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Chapters 5, 22, and 24

2

Key Concepts

- Human effects on biodiversity
- Importance of biodiversity
- How human activities affect wildlife
- Management of wildlife

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What factors contribute to speciation?

- Why would an organism be needed?
 - function
- What could lead to new niches?
 - Structure

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cyanobacters

- May use CO₂ from atmosphere or water
- Can convert EMS energy to chemical energy
- Created pollution crisis due to production of O₂
- Contributed to the rise of aerobic prokaryotes

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eukaryotes

- Fossil evidence 1.2 bya
- some O₂ in atmosphere was converted by solar energy to O₃ now protected from UV
- green plants near surface water
- 780 mya first plants fossil evidence on land

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Biologic Timeline

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Allopatric Speciation

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Sympatric Speciation

- A new species forms within the same spatial and temporal location as the original species;
- There is no geographic isolation or difference in diurnal or seasonal patterns
- Changes in niche availability can lead to sympatric speciation
- Co-evolution can lead to sympatric speciation
- Need for resource partitioning can lead to sympatric speciation

10

What is required to maintain a species?

- 11 **Maintaining reproductive isolation to remain a species**
- Prezygotic barriers: prevent zygote from forming
 - postzygotic barriers: prevent new species from occurring
- 12 **Prezygotic barriers**
- Habitat isolation: live in different habitats don't encounter others
 - Behavioral isolation: mating/courtship rituals, songs, other signals
 - Temporal isolation: different mating times diurnal, seasonal, or annual differences
 - Mechanical isolation: anatomically incompatible
 - Gametic isolation: gametes may not meet or cannot fuse
- 13 **Postzygotic Barriers**
- Reduced hybrid variability: genetic incompatibility may abort development of zygote
 - Reduced hybrid fertility: if hybrid offspring is vigorous, hybrid is sterile-meiosis can't produce gametes
 - Hybrid breakdown: 1st generation hybrid viable and fertile, 2nd generation feeble or sterile
- 14 **microevolution**
- dev of genetic variability in population
 - heritable traits; gene pool → alleles
 - 4-mutations: exposure of DNA to ext agents radioactivity, X rays, natural and hman made chem. Mutagens
 - random mistakes DNA copied or when reproduces
 - most mutations harmful few are beneficial
 - bene if: give offspring better chances for survival under existing env conditions and when conditions change
 - mutations random and unpredictable, source of totally new genetic raw material (alleles) and are rare events
- 15 **selection**
- artificial selection: we choose traits and we selectively breed (dog types)
 - natural selection some indiv of pop have genetically based traits that increase their chances of survival and their ability to produce offspring
 - must be natural variability in pop
 - trait must be heritable
 - trait must lead to differential reproduction (leave more offspring)
 - allele becomes more common in successive pop
 - called adaptation or adaptive trait
- 16 **When is selection likely to occur?**
- when change in env conditions occurs pop can adapt through nat select or migrate if poss to better conditions or become extinct
 - example: peppered moth in England soot on tree trunks birds eat if not blend in
- 17 **3 types of natural selection**
- directional natural selection
 - stabilizing natural selection
 - diversifying natural selection
- 18 **Directional selection**

- changing env conditions cause allele freq to shift so individual w traits at end of normal range become more common than midrange forms
- eg peppered moths, genetic resistance to pesticides or to antibiotics

19 Directional Natural Selection

20 stabilizing natural selection

- favor indivi in mid curve -average
- works best if env changes little and most member of pop are adapted to env

21 Stabilizing Natural Selection

22 diversifying natural selection

- occurs when env cond favor individuals at extremes of curve
- eliminate indeterminate traits
- pop may be split into two groups

23 Diversifying Natural Selection

24 Coevolution

- interactions between species results in micro evol of each of pop

25 ecological niche: function

- include range of tolerance for physical and chemical factors
- types and amts of resources it uses
- how interacts w other living and nonliving components
- role it plays in energy flow
- adaptative traits reflect niche traits enable population to survive and reproduce effectively under given set environmental conditions

26 niche significance

- prevent from becoming prematurely extinct
- assess environmental changes we make in terrestrial and aquatic systems

27 fundamental niche vs realized niche

- Fundamental niche is what it could be in the best of all circumstances
- Realized niche is what it is with limitations that are present

28 what limits adaptation?

- traits have to be present to start w
- even if beneficial heritable trait present the population ability to adapt can be limited by its reproductive capacity

- don't just eliminate rest of population so that trait can show-usually most of population still around in gene pool

29 evolution misconceptions

- fitness is reprod potential not strongest
- there is no grand plan for perfection

30 divergent evolution

- speciation: geographic isolation - allopatric speciation
- no geographic isolation: sympatric speciation
- for either next step is reproductive isolation

31 **Why Should We Care About Biodiversity?**

- **Instrumental value**
- **Intrinsic value**

32 biodiversity: speciation - extinction

- extinction followed by period of recovery that are characterized by adaptive radiation
- new species evolve to fill new or vacated ecological roles or niches in changed environments
- 5 mya years to rebuild biological diversity

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34 Effects of Human Activities on Biodiversity

35 Increasing Biodiversity

- Physically diverse habitat
- Moderate environmental disturbance
- Small variations in conditions
- Middle stages of ecological succession

36 Decreasing Biodiversity

- Environmental stress
- Large environmental disturbance
- Extreme environmental conditions
- Severe limiting factors
- Introduction of alien species
- Geographic isolation

37 US Diversity

38 Strategies for
Protecting

Biodiversity

- Species approach
- Ecosystem approach

39 Species Extinction

- Local extinction
- Ecological extinction
- Biological extinction

40 mass depletion

- extinction rate higher than normal but not high enough to consider it mass extinct

