

## CHAPTER 13 ENVIRONMENTAL ISSUES AND CONCERNS

### *Objectives*

1. To convince you, that in man's short span as a mover and shaker on this planet, potentially irreversible changes have occurred to the nature and quality of the marine environment and its inhabitants. No species that has ever walked, crawled, or swam in its seas has had the capacity to forever alter the face of our planet, or change the direction of evolutionary processes.
2. To show you that modification of natural processes without full understanding of the short- and long-term implications is perhaps a dangerous thing.
3. To increase your awareness of how human habitation, recreation, industrial development, and demands for major food resources continue to put ever-increasing pressure on coastal, littoral and oceanic environments. Inevitably, these separate worlds collide in conflicting uses and perceptions of value and economics versus long-term survival of species and our own kind.
4. Judicious use of science through educated policy may be the best chance for improving our use of the environment.

### *Key Concepts*

**Major Concept (I)**      *Dumping of solid waste, sewage, and toxicants into lakes and rivers as well as the sea is a common occurrence and has been going on for many years.*

Related or supporting concepts:

- More than 25% of the solid waste dumped at sea has been dredged from ports and waterways.
- One of the major ways of disposing of industrial waste is dumping at sea.
- Obsolete military hardware and munitions have been dumped at sea following each modern war.
- One of the largest disposal sites in the United States is the New York Bight. Dumping in this area began in 1890.
- In 1934, laws were passed to prohibit the dumping of "floatables" in response to the increasing amount of material that was washing up on the beaches of Manhattan.
- In 1972, the United States passed the Marine Protection, Research, and Sanctuaries Act (MPRSA), also known as the Marine Dumping Act.
- The MPRSA prohibits all ocean dumping, except as allowed by permits awarded by the Environmental Protection Agency (EPA) in any ocean waters under United States jurisdiction, by any U.S. vessel, or by any vessel sailing from a U.S. port.
- The MPRSA also authorized the establishment of marine sanctuaries.
- In 1986, amendments to the MPRSA banned all dumping at the New York Bight and ordered that further dumping be moved to a new site at the edge of the continental shelf 171 km (106 mi) from shore in water about 2500 m (8200 ft) deep.
- 42 million tons of sewage sludge were dumped at the 106-mile Dumpsite between 1986 and 1992.
- Biological surveys at the site have revealed an incredible diversity of organisms. The sludge appears to have a significant effect on the metabolism, diet, and variety of organisms living at the site.
- It appears that the long-term disposal of sludge into the food web at a particular site can change the diversity of species at the site to favor those organisms that can use the sludge as a food source.
- Most city sewer systems in the United States were built in the late 1800s and early 1900s. It was standard for these systems to discharge raw sewage directly into the nearest body of water.
- Until 1972 it was legal to discharge anything into a body of water until the water was declared polluted.
- In 1972, the Federal Clean Water Act mandated the upgrade of sewage treatment facilities to secondary treatment levels by 1977.
- Indiscriminate dumping of both liquid and solid wastes have been substantially reduced; however, many toxic compounds and nutrients still find their way to the oceans by agricultural runoff, also

- known as non-point sources.
- Excess nutrients can harm the environment because they promote rapid plant growth in the water that eventually dies and decays. Decomposition of this large mass of organic material can consume large quantities of oxygen in the water, killing other organisms.
- As water quality improves in some bays and estuaries, we are finding that the contaminants still remain trapped (a legacy) in the bottom sediments (fig. 13.3).
- Toxicants can be attracted to small suspended particles in the water that sink and contribute to the bottom sediment.
- Some of the particles these toxicants are attracted to are organic and provide a food source for marine animals. The toxicants can accumulate in the tissues of these organisms and may be concentrated up the food chain.
- Shellfish can concentrate heavy metals thousands of times higher than levels found in the water.
- Scallops have been found to have levels of cadmium 2 million times higher than the water and oysters can have DDT levels 90,000 times higher than the water.
- One of the most tragic examples of this concentration was the concentration of mercury in shellfish in the coastal bay from which the people of Minamata Japan harvested shellfish for food. This resulted in severe mercury poisoning and death among the people of Minamata as well as birth defects in children.
- Since 1986 the NOAA Mussel Watch Project has collected samples of shellfish to monitor the concentration of some chemical contaminants in United States' estuaries and coastal waters. More than 200 sites are sampled annually.
- Sampling has documented decreasing levels of contaminants such as DDT, PCB, tin, and cadmium.

