

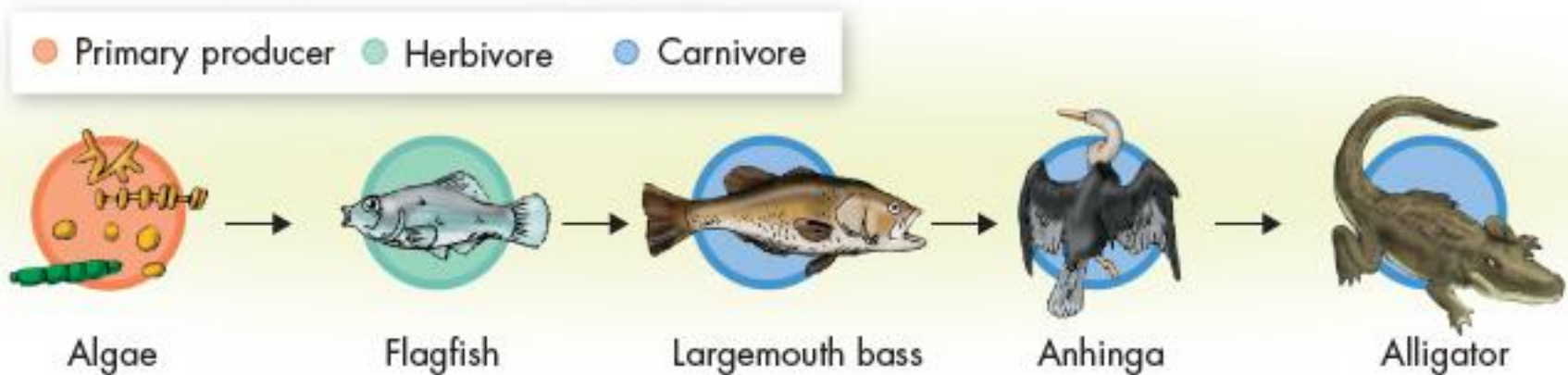
Lesson Overview

3.3 Energy Flow in Ecosystems

THINK ABOUT IT

What happens to energy stored in body tissues when one organism eats another?

Energy moves from the “eaten” to the “eater.” Where it goes from there depends on who eats whom!



Food Chains and Food Webs



How does energy flow through ecosystems?

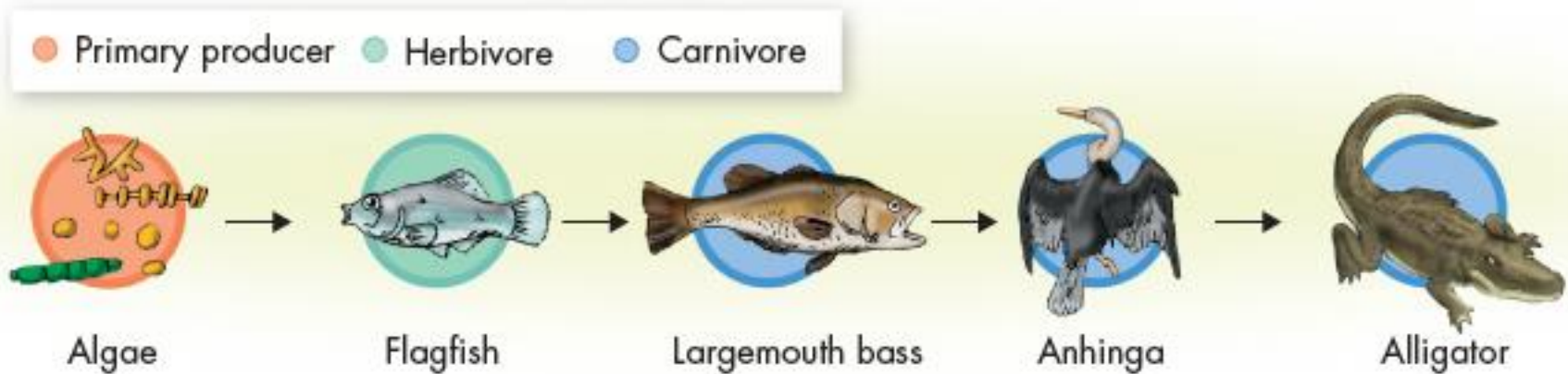


Energy flows through an ecosystem in a one-way stream, from primary producers to various consumers.

