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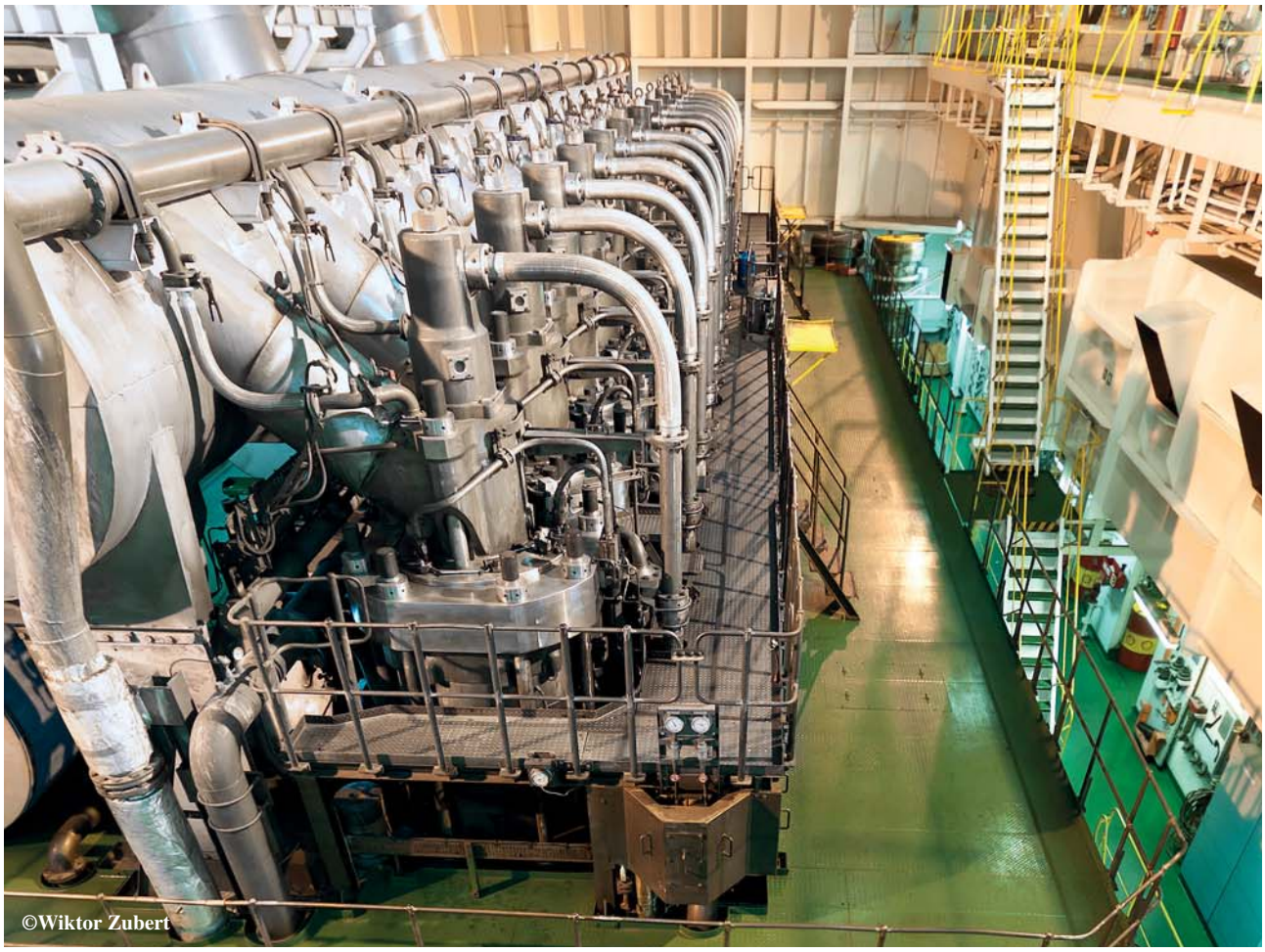
NEWS

LETTER



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Ice – The Ship Hull Nemesis
Part I: Shipping In Ice

By Steven Ferry

For as long as men have traveled and traded by water-routes, ice has been a nemesis for ships and their hulls.

And with good reason since, on average, sea ice covers about 25 million square kilometers (9,652,553 square miles) of the planet—amounting to about two-and-a-half times the area of Canada.

