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Communities: Community Ecology

EVPP 111 Lecture
Dr. Largen
Spring 2004
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2 Sections

- ✓ definitions
- ✓ properties
- ✓ organism interactions
  - – competition
  - – predation
  - – symbiotic relationships
- ✓ disturbances
  - – succession

3 Sections

- ✓ definitions
- ✓ properties
- ✓ organism interactions
  - – competition
  - – predation
  - – symbiotic relationships
- ✓ disturbances
  - – succession

4 **Communities: Community Ecology**

- ✓ **definitions**
  - – **population**
    - all individuals of particular species living in same place at same time
  - – **community**
    - all populations of organisms that live together & potentially interact in particular area at particular time
  - – **ecosystem**
    - all communities of area & their interactions with each other & physical environment

5 Figure: Lion with kill in a grassland community

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7 Sections

- ✓ definitions
- ✓ properties
- ✓ organism interactions
  - – competition
  - – predation

- symbiotic relationships

✓ disturbances

- succession

8 ## Communities: Community Ecology

✓ **Community properties**

- community has own set of properties
  - **diversity**
  - **prevalent forms of vegetation**
  - **stability**
  - **trophic structure**

9 ## Communities: Community Ecology

✓ **Community properties**

- community has own set of properties
  - **diversity**
  - **prevalent forms of vegetation**
  - **stability**
  - **trophic structure**

10 ## Communities: Community Ecology

✓ **Community properties**

- **Diversity**
  - variety of organism that make up a community
  - has two components
    - **species richness**
    - **relative abundance of different species**

11 ## Communities: Community Ecology

✓ **Community properties**

- **Diversity**
  - **species richness**
    - total number of different species in community
  - **relative abundance of different species**
    - number of individuals of each of different species

12 ## Communities: Community Ecology

✓ **Community properties**

- **Diversity**
  - consider two communities, each made of up 4 species, A, B, C, D
    - community 1 has 25A, 25B, 25C, 25D
    - community 2 has 97A, 1B, 1C, 1D
  - **species richness**

- same for both communities, each made up of 4 species
- **relative abundance of different species**
  - relative abundance is very different

13 ## Communities: Community Ecology

✓ **Community properties**

– community has its own set of properties

- **diversity**
- **prevalent form of vegetation**
- **stability**
- **trophic structure**

14 ## Communities: Community Ecology

✓ **Community properties**

– **Prevalent form of vegetation**

- applies mainly to terrestrial communities
- two components
  - types of dominant plants
  - structure of dominant plants
- largely determines types of animals that will live in a community

15 ## Communities: Community Ecology

✓ **Community properties**

– **Prevalent form of vegetation**

- for example, consider deciduous trees of temperate deciduous forest versus coniferous trees of northern coniferous forest
  - types of dominant plants
    - » are different
  - structure of dominant plants
    - » vertical structure of forests is different

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17 ## Communities: Community Ecology

✓ **Community properties**

– community has its own set of properties

- **diversity**
- **prevalent forms of vegetation**
- **stability**
- **trophic structure**

18 ## Communities: Community Ecology

✓ **Community properties**
- **Stability**
  - community's ability to resist change
    - return to its original species composition after being disturbed
  - depends on
    - type of community
    - nature of disturbance

19 **Communities: Community Ecology**

✓ **Community properties**
- community has its own set of properties
  - **diversity**
  - **prevalent forms of vegetation**
  - **stability**
  - **trophic structure**

20 **Communities: Community Ecology**

✓ **Community properties**
- **Trophic structure**
  - feeding relationships among various species in community
  - determines passage of energy and nutrients from autotrophs to heterotrophs

21 Sections

✓ definitions
✓ properties
✓ organism interactions
- competition
- predation
- symbiotic relationships

✓ disturbances
- succession

22 **Communities: Community Ecology**

✓ **Organism interactions**
- populations of community are linked via
  - **interspecific interactions**
    - relationships between populations of different species of community
    - can be considered based on
      - » affect interaction has on each species involved