Food Chains

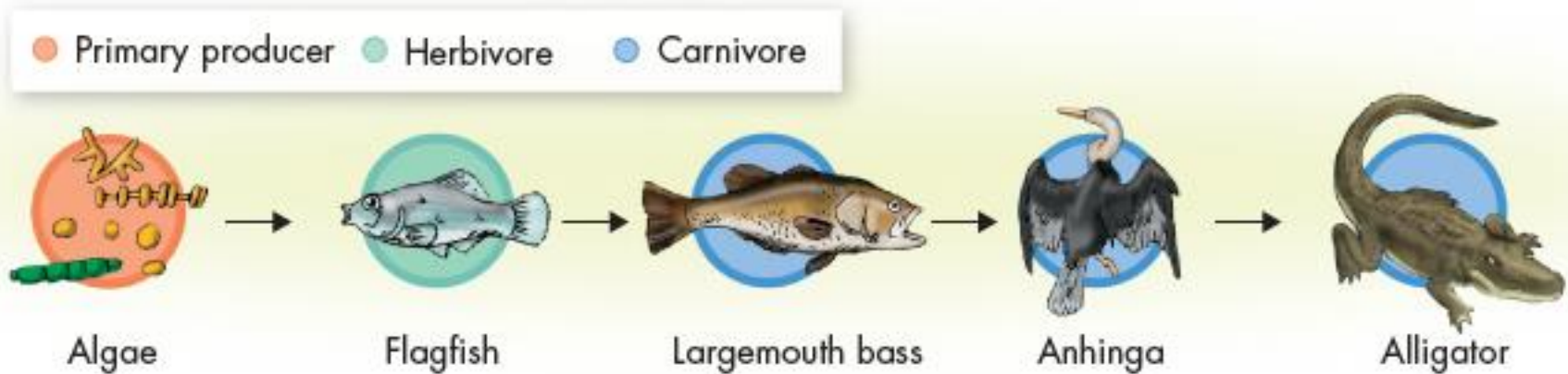
A **food chain** is a series of steps in which organisms transfer energy by eating and being eaten.

Food chains can vary in length. An example from the Everglades is shown.



Food Chains

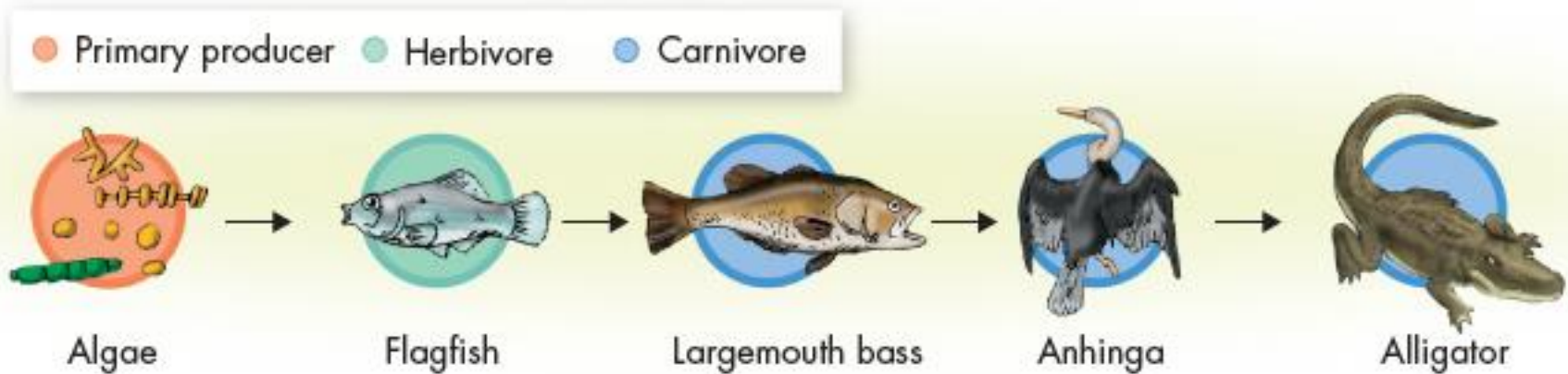
In some aquatic food chains, such as the example shown, primary producers are a mixture of floating algae called **phytoplankton** and attached algae. These producers are eaten by small fishes, such as flagfish. Larger fishes, like the largemouth bass, eat the small fishes. The bass are preyed upon by large wading birds, such as the anhinga, which may ultimately be eaten by an alligator.



