Arctic Shipping Best Practices Information Forum
FEDNAV LIMITED – ARCTIC EXPERIENCE

- 60+ years of Arctic Trading
- More than 35 Million tonnes of cargo carried
- In excess of 850 voyages
- The vast majority of voyages using Category C (light or no ice class) vessels
- No environmental incidents
EVOLUTION OF DATA
EVOLUTION OF DATA

Milne Inlet

Milne Inlet is entered between Ragged Island and Athole Point (72°31' N, 80°32' W), 6.5 miles west.

Dangers in approaches. — An isolated rock with 3 feet (0.9 m) over it and a 3-fathom (5.5 m) patch, reported in 1956 (position approximate), are charted 4 miles NNE and 5.5 miles ENE, respectively, of the NE point of Ragged Island.

Ragged Island has cliffs on its east coast where it rises to over 1,500 feet (457 m) and a gravel beach at its south end. The larger of the islands off its NE coast has an elevation of 500 feet (152 m). Drying rocks are situated close west of the south end of the channel which runs between Ragged and Baffin Islands. Anchorage can be obtained in the bay on the west side of Ragged Island.

The outer part of Eskimo Inlet (entrance: 72°19' N, 80°12' W) runs between sedimentary walls rising to 2,500 feet (762 m) on the west and about 1,500 feet (457 m) on the east side. The shores of the inner 3 miles are lower and there is a 3-foot (0.9 m) shoal 1.8 miles from the head.

Angmagssalik Mountain, on the west side of the inlet near the entrance, is over 1,400 feet (427 m) in elevation and is described as “rising like a tremendous wall over a low foreland.”

Ipiutak Peninsula lies 7 miles SSW of the entrance to Eskimo Inlet, and Tigherdkjuak Mountain rises 3 miles farther south. The bay on the east side of Ipiutak Peninsula is named Deep Cove; the one farther east, Milly Bay. A 1-fathom (1.8 m) shoal named Lone Shoal lies 1.2 miles WNW of Ipiutak Peninsula. Anchorage can be obtained NW of this shoal.

Low Island (72°14' N, 80°38' W) has shoal water extending SSE from it; Stephens Island is steep-sided and rocky.

The west side of Milne Inlet, from Athole Point to Fairweather Bay, is formed by a wall of sediments rising to a fairly flat plateau with an elevation of 1,600 feet (488 m). The sharp point
MODERN NAVIGATION CHARTS
<table>
<thead>
<tr>
<th>AES / WMO Ice Codes</th>
<th>Ice Types</th>
<th>Thickness</th>
<th>Type E</th>
<th>Type D</th>
<th>Type C</th>
<th>Type B</th>
<th>Type A</th>
<th>CAC 4</th>
<th>CAC 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>7* or 9*</td>
<td>Old / Multi-Year Ice</td>
<td></td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
<td>-3</td>
<td>-1</td>
</tr>
<tr>
<td>8*</td>
<td>Second-Year Ice</td>
<td></td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
<td>-3</td>
<td>-2</td>
<td>1</td>
</tr>
<tr>
<td>6 or 4*</td>
<td>Thick First-Year Ice</td>
<td>&gt; 120 cm</td>
<td>-3</td>
<td>-3</td>
<td>-3</td>
<td>-2</td>
<td>-1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1*</td>
<td>Medium First-Year Ice</td>
<td>70-120 cm</td>
<td>-2</td>
<td>-2</td>
<td>-2</td>
<td>-1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Thin First-Year Ice</td>
<td>30-70 cm</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Thin First-Year Ice - 2nd Stage</td>
<td>50-70 cm</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Thin First-Year Ice - 1st Stage</td>
<td>30-50 cm</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3 or 5</td>
<td>Grey-White Ice</td>
<td>15-30 cm</td>
<td>-1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Grey Ice</td>
<td>10-15 cm</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Nilas, Ice Rind</td>
<td>&lt; 10 cm</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>New Ice</td>
<td>&lt; 10 cm</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Brash (ice fragments &lt; 2 m across)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Bergy Water</td>
<td></td>
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<td></td>
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<td></td>
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<tr>
<td></td>
<td>Open Water</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Decayed Ice: For the following ice types: MY, SY, TFY, and MFY that are ‘Decayed’, add +1 to the Ice Multiplier.

Ridged Ice: For ice floes that are over 3/10ths ‘Ridged’ and in an overall ice concentration that is greater than 6/10ths, subtract 1 from the Ice Multiplier.