23 **Communities: Community Ecology**

✓ **Organism interactions**

- **interspecific interactions**
  - types include
    - competition
    - predation/parasitism
    - mutualism
    - commensalism

24 ## Communities: Community Ecology

✓ **Organism interactions**
- **interspecific interactions**
  - some types also considered “symbiotic”
    - relationships between organisms of two different species that live together in relative permanent, close relationship
    - parasitism
    - mutualism
    - commensalism

25 ## Communities: Community Ecology

✓ **Organism interactions**
- **interspecific interactions**
  - competition
    - detrimental to both species involved
  - predation/parasitism
    - beneficial to one species, detrimental to other species
  - mutualism
    - beneficial to both species
  - commensalism
    - beneficial to one species, other species unaffected

26 Table: Interspecific Interactions

27 ## Sections

✓ definitions
✓ properties
✓ organism interactions
- competition
- predation
- symbiotic relationships

✓ disturbances

– succession

28 ☐ **Communities: Community Ecology**

✓ **Interspecific interactions**

– **Competition**

• may occur

– when a shared resource is limited

– between any 2 species that need same

» **limiting resource** or **limiting factor**

» shortage of which restricts success of species

» may be biotic or abiotic

» differ from species to species

29 ☐ **Communities: Community Ecology**

✓ **Interspecific interactions**

– **Competition**

• types

– **interspecific competition**

» between populations of two species

– **intraspecific competition**

» between members of same species

30 ☐ **Communities: Community Ecology**

✓ **Interspecific interactions**

– **Competition**

• between populations may result in

– reduction in density of one or both species

– local elimination of one of competitors

• is considered detrimental to both species involved

– though one will “win”

– neither will do as well as in absence of competitor

31 ☐ **Communities: Community Ecology**

✓ **Interspecific competition**

– restated

• struggle between two populations to utilize same resources

– when there is not enough of that resource to satisfy both

32 ☐ **Communities: Community Ecology**

✓ **Interspecific competition**

– studied by Russian ecologist G.F. Gause in 1934

• based on experiments in lab with 2 species of protists from genus *Paramecium*

– *Paramecium aurelia*
– *Paramecium caudatum*

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✓ **Interspecific competition**

– experiments by Gause
  • lab experiments
    – *P. aurelia* and *P. caudatum* were grown separately, in same conditions
      » each grew rapidly, leveled off at carrying capacity
    – when *P. aurelia* and *P. caudatum* were grown together
      » *P. caudatum* was driven to extinction

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38 ## Communities: Community Ecology

✓ **Interspecific competition**

– Gause concluded
  • if two species are so similar that they compete for the same limiting resources
    – then they can't coexist in the same place
    – one species will use resource more efficiently, gain competitive advantage
      » eventually leading to local extinction of inferior competitor

39 ## Communities: Community Ecology

✓ **Interspecific competition**

– Gause restated his ideas as the
  • **competitive exclusion principle**
    – no two species can occupy the same ecological **niche** in the same place at the same time

40 ## Communities: Community Ecology

✓ **Competition and niche**

– **niche**
  • functional role of an organism in its surroundings
  • sum total of organism's use of resources of its habitat
    – can be thought of as organism's role in its community, its profession

41 ## Communities: Community Ecology

✓ **Competition and niche**

- **niche** of an organism
  - can be described in terms of a number of factors, such as
    - space utilization
    - food consumption
    - temperature range
    - moisture requirements

42 Communities: Community Ecology

✓ **Competition and niche**

- niche
  - is **not** synonymous with
    - **habitat**
      - » space that organism inhabits
  - is a pattern of living
- sometimes an organism cannot occupy its entire niche because someone else is using it

