11 Setting one’s course with a nautical chart

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11.1 Introduction

On land, even those with a good sense of direction can get lost in a location with few landmarks or direction indicators. At sea, you cannot just follow the signs, the road or the rail track. Unless they remain close to the shore, mariners may find themselves in the middle of a body of water with few reference points and no way of knowing where the safe water lies. To be able to navigate at sea, mariners need nautical charts, which show information such as the depth of the water and the position of known but invisible underwater obstructions. Being able to use nautical charts is essential to save a mariner the time and embarrassment of getting lost and can certainly save lives by avoiding the hazards that lie under the surface of the sea.

Like a map, a nautical chart is a graphical representation of part of the earth's surface. Unlike a map, a nautical chart is a biased representation. It emphasises areas of water and features that allow mariners to determine position, to avoid hazards and to find a safe route to a destination. It is the mariner's road map. Whilst a map tries to depict as much as possible of the land area, roads, landmarks, etc., the nautical chart conveys a selection of information specifically designed to assist in safely navigating the area that the chart covers. It identifies navigable areas, shorelines and areas not suitable for navigation. Such information includes the depth of the water, the shoreline of adjacent land, rocks and other hazards, and buoys and beacons. Details about the land areas are less important on a nautical chart unless they are useful as reference elements for navigation and to help the mariner know where he or she is.

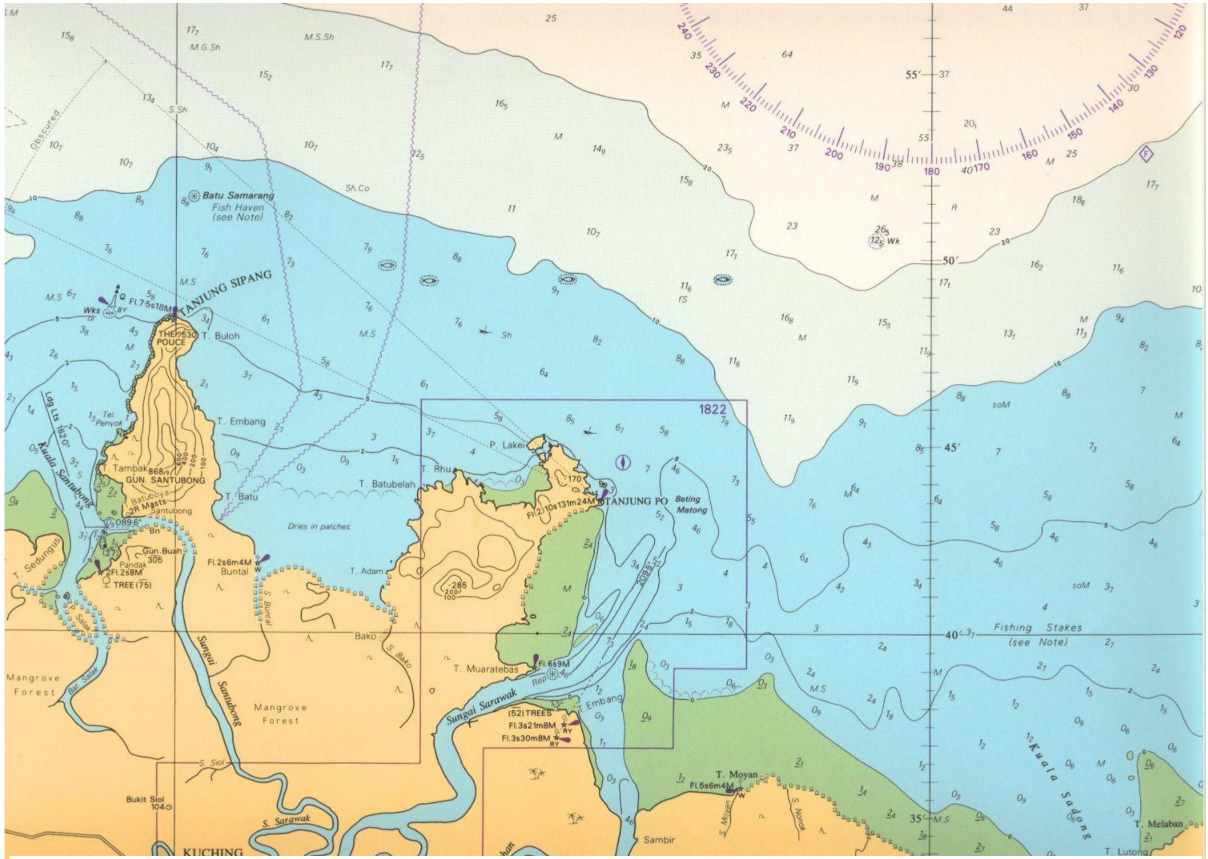

Figure 11.1. Example of a nautical chart: Approaches to Kuching, Sarawak, Malaysia. Source: United Kingdom Hydrographic Office.