Food Chains

There are four steps in this food chain.

The top carnivore is four steps removed from the primary producer.



Food Webs

In most ecosystems, feeding relationships are much more complicated than the relationships described in a single, simple chain because many animals eat more than one kind of food.

Ecologists call this network of feeding interactions a **food web**. An example of a food web in the Everglades is shown.



Food Chains Within Food Webs

Each path through a food web is a food chain.

A food web, like the one shown, links all of the food chains in an ecosystem together.

-  Scavenger
-  Decomposer
-  Detritivore
-  Omnivore
-  Carnivore
-  Herbivore
-  Primary producer
-  Consumed after death
-  Detritus pathway



Decomposers and Detritivores in Food Webs

Most producers die without being eaten. In the detritus pathway, decomposers convert that dead material to detritus, which is eaten by detritivores, such as crayfish, grass shrimp, and worms.

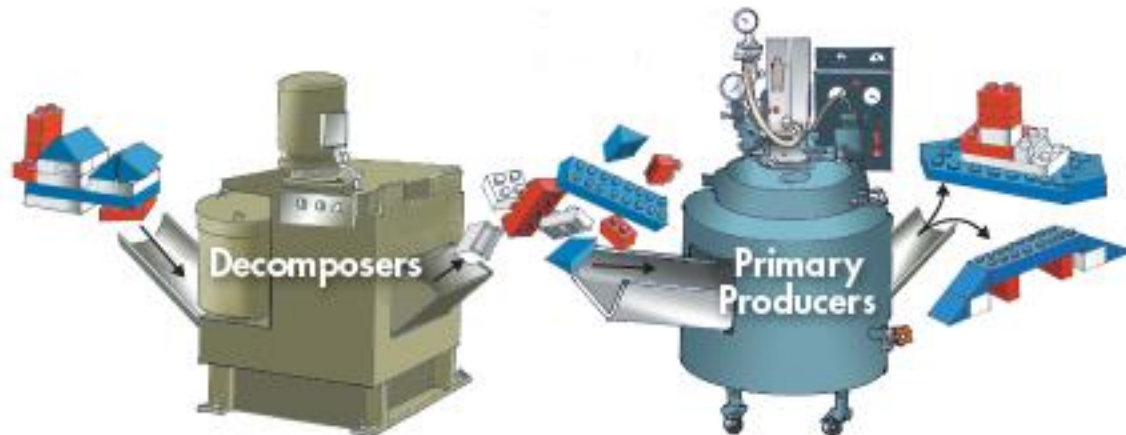
Pig frogs, killifish, and other fishes eat the detritivores.



Decomposers and Detritivores in Food Webs

At the same time, the decomposition process releases nutrients that can be used by primary producers. They break down dead and decaying matter into forms that can be reused by organisms, similar to the way a recycling center works.

Without decomposers, nutrients would remain locked in dead organisms.