43 Communities: Community Ecology

✓ **Competition and niche**

- competitive exclusion principle can be restated incorporating concept of niche:
  - *two species cannot exist in a community if their niches are identical*
    - ecologically similar species can coexist in a community if there are one or more significant differences in their niches

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✓ **Competition and niche**

- classic test of competitive exclusion in field
  - involved two species of barnacles attached to intertidal rocks on North Atlantic coast
    - *Balanus*
    - *Chthalamus*

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✓ **Competition and niche**

- classic test of competitive exclusion
  - natural situation
    - *Balanus* lived on lower rocks, rarely exposed to atmosphere
      - » here, *Balanus* could always outcompete *Chthalamus*, crowding it off rocks
    - *Chthalamus* lived higher up on rocks in shallower water that was frequently exposed to air due to tides

46 Communities: Community Ecology

✓ **Competition and niche**

- classic test of competitive exclusion
  - manipulated situation
    - *Balanus* was removed from lower rocks
      - » *Chthalamus* could easily occupy the deeper zone

» indicating there was no physiological obstacle to it living in that zone

47 **Communities: Community Ecology**

✓ **Competition and niche**

– classic test of competitive exclusion

• manipulated situation

– *Balanus* was physically placed in upper zone (where *Chthalamus* usually lived)

» it couldn't survive

» apparently due to drying out in the air

48 **Communities: Community Ecology**

✓ **Competition and niche**

– classic test of competitive exclusion

• conclusion

– *Chthalamus*

» fundamental niche included both zones

» realized niche was only upper zone

– *Balanus*

» fundamental niche was lower zone only

» realized niche was lower zone only

49 **Communities: Community Ecology**

✓ **Competition and niche**

– competitive exclusion principle can be restated

• no 2 species with same niche can coexist

• no 2 species can occupy same niche indefinitely

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51 **Communities: Community Ecology**

✓ **Competition and niche**

– **fundamental niche**

• niche of species in absence of competition

– as determined by maximum combination of tolerable environmental conditions

– **realized niche**

• portion of species' fundamental niche that it can occupy in presence of competition

52 **Communities: Community Ecology**

✓ **Competition and niche**

– **fundamental niche versus realized niche**

– examples

• anole lizards, *Anolis* sp.

53 Figure: *Anolis distichus* (left) and *Anolis insolitus* (right)

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56 ## Communities: Community Ecology

✓ **Competition and niche**

– two possible outcomes of competition between species having identical niches

- 1) less competitive species will be driven to **local extinction**
  - loss of species at local level
- 2) one species may evolve to use a different set of resources
  - known as **resource partitioning**

57 ## Communities: Community Ecology

✓ **Competition and niche**

– **resource partitioning**

- differentiation of niches
- enables similar species to coexist in a community

58 ## Communities: Community Ecology

✓ **Competition and niche**

– **resource partitioning**

- example
  - *Anolis* lizards in Dominican Republic
    - » 7 species live in close proximity
    - » all feed on insects, other small arthropods
    - » competition is minimized because each species perches in a certain microhabitat

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Figure: Resource partitioning in a group of lizards

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✓ **Competition and niche**

– **character displacement**

- tendency for characteristics to be more divergent when two species live in same area than when same two species live in different areas

62 ## Communities: Community Ecology

✓ **Competition and niche**

– **character displacement**

- example is two species of Galapagos finches, *Geospiza fulginosa* & *G. fortis*
  - when they occur on different islands
    - » beak sizes are similar because they eat similar size seeds
  - when they occur on same island

» beak sizes are different
» they eat different sized seeds to avoid competition

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Figure: Character displacement: circumstantial evidence for competition in nature

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Sections

- ✓ definitions
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- ✓ organism interactions
  - – competition
  - – predation
  - – symbiotic relationships
- ✓ disturbances
  - – succession

65 
Communities: Community Ecology

- ✓ **Predation**
  - – definition & concept
  - – coevolution
  - – anti-predator defense mechanisms
  - – predator-prey interactions
  - – role in community diversity

