NAVIGABILITY OF THE CANADIAN ARCTIC

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SUMMARY

According to the Canadian Hydrographic Service, 20% of its chart catalogue relates to the Arctic, but only 10% of those charts meet modern standards.

Recent analysis of available charts for one portion of the Arctic suggests that even those charts that are available may not meet the needs of shipmasters, particularly with the trend towards use of deeper draft ships to service the north.

The growing loss of seasonal ice cover, due to global climate change will also likely result in even greater demands on an up to date and comprehensive chart catalogue for regions North of 60^{o} N.

The paper presents an overview of the situation, even though it focuses on a recent (2011) study of the Western Arctic. It also suggests how a collaborative approach may enable survey work to be accelerated, although it recognises that there is still a bottleneck in actually getting the survey work processed and into the catalogue.

Keywords: Arctic Shipping, Arctic Hydrography, Arctic Navigation, Remote Communities, Public Service Obligations

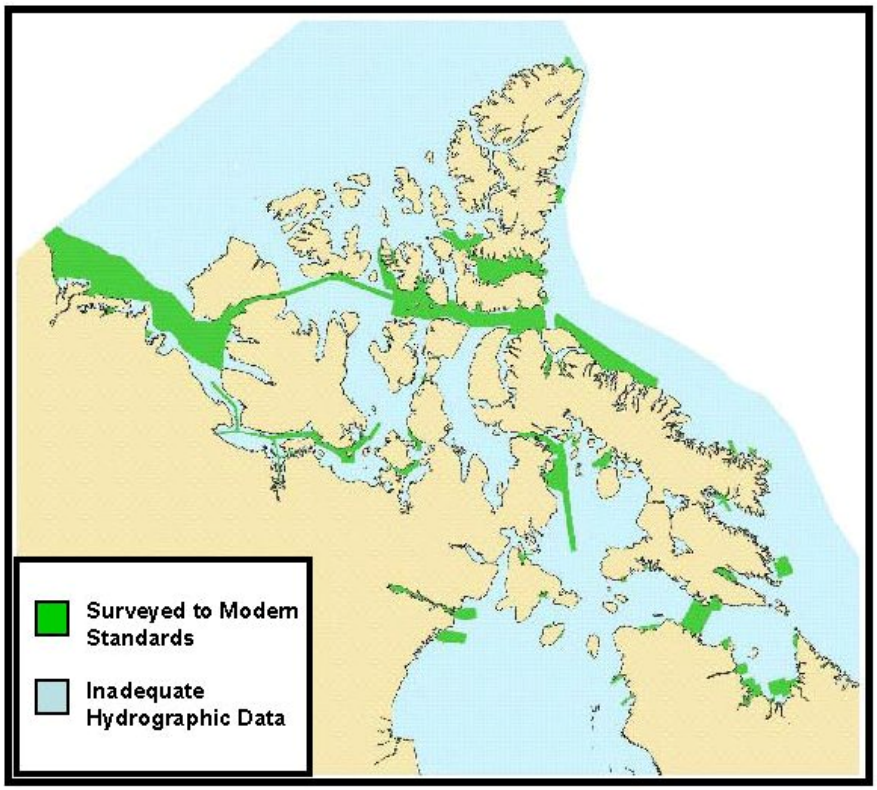
DISCLAIMER

The paper has been prepared on behalf of, and with the support of, the Government of the Northwest Territories (GNWT) and the Government of Nunavut (GN). It is based, in part, on a report prepared for GNWT. However, the views and comments presented are solely those of the author and should not be construed as representing the position of the two Territories.

ARCTIC CHARTS RELATIVE TO SOUTHERN CANADA

There has been a generally accepted statement, attributed to the Canadian Hydrographic Service (CHS), that the Arctic represents 20% of their chart catalogue and only 10% of these charts meet modern standards. Figure 1, provided some years ago, graphically represents those few areas of the Arctic where charts are considered up to standard.

Fig.1 CHS Representation of areas in the Canadian Arctic that are surveyed to modern standards



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However, if one looks at the detail of charts, comparing what is currently available with charts for other regions in Canada, the situation shifts somewhat.