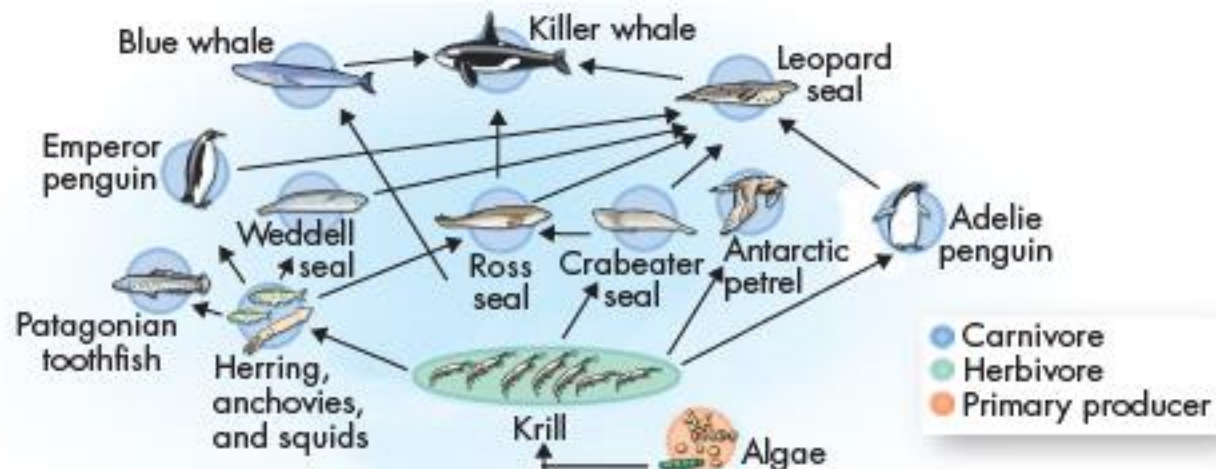


Food Webs and Disturbance

When disturbances to food webs happen, their effects can be dramatic.

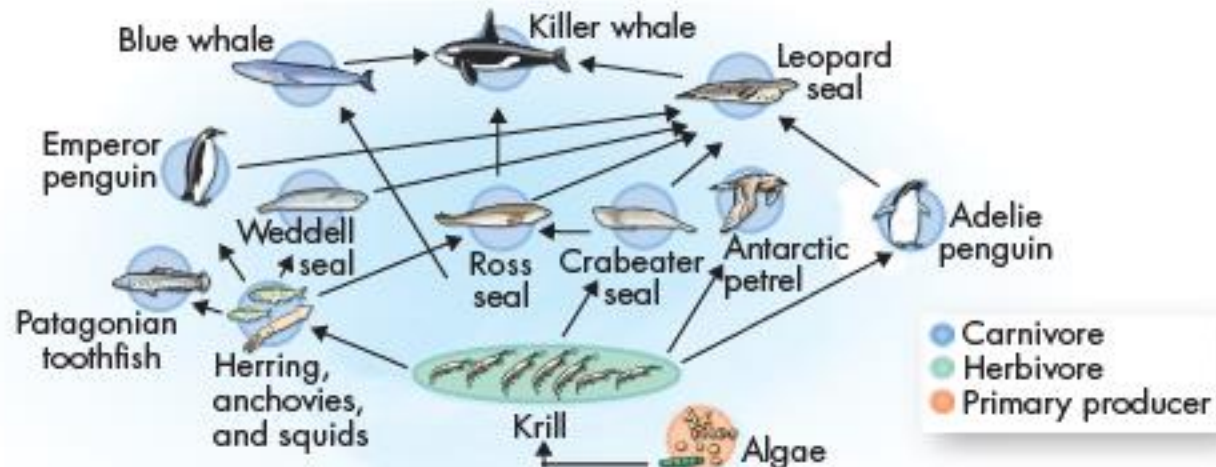
For example, all of the animals in this food web depend directly or indirectly on shrimplike animals called krill.

Krill are one example of small, swimming animals called **zooplankton**.



Food Webs and Disturbance

In recent years, krill populations have dropped substantially. Given the structure of this food web, a drop in the krill population can cause drops in the populations of all other members of the food web shown.