66 
Communities: Community Ecology

- ✓ **Predation**
  - – definition & concept
  - – coevolution
  - – anti-predator defense mechanisms
  - – predator-prey interactions
  - – role in community diversity

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Communities: Community Ecology

- ✓ **Predation**
  - – interaction in which one species eats another
    - **predator**
      - – the consumer in such interaction
      - – benefits
    - **prey**
      - – the organism in such an interaction that is consumed
      - – does not benefit (is harmed)

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Communities: Community Ecology

- ✓ **Predation**
  - – concept and terms can be applied to
    - animal-animal interactions

– such as lion killing and eating antelope or other prey
- animal-plant interactions
  – such as when an animal (bison, insect) eats part of a plant
    » called **herbivory**
- parasitism

69 **Communities: Community Ecology**

✓ **Predation**
– concept and terms can be applied to
- **parsitism**
  – one organism (parasite) lives in or on another organism (host), depends on host for nutrition
    » also typically considered one of three types of **symbiotic relationships**

70 **Communities: Community Ecology**

✓ **Predation**
– definition & concept
– coevolution
– anti-predator defense mechanisms
– predator-prey interactions
– role in community diversity

71 **Communities: Community Ecology**

✓ **predation**
– predator-prey interactions can illustrate concept of
- **coevolution**
  – concept that two or more species can reciprocally influence evolutionary direction of other
  – adaptive responses of two species to one another

72 **Communities: Community Ecology**

✓ **Predation**
– definition & concept
– coevolution
– anti-predator defense mechanisms
– predator-prey interactions
– role in community diversity

73 **Communities: Community Ecology**

✓ **predation**
– **anti-predator defense mechanisms**
- needed because no species is entirely free from predation
- have evolved in every species
  – in response to natural selection
  – examples

» size, ability to flee, ability to hide, protective armor, noxious chemicals

74 **Communities: Community Ecology**

✓ **predation**
– **anti-predator defense mechanisms**
• types
– **plant defenses against herbivores**
– **animal defenses against predators**

75 **Communities: Community Ecology**

✓ **predation**
– **anti-predator defense mechanisms**
• **Plant defenses against herbivores**
– two major types
» **morphological**
» **chemical**

76 **Communities: Community Ecology**

✓ **predation**
– **anti-predator defense mechanisms**
• **Plant defenses against herbivores**
– **morphological**
» structural features that discourage browsing and feeding
» such as thorns, spines, prickles, plant hairs, deposits of silica in leaves

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78 **Communities: Community Ecology**

✓ **predation**
– **anti-predator defense mechanisms**
• **Plant defenses against herbivores**
– **chemical**
» more crucial than morphological
» chemical compounds act by being toxic, repulsive, disrupting metabolism

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80 **Communities: Community Ecology**

✓ **predation**
– **anti-predator defense mechanisms**
• **Animal defenses against herbivores**
– major types
» **mechanical**

» **chemical**
» **camouflage**
» **aposematic (warning) coloration**
» **deceptive coloration/appearance**
» **mimicry**

81 ## Communities: Community Ecology

✓ **predation**
– **anti-predator defense mechanisms**
• **Animal defenses against herbivores**
– **mechanical**
» structural features such as quills, claws, shells, spines

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84 ## Communities: Community Ecology

✓ **predation**
– **anti-predator defense mechanisms**
• **Animal defenses against herbivores**
– **chemical**
» venom in venomous animals, alkaloids in skin of poison-arrow frogs, malodorous spray of a skunk

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89 ## Communities: Community Ecology

✓ **predation**
– **anti-predator defense mechanisms**
• **Animal defenses against herbivores**
– **camouflage**
» also known as **cryptic coloration**
» use of color/patterns that cause animals become less apparent to predators by blending in with their background
» a passive defense