**Major Concept (II)**      *A large low-oxygen area is found annually in the Gulf of Mexico near the mouth of the Mississippi River (fig. 13.4).*

Related or supporting concepts:

- This low-oxygen region begins to form in February, peaks in the summer, and then dissipates in the fall.
- It is called the "dead zone" because oxygen levels are too low to support most marine organisms.
- The low-oxygen levels can affect 80% of the water column in shallow regions and may extend upward to within a few meters of the surface.
- The dead zone occupies different areas in the northern gulf from year to year making it difficult to predict where it will next appear.
- The dead zone covered nearly 20,000 km<sup>2</sup> (7700 mi<sup>2</sup>) in 1999. The next year was quite dry and the zone shrank to its smallest recorded size. It rebounded in 2001 and in 2002 when it covered 22,000 km<sup>2</sup> (8484 mi<sup>2</sup>).
- The Mississippi discharges an average of 580 km<sup>3</sup> (140 mi<sup>3</sup>) of fresh water to the Gulf of Mexico annually.
- Thirty-one states, covering 41% of the area of the 48 contiguous states and half of the country's farmlands, have rivers that drain into the Mississippi.
- Fresh water runoff from the Mississippi carries high concentrations of nitrogen as nitrate from agricultural fertilizers.
- Between 1960 and the late 1900s the amount of nitrate introduced to the Gulf of Mexico tripled while the amount of phosphate (another fertilizer) doubled.
- The leading source of nitrogen seems to be croplands but it is also supplied by livestock manure, treated sewage effluent, nitrogen-rich soil in drained wetlands, and airborne nitrogen oxide produced by the burning of fossil fuels.
- The nitrates and phosphates stimulate the growth of small plant-like organisms in the water creating explosive growth in their population known as a bloom.
- The death and decay of these organisms consumes oxygen in the water, creating the dead zone.
- Similar problems occur elsewhere.
- The dead zone in the Gulf of Mexico is not a unique phenomenon. Similar dead zones, although smaller in size, occur in Chesapeake Bay, Japan, Australia, New Zealand, and the Kattegat strait between Denmark and Sweden, and the Black Sea.

**Major Concept (III)**     *Plastics compounds are not only “trash” but also continue to degrade habitat and endanger organisms for decades to hundreds of years!*

Related or supporting concepts:

- Plastic trash: Every year over 135,000 tons of plastic trash is dumped by naval, merchant, and fishing vessels.
- It is estimated that an additional 149,000 tons of fishing gear (nets, ropes, traps, and buoys) made mostly of plastic is lost or discarded by the fishing industry annually. In addition, the fishing industry dumps another 26,000 tons of plastic packaging material.
- Currents all over the world can distribute plastics that are dumped in the ocean.
- Plastic is strong, durable, and inexpensive and may remain stable for hundreds of years in the oceans. It is estimated that an ordinary plastic six-pack ring could last 450 years.
- Plastic trash is responsible for crippling and killing tens of thousands of marine animals yearly.
- In 1960 the U.S. production of plastics was 3 million tons, yet forty years later in 2000 it had risen to more than 50 million tons.
- As many as 30,000 fur seals year are estimated to become entangled or trapped in lost fishing nets alone.
- Lost lobster and crab traps, made partially or entirely of plastic, continue to trap animals. One year 25% of the 96,000 traps set off Florida’s western coast were lost.
- Plastics are responsible for as many deaths of marine organisms as oil spills, toxic wastes, and heavy metals (see fig. 13.6).
- The Marine Plastic Control and Pollution Act of 1987 is the U.S. law that attempts to implement an international convention for prevention of pollution from ships, however, there is no international enforcement.
- Biodegradable plastics have been manufactured with the addition of light-absorbing molecules that break down the plastic after a few months of exposure to sunlight. It is not known how long these plastics would survive in the oceans however because immersion in the water would keep the plastic cool and slow the process of degradation. In addition, the plastic would be covered very quickly with a thin coat of organisms that would partially shield it from the light.