Ice Ships

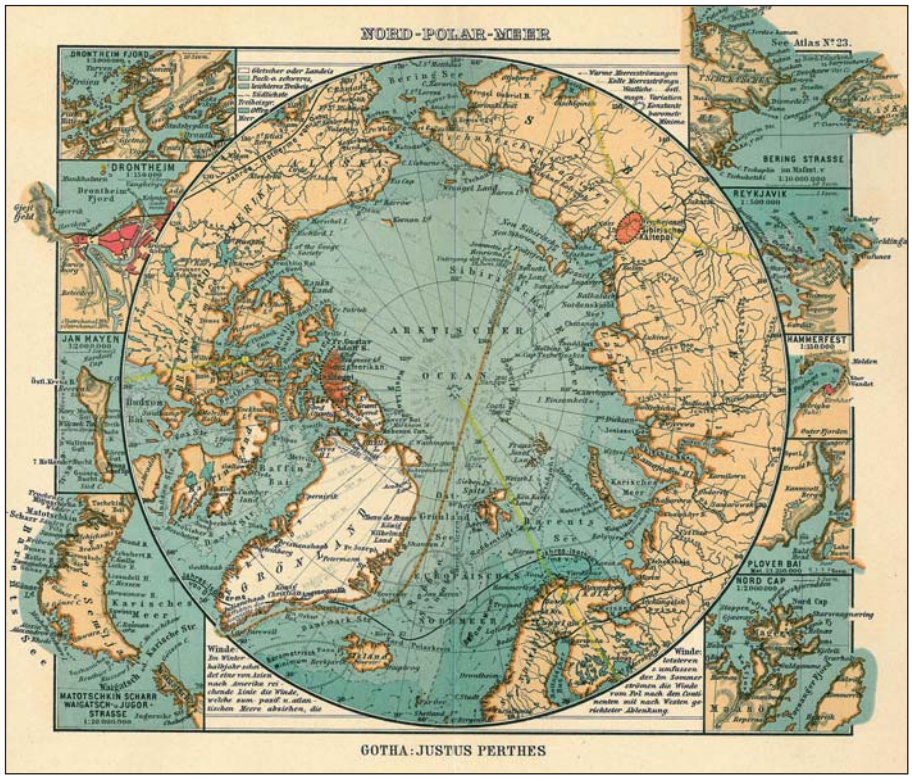
To wage ice battle, even in the earliest days of polar exploration, sailors used strengthened ships to ply icy waters. Naturally, these ships were originally wooden and based on existing designs but reinforced, particularly around the waterline, with double planking to the hull and strengthening cross members inside the ship. Often, bands of iron were wrapped around the waterline as well—forming what's known, to this day, as the *Ice Belt*.

Exploring the Arctic

What would possibly lure explorers and traders into such unfriendly waters? Well, curiosity, for one, and the hope of charting new trade routes for another.

In fact, as early as 330 B.C., a curious Pytheas sailed north from Greece and, by all accounts, reached Iceland or Northern Norway.

A little later, in 890 C.E., a Norwegian Viking chieftain called Ottar travelled northeast to explore the extent of his country. It is known that he reached the White Sea in the southern inlet of the Barents Sea.



Historic map of the Arctic

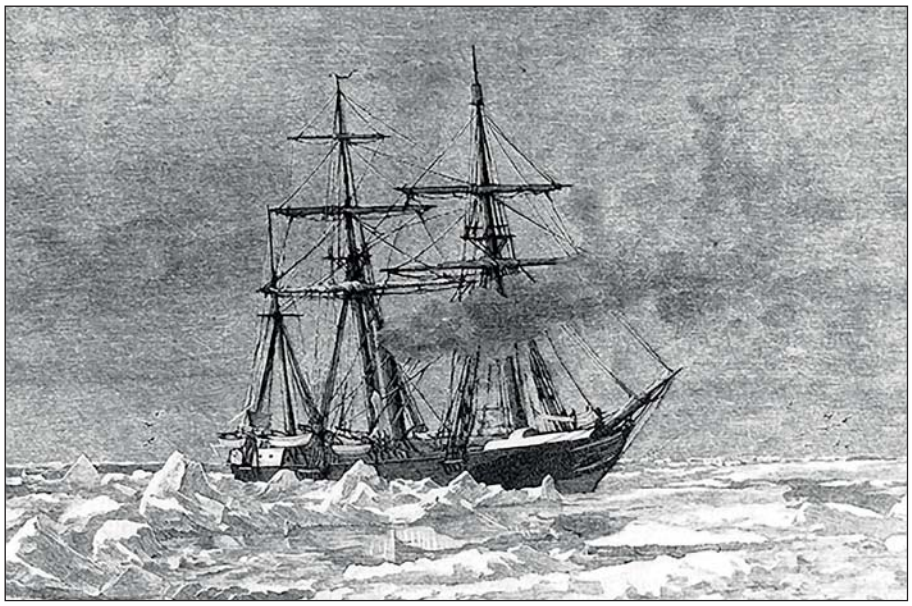
At the end of the 16th century, the British and Dutch started looking in earnest for a northern passage to the East. This time the driving motive was to outmaneuver the Spanish and the Portuguese who, by this time, controlled the sea traffic to the Far East.

