1.2.4 Old Ice

Old ice is extremely hazardous for shipping, even icebreakers, and any attempt to navigate in such conditions must be thoroughly risk assessed before entry. By the time ice has reached multi-season in age, it has a hardness similar to solid rock and must be approached with that in mind. Old ice has survived at least one melt season.

Courtesy of USCG

Figure 1.24: Old ice >120 cm thick with melt pools

Figure 1.25: Old sea ice in the Arctic

Second-year Ice

This is old ice that has survived only one summer's melt. It is thicker than first-year ice and, in contrast to multi-year ice, summer melting produces a regular pattern of numerous small puddles that are usually greenish-blue.

Multi-year Ice

This is old ice that has survived at least two summers' melt. It is almost salt free and hummocks will be smoother than on second-year ice. Where bare, this ice is usually blue in colour. The melt pattern consists of large interconnecting, irregular puddles and a developed drainage system.

Melt Pools

In the Arctic during the summer, snow and ice melt on the surface of the ice pack and create ice pools, although the melting effect rarely reaches to the ocean below. As winter returns, the melt pools re-freeze, appearing as glassy surfaces among the weathered hummocks of the pack ice.

Figure 1.26: Multi-year ice

1.3 Glacial Ice

This is ice of land origin and is made up of icebergs, bergy bits and growlers. It should be noted that the colours used to describe ice types usually depend on the light that falls on them, but can sometimes be due to contaminants within the ice structure.

Some icebergs appear green (jade icebergs) because of a mixture of particulate protein-nitrogen contaminants.

Glacial ice is generally white in appearance, but will often sparkle with reflected sunlight and appear blue. However, if viewed at night with the moon directly ahead, it can be seen as a silhouette.

Growlers can generally only be observed at close range, as they lie low in the water.

1.3.1 Icebergs

An iceberg is a floating block of ice that has broken off from ice that formed on land. Large icebergs may be hundreds of metres or even several kilometres in length. Irrespective of size, icebergs present a significant danger to ships. A proper lookout and a safe speed are essential.