**Major Concept (IV)**     *In recent years there have been a variety of proposals to use the deep-ocean floor for waste management in order to reduce the amount of waste stored in landfills or incinerated.*

Related or supporting concepts:

- Increased population, industrialization, and economic growth have caused a rapid increase in the production of waste material.
- We are running out of room on land for storing waste material and landfills are susceptible to leakage and can pollute groundwater and soil.
- In 1991 a group of scientists held a workshop at the Woods Hole Oceanographic Institution to assess the feasibility of dumping waste materials on the deep sea floor of the Atlantic Ocean. They argued that this proposal would pose less risk to life than land disposal because:
  - a. landfills can create groundwater and soil pollution,
  - b. incineration of waste can pollute the atmosphere,
  - c. relatively few animals live on the deep abyssal plains of the oceans, and
  - d. deep currents move slowly and the water just above the floor of the abyssal plain wouldn’t return to the surface for thousands of years.
- The workshop participants recommended conducting an experiment in ocean waste management by dumping one million tons of sewage sludge annually for ten years on the floor of the Hatteras Abyssal Plain in the Atlantic Ocean. The plan has not been implemented however because it would require changing the Ocean Dumping Act.
- Other people have suggested disposing of highly radioactive and long-lived nuclear waste on the deep

- sea floor or in subduction zones but no experiments have been planned at this time.
- Some people believe that experiments with ocean waste disposal should only be carried out with other countries and the cooperation of the United Nations.

**Major Concept (V)**      *Our global quest for energy has put our coasts in peril from oil related activities-- from exploration, production, transport, and off-loading.*

Related or supporting concepts:

- The number of annual oil spills over 700 metric tons during the past thirty years is graphed in figure 13.7a. The average number of spills per decade has declined over these years.
- The volume of oil spilled annually is shown in fig. 13.7b. The volume of oil spilt in any given year is strongly influenced by single large spills.
- One of the largest recorded spills was from the *Amoco Cadiz* which ran aground on the Brittany coast of France in March 1978 releasing 210,000 metric tons ( $66.4 \times 10^6$  gallons), of oil (see fig. 13.8).
- Roughly 30% of the *Amoco Cadiz* spill evaporated, 20% was cleaned up, 20% penetrated into the beach sands where it stayed until winter storms washed it away, 10% dissolved in the water, and the remaining 20% sank to the sea floor in deeper water where it remained for an unknown period of time.
- One of the most highly controversial recent oil spills occurred in March of 1989, when the *Exxon Valdez* ran into a reef and released approximately 34,000 metric tons (almost  $10.8 \times 10^6$  gallons), of oil she was carrying into Alaska's Prince William Sound. Many complicating factors, combined with inadequate contingency plans, allowed the oil to quickly spread over 2300 km<sup>2</sup> (900 mi<sup>2</sup>) of the sound, impacting a very rich and diverse marine habitat.
- In the cold environment of Prince William Sound the photochemical and microbial degradation of the oil proceeded slower than expected.
- An inspection of the area three years later found that the area was recovering and repopulating. Interestingly, it was discovered that the areas that were most aggressively cleaned following the spill were recovering the slowest and had less well-balanced populations.
- Not all spills are associated with tankers. One of the world's largest and longest-lasting oil spills lasted from June, 1979 until March, 1980 when an offshore oil well in the Gulf of Mexico blew out and caught fire. Similar accidents have occurred in the North Sea, the Persian Gulf, and off the United States coast.
- During the eight-year Iran-Iraq war the bombing of oil facilities in the Persian Gulf resulted in a number of major oil spills. One oil rig poured 172 metric tons (54,350 gallons) of oil per day into the sea for a period of three months, resulting in widespread devastation of reef and beach environments. At one time this spill covered an area of the gulf larger than Belgium.
- Sadly enough, this spill was dwarfed by the spills from the U.S./UN Iraq conflict, where many Kuwaiti wells leaked into the sea. In the 1991 Gulf War, mankind created the worst oil spill yet, approximately 800,000 metric tons ( $240 \times 10^6$  gallons) of crude oil.
- This spill polluted some 570 km (350 mi) of Saudi Arabia's shoreline.
- Once released into the water, oil may evaporate, disperse, coat the coastline or organisms, penetrate into beaches, dissolve (this is the more toxic fraction), or it may sink to the sea floor in deep water. Just because you can no longer see the oil does not mean that it is no longer adversely affecting the environment. Today's technologies cannot cope with massive spills in remote or harsh environments and most of the oil is not recovered.
- There is still no adequate technology available to handle large oil spills. It is estimated that on average only 8–15% of oil spilled is recovered.
- Equipment used to handle oil spills includes oil booms and oil skimmers (see fig. 13.9). These are relatively effective in handling smaller spills in protected waters but are not very effective on large spills or in open and exposed areas or in rough seas.
- The onshore cleanup of oil spills can be as damaging to the environment as the spills themselves.
- Beaches treated with high-pressure, hot water washing take longer to recover than areas where the oil is left to degrade naturally.
- Large volumes of crude oil also enter the marine environment from natural seeps. These are believed to be the single greatest source of oil in the marine environment.