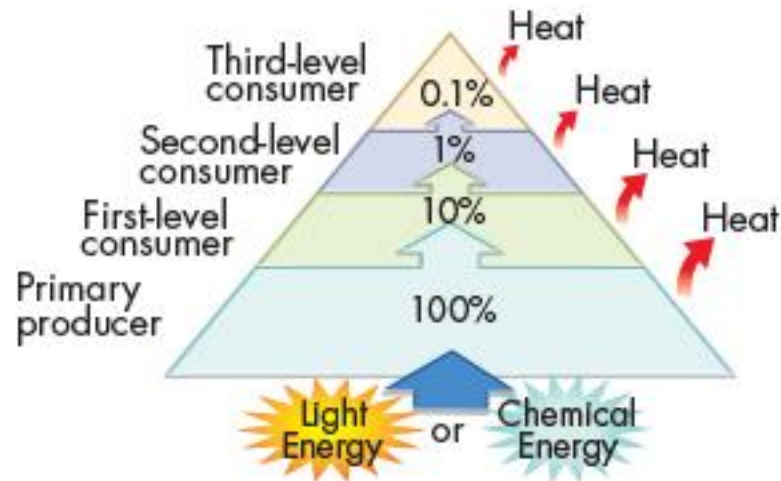


Trophic Levels and Ecological Pyramids

Each step in a food chain or food web is called a **trophic level**.

Primary producers always make up the first trophic level.

Various consumers occupy every other level. Some examples are shown.



Trophic Levels and Ecological Pyramids

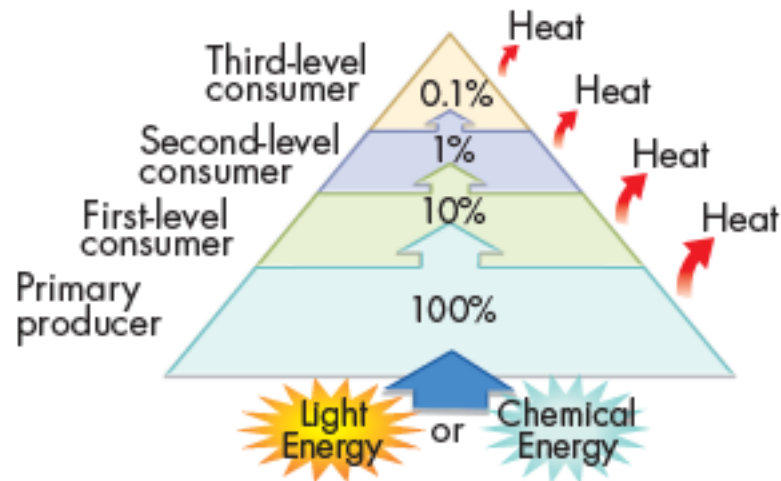
Ecological pyramids show the relative amount of energy or matter contained within each trophic level in a given food chain or food web.

There are three different types of ecological pyramids:

1. pyramids of energy,
2. pyramids of biomass, and
3. pyramids of numbers.

Pyramids of Energy

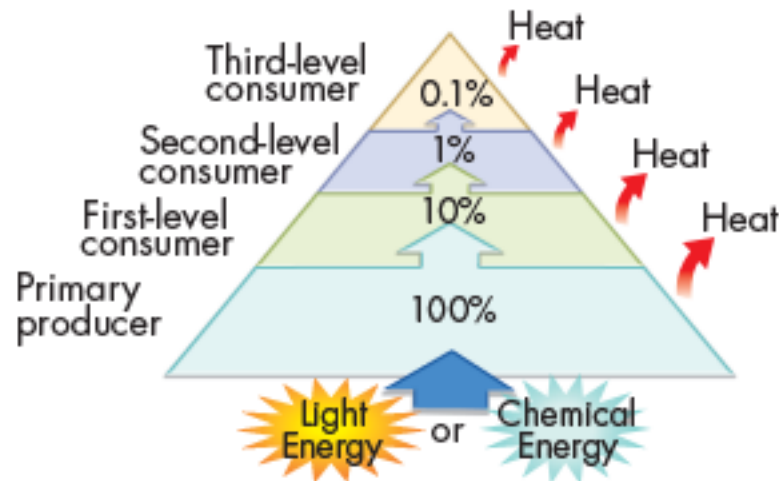
Pyramids of energy show the relative amount of energy available at each trophic level.



Pyramids of Energy

There is theoretically no limit to the number of trophic levels in a food web or the number of organisms that live on each level.