The CHS catalogue has "946 charts covering all three of Canada's coastlines plus major inland waterways[1]". The current Arctic catalogue (2008) lists 179 charts, or 19% of all charts, however note the distribution of charts in Table 1 below.

Table 1 Arctic Chart Catalogue

Coverage	Number
Major Lakes[2] & Mackenzie River	52
General 1:1,000.000+	11
For deep draft navigation	116
Total	179

[1] Statement from www.charts.gc.ca. Note that the author has only been able to account for 898 charts including small boat charts and inland waterways from the current chart catalogues.
[2] Lake Athabasca, Great Slave, Great Bear Lakes.

Of 116 charts for deep draft navigation identified in Table 1, 18 are 1:500,000scale (this is far more than any other coastline in Canada). Thus depending on your viewpoint, the number of effective charts available for Arctic navigation is probably no more than 100, or around 10% of the CHS catalogue.

To put this in perspective, Canada's coastline, including the Great Lakes, is about 247,000km[3]. Of this coastline, approximately 172,000km or 70% can be considered equivalent to the coverage of the Arctic Catalogue. The general distribution of coastline and charts is given in Table 2 below.

Table 2 Charting of Canada's Coastline

	Coastline	**Charts**[4]	**1:500,000+**[5]
Arctic	70%	16%	15%
Atlantic	18%	48%	.5%
Great Lakes	2%	14%	0
Pacific	10%	22%	0
Total	100	100	-

The situation relative to detailed charts associated with communities in the Arctic is just as dire as the overall availability of a comprehensive catalogue of charts for the region. Generally, community charts for other regions of Canada are available in considerable detail. The only detailed chart published for the Arctic is Falconbridge[6] Wharf, Deception Bay at 1:4,000. Very few of the 40-plus Arctic communities have an adequate inshore chart and even fewer have a chart adequate for safe planning of an approach under all weather conditions.

WESTERN ARCTIC CASE STUDY

This section of the paper draws on an analysis of 40 Western Arctic charts undertaken on behalf of the Government of the Northwest Territories[7] by the author, together with two Master Mariners. While the focus was on coastal communities in the North West Territories, there is no reason to believe that the situation is any better – or worse – for Nunavut communities. The lack of adequate charts is also a hindrance to development in the Arctic, as two anecdotal situations demonstrate.

In the Western Arctic, current charting indicates that the maximum draft that could be safely carried through Dolphin and Union Strait is 12m. However, Fednav have reported

[3] See References to the paper for source and attribution.
[4] Author's estimate of deep draft navigation charts excludes general, small craft and inland lakes.
[5] After exclusion of general charts 1:1,000,000 or smaller scale.
[6] Now Xstrata Nickel
[7] Referenced by permission

that privately undertaken survey work indicates that a 15m channel is present, although it is narrow and requires proper definition.

In the Eastern Arctic, as part of the development process for the Mary River iron ore project, Fednav reports that a channel from Steensby Inlet through Foxe Basin, suitable for a 20m draft ship, has been identified. The current charts would not support such a conclusion.

The grounding of the *Clipper Adventurer* in the Western Arctic also demonstrates the hazards of operating in a region where much of the bathymetry is dependent on spot and track soundings, and even where a consistent survey has been undertaken, line spacings of 1 and 2km are common and 6km is not unknown.

Fig 2 *Clipper Adventurer* aground off Port Epworth

http://www.canada.com/news Photograph by: Keith Levesque, ArcticNet

Returning to the *Clipper Adventurer*, when the vessel grounded, it was apparently following the original track but was seconds off the west and found the seamount. No date is given for the original track, but much of the survey work for this area goes back to the 1960's, or even earlier. See chart extract below, note the 2.3m reef area next to a 29m sounding.