Today, both the Northwestern Passage, hugging the northern Canadian coast, and the North Sea Route (also called the Northeastern Passage), hugging Russia's northern coast, have been charted and sailed successfully.

Discovering the Antarctic

Antiquity pictured the Antarctic as the country where the antipodes lived—those who walk upside down—in a baking hot climate. By the end of the 1500s, however, seafarers began bringing back another, much colder version of this world. A world that was generally left alone until the beginning of the 20th century, when Norway, among others, began whaling these icy seas. At the height of this activity, Norway deployed 9 factory ships and over 100 whaling vessels.

Today, Antarctic whaling is illegal and the traffic volume is nowhere near that of other seas, with the main shipping activities in the Southern



Jeanette Arctic exploring exposition, 1879-1881

Oceans being fishing, research, and tourism.

Icy Waters

The majority of the world's ships do their best to avoid icy waters. Most succeed. There are, however, several regions where ice-going vessels are the norm, especially during the winter months.

Norway

While Norway's Arctic shipping evolved gradually—mainly by expanding its fishing and hunting regions—recently, oil companies have begun setting their sights on exploration and recovery in the Arctic. As a major stakeholder, Norway is planning to deploy ice-class ships and cold-climate drilling rigs to meet this demand.

The country is also sailing Arctic ice-reinforced cruise vessels during the summer months, while deploying ice-going cargo vessels to transport coal from the Svea mines on Svalbard year-round.

Greenland

Greenland has mirrored Norway's cruise industry, and over the past few years has seen an annual growth in tourism of 30-40%.

Greenland also deploys several ice-reinforced cargo vessels to supply the many settlements along the coast.

Rising raw-material prices on the world market have also led to several new mining projects with shipping needs; possible oil and gas reserves in both East and West Greenland also may call for additional ice-going vessels.

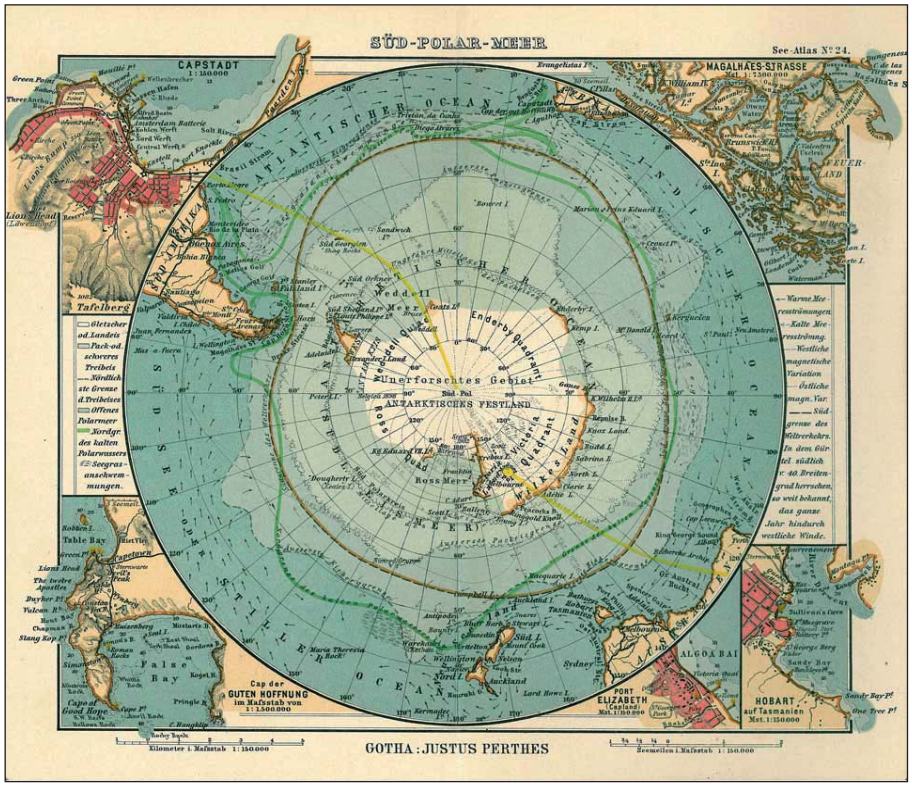
At this time, Greenland has no specially built icebreaker, but new Coast Guard ships are ice-reinforced to tackle most normal ice conditions.