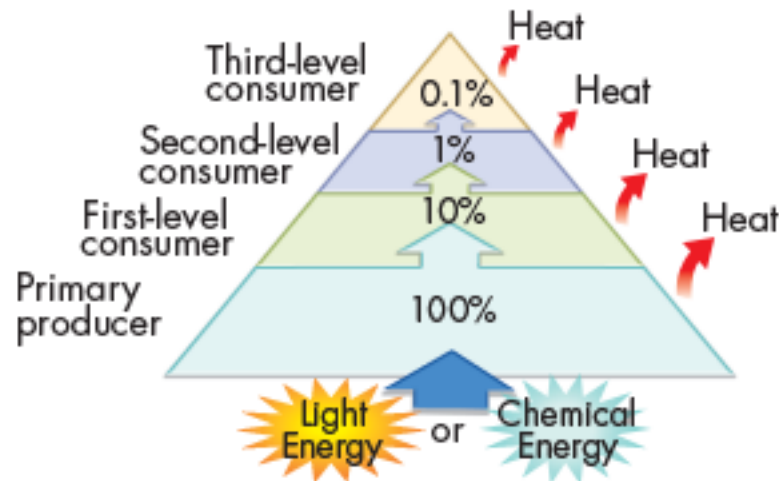
However, only a small portion of the energy that passes through any given trophic level is ultimately stored in the bodies of organisms at the next level.



Pyramids of Energy

Organisms expend much of the energy they acquire on life processes, such as respiration, movement, growth, and reproduction.

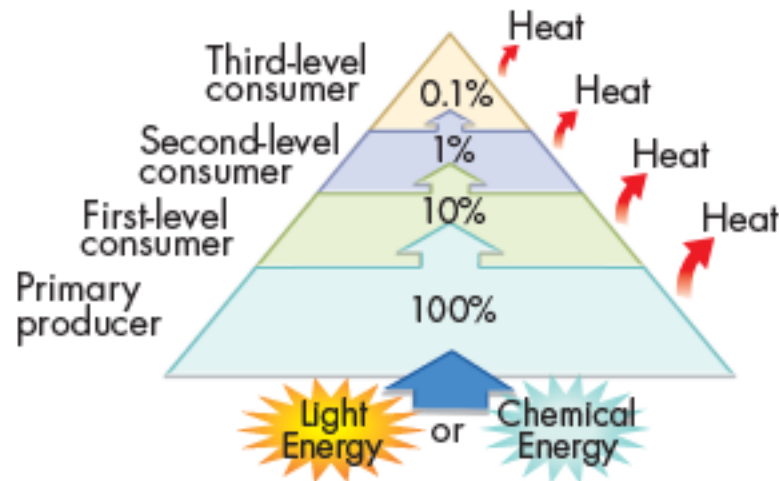
Most of the remaining energy is released into the environment as heat—a byproduct of these activities.



Pyramids of Energy

On average, about 10 percent of the energy available within one trophic level is transferred to the next trophic level.

The more levels that exist between a producer and a consumer, the smaller the percentage of the original energy from producers that is available to that consumer.



Pyramids of Biomass and Numbers

The total amount of living tissue within a given trophic level is called its **biomass**.

The amount of biomass a given trophic level can support is determined, in part, by the amount of energy available.



Pyramids of Biomass and Numbers

A pyramid of biomass illustrates the relative amount of living organic matter at each trophic level.

Typically, the greatest biomass is at the base of the pyramid, as is seen in the field ecosystem modeled here.



Pyramids of Biomass and Numbers

A pyramid of numbers shows the relative number of individual organisms at each trophic level in an ecosystem.



Pyramids of Biomass and Numbers

In most ecosystems, the shape of the pyramid of numbers is similar to the shape of the pyramid of biomass for the same ecosystem, with the numbers of individuals on each level decreasing from the level below it.



Pyramids of Biomass and Numbers

In some cases, however, consumers are much smaller than organisms they feed upon.

Thousands of insects may graze on a single tree, for example. The tree has a lot of biomass, but represents only one organism.

In such cases, the pyramid of numbers may be turned upside down, but the pyramid of biomass usually still has the normal orientation.