Introduced species.

One estimate is that 40% of extinctions have been caused by introduced species. We'll look at some specific examples, followed by a summary of the problems that introduced species cause. See also your textbook starting on page 248.

Some specific examples (other than the case studies; several examples of introduced species (cats, rats, pigs) causing extinctions or near extinctions are illustrated in the case studies):

Brown tree snake. This was introduced to several pacific islands, presumably by hitching a ride with produce, in ship holds, or even in airplanes (a dead brown tree snake was found in the wheel well of a plane in Hawaii).

- Birds in Guam and elsewhere are not used to the this type of predator, and many species soon became extinct. According to a plaque at the National Zoo, 18 species of bird have become extinct. In Guam 10 species are near extinction.

- Snakes have been known to bite people (fortunately they aren't very venomous), and short out the electrical distribution network.

- There is a bounty on snakes, but it doesn't seem to be helping much.

- Most control efforts have not had great results. Trapping does catch snakes, but it isn't intensive enough.

Zebra mussels. Arrived in the Great Lakes in 1988, presumably in the ballast of a European freighter (details below).

- Within two years had reached densities of up to 700,000 individuals/m^2 in some parts of the great lakes.

- Native mussels are dropping in number.

- One estimate indicates that just cleaning water intakes will cost 3.1 billion over the next 10 years.

- It is spreading south across the Mississippi river basin.

A North American Comb Jelly (phylum Ctenophora). This was introduced into the Black Sea from our coastal waters. Once again, it presumably was discharged with ballast.

- in the black sea there are no competitors or predators.

- likes to eat fish larvae, and zooplankton (food for fish larvae).

- within 7 years (1989), this species constituted 95% of the biomass in the Black Sea and essentially caused the Black Sea fisheries industry to collapse.

Numerous other examples:

Earthworms - are native to Europe and are outcompeting our own endemic species. In some parts of the country (Wisconsin) they have led to a decline in forests due to soil modifications.

Gray squirrel - introduced into Great Britain, and has driven the Red Squirrel to the brink of extinction (also introduced to South Africa and the Pacific Northwest where it's also doing well).

Prickly Pear Cactus - now grows over large parts of the Mediterranean.

Gypsy moth - brought in to a lab to investigate the possibility of using this species to grow silk. Escaped.

"Killer bees" - brought into South America to study it's ability to pollinate/make honey. Escaped.

Kudzu - brought into the country to help control erosion. Went nuts.

Nile Perch - introduced into Lake Victoria in the 1980's. Wiped out about 200 species of native cichlid.

Carnivorous snail - Introduced to many islands in an effort to control the African giant snail (which was introduced to serve as food - some folks like to eat snails - and turned into a pest). Wound up exterminating numerous native snails instead and completely ignored the African giant snail (see p. 252).

Fire Ants / Honeysuckle / Honeybees / Mongooses (e.g. Hawaii) / Rabbits / Cats / Dogs / Livestock / crops / antelope (from Africa into Texas) / monkeys / rats / mice / numerous other examples.

Reasons for introductions:

Stowaways - hitching a ride (unintentional), thus being spread to "new" parts of the world:

Probably the most notorious examples here are the Norway rat, House mouse, and Black/Brown/Roof rat. They were (are?) common aboard ships, and used to stow away in the lower parts of the ship eating refuse and other leftovers. Upon arrival elsewhere, they simply left the ships and made a new home for themselves. Rat guards are reasonably effective in preventing the movement of rats.

- Cause billions of dollars of damage every year.

- Are important disease vectors.

- Have decimated and exterminated many species around the world.

Ship ballast. Many ships take on enormous amounts of water to act as ballast when they are empty or near empty. This gives the ship much better stability and handling. Unfortunately, when they get to another part of the world, all this water is emptied, and this may include numerous stowaways (example above include the zebra mussel and the comb jelly).

Seeds stowing away in dirt - dandelions, plantains, thistles, many others may have been brought in as seeds buried in dirt (dirt being transported with other plants such as fruit trees).

Disease organisms - hitched rides with humans or other animals (rabies virus, smallpox, plague, etc.). The main cause of death for Native Americans wasn't hostilities with Europeans, but diseases to which they had no resistance.

This is obviously difficult to control, even today. But there has been increased vigilance, particularly for agricultural pests (coming back from overseas you have to be careful what kinds of food/drinks, etc. you bring back).

Subsistence & commerce - species that are introduced for food and/or to raise money.

Pigs/cattle/dogs/chickens etc.

Traffic is in all directions. Tomatoes, potatoes, corn, turkeys, etc. went to the old world.

Usually the consequences aren't too bad unless these animals escape (pigs and goats are very bad this way). Seriously - who would worry about corn "escaping"?

But sometimes this can lead to disasters - Nutria escaped from fur farms in the southeast and are now found all up and down the East Coast. There not so bad here, but in England (where they also escaped), they're destroying centuries old water ways with their burrows.

Recreation - Some animals or plants are introduced to help in recreation.

Fish are often introduced to lakes and streams where they are not native because local fishermen want to catch them.

Game birds - in Hawaii, 75 species of bird have been introduced for hunters.

Antelope in Texas - also introduced for hunters.