Sweden and Finland

Sweden and Finland—which between them surround the Baltic Sea, the Gulf of Finland, and the Gulf of Bothnia—have for a long time had to deploy ice-going vessels and icebreakers to sail these waters in the winter.

As a result, both countries have led in the development of ice-going ships and in establishing regulations to operate them safely.

During the winter months the deployment of icebreakers is coordinated between the two countries,



Historic map of the Antarctic

Arctic Region

while in the summer these vessels are used for expeditions to the Arctic/Antarctic, or rented out to the Navy or for offshore purposes.

As an example, Sweden's largest icebreaker, the *Oden*, has played an important role in international expeditions both in the Arctic and Antarctic.

Over the last few decades, Finland especially has focused its efforts on technological ice-vessel improvements and through the Aker shipyards—which has its own ice laboratory and which has built a large part of the Russian ice-going fleet—Finland is possibly the largest supplier of high ice-class ships in the world.

Additionally, ever since Russia opened the oil terminal in Primorsk a few years ago, the Gulf of Finland has experienced considerable growth in tanker traffic, calling for icebreaker assistance. This need, while met, has been a great challenge since tankers as a rule are much wider than icebreakers.

The Busy Baltic

Not surprisingly, the Baltic during the winter months—when large parts of the waters are covered by ice—is one of the busiest areas in the world when it comes to icebreaker assistance and ice-going shipping. According to the Finish Maritime Administration, the total number of vessels needing icebreaker assistance in the Baltic during the winter of 2006-2007 was 4,327—hence a fleet of 20 icebreakers and a stable of ice-captains who rarely sleep.

Germany, Great Britain, and Japan

The main efforts of these nations have been building icebreaking research ships to make their Arctic mark in a geopolitical context.

The United States and Canada

The U.S. and Canada, both with large oil and gas reserves in their northern territories, are planning to add to their ice-going fleets.

Canada also operates several ice-reinforced bulk ships for shipment of ore from the northern areas.

As with Sweden and Finland, Canada is investing great resources in formulating efficient and secure rules for the operation of ships in its Arctic regions.

The U.S. also faces winter ice on the Great Lakes.

Russia

Russia, with its long northern shoreline, is more dependent on Arctic shipping than any other country in the world, and is without doubt the country that has focused and spent the most resources on research and ice-ship construction.

Also, over the last several years, Russia has developed her Northwestern oil and gas fields, as well as those at Sakhalin. These will eventually require additional ice-going ships to serve them.

Russia's northern coastal area, which stretches over 165 degrees of longitude, was closed to all international traffic after the revolution in 1917, and was not opened again until 1987, when the then Soviet leader Mikhail Gorbachev announced the re-opening of The Northern Sea Route for western ships in his legendary Murmansk speech.

The near future will doubtless see increased activity in the oil and gas shipping sector, while the warming climate also spells increased transit traffic through the Northeastern Passage. How extensive the international traffic will be is uncertain, and will depend on how much Russia will charge for icebreaker support. In 2011, this was approximately $50,000 per day.

There are also indications that Russia will see a considerable growth in cruise traffic. Up until today, cruise traffic has largely been limited to expedition tourism with Russian ships, but gradually larger cruise ships will find their way into this area.

Other Countries

Several other countries face ice-shipping challenges, or are conducting research in the polar regions. In the northern hemisphere this includes, primarily, Poland and the Baltic states.

Also, as a result of ice in both the northern Black Sea (the Azov Sea) and the Caspian Sea, the Ukraine and Kazakhstan do yearly battle with ice-covered harbors.

