

Evidence essay · Wildlife and ecology

The bloom can begin before open water

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ABSTRACT

An ice-covered blank in an ocean-colour product does not establish an absence of phytoplankton growth. Drawing on the cited under-ice bloom review and NOAA productivity assessment, the essay follows light through snow, ice, and melt ponds, then examines nutrient supply, stratification, and mixing. Ice algae and water-column phytoplankton remain distinct sources within the food web. Hypothetical bloom calendars show how equal seasonal production can offer different feeding opportunities without demonstrating a real mismatch. The account also separates chlorophyll concentration from production rate and identifies the seasonal and ice-concentration boundaries of the satellite calculation. A stronger interpretation combines under-ice measurements and consumer observations with regional imagery, preserves missing-data meaning, and tests ecological consequences rather than assuming that more production benefits every organism.

Keywords: under-ice blooms · primary productivity · light transmission · nutrient supply · seasonal mismatch

Adapted from the Still North field journal. Original article. A source-based editorial text, not a report of original Still North research. Examples and imagery are illustrative.

A satellite ocean-colour map leaves an ice-covered region blank. Beneath that blank, algae may already be growing. The opening of the sea surface is not a universal starting gun for the Arctic food web. Light can pass through ice, and changing snow, melt ponds, nutrients, and water-column structure determine what happens before open water appears.

That distinction changes how to read an early summer image. A missing ocean-colour value may mean the sensor cannot observe the water, not that the water contains no phytoplankton. [Ardyna and colleagues' review of under-ice blooms](#) brings together evidence from many Arctic regions and shows why open-water observations alone miss part of the productive season.

Daylight is only the first part of the journey

Sunlight reaching the top of an ice cover must still pass through snow, ice, and any surface water before it becomes available to organisms beneath. Thick snow can keep the under-ice environment dim despite long days. Snowmelt and pond formation change transmission. Two places at the same latitude, on the same date, can therefore have very different underwater light conditions.

Ice algae and phytoplankton should not be collapsed into one category. Ice algae live within or attached to the ice environment, including its underside; phytoplankton grow suspended in the water column. Both contribute to food webs, but their access to light and nutrients, and their availability to grazers, differ. Losing an ice-associated source of food is not necessarily compensated by adding the same amount of production somewhere else.

The same seasonal total, a different meal

Consider two invented bloom calendars. Each produces the same amount of organic material over spring and summer. In the first, much of the pulse occurs while a consumer is feeding actively in that location. In the

second, it occurs before that consumer arrives or reaches the relevant life stage. Equal seasonal totals do not imply equal access to food. This example isolates timing; it is not evidence that a particular Arctic population has suffered a mismatch.

To test a real mismatch, researchers would need dates and durations for production and consumer demand, their spatial overlap, and evidence of the feeding or demographic consequence. An earlier bloom paired with an unchanged bird arrival date is a hypothesis worth investigating. It is not yet proof of reduced breeding success, especially if birds can change prey, location, or timing.

Our [wildlife and food-web guide](#) follows those relationships beyond one conspicuous animal. The useful unit is not simply 'more algae'. It is food of a usable kind, at an accessible depth and place, during a period when another organism can use it.

More light can expose a nutrient limit

Light is necessary for photosynthesis, but it is not the only control. Nutrients can be depleted from the surface layer during a bloom. Stratification, the layering of water by density, can keep organisms in sufficient light while limiting the upward resupply of nutrients. Mixing may replenish nutrients but also move cells into darker water. The outcome depends on the setting and season.

The NOAA 2025 primary-productivity assessment describes this regional complexity. It also distinguishes chlorophyll concentration, a proxy for algal biomass, from the rate of primary production. A large standing stock can reflect growth, weak grazing, or transport. It is not a direct stopwatch for how quickly carbon is being fixed.

Read the invisible part of the estimate

In that assessment, satellite-based productivity calculations include only pixels with less than 10% sea-ice concentration. They exclude ice algae and under-ice phytoplankton blooms, and can miss production associated with deeper chlorophyll maxima. The report defines its annual calculation over March to September. Those boundaries make the estimate interpretable; they do not describe all production everywhere throughout the year.

A stronger seasonal account combines ocean colour with under-ice light measurements, profiles, nutrient samples, and observations of consumers. It also records dates when clouds or ice prevent satellite retrievals. Filling every blank with zero would turn a limitation of observation into a false ecological result. The [open-observations](#) page sets out why missing-data meaning must survive into public graphics.

When the first clear-water image arrives, ask what may already have happened beneath the cover. That question does not diminish the satellite record. It places its remarkable regional view within the full seasonal sequence, where light, nutrients, and hungry organisms do not all keep the same calendar.

References

1. Ardyna and colleagues' review of under-ice blooms (frontiersin.org)
2. NOAA 2025 primary-productivity assessment (arctic.noaa.gov)