90 Figure: Camouflage: Poor-will (left), lizard (right)

91 ## Communities: Community Ecology

✓ **predation**
- – **anti-predator defense mechanisms**
  - • **Animal defenses against herbivores**
    - – **aposematic (warning) coloration**
      - » often found in animals with effective chemical defenses
      - » warns predators that animal is toxic

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93 ## Communities: Community Ecology

✓ **predation**
- – **anti-predator defense mechanisms**
  - • **Animal defenses against herbivores**
    - – **deceptive coloration/appearance**
      - » a species comes to look like a larger animal or predator

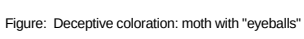
94 

Figure: Deceptive coloration: moth with "eyeballs"

95 

Figure: Batesian mimicry

96 ## Communities: Community Ecology

✓ **predation**
- – **anti-predator defense mechanisms**
  - • **Animal defenses against herbivores**
    - – **mimicry**
      - » "copycat" adaptation in which one species mimics appearance of another
      - » species that lacks a defense comes to resemble a species that has a defense

97 ## Communities: Community Ecology

✓ **predation**
- – **anti-predator defense mechanisms**
  - • **Animal defenses against herbivores**
    - – **mimicry,** two types of mimicry
      - » **Batesian mimicry**
      - » **Mullerian mimicry**

98 ## Communities: Community Ecology

✓ **predation**
- – **anti-predator defense mechanisms**
  - • **Animal defenses against herbivores**
    - – **Batesian mimicry**
      - » undefended species mimics defended species

» undefended species must be rare in the area
» flower fly (no stinger) mimics a honey bee (with stinger), predators avoid both

99 
Figure: Batesian mimicry

100 ## Communities: Community Ecology

✓ **predation**
– **anti-predator defense mechanisms**
• **Animal defenses against herbivores**
– **Mullerian mimicry**
» two defended species in community come to resemble each other
» each species gains advantage because predators learn more quickly to avoid both
» cuckoo bee and yellow jacket

101 
Figure: Müllerian mimicry: Cuckoo bee (left), yellow jacket (right)

102 ## Communities: Community Ecology

✓ **Predation**
– definition & concept
– coevolution
– anti-predator defense mechanisms
– predator-prey interactions
– role in community diversity

103 ## Communities: Community Ecology

✓ **Predation**
– **predator-prey interactions**
• predators rarely drive prey to extinction because
– natural communities are complex
– predators themselves are often preyed upon
– predators can switch to alternative food sources
– defense mechanisms of prey can be successful

104 ## Communities: Community Ecology

✓ **Predation**
– **predator-prey interactions**
• occur in virtually all communities
• may or may not generate cycles in both populations
– determined by two factors
» population growth of prey in absence of predator
» relationship between prey population size & amount of prey eaten by average predator (known as **functional response**)

105 ## Communities: Community Ecology

✓ **Predation**

- **predator-prey interactions**
  - probability of predator-prey cycles occurring (all else being equal) increases
    - when prey exhibit little density dependence
    - predators functional response increases rapidly as prey density increases

106 ☐ **Communities: Community Ecology**

✓ **Predation**
- **predator-prey interactions**
  - **functional response**
    - relationship between prey population size and amount of prey eaten by an average predator
    - affected by
      - » population densities
      - » search time
      - » capture/subduing time
      - » consuming time
      - » digestion time

107 ☐ **Communities: Community Ecology**

✓ **Predation**
- **predator-prey interactions**
  - **functional response**
    - three types
      - » type 1
      - » type 2
      - » type 3

108 ☐ **Communities: Community Ecology**

✓ **Predation**
- **predator-prey interactions**
  - **functional response**
    - **type 1**
      - » prey consumption rises linearly to a plateau
      - » characteristic of filter feeders
      - » at high concentrations of prey, predation rate is “maxed out”
      - » predator “processes” prey as fast as it can, reaches plateau