In the Southern hemisphere, ice-going activity will largely be connected to Antarctic research. Australia, South Africa, Chile and Argentina have all commissioned ships with a high ice class for this purpose, most of which are being built in Finland.

Summary

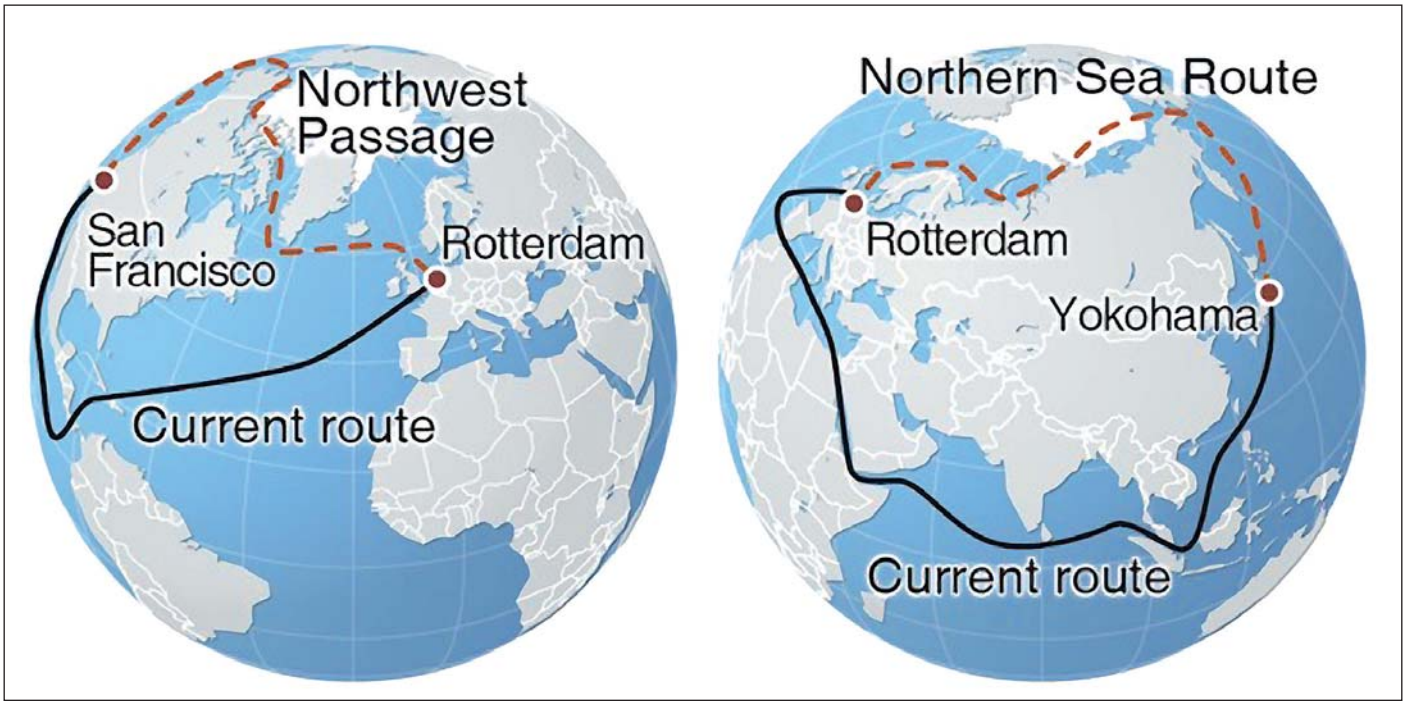
Here's a brief summary of countries and regions that have ice cover at least some part of the year:

- Canada
  - o Hudson Bay, Lake Winnipeg, Great Lakes
- Denmark/Greenland
  - o Greenland Sea, Baffin Bay
- Finland
  - o Baltic Sea, Gulf of Bothnia, Gulf of Finland
- Germany
  - o Baltic Sea
- Norway
  - o North Sea, Norwegian Sea, Barents Sea
- Russia
  - o Baltic Sea, Kara Sea, Laptev Sea, East Siberian Sea, White Sea
- Sweden
  - o Baltic Sea, Gulf of Bothnia
- United States
  - o Alaska, Great Lakes
- Antarctica

During the ice-season, these regions not only call for ice-class vessels (with ice-resistant hull coatings), but quite often also require icebreaker assistance.