Figure 11.2. Officer on a survey ship using a chart for navigation. Source: Chilean Hydrographic Office.

11.2 Scale

Nautical charts cover the open sea, coastlines, navigable inland waters and canal systems. They can cover a large area, for example, the shipping lanes of the North Atlantic; or provide a detailed representation of a smaller area, such as a harbour or anchorage. The area covered by a nautical chart is defined by its scale, which is the ratio of a given distance on the chart to the actual distance that it represents on the earth. A scale of 1:10 000 means that the chart is one ten-thousandths of the size of the area it represents: objects shown as a centimetre apart on the chart are physically 10,000 centimetres (100 metres) apart on the earth. A chart covering a relatively large area is called a small-scale chart, for example, scale 1:500,000 and one covering a relatively small area is called a large-scale chart, for example, scale 1:25,000 (See Figure 11.3). The choice of a chart scale will be determined by the type of navigation. For example, navigation in harbours and local waterways will generally require a scale larger than 1:50 000. The same geographic area may be covered by several charts of differing scales. A golden rule for the mariner is always to use the largest scale chart available. This will allow the mariner to see the greatest level of detail in the area being covered by the chart.

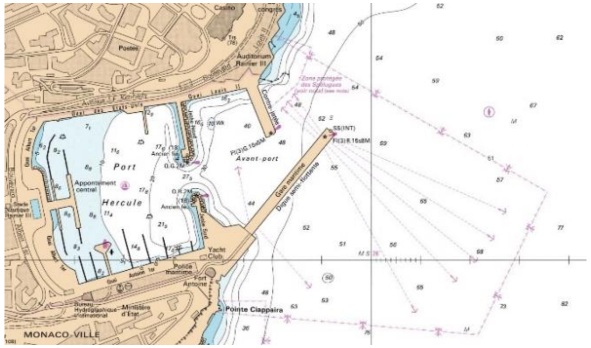

Figure 11.3 Example of a large-scale chart: Monaco Harbour. Source: French Hydrographic Office (SHOM).

11.3 Projection

Like a map, a nautical chart represents part of the spherical earth displayed on a plane surface such as a sheet of paper or on a video screen (a digital chart). The process of transferring information from the spherical earth to a flat surface is known as chart projection. The projection most commonly used for nautical charts is called Mercator projection, after Gerhard "Mercator" Kremer (1512-1594), a Flemish scholar who invented this projection in 1569. Roughly, it can be described as projecting the surface of the earth on a cylinder wrapped around the earth so that it touches the equator, then cutting open the cylinder to yield the 2-dimensional chart, (i.e., to make it flat). This results in meridians and parallels crossing each other at right angles to form a rectangular grid of latitude and longitude, with lines of latitude being wider apart further north (See Figure 11.4 and Section 9.5.1). The Mercator projection is popular among mariners because a straight course through the water, known as a rhomb line, will appear as a straight line on the chart, and also directions and distances can be easily measured directly on the chart. Latitude is graduated along the sides of the chart and longitude is shown along the top and bottom of the chart. The subdivisions are usually in degrees, minutes, and tenths of minutes. The Mercator projection is not suitable for charts covering the Polar Regions.

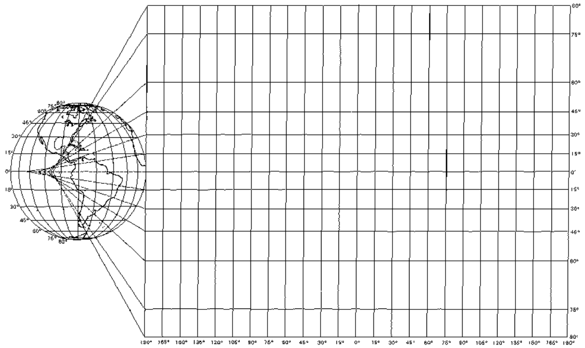

Figure 11.4. The Mercator projection. Source: Harvard University – Graduate School of Design.