**Major Concept (VI)** *Bordering estuaries are wetlands, particularly freshwater and saltwater marshes and swamps that are critical to large numbers of marine species that depend on them for nutrients, food, shelter, and spawning grounds.*

Related or supporting concepts:

- Wetlands have traditionally been sacrificed for a variety of uses, including industry and port facilities.
- Mangrove swamps are being rapidly destroyed in many areas. Mangroves have been logged for timber, wood chips, and fuel.
- Mangrove swamps have also been cleared and filled to create fields for crops, shrimp ponds, and resorts.
- Over 50% of the world's mangroves are gone. Destruction has been particularly severe in the Philippines (80% gone), Bangladesh (73% gone), and Africa (over 50% gone).
- More than 53% of the population of the United States lives along the coast. The number of people living in the U.S. coastal environment is expected to continue to grow more rapidly than the nation's population growth rate in the future.
- From the mid-1950s to the mid-1980s the average rate of loss of estuarine wetlands was 20,000 acres per year in the contiguous United States.
- Wetland losses have been greatest in six states: California, Florida, Louisiana, New York, New Jersey, and Texas.
- Public concern has led to the passage of wetland protection laws in many coastal states, but usage and development pressures often pit government agencies and regulators against each other.
- Estuaries continue to face increasing pressure with the expanding population.

**Major Concept (VII)** *Animals have been exquisitely adapted over millions if not billions of years to live in habitats and intricate ecosystems—now human activities have bridged natural barriers to create situations where introduced species have no natural controls, predators or checks on their behavior.*

Related or supporting concepts:

- As people travel the globe, they carry plants and animals with them (on purpose or totally accidentally) that are introduced to other habitats and ecosystems with no natural barriers to their activities or population growth.
- Organisms find it hard to attach themselves to modern steel-hulled boats because they are protected by anti-fouling paint. Those organisms that are able to attach themselves to modern boats are often removed by friction with the water as the boats move at high speed.
- Ballast water in modern ships does serve as a home for many marine organisms.
- It is estimated that at any one time there are over 3000 species of marine organisms moving around the oceans in the ballast water of ships.
- Some invaders are not noticed for years or perhaps decades in the new environment, whereas others can affect new areas immediately.
- Biological oceanographers and marine biologists now fear that an ecological revolution is occurring in estuaries, bays, and along the rocky shores of the world's lakes and oceans.
- We must realize that scientists are split on the severity of these issues, however, as James Carlton states "No introduced marine organism, once established, has ever been successfully removed or contained, or the spread successfully slowed."

**Major Concept (VIII)** *Management theories have purported as dogma for many years that regulated catch limits would allow for a long-term sustainable catch for not only the United States, but for world fisheries. However, a lack of basic understanding of the complex physical and biological systems controlling populations or real controls on the*

*world's actual catch have allowed the virtual collapse of many of the world's major fisheries.*

Related or supporting concepts:

- A 1995 report from the U.N. Food and Agricultural Organization estimates that 70% of fish stocks worldwide are now overfished, depleted or recovering after previous overfishing.
- The U.S. Office of Fisheries Conservation and Management estimates that 41% of the species in U.S. waters are overfished.
- The 200 year-old Newfoundland cod fishery was closed by Canada in 1992. In 1993 the National Marine Fisheries Service closed large parts of the U.S. cod fishery.
- North Atlantic swordfish catch in the United States declined 70% from 1980 to 1990. The average weight of the swordfish dropped from 115 to 60 pounds.
- The bluefin tuna fisheries have also been devastated. The Atlantic population dropped 80% between 1970 and 1993. The Gulf of Mexico population has dropped by 90% since 1975 and the Mediterranean population has declined by 50%.
- Other marine animals and birds are also adversely affected as they compete for their share of the catch.
- 200 million people make their living by catching, processing, or selling fish. Millions more depend on fish as their source of protein.
- To increase our control over the coastal areas of the United States in 1977 we created a 200 mile exclusive Economic Zone (EEZ) where only U.S. boats can legally fish. To date, some 122 other nations have set up similar regions for their countries.
- The extension of the EEZ has resulted in an increase in the fishing capacity of many of the nations involved. The world's fishing industry today has about twice the capacity it needs to make its annual catch.
- The world's fishing fleet doubled between 1970 and 1999, from 585,000 to 1.2 million large boats.