Forecast: Arctic Shipping

Not only is the current ice water environment a busy place, growing busier by the year, but now a whole new area of icy waters is opening up



commercially: the Arctic.

Today, the Arctic Ocean is still too icy and treacherous for open-water ships to traverse unaided by icebreakers, and the Northwest Passage is only navigable during the summer months once every seven years or so.

This, however, is changing and a predicted loss of sea ice will open up potentially lucrative new trade routes between the Atlantic and Pacific Oceans.

As the illustration shows (page 6), ships that currently have to navigate through the Suez or Panama canals can reach their destination a lot sooner via the top of the world (Santa's Shortcut).

Quadruple

It is not surprising then, that a *Financial Times* article reports that as of July 2013, 204 ships had received permits to ply the Northern Sea Route, which connects East Asia to Europe via the waters off Russia's northern coast. Last year, just 46 vessels made the trip. Two years ago, the number was four.

UCLA Study

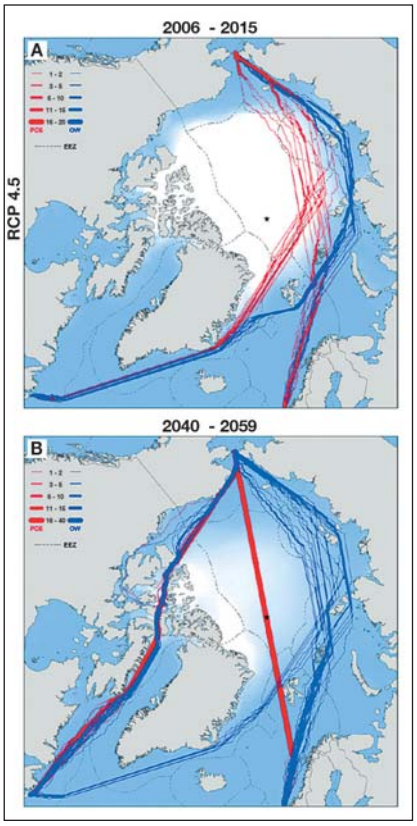
While Arctic shipping lanes will not put the Suez and Panama canals out of business anytime soon, new UCLA research predicts that these frigid routes will become more accessible in the future.

"The development is both exciting from an economic development point of view and worrisome in terms of safety, both for the Arctic environment and for the ships themselves," said lead researcher Laurence C. Smith, a professor of geography at UCLA.

The researchers predict that by mid-century even ordinary shipping vessels would be able to navigate previously inaccessible parts of the Arctic Ocean, and so would not need icebreakers to blaze their path as they do today.

"We're talking about a future in which open-water vessels will, at least during some years, be able to navigate unescorted through the Arctic, which at the moment is inconceivable," said co-author Scott R. Stephenson, a Ph.D. candidate in the UCLA Department of Geography.

"Nobody's ever talked about shipping over the top of the North Pole," Smith said. "This is an entirely unexpected possibility."



The blue lines show the fastest routes available for common open-water ships during the summer, while the red lines show routes available for Polar Class 6 ships with moderate icebreaker capacity. By 2040-2059, as shown, there would be many more routes.

Even the fabled and notoriously treacherous Northwest Passage, which traces Canada's coastline and offers the most direct route from Asia to eastern Canada and the north-easternmost part of the U.S., is expected to become more viable for Polar Class 6 vessels and possibly even ships with unreinforced hulls, which make up the lion's share of the world's commercial fleet.

While this prospect is attractive to business, the researchers stress that the lack of current regulations poses safety, environmental, and legal issues that have yet to be resolved. The prospect of open-water ships entering the Arctic Ocean in late summer heightens the urgency for comprehensive international regulations that provide adequate environmental protection, vessel safety standards, and search-and-rescue capability, they said.

The Polar Code

While different countries and jurisdictions have some rules and regulations in place pertaining to Arctic shipping, including rules to protect the polar environment, the International Maritime Organization (IMO) is still at work reconciling such rules into a Polar Code.

Many had hoped that this code would already have been in place, but as of this writing, it is still with a sub-committee considering various proposals from countries concerned.

The current estimate is that there will be an International Polar Code in place governing both safety and environmental Arctic shipping issues, but not until 2016.