109 ☐ **Communities: Community Ecology**

✓ **Predation**
- **predator-prey interactions**
  - **functional response**
    - **type 2**
      - » prey consumption rises asymptotically a plateau
      - » characteristic of invertebrates
      - » as prey density increases, predation increases at slower and slower rate
      - » prey are dense enough that predator doesn’t have to spend time searching, only handling

110 ☐ **Communities: Community Ecology**

- ✓ **Predation**
  - – **predator-prey interactions**
    - • **functional response**
      - – **type 3**
        - » prey consumption is a sigmoid (S-shaped) function of prey density
        - » at low prey densities, greater proportion of search effort is "wasted" (unsuccessful)
        - » triggers more attempts which then increase success rate
        - » plateau is eventually reached time of predator is dominated by handling time

111 ☐ **Communities: Community Ecology**

- ✓ **Predation**
  - – **predator-prey interactions**
    - • **predator-prey cycles**
      - – characterized by
        - » sharp increases in numbers followed by
        - » seemingly periodic crashes
      - – classic example is snowshoe hare and Canadian lynx cycle

112 🖼 Figure: snowshoe hare and lynx

113 ☐ **Communities: Community Ecology**

- ✓ **Predation**
  - – **predator-prey interactions**
    - • **predator-prey cycles**
      - – explained by two hypotheses
        - » top-down control
        - » bottom-up control

114 ☐ **Communities: Community Ecology**

- ✓ **Predation**
  - – **predator-prey interactions**
    - • **predator-prey cycles**
      - – top-down control hypothesis
        - » lynx prey on hare
        - » reduces hare population
        - » fewer hares supports fewer lynxes
        - » causes periodic reduction in lynx population
        - » lag-time, offset from hare reduction

115 ☐ **Communities: Community Ecology**

- ✓ **Predation**
  - – **predator-prey interactions**

- **predator-prey cycles**
  - top-down control hypothesis *cont*
    - » reduced numbers of predators (lynx) allows population of prey (hare) to recover and increase
    - » increased numbers of prey (hare) support increased numbers of predators and lynx population increases
    - » cycle continues

116 ☐ **Communities: Community Ecology**

✓ **Predation**

- **predator-prey interactions**
  - **predator-prey cycles**
    - top-down control hypothesis *cont*
      - » doubt has been cast on this
      - » snowshoe hares have been found to exhibit similar 10-year “boom-or-bust” cycles on islands where lynx are absent
      - » leading to 2nd hypothesis
      - » bottom-up control

117 ☐ **Communities: Community Ecology**

✓ **Predation**

- **predator-prey interactions**
  - **predator-prey cycles**
    - bottom-up control hypothesis
      - » rather than cycle being driven by predator at top
      - » might be driven by food source of prey (hare) at bottom

118 ☐ **Communities: Community Ecology**

✓ **Predation**

- **predator-prey interactions**
  - **predator-prey cycles**
    - bottom-up control hypothesis *cont*
      - » reduction in quantity or quality of food source (plants) of hare leads to crash of hare population
      - » fewer hare support fewer predators and lynx population crashes
      - » reduction in hare population gives plant population time to recover

119 ☐ **Communities: Community Ecology**

✓ **Predation**

- **predator-prey interactions**
  - **predator-prey cycles**
    - bottom-up control hypothesis *cont*
      - » increased plant population supports more hares and hare population increases
      - » increased hare population supports more lynx and lynx population increases
      - » cycle continues, driven by plant availability

120 Figure : Population cycles of the snowshoe hare and lynx

121 **Communities:**
Community Ecology

✓ **Predation**
- definition & concept
- coevolution
- anti-predator defense mechanisms
- predator-prey interactions
- role in community diversity

122 **Communities:**
Community Ecology

✓ **Predation**
- **role in community diversity**
  - predator-prey relationships can help maintain community diversity
    - some species have more central roles in community or ecosystem than do others
      - » **keystone species**