### **Major Concept (IX)**

*Economic pressures for the most cost-efficient capture of marketable fish, has led to practices, which trap other species of fish and marine life, which are essentially discarded. These organisms are often dead or near death, or severely weakened. These species are now endangered because of their intimate association with either the market species or their habitat.*

Related or supporting concepts:

- Large numbers of marine animals are inadvertently killed each year during commercial fishing operations.
- These animals are called incidental catch, or by-catch, or sometimes "trash fish."
- The U.N. Food and Agricultural Organization estimates that each year 30 million tons of fish are caught as by-catch and discarded. This amounts to 25% of commercial marine landings.
- The world's shrimp fishery has an annual catch of about 1.8 million tons at the expense of 9.5 million tons of by-catch. This includes more than 45,000 sea turtles: more than 12,000 of which do not survive.
- 25 million tons of halibut (worth about \$30 million) are discarded by Alaskan pollock and cod fishermen because they are not allowed to keep or sell the halibut.

### *Matching Key Terms with Major Concepts*

At the end of the chapter in the textbook is a list of key terms. You should be able to match each of these with one of the previously listed major concepts. To test your ability, try to match the following key terms with the number (I-IX) of the appropriate major concept identified in this section:

breakwater  
land-use conflicts  
surface runoff

jetties  
Clean Water Act  
sludge

groins  
toxicants  
heavy metals

Minamata  
mangroves  
overfishing  
by-catch

*Exxon Valdez*  
ballast  
trash fish

wetlands  
biological pollution  
incidental catch

### *Test Your Recall*

#### **Answer the following questions to test your understanding**

##### FILL IN THE BLANK

1. “ \_\_\_\_\_ is the solution to pollution” is an old axiom responsible for much of our problems in estuarine contamination.
2. Marshes and swamps bordering estuaries are known as \_\_\_\_\_.
3. \_\_\_\_\_ and \_\_\_\_\_ are coastal engineering projects built to protect harbors and coastal areas from the force of the waves.
4. Most of the critical beach areas in the United States were on the \_\_\_\_\_ and \_\_\_\_\_ coasts, the majority include barrier islands.
5. In \_\_\_\_\_ sediment must be pumped south of the harbor continuously to prevent beach erosion.
6. At Ediz Hook, the annual maintenance costs compared to harbor revenue are approximately \_\_\_\_\_.
7. Each year 40 to 50 square miles of Louisiana's Mississippi River wetlands disappear into the \_\_\_\_\_.
8. Twelve thousand years ago, \_\_\_\_\_ shoreline extended 120 miles further into the Gulf.
9. \_\_\_\_\_ is a product of today's secondary sewage treatment plants.
10. In \_\_\_\_\_ the U.S. Marine Protection, Research, and Sanctuaries Act was enacted to prohibit ocean dumping of all types of materials in to the ocean.
11. Also in 1972, the Federal \_\_\_\_\_ was created in an effort to make waters of the United States safe for fishing and swimming.
12. In the NOAA Mussel Watch Program more than \_\_\_\_\_ coastal and estuarine sites are sampled each year.
13. It is estimated that over \_\_\_\_\_ tons of plastic trash have been routinely dumped by naval and merchant ships each year.
14. As many as 30 thousand \_\_\_\_\_ become entangled in lost or discarded fishing nets or cargo straps each year.
15. The average discharge of \_\_\_\_\_ into the oceans has been about 340 million gallons per year over the last ten years.
16. Much of the world's crude oil comes from the oil wells of the \_\_\_\_\_ Gulf.
17. The toxicity of weathered crude oil is \_\_\_\_\_.
18. Ship \_\_\_\_\_ contains members of all the major groups of planktonic marine organisms.
19. It has been calculated that at any one time, in excess of \_\_\_\_\_ species are in ocean-going ship's ballast.
20. \_\_\_\_\_ million people make their living in fishing related activities around the world.