Idiocy - One text calls this "whimsey or aesthetics", but idiocy is more appropriate:

In 1890, a resident of New York was both bird lover and lover of Shakespeare. To quote:

> I'll find him where he lies asleep
> And in his ear I'll holler "Mortimer."
> Nay I'll have a starling shall
> Be taught to speak nothing but "Mortimer."
>
> - King Henry IV, Part I

He decided (you guessed it) to import all birds mentioned by Shakespeare into the U.S. Most attempts were unsuccessful, but after trying a few times with starlings...

Acclimation societies - groups that tried to make foreign lands more "home-like" by introducing European species. In New Zealand there are more foreign songbirds than native ones. (the Auckland Acclimation Society still exists, though it changed it's name to "Auckland Fish and Game Council).

Numerous ornamental plants also fall into this category.

Science - Studying species that then escape.

From above, the gypsy moth and killer bee are probably two of the most notorious examples.

Genetically modified plants are a current subject of controversy.

Biological Control - Basically, introducing a species to help control another. Sometimes this works quite well, sometimes it backfires.

Early attempts at controlling rabbits and rats (particularly on islands) included introducing stoats, weasels or mongooses. In general, these predators ignored the rabbits and rats and ate the local birds.

Foxes were introduced for the same reason into Australia. Again, they ignored rabbits and went for local marsupials (we discussed the numbat earlier).

Sometimes it works - myxomatosis was finally used in Australia to control rabbits. It has decimated the rabbit population, though because of evolving resistance a new strain of myxomatosis must be introduced every once in a while.

This is effective often enough that it is considered many times when a problem due to an exotic species arises. Predators of zebra mussels, kudzu, and hydrilla are all being studied.

The trick is to know the biology of the organisms (and ecosystems!) quite well, and even then it's not always guaranteed to work.

Habitat changes - Human activities have disrupted the habitat so that it no longer is a barrier and species can move across it.

Finishing the St. Lawrence Sea Way all the way from the Great Lakes to the Atlantic allowed lampreys to invade the Great lakes. They then started to impact fish in the great lakes.

The Suez Canal has allowed species from the Mediterranean and Red Sea to mingle.

In the U.S. the coyote, mallard, cowbird, and numerous others have extended their range due to habitat changes (the coyote can be found in Virginia!).

Consequences of exotic species:

Some of this is (again) obvious, but let's enumerate these.

Predators & Grazers: killing and/or eating is an obvious effect. Numerous examples above are in this category (brown tree snake, Nile perch, mongooses,

etc.). This also includes crop pests (Mediterranean Fruit fly, etc.).

Parasites & Pathogens: we already mentioned some of these (smallpox) above. Many of these arrive as stowaways in exotic species that are moved around. Sometimes these are introduced deliberately (over 100 parasites, pathogens and predators have been introduced to try to control the gypsy moth).

Competition: Due to lack of predation (or more effective competition), many species simply outcompete native ones. Kudzu, zebra mussels, gray squirrels all fall into this category. So do starlings - eastern blue birds were in trouble until folks designed starling resistant nesting boxes.

Hybridization: Some foreign species are able to mate with native ones. If they are more successful overall, the native species' genes are simply "swamped out". Some species or subspecies of duck are declining due to the mallard (another introduction!).

Ecosystem effects: By removing or outcompeting native species, introduced species can alter the ecyosystem. Some obvious examples are overgrazing by goats. Less obvious is streams which due to the introduction of fish no longer support the same diversity of aquatic insects. Whole areas of the wester U.S. are home to Cheat grass. This was introduced for livestock to graze. But because of the dryness out west, it quickly becomes inedible, and now is a fire hazard in many areas. It's also a pain to walk through (literally!).

Controlling exotics:

Your text makes the very good point that before controlling (or trying to control - nothing's really worked on the gypsy moth) one should understand the biology of the organisms involved:

> Dassen Island off of South Africa - cats were found to have equal remains of sea birds and rabbits (which were introduced) in their feces. This might argue for controlling cats.
>
> > Closer examination showed the cats were largely scavenging dead sea birds and killing rabbits. In other words, they might even be beneficial to sea birds!
>
> We already discussed the woodhen, where rats were thought to be the culprits until a closer examination showed it was pigs.
>
> There are several more examples in your text. Some of these provide a little more detail then the descriptive comments above. Two examples:

A need for vigilance is stresses. Cats and red-fronted parakeets (ground nesters) co-existed for 80 years on Macquarie Island. Rabbits were introduced. They didn't have a direct impact on the parakeets. But, now the cat population increased. In turn, this caused the disappearance of the red fronted parakeet.

We already discussed the brown tree snake. In a study, rats raided 88% of quail nests in Guam. 28 months after the introduction of the brown tree snake, this increased to 100%.

These two examples show that sometimes the interaction that develops is not clear. Control in this case could be haphazard.

The most important point the text makes (many, many, many times) is that one needs a thorough knowledge of the biology of the organisms one is trying to control/help.

Some concluding remarks:

- Are all exotics "bad"? Of course not. Our agriculture is dependent on exotics. We have pets, trees, etc. that are all exotics.

- To what extent should we try to preserve a unique "native" environment? Is it even possible anymore?

- Don't become too hypocritical. It's easy to criticize the starling and then turn around and plant apple trees in your yard.

- Nevertheless, exotic species have had a huge negative impact on local species (humans are "exotic" in many places!).