobson joined the Royal Navy in 1981 and after a short period spent in General Service, joined the Hydrographic Branch in 1985 and completed the Long Hydrographic Course in 1995. He has served in HM Ships FOX, HECATE, HERALD, ROEBUCK and in detached Naval Survey Parties. During his career, he has also served as the Naval Assistant to the Hydrographer of the Navy and as the Precise Navigation expert on the Minewarfare Headquarters Staff.
Lieutenant Commander Dobson joined the Staff at the UK Hydrographic Office in 2000 to oversee the PERSGA survey and, on completion of the project, took up his current appointment as Staff Officer Survey Planning.

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