TRUE - FALSE

1. Refined petroleum products such as gasoline and diesel fuel are less toxic to marine organisms than crude oil.
2. There is no technology today capable of coping with massive oil spills in bad sea conditions or remote locations.
3. According to the National Academy of Sciences, river runoff accounts for approximately as much oil pollution in the oceans as tankers.
4. Industry, agriculture, and transportation do not require constant supplies of petroleum or petroleum products.
5. More than 30,000 fur seals die each year from entanglement with, or choke to death on, plastic trash in the oceans.
6. Marine organisms can concentrate toxic heavy metal in their tissues.
7. The increase in the use of unleaded gasoline is directly related to a reduction in the amount of lead entering the marine environment.
8. Chemical spills on the Rhine River have improved local municipal water supplies.
9. PCB concentrations in water are typically much larger than those found in sediments.
10. Coastal municipalities plan to continue dumping sewage at sea into the 21<sup>st</sup> century.
11. A slowly flushing estuary is particularly susceptible to damage from pollutants.
12. According to a U.S. Army Corps of Engineers study, less than 40% of the U.S. continental shoreline loses more sediment than it receives.
13. Designing coastal structures that correct or solve one problem without creating more is primarily a science.
14. The Mississippi River is free to meander across its delta, cutting new channels at random.
15. Louisiana's delta region accumulates sediment slower than it is subsiding.
16. After each modern war countries have disposed of obsolete military hardware and munitions at sea.
17. The United States still continues to dump waste materials into the ocean.
18. The New York Bight dump site has been closed.
19. Most urban sewer systems in the U.S. were built in the late 1900s.
20. Excess nutrients in fresh or marine waters are not as destructive as pesticides or other toxic materials.
21. Sediment cores measured for contaminant levels have the highest levels of PCB's from the early 1960s.
22. Plastics are a minor source of mortality to marine organisms when compared to the effects of oil spills, toxic wastes, and heavy metals.
23. The deep-ocean floor is a safer place to dump our wastes than current landfills.
24. Very little oil is actually spilled into the Persian Gulf each year due to normal operations.
25. Cleanup activities after an oil spill are often more destructive than the effects of the spill itself would be without human interference.

MULTIPLE CHOICE

1. In the United States over \_\_\_\_\_ % of the population lives within 50 miles of the coastline (including the Great Lakes).
  - a. 10
  - b. 70
  - c. 50
  - d. 20
  - e. 30
2. Which of the following statements about the concentration of toxins in the marine environment is true?
  - a. they tend to concentrate in the water
  - b. they tend to concentrate in the sediment
  - c. they tend to concentrate in organisms
  - d. b and c above
  - e. all of the above
3. The increase in the use of unleaded gasoline is thought to be responsible for a \_\_\_\_\_ % decrease in the amount of lead in the Mississippi River in the last decade.
  - a. 10
  - b. 20
  - c. 30
  - d. 40
  - e. 50
4. \_\_\_\_\_ disease is named after the city in Japan where large numbers of people were poisoned

- by mercury.
- a. Minamata
  - b. Hiroshima
  - c. Tokyo
  - d. Hualien
  - e. Sarawak
5. Plastics are widely used in society because they are
- a. inexpensive.
  - b. durable.
  - c. strong.
  - d. all of the above.
  - e. none of the above.
6. "Biodegradable" plastics may not break down readily in the sea because
- a. submergence in the water will protect them from sunlight.
  - b. the water will keep the plastic cool.
  - c. micro-organisms will rapidly coat the plastic.
  - d. a and b above.
  - e. all of the above.
7. The wetlands of Louisiana provide habitat for
- a. fish
  - b. shellfish
  - c. birds
  - d. other animals
  - e. all of the above
8. When ordering dinner at a fine restaurant, an individual aware of biological concentration of toxic substances would be least likely to order
- a. cormorant.
  - b. pickerel.
  - c. plankton.
  - d. heron.
  - e. tern.
9. The world's largest oil spill was due to
- a. an oil tanker accident.
  - b. an industrial explosion.
  - c. an offshore well accident.
  - d. a massive oil seep from a spreading center.
  - e. none of the above.
10. It is estimated that industries and sewage treatment facilities discharge into the Chesapeake an amount of waste water equal to \_\_\_\_\_ % of the volume of the bay annually.
- a. 5
  - b. 10
  - c. 15
  - d. 20
  - e. 25
11. Wetlands bordering estuaries are important as
- a. sources of nutrients.
  - b. sources of food.
  - c. sources of shelter.
  - d. a and b above.
  - e. all of the above.
12. Today \_\_\_\_\_% of the materials dumped at sea are dredged sediments from ports and waterways.
- a. 5
  - b. 10
  - c. 15
  - d. 20