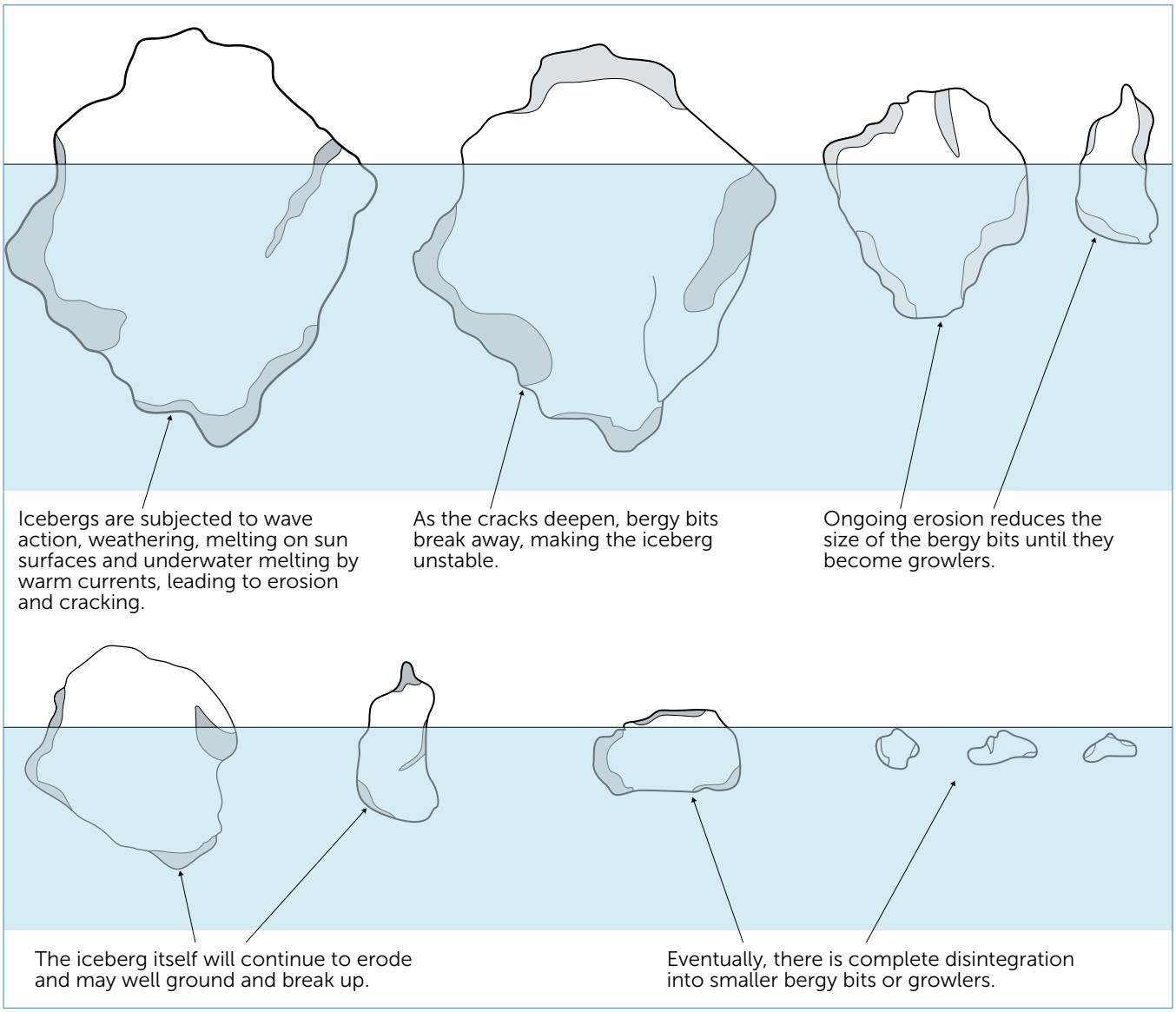

Figure 1.27: Life cycle of an iceberg

Figure 1.28: Bergy bits and growlers

Icebergs are inherently unstable because their centre of gravity is very close to their centre of buoyancy. They are, therefore, always close to a constant state of capsize and this is their pattern as they melt.

Most icebergs are formed from the effects of tide and wave action on a tongue of ice at the end of a glacier, including when the moving glacier advances towards the sea. This causes a large ice formation to drop from the glacier's front into the sea.

Tabular icebergs break away from an ice shelf and, although they can be found in Arctic waters from the few ice shelves that do exist, they are more characteristic of the Antarctic seas. Arctic tabular bergs are rarer and tend to be smaller than the Antarctic versions.