* Another version of this table can be found in TP 12259.
NUNAVIK IN ICE HEADING INTO PRINCE OF WALES STRAIT
Fednav Limited – Arctic Shipping Projects Through The Years

Category B Vessels
NORTHERN RESOURCE WEALTH
NORTHERN RESOURCE WEALTH

Advanced Projects = potential mines?

Map showing various resource projects including:
- Hackett River (base metals)
- High Lake (base metals)
- Izok (base metals)
- Ulu (gold)
- Mactung (tungsten)
- Selwyn (base metals)
- Indin Lake (gold)
- Courageous (gold)
- NICO (gold, cobalt, bismuth)
- Prairie Creek (base metals, silver)
- YK Gold (gold)
- Pine Point (base metals)
- Nechalacho (rare earths)
- Kennady (diamonds)
- Jericho (diamonds)
- Kiggavik (uranium)
- Meliade (gold)
- Back River (gold)
- 3 Bluffs (gold)
- Amaruq (gold)
- Chidliak (diamonds)
- Roche Bay (iron)
- Angilak (uranium)
‘OPEN WATER’ ONLY OPERATIONS
BAFFINLAND IRON MINE
BAFFINLAND IRON MINE – LOCAL ECONOMIC DRIVER
RED DOG MINE AND PORT, ALASKA
Red Dog (Alaska) 67.34 N 164.04 W loading operations during summer
Open Water Vessels – Category C

25 plus seasons, over 35,000,000 tonnes, nearly 600 voyages
RESOURCE DEVELOPMENT IN THE LOCAL ECONOMY

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**RED DOG WAGES**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual average jobs (including on-site, year-round contractors)</td>
<td>610 jobs</td>
</tr>
<tr>
<td>Average Red Dog regular annual wage</td>
<td>$112,000</td>
</tr>
<tr>
<td>Red Dog (Teck) employee wages (excluding benefits) to NANA shareholders</td>
<td>$31 million</td>
</tr>
<tr>
<td>Red Dog (Teck) cumulative wages paid to NANA shareholders (1999-2013)</td>
<td>$303 million</td>
</tr>
<tr>
<td>Red Dog state and federal taxes (annual)</td>
<td>$100 million</td>
</tr>
<tr>
<td>Red Dog (Teck) cumulative wages paid to NWAB residents shareholders (1999-2013)</td>
<td>$132 million</td>
</tr>
</tbody>
</table>
EARLY SEPTEMBER, POLAR TEMPERATURES
CANADIAN ICE SERVICE
CANADIAN ICE SERVICE
CANADIAN ICE SERVICE
Marine forecasts for Newfoundland issued by Environment Canada at 3:30 p.m. NDT Wednesday 2 May 2018 for tonight and Thursday. The next scheduled forecast will be issued at 8:00 p.m. NDT.

Fog implies visibility less than 1 mile.

Strait of Belle Isle.
Wind variable 10 to 15 knots except northeast 15 to 20 over eastern sections. Wind increasing to northeast 25 this evening then diminishing to northeast 15 to 20 near noon Thursday. Wind diminishing to variable 10 to 15 Thursday evening. Showers or flurries ending late overnight. Visibility 1 mile or less in precipitation. Temperatures minus 2 to plus 4.

Northeast Gulf
Gulf - Port au Port.
Wind southwest 15 to 20 knots increasing to northeast 30 this evening except variable 15 over southeastern sections tonight. Wind diminishing to northeast 15 to 20 Thursday afternoon. Showers changing to showers or flurries this evening and ending Thursday morning. Fog patches dissipating Thursday morning.

Southwest Coast.
Wind southwest 15 to 20 knots diminishing to variable 10 to 15 late overnight then increasing to northeast 15 to 20 near noon Thursday. A few showers changing to rain late overnight and ending Thursday afternoon. Fog banks dissipating Thursday afternoon.
SENTINEL - 1
MODIS
TERRA SAR-X
NWS ALASKA SEA ICE PROGRAM
Arctic Sea Ice Extent
(Area of ocean with at least 15% sea ice)
Probability of tercile categories May/Jun/Jul Issued April 2018

above normal 2m temperature

below normal 2m temperature

near normal 2m temperature
NORWEGIAN METEOROLOGICAL INSTITUTE
FINNISH ICE REPORT 03.05.2018

The ice condition is virtually unchanged.

In the northern Bay of Bothnia there is 40-75 cm thick fast ice in the archipelago. At the fast ice edge 30-50 cm thick ridged consolidated ice to Kemi 2 and Oulu 4. Farther out a wide lead from Kemi 1 to Kokkola, but containing a few vast floes. Farther out 25-50 cm thick rafted and ridged, mainly very close ice. There are small leads and areas of open water in the ice field.