- e. 25
13. Southern California wastewater discharges have continued to increase in terms of the gallons of effluent released, however the amount of sewage components has been reduced because
- people are eating less greasy foods.
  - harmful materials are kept out of the system at their sources.
  - waste water treatment levels have increased.
  - less people live there now due to earthquakes.
  - b and c above.
14. The NOAA Mussel Watch checks for \_\_\_\_ metals in shellfish.
- 10
  - 5
  - no
  - 15
  - 25
15. The deep abyssal plain may be a good place for waste dumping because
- it is a stable marine environment.
  - currents are very slow.
  - overlying water masses stay at the bottom for thousands of years.
  - very few organisms live there.
  - all of the above.
16. The three oil spills/events in the last twenty-five years that have become ecological landmarks are
- Exxon Valdez, Burmah Agate, and the Persian Gulf War.
  - Exxon Valdez, Amoco Cadiz, and the Persian Gulf War.
  - Ixtoc, Castillo de Bellver, and the Aegean Captain.
  - all of the above.
  - none of the above.
17. Microbial and photodegradation of oil occurred more slowly in Alaskan waters because
- it is very cold.
  - organisms grow more slowly.
  - organisms take longer to reproduce.
  - a, b, and c.
  - none of the above.
18. Gasoline and diesel fuel are more toxic to marine life but they also
- disperse rapidly and evaporate quickly.
  - disperse slowly and don't evaporate.
  - marine animals are used to them by now.
  - don't settle down into the sediments.
  - a and d.
19. \_\_\_\_% of the world's coastal mangroves are gone.
- 25
  - 50
  - 75
  - 90
  - 100
20. The U.S. Marine Mammal Commission estimated that \_\_\_\_miles of lost gill nets are floating in the world's oceans.
- 250
  - 25
  - 2500
  - 25,000
  - 250,000

*Visual Aids: Test Your Understanding of the Figures*

1. Examine figure 13.1. How have the annual emissions of TSS, BOD, and oil and grease changed over time? Are the emission patterns similar? What can account for this?
2. Look at figure 13.5. What can you say about the variation in the size of the Gulf of Mexico dead zone as a function of climate conditions?

### *Study Problems*

1. Toxic chemicals are often concentrated at successively higher levels in the food chain. From table 13.2 in the text, calculate the concentration factor for DDT in cormorants with respect to seawater.
2. Why is science not the sole answer to environmental issues in the ocean and elsewhere on this planet?

### *Answer Key for Key Terms and Test Your Recall*

#### KEY TERMS

land-use conflicts (VI)  
 surface runoff (I)  
 Minamata (I)  
 mangroves (VI)  
 overfishing (VIII)  
 by-catch (IX)

Clean Water Act (I)  
 sludge (I)  
*Exxon Valdez* (V)  
 ballast (VII)  
 trash fish (VII)

toxicants (I)  
 heavy metals (I)  
 wetlands (VI)  
 biological pollution (VII)  
 incidental catch (IX)

#### FILL IN THE BLANK

1. pollution  
 4. Atlantic, Gulf  
 7. Gulf of Mexico  
 10. 1972  
 13. 135,000  
 16. Persian  
 19. 3000

2. wetlands  
 5. Santa Barbara  
 8. Louisiana's  
 11. Clean Water Act  
 14. fur seals  
 17. low  
 20. 200 million

3. breakwaters, jetties  
 6. 1:14  
 9. sludge  
 12. 200  
 15. oil  
 18. ballast water

#### TRUE - FALSE

1.F 2.T 3.T 4.F 5.T 6.T 7.T 8.F 9.F 10.F 11.T 12.F 13.F 14.F 15.T 16.T 17.F 18.T 19.F 20.F 21.T 22.F 23.F 24.F 25.T

#### MULTIPLE CHOICE

1.c 2.d 3.d 4.a 5.d 6.e 7.e 8.a 9.e 10.e 11.e 12.e 13.e 14.a 15.e 16.b 17.d 18.e 19.b 20.d

#### STUDY PROBLEMS

1. 528,000
2. Science and scientists can only provide guidance for policy, however, each one of us can become better educated about our environment and help legislators and policy makers make better and wiser choices.