11.4 Datum

Water depths or soundings are vertical distances depicted on charts by numbers expressed in whole metres or metres and decimetres if the depth is less than 31m. The depths are supplemented by depth contours or isobaths similar to the contour lines on land maps. These are lines connecting points of equal depth

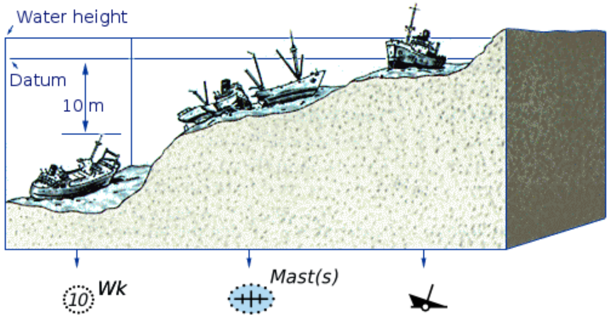

Figure 11.5. Datum and depiction of wrecks at various depths Source: Advanced navigation courses (*www.sailingissues.com/navcourse0.html*)

which provide a more intuitive "picture" of the sea-floor. Depth contours are labelled with numerals in metres. All depths indicated on nautical charts are measured from a selected zero point or datum called the chart datum. This is the calculated level below which the water seldom falls - in other words, the theoretical lowest low tide in the area of the chart. The chart datum adopted by the International Hydrographic Organization (IHO) is known as Lowest Astronomical Tide (LAT). When navigating or planning a journey, the mariner will need to add the current tide height expressed from the chart datum, which can be predicted or obtained in real time, to the charted depth in order to know the actual depth. Coloured areas on the chart emphasise shallow water and dangerous underwater obstructions. Shoal areas are often given a blue tint.

The position of places shown on the chart can be obtained from the longitude and latitude scales on the borders of the chart. The longitude and latitude of any

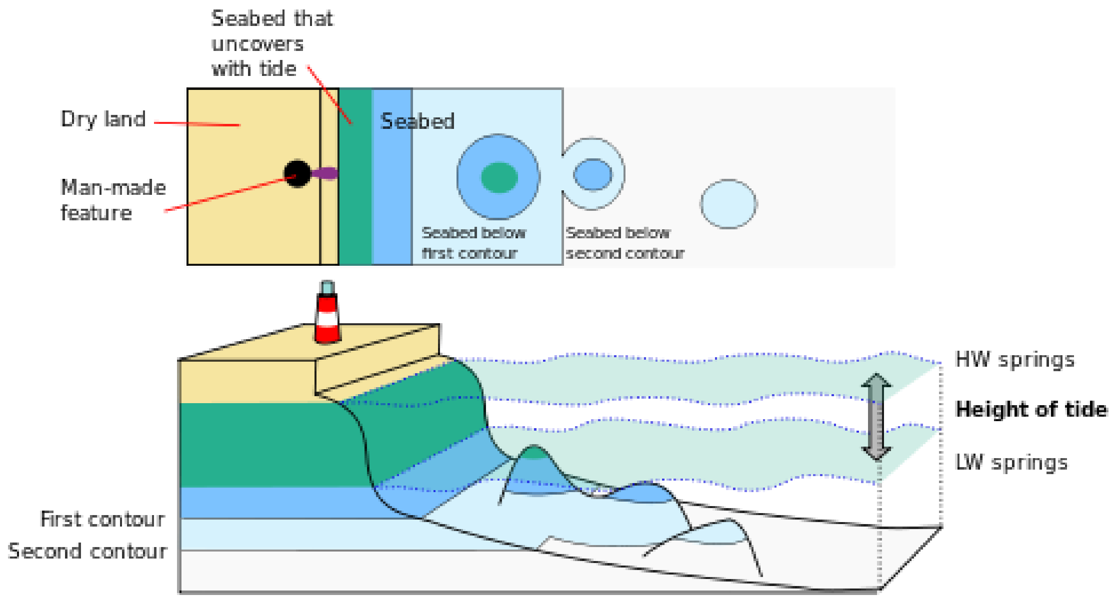

Figure 11.6. Use of colours in British Admiralty charts. Source: United Kingdom Hydrographic Office.

given place depends on the reference frame in which they are measured, known as the geodetic datum. The WGS (World Geodetic System) 84 is currently the geodetic datum most commonly used for nautical charts.

This is the same datum that satellite navigation systems such as GPS use. This means that GPS positions can be plotted directly on a chart that uses WGS 84 as its datum for latitude and longitude.