In the southern Bay of Bothnia rotten fast ice in the archipelago. Farther out first 5-15 nautical miles wide lead with wide ice floes in places. Then, 20-50 cm thick close and very close ridged ice.

In the Quark generally open water, in places strips and patches of drift ice. From Vaasa to Ensten very open ice. Farther out open water. In the Vaasa’s northern archipelago rotten ice.

Icebreakers: Kontio, Urho and Sisu assist in the Bay of Bothnia. Otso assists in the Bay of Bothnia and in the Quark.

Restrictions to navigation: Minimum ice class and deadweight required of assisted vessels:
Tornio, Kemi, Oulu and Raase, IA of more than 4000 tons.
Kalajoki, IA of more than 2000 tons.
Kokkola and Pietarsaari, IA or IB of more than 2000 tons.
Vaasa, I or II of more than 2000 tons.

Vessels bound for Gulf of Bothnia ports in which traffic restrictions apply shall, when passing the latitude 60°00’N, report their nationality, name, port of destination, ETA and speed to ICE INFO on VHF channel 78. This report can also be given directly by phone +46 31 699 100.
SWEDISH ICE SERVICE

RESTRICTIONS
2018-05-03

RESTRICTIONS TO NAVIGATION

SWEDEN

Current traffic restrictions

Karlsborg - Skelleftehamn
Minimum ice class IA and minimum 2000 dwt

Angermanalven
Minimum ice class IC and minimum 2000 dwt

The traffic separation scheme in the Quark is temporarily suspended from 2018-01-25

FINLAND

Current traffic restrictions

Tornio - Rahe
Minimum ice class IA and minimum 4000 dwt

Kalajoki
Minimum ice class IA and minimum 2000 dwt

Kokkola - Pietarsaari
Minimum ice class IB and minimum 2000 dwt

Vaasa
Minimum ice class II and minimum 2000 dwt

Icebreakers:
FREJ, YMER, KONTIO, OTSO, SiSÜ and URHO assist in the Bay of Bothnia.
ARCTIC AND ANTARCTIC RESEARCH INSTITUTE
ARCTIC AND ANTARCTIC RESEARCH INSTITUTE
INFORMATION SOURCES – IMAGERY AND WEATHER

**Satellite Imagery:**
- Sentinel-1 (https://www.polarview.ag/arctic)
- MODIS (https://worldview.earthdata.nasa.gov)
- Radarsat (https://mdacorporation.com/geospatial/international/satellites/RADARSAT-2/services)
- CosmoSkyMed (http://www.e-peos.it/cosmo-skymed.html)
- MIRS (https://www.class.ncdc.noaa.gov/ir3a/products/welcome)

**Weather:**
- Environment Canada, Analyses and Modelling https://weather.gc.ca/mainmenu/modelling_menu_e.html
- Environment Canada, Marine text bulletins https://weather.gc.ca/marine/marine_bulletins_e.html
- Environment Canada, Historical data
  - Search tool http://climate.weather.gc.ca/historical_data/search_historic_data_e.html
  - Climate normals http://climate.weather.gc.ca/climate_normals/
- Environment Canada, Weather forecasts https://weather.gc.ca/canada_e.html
- NOAA surface temperature charts: http://www.ospo.noaa.gov/Products/ocean/sst/contour/
- British Met Office – Surface Pressure Charts https://www.metoffice.gov.uk/public/weather/surface-pressure/?#tab=surfacePressureColour&fcTime=1525885200
- Finish Meteorological Institute – Baltic Sea and Gulf of Bothnia Forecast http://en.metsatietenlaitos.fi/weather-forecast-for-shipping
- Norwegian Meteorological Institute – Weather around Baltic Sea and Gulf of Bothnia https://www.yr.no/
INFORMATION SOURCES – ICE DATA

Ice services:

Canadian Ice Service
http://www.ec.gc.ca/places-ice/?lang=En

US National Ice Center (US NIC)
http://www.natice.noaa.gov

Alaska Ocean Observing System (AOOS) Arctic Portal
https://portal.aaos.org/arctic#map?lg=a3b58402-a9c1-11e3-a3fe-0021594e5678&p=prop1572&b=bluemarble07

NWS Alaska Sea Ice Program
https://www.weather.gov/ak/ice

Finnish Meteorological Institute
http://en.ilmapiiri.iki.fi/ice-conditions

Swedish Meteorological and Hydrographic Institute – Ice Service
https://www.smhi.se/en/services/professional-services/shipping/swedish-ice-service-18715