123 **Communities:**
Community Ecology

✓ **Predation**
- **role in community diversity**
  - **keystone species**
    - not most abundant species in community
    - exerts control on community structure not by its numbers but by its ecological niche
    - reduces density of strongest competitors in community

124 **Communities:**
Community Ecology

✓ **Predation**
- **role in community diversity**
  - **keystone species,** example
    - sea star (P*isaster ochraceous*) of rocky intertidal zone of Washington state
    - feeds preferentially on mussels, will also eat other invertebrates
    - removal sea star resulted in explosion of mussel population
    - mussels monopolized space and excluded other invertebrates
    - community became less diverse

125 Figure: Testing a keystone predator hypothesis

126 Figure : Testing a keystone predator hypothesis

127 **Communities:**
Community Ecology

✓ **Predation**
- **role in community diversity**
  - **keystone species,** example
    - sea otters in North Pacific
      - » declines in their populations (possibly due to killer whales) have resulted in destruction of

kelp forests
» sea otters feed on sea urchins who feed on kelp
» in absence of sea otters, sea urchin populations explode and decimate kelp forests

128 Figure: Sea otters as keystone predators in the North Pacific

129 ## Sections

✓ definitions
✓ properties
✓ organism interactions
– competition
– predation
– symbiotic relationships
✓ disturbances
– succession

130 ## Communities: Community Ecology

✓ **Symbiotic relationships**
– interaction between two or more species that live together in close proximity (on, in, very near) in relatively permanent relationships
– three types
• **parasitism** (also considered predation)
• **commensalism**
• **mutualism**

131 ## Communities: Community Ecology

✓ **Symbiotic relationships**
– **parasitism**
• one organism (**parasite**) lives in or on another organism (**host**)
– parasite is generally smaller than host
• one species benefits (parasite) and other species is harmed (host)

132 ## Communities: Community Ecology

✓ **Symbiotic relationships**
– **parasitism**
• can be viewed as type of predator-prey relationship
– organism that is “preyed” upon doesn’t necessarily die
• examples
– tapeworms, bloodflukes, apicomplexans, nematodes, leeches

133 Figure: The two-host life history of *Plasmodium*, the apicomplexan that causes malaria
134 Figure: The life history of a blood fluke, *Schistosoma mansoni*
135 Figure: Anatomy of a tapeworm
136 Figure: Parasite nematode, *Trichinella spiralis*

137

138 Figure: Parasitic behavior: A female *Nasonia vitripennis* laying a clutch of eggs into the pupa of a blowfly (*Phormia regina*)

139 Communities: Community Ecology

- ✓ **Symbiotic relationships**
  - – **mutualism**
    - both species benefit from relationship
    - example
      - – ants and acacia trees
        - » tree provides protein-rich structures, sugar, housing
      - – ants provide protection to tree from other insects

140 Figure: Mutualism: bacterial "headlights"

141 Figure: Mutualism between acacia trees and ants

142 Communities: Community Ecology

- ✓ **Symbiotic relationships**
  - – **commensalism**
    - one species benefits and other species is not significantly affected (neither benefits nor is harmed)
    - few true cases probably exist
      - – unlikely that one of species is truly unaffected
    - example
      - – tropical fish living among tentacles of sea anemone gain protection and eat scraps from the anemone's food

143 Figure: Commensalism between a bird and mammal

144 Sections

- ✓ definitions
- ✓ properties
- ✓ organism interactions
  - – competition
  - – predation
  - – symbiotic relationships
- ✓ disturbances
  - – succession

145 Communities: Community Ecology

- ✓ Disturbances
  - – events that alter a community and usually remove organisms from it
  - – affect all communities

- frequency and severity vary from community to community

– can have positive or negative affects

146 ## Communities: Community Ecology

✓ Disturbances

– types include
- storms
- fire
- floods
- droughts
- overgrazing
- human activities