The Fragile Polar Environments

As the UCLA and other reports point out, increased arctic shipping does pose a threat to the fragile and, as yet, pristine polar environment, where over centuries, polar biota have adapted to extreme conditions characterized by large variations in temperature and light, and the effects of snow and ice.

However, these adaptations have made some plants and animals more sensitive to human environmental impact.

Curious polar bears approach the USS Honolulu surfacing near the North Pole (photo source US Navy).

Environmental Threats

Though it normally (and unfortunately) takes a back seat in these discussions, the projected increase in Arctic shipping could, if not managed responsibly, have a devastating effect on the polar environment.

These potential catastrophes come in these forms:

- First, and most dramatic, are accidental spills—either through collision or other mishaps—of oil and other toxic material;
- Second, the toxic substances used in conventional, and typically fragile, hull coatings are scraped off along with the paint when ships move through icy waters;
- Third, toxic antifouling systems in general use leach heavy metals and highly toxic biocides or emit other toxic substances into the water as a matter of course;
- Fourth, a grave environmental hazard to polar waters is posed by the translocation of invasive, non-indigenous aquatic species in the form of hull-borne fouling organisms;
- Fifth, biocidal antifouling coatings create a copper-tolerant or biocide-tolerant type of non-indigenous species which are particularly dominant and harmful to the environment they invade; and
- Finally, atmospheric emissions such as GHG and black carbon increase in direct relation to fuel consumption—a rough hull can increase the fuel cost, and with it harmful emissions, by as much as 40%.

Spills

The polar-zone ice creates a hazardous and harsh environment for ships that heightens the possibility of wrecks, spills and other forms of environmental damage.

Oil spills come in two varieties: a struck tanker can leak crude oil into the waters, as in the case of the *Exxon Valdez*; or a tanker or other ship can leak its own bunkers, consisting usually of heavy fuel oil (HFO), which is even more harmful to the environment than crude.

There are proposals on the table to ban the use of HFO for Arctic-going vessels, only permitting the use of distilled (and less hazardous) fuels.

Paint Debris

A conventionally hull-coated ship plying icy waters for a season reports back to drydock virtually coat-free—just metal.

And what happened to the coat? It was scraped off by the ice and left to contaminate the polar waters. If this was a biocidal antifouling coating, tons of toxic heavy metals and biocides are left behind in the polar regions.

Antifouling Systems

For as long as ships have been around, their owners have attempted, with varying degrees of success, to surface treat their underwater hulls with coatings to prevent the adhesion and growth of fouling organisms that, once settled in, cause severe drag, reducing vessel speed and maneuverability, and greatly increasing fuel consumption.

Today, two major approaches are used:

- Foul-release coatings, usually employing silicones or fluoropolymers designed to prevent strong adhesion of foulants. These are paints that are very easily scraped off in icy waters.
- Biocidal antifouling coatings which typically contain heavy metals and other biocides which are toxic to foulants upon release, and which are slowly but continuously released from the coating during its ablative process.

Let's note the derivation of "*biocide*" — *bio*, life; *cide*, kill. In other words, these antifouling systems work by releasing heavy metals and poisonous chemicals designed to kill marine life. Such coatings do not stop releasing the toxic substances in icy waters, and kill much more marine life than intended. They can also lead to the translocation of copper-tolerant or biocide-tolerant invasive species which are even more dominant in the invaded environment than usual.

Non-Indigenous Invasion

Any owner of even a small boat may be surprised to find how quickly the below-waterline hull, while sitting in the water, is populated by marine life of various forms and sizes—this marine life, transported to a zone where it is not native, then classifies as non-indigenous species (NIS) some of which are a nuisance or worse in the new environment.

That problem, times, say a thousand, is what ship owners face on an ongoing basis while in port—especially warm-water ports.

If the ship in question is then heading for polar waters, it faces a dilemma: either use biocidal antifouling to keep the NIS population in check—to then release the biocides and the biocide-tolerant species into the polar ecosystem—or, since conventional hull coatings are very hard to underwater clean of such marine life, bring a hull full of non-indigenous marine life into the Arctic where it soon will be scraped off by ice and so deposited into a pristine and vulnerable environment where it then proceeds to wreak havoc.

Is there a third option? Fortunately, as you will see in Part II, there is.

Steven Ferry, Words & Images (www.words-images.com)

Ecoshield keeps on protecting rudders for their entire service life

Cavitation and corrosion damage can destroy a rudder, so a lasing protection is essential.