Fig 3 chart extract showing location of grounding

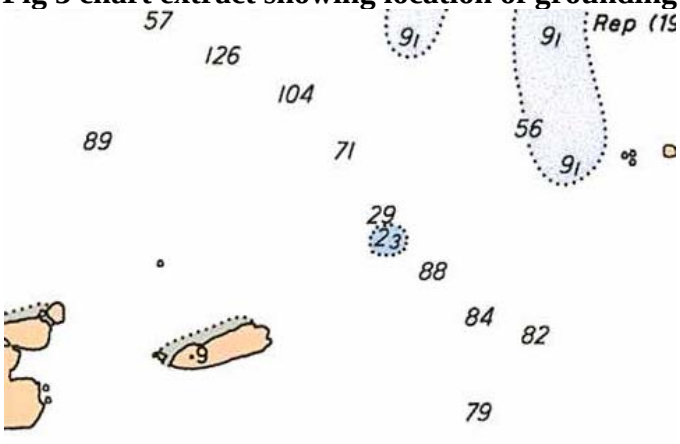
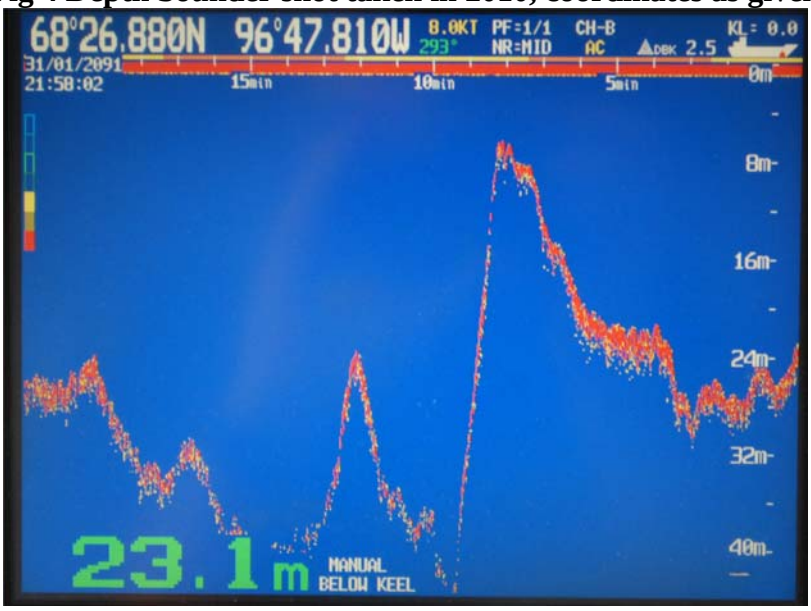


Chart section reproduced with permission of the Canadian Hydrographic Service

Such problems are not unknown; see the depth sounder shot below (Fig 4) and compare the chart extract of the same area (Fig 5). There may be many more shallow spots out there awaiting a vessel transit to find them.