41 Endangered and Threatened Species

- Endangered species
- Threatened (vulnerable species)
- Rare species

42 Extinction Risks

- Factors: population size, habitat, and genetics
- Population viability analysis
- Minimum viable population
- Minimum dynamic area
- Characteristics of extinction-prone species

43 Extinction Rates

- Background (natural) rate of extinction
- Mass extinction
- Adaptive radiations

44 Causes of Depletion of Wild Species

- Human population growth
- Failure to value the environment or ecological services
- Increasing per capita resource use
- Increasing use of Earth's primary productivity
- poverty

45 Causes of Premature Extinction of Wild Species

- Habitat degradation
- Introduction of non-native species

46 Solutions: Protecting Wild Species from Depletion and Extinction

- Bioinformatics
- International treaties: CITES
- National Laws: Lacey Act
- Endangered species Act
- Habitat conservation plans
- Wildlife refuges and protected areas
- Zoos, botanical gardens, and gene banks

47 Wildlife Management

- Laws regulating hunting and fishing

- Harvest quotas
- Population management plants
- Improving habitat
- Treaties and laws for migrating species

48 **2 main types of aquatic ecosystems**

- Marine: saltwater
- Freshwater

49 **Most diverse habitats**

- Coral reefs
- Estuaries
- Deep-ocean floor
- Needs structure to be diverse

50 **Advantages of aquatic ecosystems**

- support more dense
- constant temp
- nourish dissolved nutrients
- water
- easy dispersment of organisms larvae and eggs
- less UV
- dilution of dispersion of pollutants

51 **Advantages of aquatic ecosystems**

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52 **Disadvantages of aquatic ecosystems**

- tolerate only a narrow range of temperatures
- Exposure to dissolved pollutants
- fluctuating population size for many species
- dispersion separates many aquatic offspring from parents

53 **major types organisms**

- 1-phytoplankton
- 2-zooplankton
- 3-nekton
- 4-benthos
- 5-decomposers

54 **Factors which limit life zones (surface, middle, bottom)**

- temperature

- Dissolved oxygen (DO)
- light penetration
- availability of nutrients

55

56 Oceans

- 99.5% of habitable VOLUME
- contain 250,000 species
- ecological and economic services
- only 5% mapped or explored w level of detail of moon or mars

57 Ecological Services

- climate moderation
- CO₂ absorption
- nutrient cycling
- waste treatment and dilution
- reduced storm impact
- habitats and nursery areas
- genetic resources and biodiversity
- scientific information

58 Economic Services

- food
- animal and pet feed
- pharmaceuticals
- harbors and transport
- coastal habitats
- recreation
- employment
- offshore oil and natural gas
- minerals
- building materials

59

60 Neritic Zone: Coastal zone of Ocean

- continental shelf
- 10 % of ocean area 90% of all marine species most commercial fisheries
- high PP (primary productivity) per unit area : sunlight and nutrients
- Most prolific in abundance and diversity
- Greatest nutrient availability
- Greatest O₂ availability
- Most structure

61 Estuaries (and wetlands)

- Estuaries partially enclosed saltwater and freshwater mix
- temperature and salinity vary greatly in estuaries
- tides/seasonal variation/rain
- constant water movement stirs up nutrient rich silt

- high productive ecosystems -ecological and economic services

62 Coral Reefs

- Low nutrient availability
- High variation in structure
- Moderate temperatures not much colder than 60F
- Most (NOT ALL) are between tropics of Capricorn and Cancer (arctic reefs)
- Pacific are oldest and have most diversity

63

64 Major threats to coral reefs

- Ocean warming
- Soil erosion
- Algae growth from fertilizer runoff
- Mangrove destruction
- Coral reef bleaching
- Rising sea levels
- Increased UV exposure from ozone depletion
- Using cyanide and dynamite to harvest coral reef fish
- Coral removal for building material, aquariums, and jewelry
- Damage from anchors, ships, and tourist divers

65 Human Impact

- degrade resources
- 40% of our pop on shores w/n 100Km
- 13 of 19 megacities on shores
- marshes/mangroves/seagrass lost
- wetlands gone
- trawlers
- coral reef destruct

66 Characteristics of freshwater streams and rivers

- Less than 1 ppt (book says 10 ppt!)
- Standing bodies of water: lentic
- Flowing bodies of water: lotic
- Flow from streams - rivers-oceans
- surface water - not sink or evaporate runoff when flows into streams
- **watershed** or drainage basin is area that delivers runoff sediment and dissolved substances to a stream

67 Lentic bodies of water

- Lakes and ponds (depth)
- Lakes have 4 zones; ponds usually only one
- Lakes are formed from depressions caused by glaciation, crustal displacement, or volcanic activity
- Sources of water include: springs, streams, rainfall, melting snow, and runoff

68 **Zones in lakes**

- Littoral zone: shore w emergent vegetation
- Limnetic zone: surface waters photic zone
- Profundal zone: deep, open water dysphotic or aphotic zone, low DO
- Benthic zone: bottom

69 **Zones of a Temperate Lake**

70 **Oligotrophic lake**

71 **Eutrophic Lake**

72 **Stratification and Seasonal Turnover**

73 **Zonation of freshwater streams**

- 3 aquatic zone in rivers
- source zone
- transition zone
- flood plain zone

74 **Sustainability in Aquatic Ecosystems**

- How sustainable are aquatic ecosystems
- each stream, river, and lake reflects the sum total of all that occurs in watershed
- nutrients, wastes, pollutants produced by human activities end up in the ocean
- many chemicals reaching aquatic systems come from the atmosphere

75 **Aquatic ecosystems renewed by**

- water purified by natural hydrologic cycle
- nutrients cycle in and out
- populations of biological organisms can be replenished, given opportunity and time