Figure 1.29: Large tabular iceberg

Figure 1.30: A non-tabular iceberg, with a weathered pinnacle

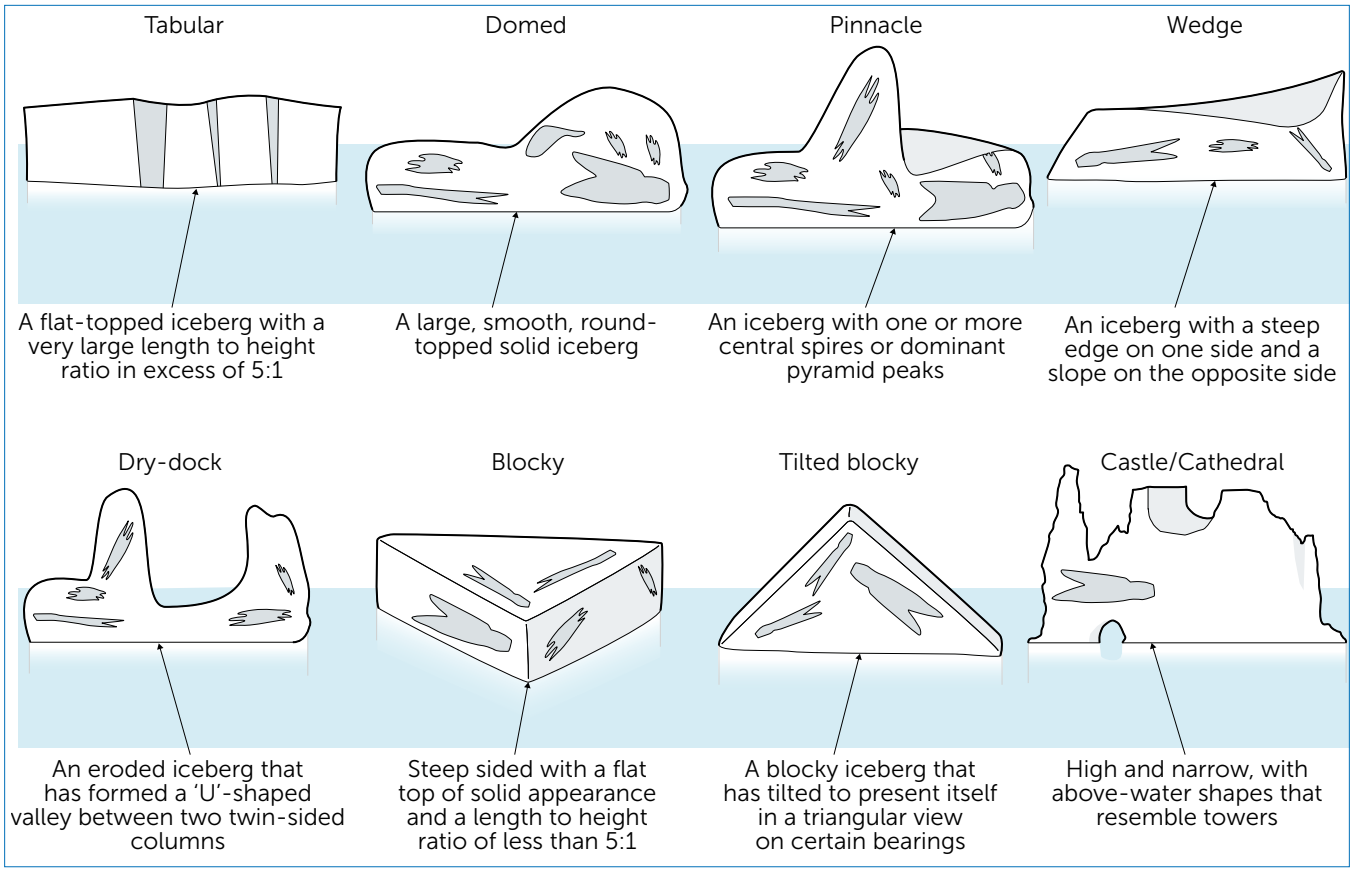

Figure 1.31: Iceberg shapes and definitions

Figure 1.32: Decomposing dry-dock iceberg

Iceberg drift is affected more by the current than the wind and icebergs may even travel upwind. This may cause ice floes to develop leeward.

1.3.2 Bergy Bits

Bergy bits are pieces of ice that have broken off from the main iceberg and they often drift in the vicinity of larger bergs. Navigators should be aware that bergy bits are more difficult to detect than smaller icebergs.

MOF via Getty Images

Figure 1.33: Bergy bits

1.3.3 Growlers

Growlers are smaller bergy bits or bergs, with an area of approximately 20 m^2 (215 ft^2), that have melted down so that their surface is less than a metre in height above sea level. Growlers are very difficult to detect visually or by radar and are, consequently, very dangerous.

All glacial ice is hazardous and should not be approached closely.

Figure 1.34: A growler

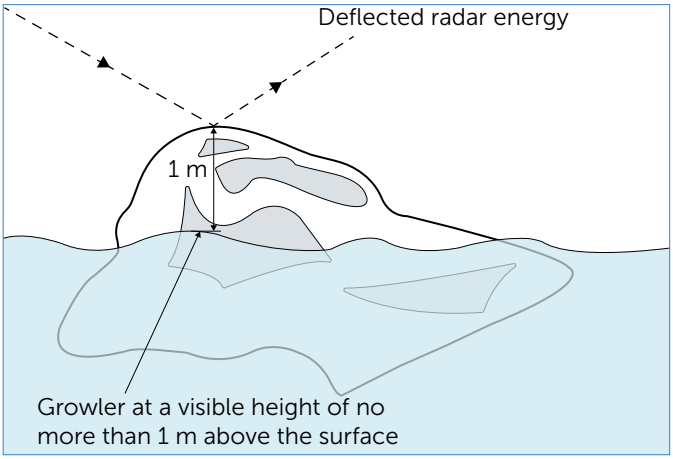

Figure 1.35: Deflection of a radar beam from a growler

Type	Height (m)	Length (m)	Mass (tonnes)
Growler	0–1	<5	<200
Bergy bit	1–5	6–15	200–7,000
Small iceberg	6–15	16–60	7,000–200,000
Medium iceberg	16–45	61–120	200,000–2,500,000
Large iceberg	46–75	121–200	>2,500,000
Very large iceberg	>75	>200	

Figure 1.36: Iceberg size and categories

1.4 Fast Ice

This term describes ice that is attached to any shore, extends seaward and remains in place all winter.

Fast ice can be of any age and stage of development or deformation. It may disappear and re-form during the course of a winter.

Courtesy of NASA

Figure 1.37: Fast ice off Bylot Island

Courtesy of Ian Stewart

Figure 1.38: Fast ice in Hudson Bay

1.5 Pack Ice

Pack ice is any other aggregation of sea ice that is not fast ice, ie not attached to the shore. It ranges from open pack ice, which can be navigated relatively easily with vigilance and good visibility, to close pack ice. It is also known as drift ice or field ice. The two largest ice packs are the Arctic ice pack and the Antarctic ice pack.

Close pack ice is caused by the force of wind blowing the ice together. During this process, compacting ridges and hummocking can occur.

Figure 1.39: Open pack ice

Michelde nijs via Getty Images

Figure 1.40: Pack ice near Arctic Island, Svalbard

Figure 1.41: Pack ice seen from high altitude