147  Figure: Storm disturbance to coral reef communities: Heron Island Reef in Australia

148  Figure: Storm disturbance to coral reef communities

149  Figure: Routine disturbance in a grassland community

150  Figure: Environmental patchiness caused by small-scale disturbances: A fallen tree

151  Figure: Patchiness and recovery following a large-scale disturbance

152  Figure: Large-scale disturbance: Mount St. Helens

153  Figure: Forest fire

154 ## Communities: Community Ecology

✓ **Disturbances**

– **ecological succession**
- process of community change that results from disturbance
- predictable transition in species composition over time following a disturbance
  – ultimately producing a relatively stable, long-lasting community called
    » **climax community**

155 ## Communities: Community Ecology

✓ **Disturbances**

– **ecological succession**
- **climax community**
  – relatively stable, long lasting
  – complex and interrelated community
  – specific types that occurs depends on climate, soil type
    » in some areas, the climax community never occurs

156 **Communities:**
Community Ecology

✓ **Disturbances**
- **ecological succession**
  - **climax community vs. successional community**
    - maintains mix of species for long time vs. temporary
    - tends to have many specialized niches vs. generalized niches
    - have more types of organisms vs, fewer types of organisms
    - tend to recycle nutrients, maintain constant biomass vs. accumulate large amounts of material

157 **Communities:**
Community Ecology

✓ **Disturbances**
- **ecological succession**
  - concept that communities proceed through a series of regular, predictable changes in structure over time
    - occurs because activities of organisms cause changes in their surroundings
      - » making local environment suitable for other kinds of organisms

158 

159 **Communities:**
Community Ecology

✓ **Disturbances**
- **ecological succession**
  - pace and direction affected by several factors
  - two different kinds are recognized
    - **primary succession**
    - **secondary succession**

160 **Communities:**
Community Ecology

✓ **Disturbances**
- **primary succession**
  - begins with
    - total lack of organisms and bare mineral surfaces or water
    - less frequently observed
  - usually takes very long time
    - due to lack of soil and few nutrients for plants
  - examples; new volcanic islands, rubble left by retreating glacier

161 **Communities:**
Community Ecology

✓ **Disturbances**
- **primary succession**
  - factors that determine rate of succession and kind of climax community
    - type of substrate

» rock, sand, clay
– types of spores, seeds, vegetative structures of plants
– climate

162 **Communities: Community Ecology**

✓ **Disturbances**
– **primary succession**
• challenging because bare rock or soil is inhospitable place for organisms to live
• collection of organisms that can become established and survive is called
– **pioneer community**

163 **Communities: Community Ecology**

✓ **Disturbances**
– **primary succession**
• **pioneer community**
– **lichens**
» common members
» small, slow growing, mutualistic
– each step in process from pioneer community to climax community is called
» **successional stage** or **seral stage**
» entire process is called a **sere**

164 Figure: Primary succession on land

165 **Communities: Community Ecology**

✓ **Disturbances**
– **aquatic primary succession**
• except for oceans, most aquatic ecosystems are considered temporary
– will eventually be replaced by a terrestrial ecosystem
• aquatic ecosystems receive continual input of soil and organic particles
– resulting in gradual filling of shallow bodies of water

166 **Communities: Community Ecology**

✓ **Disturbances**
– **aquatic primary succession**
• as sediments accumulate, different types of plants can eventually become established
– wet soil will form
» grasses will become established

» more sediments will be trapped

167 Fig.

168 **Communities:**
Community Ecology

✓ **Disturbances**

– **secondary succession**

- more commonly observed
- proceeds more rapidly
- begins with destruction or disturbance of existing ecosystem
  – some soil present
  – some seeds or roots from which plants can begin growing

169 Figure: Secondary succession on land

170 Fig.

171

172 Figure: Alders and cottonwoods covering the hillsides

173 Figure: Spruce coming into the alder and cottonwood forest

174 Figure: Spruce and hemlock forest

175 The end