

The “500 lbs. Algae Adage”

Where did it come from – and is it true?

Have you heard this adage?

One pound of phosphorus can produce from 300 to 500 pounds of algae.

You probably have. It is much quoted in articles and during presentations when the “greening” of lakes is discussed. It means a pound of the nutrient phosphorus entering a lake (or river) from wastewater or stormwater runoff can promote growth of up to 500 pounds of “pea soup” algae.

Not only have I heard this adage, I have repeated it to others - which led me to ask, *where did it come from, and is it TRUE?*

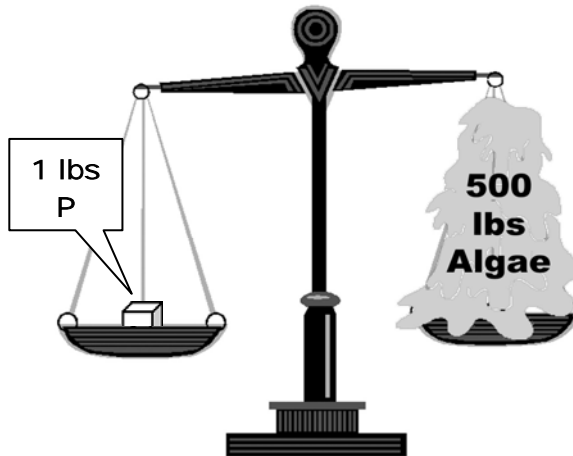
Steve Heiskary, limnologist with the Minnesota Pollution Control Agency, put me on the trail of the “algae adage” origins by directing me to *Limnology*, a standard textbook by Robert G. Wetzel. While it is not known who first coined the adage, the rationale for it is laid out in a section titled *Effects of Phosphorus Concentration on Lake Productivity* (Second Edition, page 285). A main reference for the section is J.R. Vallentyne’s book *The Algal Bowl – Lakes and Man* (Ottawa Department of the Environment, 1974).

Core to the rationale is the “law of the minimum”, that is, the nutrient that is in the shortest supply in relation to a plant’s needs will control the growth of that plant. The “law of the minimum” can be illustrated using a baking example: A pound cake takes a pound of flour, a pound of butter, a pound of sugar and four eggs. If you have ten pounds of flour, butter, and sugar, but only four eggs, you can only bake one pound cake. The eggs are the limiting factor to baking more.

The limiting factor for algae growth in most Minnesota lakes is the nutrient phosphorus. It is not limiting because algae need so much of it, but rather because it is usually in very short supply. The average ratio of the phosphorus needs of algae to what is available in water is 80,000 to 1.

According to J.R. Vallentyne, a 500 pound “batch” of wet algae requires:

1 pound phosphorus
7 pounds nitrogen
40 pounds carbon



Since there is usually more than adequate levels of nitrogen and carbon in lake and river water, for every pound of phosphorus added, another 500 pound batch of wet algae can be produced. Since 500 pounds is the theoretical maximum that can be produced, the range of 300 to 500 pounds is typically used when the adage is quoted. I did not find how the 300 pound lower limit was set – it is likely the best estimate of the specialist who first coined the adage. The 300 pound to 500 pound range is wet weight algae; in dry weight the range is 60 to 100 pounds.

All types of algae can experience periods of rapid growth known as “blooms”. In Minnesota lakes, however, blooms of blue green algae, also known as cyanobacteria, draw the most notice. They form surface scum, are smelly, and occasionally produce toxins harmful to drinking livestock and pets.

Blooms of blue green algae are a classic case of too much of a good thing. Although annoying and harmful in excess, we owe lots to blue green algae for both past and present good. Similar to bacteria in structure, these simple organisms are credited for first using chlorophyll to make food from sunlight and for boosting oxygen in the Earth’s early atmosphere. In lakes today they form the base of the food web that feeds increasing larger and larger animals - including you if you were lucky enough to hook a lunker this season!

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