11.5 Symbols

International regulations require the use of official nautical charts published by government hydrographic offices in accordance with IHO standards. These standards define internationally agreed symbols, abbreviations, and terms to depict chart features, thus allowing mariners from any country around the world to use any charts without confusion. For example, a wreck that is visible at least at low tide will always be shown with the symbol .

11.6 Paper chart versus digital chart

Until the early 1990s, nautical charts were available in paper form only. Paper charts are usually quite large, about 70 cm by 1 m, in order that a mariner may work with them efficiently. More and more, digital charts consisting of a digital database and a display system are in use aboard most vessels. Those digital charts published by government hydrographic offices are called Electronic Navigational Charts (ENC). Combined with other information, such as GPS, radar, ship course, speed and draught, ENCs are normally used in Electronic Chart Display and Information Systems (ECDIS). An ENC is not simply a digital version of a paper chart; it introduces a new navigation methodology with capabilities and limitations very different from paper charts. An ENC includes a wealth of geo-spatial intelligence within its data, not available in paper charts. On an ENC, the mariner can click on different features, such as a light or buoy, and access additional information. An ENC allows users more control over the display of the chart, such as the ability to turn different layers of information on and off. ENCs used on ECDIS become part of a powerful information system that allows mariners to know their ship's position instantly and accurately and to be warned automatically of dangerous situations such as being too close to a reef.

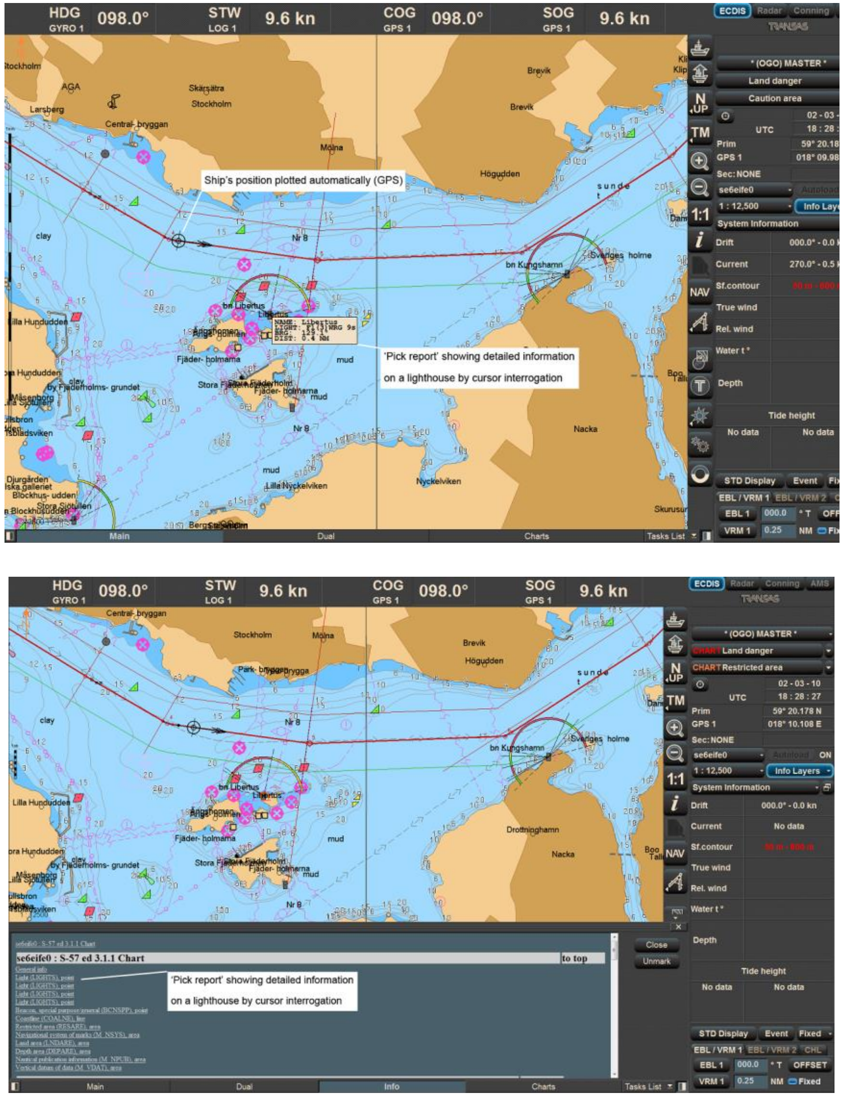

Figure 11.7. Example of an ENC used on ECDIS – Lilla Vartan Channel near Stockholm, Sweden
Source: Transas.