**Community ecology:**

First, let's define a community:

Groups of organisms living close enough together for interactions to occur.

First we probably want to describe the community a bit, so we look at:

*Biodiversity* - the variety of organisms that make up a community. This is composed of:

1) *Species richness* - how many different species are there?

2) *Relative abundance* – how many individuals of of each species are there?

Measures of diversity usually include both features (there are many different ways to measure diversity). **[Fig., similar to 37.10 A & B, p. 748]**.

For example:

| | # of individuals of each species | | | | |
|---|---|---|---|---|---|
| | species A | species B | species C | species D | species E |
| community 1: | 25 | 25 | 25 | 25 | 0 |
| community 2: | 97 | 1 | 1 | 1 | 0 |
| community 3: | 20 | 20 | 20 | 20 | 20 |

Community 1 is obviously more diverse than community 2 (1 and 2 are right out of the text), but community 3 is (also) obviously more diverse than community 1.

What kinds of interactions take place in a community?

1) *Competition*

Organisms will compete for the same resources.

For example, there is only so much water to go around, so organisms compete to see who gets the water.

There are two types of competition:

*Interspecific* (between different species)

Let's use an example form the text **[Fig., no longer in book (in older editions, e.g., the 5th , see the figure on or near p. 717)]:**

There are two species of barnacle.

Both live in intertidal areas, but one is found further up on rocks than the other (it can survive drying out at low tide better than the other).

If the species that lives lower down in the water is removed, the upper species moves down and takes over - it CAN live lower down if the other one isn't there.

If the species from lower down is allowed back in, it quickly eliminates the invader from the upper area

It *outcompetes* the species form the upper area lower down.

Incidentally, the opposite is also true – if the species from further up is removed, the species lower down invades, and so on.

Observations of interspecific competition like this gave rise to the *Competitive exclusion principle*:

***Two species in the same place cannot coexist if they are competing for the same resources.***

One will do better than the other!

*Intraspecific* (within the same species)

An example: plants all need water & nutrients from the soil. If there are too many individuals in the area (say, corn planted to densely), the plants will be stunted and not grow well.

This is very important in agriculture.

Competition has given rise to the concept of *niche*.

An organisms niche is all the biotic and nonbiotic factors that an organisms needs to survive.

*Biotic* - biological factors such as food availability.

*Abiotic* - non biological factors such as temperature or rainfall.

2) *Predation*

Predation can actually increase diversity:

Example **[Fig., again, removed from the text, but in earlier editions (see, for example, p. 720 in the 5th ed.)]**:

Kelp forests of the West Coast:

Kelp forests support a huge diverse community of other organisms.

They're almost like an underwater forest (giant kelp are huge!).

Sea otters feed on sea urchins.

Sea urchins feed on kelp.

When sea otters were seriously endangered, sea urchins at most of the kelp, and the kelp forests disappeared in many areas.

As sea otter populations recovered (they had been decimated by the fur trade), kelp forest started coming back.

Unfortunately, in some areas, killer whales are now eating sea otters, and kelp forests are again disappearing in those areas.

(Killer whales are probalby eating more otters because seals and sea lion populations have declined.)

Predation also often leads to the evolution of characteristics that help animals catch prey, or help animals avoid becoming prey.  For example:

Camouflage (blending into the surroundings)

Mimicry (looking like something deadly so you don't get bothered)

(Incidentally, competition can also cause evolution of characteristics, but in this case they often help minimize competition).

3) Other relationships:

(We won't spend quite so much time on these).

**[Fig., similar to p. 742 (some examples in the table are a bit silly)]**:

*Parasitism* - one species is hurt, one comes out ahead.

Things like tape worms, ticks, round worms, pinworm, etc.

Parasites often don't kill their host (or they're dead, too!).

*Commensalism* - one species gets a benefit, the other is unhurt (rare)

Very few re real examples, but one possibility might be cattle egrets.

These birds follow large ungulates (like cows), and eat the insects that are scared up by the cows as they move around.

The cows aren't affected, and the egrets get to eat insects.

(Egrets don't warn cows (or other ungulates) of predators, unlike some other birds).

*Mutualism* - both species come out ahead

Many, many examples, but just two here:

Sea anemone & clown fish:

Sea anemone gets food from the fish, fish gets protection (sea anemones have nasty stingers).

Acacias & ants:

Ants get shelter and food from the acacia, and the ants in turn fiercely protect the tree from predators (and competitors).

If ants are removed, the tree often dies,  The ants aren't found without the tree.).

Other factors affecting communities:

*Disturbance*:

Things like fire, hurricanes, overgrazing, human activities, etc., can all disrupt a community **[Fig., not in book]**

Not all disturbances are bad.

Some communities rely on these to perpetuate themselves.

For example, some pine trees (e.g., the Monterey pine) will only release their seeds after fire has caused their cones to open.

After a disturbance, a community goes through what is called *succession*.

Succession - starting with an essentially life-less area, and "succeeding" through various stages until we get back to the original community **[Fig., 37.12, p. 750]**.

In our area, for example, we go through the following stages of succession:

Grasses → shrubs → pine trees → deciduous trees.

(One can also distinguish between primary and secondary succession, but we won't bother (see your text if interested).)

*Trophic levels*:

A trophic level describes the energy that is available to organisms.

For example, this can explain why there are more herbivores than carnivores.

There is more overall energy available to herbivores.

Each time one moves up the food chain, energy is lost.

Essentially, all life is supported by autotrophs (= producers).  These are mostly plants and algae.

They provide energy for other organisms (obviously, this is usually not voluntary).

Herbivores eat producers, carnivores eat herbivores, other carnivores eat the first carnivores, and so on **[Fig. 37.8, p. 746]**.

Animals are classified as *primary consumers* (herbivores), *secondary consumers* (carnivores that eat herbivores), *tertiary consumers* (they eat the secondary consumers), and so on.

There are also *detritivores*, which eat dead stuff (vultures, many fungi, dung beetles, etc.), and are kind of hard to classify on a food chain.

Usually, though, animals don't eat at just one level, so we don't get food chains, we get food webs **[Fig., not in book and 37.9, p. 747]**.

But, this can't go on forever. Energy is limited.

As mentioned, only about 10% (on average) of the energy at one level (say, producers, makes it to the next level (say, to primary consumers).

**[OVERHEAD, fig. 37.16, p. 753]**

Incidentally, notice that only about 1% of sunlight is captured by photosynthesis

This makes it difficult to support too many trophic levels (e.g., you won't find too many quaternary consumers).

This also explains why meat (incl. fish) is not the most efficient way to feed humans **[Fig. 37.17, p. 754]**:

Cows only provide 10% of the energy to humans that plants can.

Finally, just a quick word on *chemical cycles*.

For example, the water, carbon, nitrogen or phosphorus cycles.

In any of these cycles, the elements (or compounds) are recycled through the ecosystem.

There are actually many, many types of chemical cycles, but we don't have the time to look at these

Just be aware they exist, and see your text if you're really interested.