Fig 4 Depth Sounder shot taken in 2010, coordinates as given



Screen Shot Courtesy Captain Jacob Sarty

Fig 5 Chart Extract of the area of the Depth Sounder Screen Shot

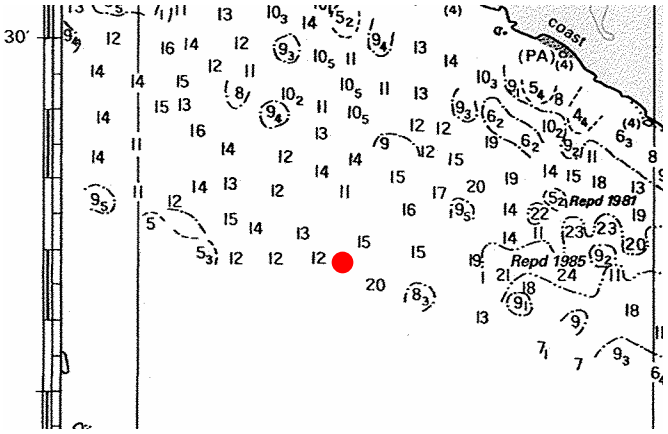


Chart section reproduced with permission of the Canadian Hydrographic Service

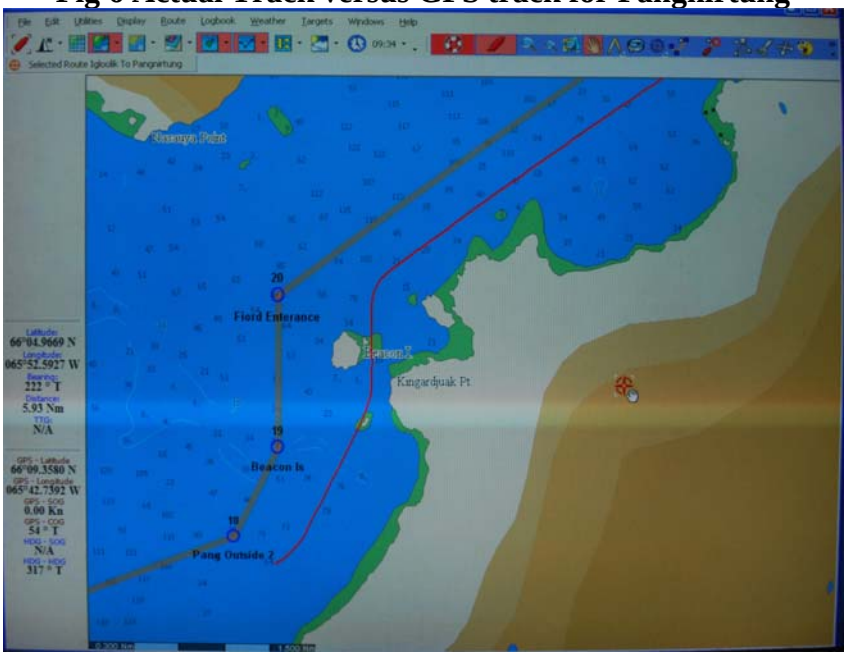
If one looks at southern charts, communities generally have charts with a good level of detail and of a useable scale. This is not the case in the Arctic. For example, Sachs Harbour used to have a chart at 1:25,000; the current edition of the chart has regressed to a less than useful 1:50,000inset. The most detailed inshore charts are, generally, for NWS sites or old DEW line stations at 1:15,000, although the survey work goes back to the 1950's. The biggest problem for all communities is not having a designated approach corridor with adequate soundings. For example, the line spacing off Sachs Harbour is 6-8km. In fact all communities in coastal NWT were found to need new inshore surveys and defined approach corridors for safe approach by deep draft ships. Even in the shipping corridors identified on the charts, the statement "*The area inside the pecked magenta lines is surveyed more completely and accurately than the surrounding area*" gives no confidence as to the draft that can be safely carried through the corridor. In terms of corridors, a major omission is a separate stand-alone chart of James Ross Strait given that this is the recommended route into the Coronation Gulf. However, charts east of Simpson Strait are of poor quality and the track shown through Simpson Strait is not suitable for vessels over 5m draft.

WHY ARE GOOD CHARTS FOR THE ARCTIC BECOMING CRITICAL?

As the graphic at Figure 1 demonstrates, very few Arctic charts meet modern standards. Much of the survey work on which current charts depend goes back thirty years, some fifty years, and much is incompatible with modern navigation. As an example Fig 6 below shows the entry to Pangnirtung in the Eastern Arctic; using GPS indicates an overland approach to the community. There is a similar discontinuity between a radar approach and GPS for Brevoort, more than likely there are other communities and approaches where GPS is in conflict with the conventional chart. This problem does not

fit well with ECDIS implementation schedule under the SOLAS convention[8]. Charts for Igloolik in the Eastern Arctic also leave a lot to be desired. The inshore chart at 1:75,000 is inadequate, but Hall Beach to the south (a NWS site) has a 1:15,000 chart. Like a number of communities, the only way they are safely accessed is by the ships finding a route that works, logging it and then repeating as necessary.

Fig 6 Actual Track versus GPS track for Pangnirtung



Screen Shot Courtesy Captain Jacob Sarty

Another important factor is that ship sizes have changed dramatically, even in the last decade. For many years, the Arctic was served by small, relatively shallow draft equipment. In the Western Arctic, re-supply was structured around tug and barge equipment with essentially Mackenzie River drafts of about 1.5m. Even barges operating beyond Tuktoyaktuk do not exceed 2mdraft (possibly this is why the Simpson Strait track is for vessels under 5m draft).