Norwegian Ice Service
http://ispolview.met.no/

Arctic and Antarctic Research Institute (AARI) – Russian Ice Service
IMPORTANCE OF LOCAL INPUT
IMPORTANCE OF LOCAL INPUT

Modified Track of MV Arctic - Admiralty Inlet

Community consultation & cooperation
Community Engagement
BEST PRACTICES IN TRAINING AND CREW RETENTION
BEST PRACTICES – DATA ACCESS AND USAGE
CARTOGRAPHIC INTERFACE
RADAR INTERFACE
SATELLITE IMAGE OVERLAY
RADAR OVERLAY
With the help of the latest ice information, IceNav can be used to plan routes based on the ice conditions.
CANADIAN ARCTIC RISK ASSESSMENT SYSTEM (CASRAS)

Datasets Included in CASRAS as of May 2018

Bathymetry Information
- Archivnet Basemaps
- Archivnet Beaufort Shelf
- International Bathymetric Chart of the Arctic Ocean

Drifting Buys
- International Arctic Buoy Program

Navigation Chart (CHS) Indexes
- Berthing ENC & Paper (2k)
- Harbour ENC & Paper (2k-20k)
- Approach ENC & Paper (20k-50k)
- Coastal ENC & Paper (50k-150k)
- General ENC & Paper (150k-500k)
- Overview ENC & Paper (500k)

Community and Infrastructure
- Inuvialuit Community Conservation Plans
- Nunavut Land Use Plan, Community tour
- Nunavut Land Use Plan, Direction to Regulators
- Nunavut Land Use Plan, Land Use Designations
- Airports
- Ports

Emergency Management
- NRC Personnel Exposure Time
- NRC Places of Refuge

Ice Charts and Atlas
- CIS Ice Atlas (1980-2010)
  ▪ Break up, Freeze up, frequency of old ice, frequency of old ice greater 4 tenths, frequency of sea ice, Median ice concentration, Median old ice concentration, Predominant ice type
- CIS Daily Ice Charts
- CIS Regional Ice Charts (since 1968)
- NRC Ice Charts (north hemisphere)

Ice Motion
- Moored Upward Looking Sonar
- Polar Pathfinder Ice Motion (Daily, weekly, Monthly and Yearly average)

Ice Properties
- Ice Thickness from HEMI flights

Marine Mammals
- WWF Cetacean Calving
- WWF Cetacean Summer Distribution
- WWF Walrus Haulouts

Marine Protected Areas
- Canada
- USA
- Greenland

Mariner Knowledge
- NRC Marine Knowledge

MetOcean
- MDLT (Mean Daily Low Temperature, 10 20 and 30 years)
- Hourly Weather Stations
- Daily Weather Stations
- Wind and Wave Hindcast
- Tide Stations
- Reanalysis modelled data
  ▪ Wind
  ▪ Air Temperature
  ▪ Sea Surface Temperature
  ▪ Visibility
  ▪ Water Current
  ▪ Wave
  ▪ Precipitation

Navigation
- Nautical Charts – Canada (B&G compatible)*
- Nautical Charts – USA (B&G compatible)*
- Shipping Safety-Control Zones
- Marine Forecast Areas
- NORDREG Zone

*The end user has to license and obtain the charts from CHS. The CASRAS is set-up to load the charts.

Other
- Frontier Well Sites
- Beaufort Sea Artificial Islands
CASRAS

Designed to provide a library of critical information to facilitate voyage planning

- Hydrographic information and aids to navigation available;
- Current information on the extent and type of ice and icebergs in the vicinity of the intended route;
- Statistical information on ice and temperatures from former years;
- Places of refuge;
- Current information and measures to be taken when marine mammals are encountered relating to known areas with densities of marine mammals, including seasonal migration areas;
- Current information on relevant ships' routing systems, speed recommendations and vessel traffic services relating to known areas with densities of marine mammals, including seasonal migration areas;
- National and international designated protected areas along the route
CASRAS will be used and tested onboard both the CCGS Amundsen and CCGS Pierre Radisson and in the CCG ROC Ice Office in Montreal.

CASRAS was licensed to the Marine Institute as a training tool - Polar Code and Ice Navigation training program at the Centre for Marine Simulations

Customizing CASRAS based on users feedback:

• New functionalities will be implemented
• New reports will be designed and generated
• New data/datasets will be included
• The system can be integrated with other tools and systems (e.g. NRC Pressured Ice/ Pack Ice Drift Forecasting Model)
NRC PRESSURED ICE MODEL UPDATES
COURTESY IVANA KUBAT, NRC

NRC Pressured Ice model maps accessible through a web interface

Ice Numeral calculation forecast