In september the rudders of six container ships were coated at shipyards in China and the United Kingdom with Ecoshield, the new special rudder coating. The vessels belong to different owners, both returning customers and new ones. More and more shipowners, operators and technical superintendents are finding that Ecoshield is the ultimate solution when it comes to protecting a rudder from cavitation damage

Cavitation erosion damage had appeared on the rudders of these vessels. The owners therefore decided to use Ecoshield because this will prevent similar damage from occurring again.

The coating provides the rudder with an impenetrable protective layer. At the same time its toughness and flexibility enables absorption of the forces that are produced by cavitation. This prevents the damage normally caused by this phenomenon. Without proper protection against cavitation and the resulting erosion and corrosion damage, the financial consequences can be severe.

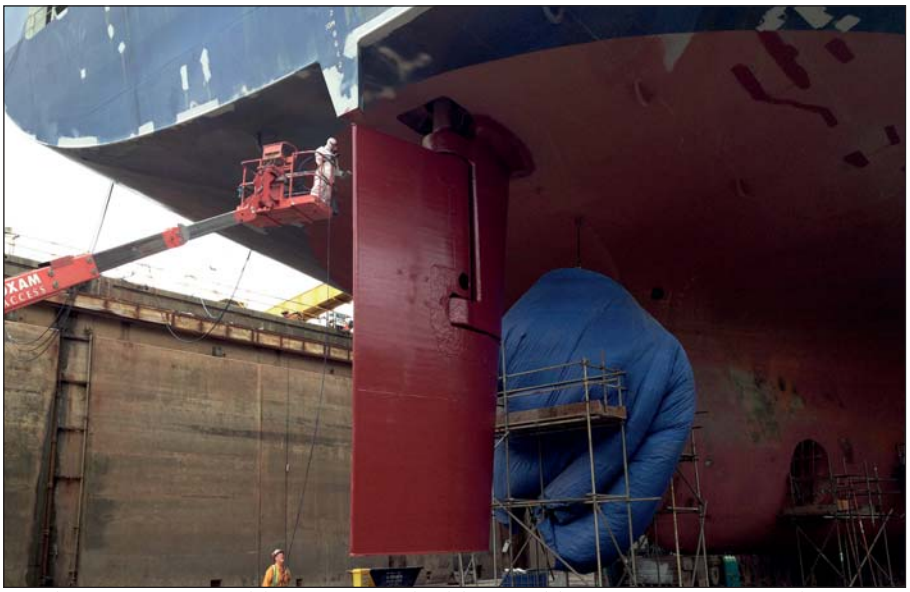
Ecoshield is guaranteed for ten years. With an Ecoshield application no repaint will be needed during drydocking. At most, minor touch-ups will be required. Planning the maintenance of the vessel's stern area therefore becomes much easier. The smoothness attained by the

Ecoshield is applied in two layers and lasts the lifetime of the vessel.

An Ecoshield application is adapted to the yard's schedule.

A rudder coated with Ecoshield is protected against the forces of cavitation.

Thruster tunnels can also be protected with Ecoshield.



Application of second layer of Ecoshield on rudder of container vessel.

No repaint or steel repairs will be needed during future drydockings.

coating also provides optimum hydrodynamic conditions. This allows rudders to operate at maximum efficiency. The ship's performance therefore remains stable and the owner's investment is secured.

Ecoshield is also ideally suited for other areas prone to cavitation erosion or other damage, such as propeller nozzles, thruster tunnels, the bulbous bow or stabilizer fins. For this reason several of the container vessels had Ecoshield applied to their thruster tunnels.

Thanks to the Ecoshield application, these areas will be safeguarded together with the rudders for the remainder of the vessels' service life.

ECOSPEED®

SHIP HULL PERFORMANCE TECHNOLOGY

Ecospeed gives a very thorough and lasting defense against cavitation and corrosion damage for a ship hull's entire service life.

The coating equally provides the underwater hull with an impenetrable protective layer while its flexibility enables absorption of the forces that are produced by cavitation. This prevents the damage normally caused by this phenomenon.

By removing the existing paint layers and applying Ecospeed on the hull we can break the never ending cycle of painting, suffering damage, having to perform extensive repairs in drydock followed by a full repainting, again and again.

With an Ecospeed application no full repaint will be needed during drydocking. Ecospeed is guaranteed for ten years. At the most, minor touch-ups will be required.

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