With climate change, it is now common for ships to serve western arctic communities from the east. Peel Sound is the gatekeeper, and the window of opportunity has moved from 22 days to 44 days in the last decade, with a reliable opening of the route. NSSI started bringing ships around in 2008, NEAS in 2009 now Woodward brings GN fuel requirements for the Kitikmeot Region in large tankers. As a result ship service drafts are now in the 8-9m range. Cruise ships are still relatively shallow draft, but more will be seeking to undertake transits of the North West passage and visit historic sites en route.

[8] There are no mandatory requirements for existing cargo vessels of under 10,000grt. In the Canadian Re-supply fleet, half the fleet of dry cargo ships and tankers in regular service exceed 10,000grt

A fairly typical dry cargo vessel used up until 2000 in the Eastern Arctic was the *Arctic Viking*, see Fig 6 below, aground in Iqaluit discharging cargo. The vessel was built in 1967, had limited ice capability and was 3,502dwt. Vessels are considerably larger today and have good ice capability. Typical vessels are NEAS' *Qamutik* shown in Fig. 7, 12,754dwt, 8.62m load draft, about 18-20,000m^3 cargo capacity; and NSSI's *Zelada Desgagnes* in Fig.8 12,744dwt, 8.0m load draft, about 20,000m^3 cargo capacity.

Fig 7 mv *Arctic Viking* aground discharging cargo in Iqaluit

Mariport file Photograph

Fig 8 NEAS vessel mv *Qamutik*

Photograph from Nunavut Eastern Arctic Shipping

Fig 9 NSSI Heavy Lift vessel mv *Zelada Desgagnes*

Photograh from Groupe Desgagnes

Tankers have also changed and a typical vessel in the trade from 20 years ago was MT *Hubert Gaucher*, 14,500dwt, 7.85m load draft. See Fig 10 below

Fig. 10 mt *Hubert Gaucher*

Photograph from Greenwood's Directory 1988

Today, Woodward's *Havelstern*, 17,080 dwt, 8.6m draft fully laden is typical. See Fig 11

Fig11 Woodward Tanker mt *Havelstern*, prior to purchase

Photograph: http://www.shipspotting.com/gallery/photo.php?lid=685009 by Ian Thomas

Desgagnes' *Maria* and *Sarah Desgagnes* also serve the Arctic and draw 9.0 and 9.49m fully laden respectively. Larger tankers have come into the Arctic and Fig.12 below shows the *Torm Lotte*, 53,160dwt, 13,5m draft fully laden at anchor in Wise Bay in the Western Arctic in 2009.

Fig 12 *Torm Lotte* 53,160dwt 13.5m draft in Wise Bay 2009

Photograph courtesy WorleyParsons

HOW TO GET THE SURVEYS UNDERTAKEN

GNWT has a history of collaborative work with CHS to facilitate survey work and production of charts. Joint approaches known to the author include Bathurst Inlet, Chesterfield Narrows and Rankin Inlet/ Melvin Bay and approaches.

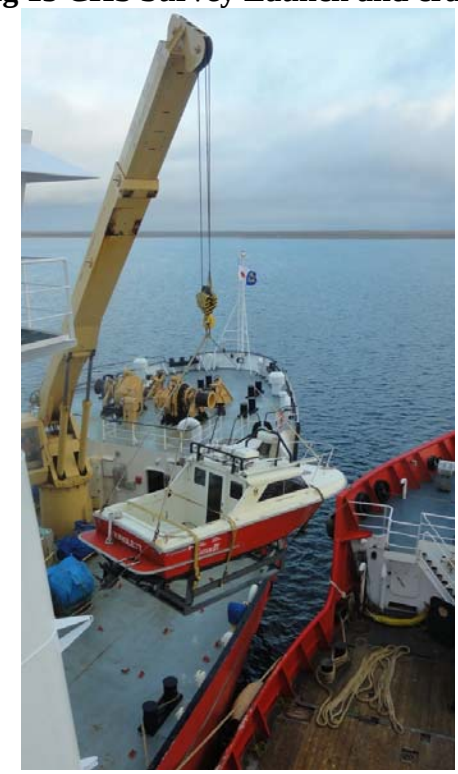
CHS survey activity is challenged in the Arctic by a combination of distance, seasonality and budgetary pressures. The typical approach to equipment deployment is to utilise CCG icebreakers to carry the equipment north on an opportunity basis. CCG have a

pricing structure that has a price for opportunity delivery and another higher level for dedicated tasking. Dedicated tasking would be needed to deliver CHS launches to a specific location with the intention of solely carrying out hydrographic survey work. While CHS has identified a number of contract vessels that could be utilised for Arctic work, their preference would be to use one or more of their own launches.

CHS is understood to be willing to consider a cooperative approach that brought one or more launches into a region, supported the crew (two launches would typically have six persons for operation) and protected the boats if wintered. The newer electronics packages are cold sensitive, and would need climate control storage if wintered. In the past CHS has worked with commercial owners, deploying launches around the Western Arctic with NTCL and shipping south on a NEAS vessel.

From a technical perspective, launches are 23' or 30' and range approximately 3,000 – 3,800kg in weight. Other than propellers, there are no sensitive appendages. Each launch comes with a shipping cradle that is usually welded to the ship's deck for transportation. Fig 13 below shows both a typical launch and its cradle.

Fig 13 CHS Survey Launch and cradle



Photograph Courtesy Canadian Hydrographic Service

SUGGESTED APPROACH

With regard to deploying the survey launches and supporting survey activity, the first task is to deliver one or more launches into the Arctic and then return them south when CHS determines that they need maintenance. This could be achieved by a combination of support from the territories and either complimentary carriage, or nominal charges from the two carriers with heavy lift capability[9] (NEAS, NSSI). Once in the Arctic, survey crew support in communities by discounting, or paying fully for hotel accommodation should be a further consideration. If CHS wished to separately deploy and retrieve the electronic packages, then support for airfreight costs would need to be considered. If the electronics remain in the arctic over a winter, then complimentary secure and temperature-controlled storage should be offered. There may also be an issue regarding winterising the engines of the launches, or providing a secure, protected environment for winter storage.

Support for CHS once the survey data has been collected, to shorten the overall production cycle, will need to be discussed separately, but pressure from the territories may persuade the federal government to free up budget for the process. However, Electronic Navigation Charts can be brought into use much faster than paper charts, so a focus on these may be appropriate.

Thus a collaborative approach involving the Territories, shipping companies and possible the province of Quebec, given their promotion of Plan Nord, may hold the best hope of actually building a suite of charts that meet the current and future needs of Arctic Navigation

REFERENCES

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Deep Draft Access to the Western Arctic

http://www.centreforthenorth.ca/blogs/herethenorth/thenorthcoast
The data in this resource has been compiled and adapted for this paper. In particular the resource includes the Quebec North Shore in their coastline estimate for Northern Quebec. Arctic regions of Quebec have been estimated by the author at two thirds of the Northern Quebec coastline.

[9] Some support from Woodward's might also be sought, if the chart upgrade work includes charts specific the Kitikmeot region

BIOGRAPHICAL NOTES

Christopher Wright is the President of The Mariport Group Ltd, a specialized marine and port consulting company formed in 1989, and now based in Digby, Nova Scotia.

He has been involved in Arctic Shipping studies since 1973 and has been involved in many Arctic projects for the public and private sector. For the Government of the Northwest Territories since 1990 and the Government of Nunavut since 2000, he has been involved in strategic studies as well as analysis and development of approaches to both dry goods and petroleum product shipment to arctic communities. This work has resulted in material changes to operations, and reductions in cost of community delivery. For Transport Canada he managed a major study of the Canadian Arctic, the Canadian Arctic Shipping Assessment.

He has been an invited speaker on Arctic issues at conferences hosted by The Company of Master Mariners and the Society of Naval Architects and Marine Engineers. He has also assisted in the programming of an Annual Arctic Conference, where he has also spoken and moderated sessions.

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