Worksheet 2.5: Krakatau

Succession in action

You are going to look at the relationships between ecosystem stability, diversity, succession and habitat, using the specific example of succession on Krakatau (Figure 1). Krakatau erupted with a force 10 times the magnitude of Mt St Helens and 2000 times the force of a nuclear explosion. The sound of the explosion was heard 2700 miles away.

**Figure 1** Krakatau is part of Indonesia, a band of islands on the equator.

Read about the [physical geology](http://www.pearsonhotlinks.co.uk/url.aspx?urlid=70820) of Krakatau and the [ecology after the eruption](http://www.pearsonhotlinks.co.uk/url.aspx?urlid=70821). Also, view [this presentation](http://www.pearsonhotlinks.co.uk/url.aspx?urlid=70823) about ecosystems, featuring definitions and key terms.

Note: Press the ‘full’ tab (bottom right of PowerPoint slide) after accessing the PowerPoint presentation.

Questions

**1** In which year did Krakatau erupt? *[1 mark]*

1883

**2** Which islands were formed following the eruption? *[1 mark]*

Verlaten, Lang, beginning part of Rakata, Anak Krakatau

**3** Was there any life left on the islands? *[1 mark]*

little amount of humans, some insects underground or blew in with the wind

**4** What type of succession occurred on the islands? *[1 mark]*

Primary succession

**5** What were the first organisms to arrive on the islands following the eruption? What is the name for this type of organism (in terms of ecological succession)? *[2 marks]*

Pocket gophers, seeds, parts of plants. These are pioneer species

**6** What changes did these pioneers make to the islands? *[1 mark]*

Gophers mixed fungi that were able to help the plant roots absorb nutrients to grow and this made energy for other organisms to then take in so they can grow

**7** What organisms came next? Why were they able to establish themselves on the islands? *[2 marks]*

Next were small animals, insects, and more diverse plants. They were able to establish as nutrients in soil allowed plants to grow meaning more food available

**8** How did new species arrive on the island? (HINT: **three** ways) *[1 mark]*

From the air by means of flying, from the sea by swimming or moving across bodies of water, and on animals as they can be foetuses or be carried by another animal

**9** Why was this overall succession able to take place rapidly? *[2 marks]*

it was able to take place as there were surviving organisms, so this saved time instead of transporting.

**10** What were the third and fourth stages of the succession? *[2 marks]*

Third is sustaining where life in ecosystem begins to enter pattern that allows cycle of life to continue, time of development. Fourth is producing when life forms are breeding and spreading around

**11** What made it possible for large trees to appear on the islands? *[1 mark]*

The pioneer species such as trees meant more nutrients in the soil so this allowed large trees to grow by taking these scarce nutrients

**12** How did diversity change through the succession? Why did diversity change in this way? *[2 marks]*

diversity changed through succession as there were more diverse species entering. With more nutrients in the soil from the pioneers, the populations grew. Through succession, the ecosystem was able to be diverse.

**13** A complex ecosystem, with its variety of nutrient and energy pathways, provides stability. What is the most complex ecosystem now on Krakatau? *[1 mark]*

Tropical rainforest

**14** Human activities often simplify ecosystems, rendering them unstable. Which human activities modify succession? What is plagioclimax? *[2 marks]*

Activities such as overgrazing, destruction of population such as fishing, and means of destroying the land and population such as fires. Plagioclimax is an area where humans have stopped succession and stopped development.

Pages 114–22 of the textbook contain further information about succession and about how human activities can modify succession (plagioclimax).

Succession on Krakatau

Studies of colonization of the volcanic island of Krakatau, after the massive eruption in 1883, show that tropical rainforest ecosystems are capable of recovery from even extreme damage, given sufficient time. After the initial eruption, no living thing remained on what was left of the island, but today Krakatau is covered by tropical forest. On the islands left after the eruption, there are now over 400 species of vascular plants, thousands of species of arthropods, over 30 species of birds, 18 species of land molluscs, 17 species of bats and 9 reptiles.

Organisms can colonize isolated land using several mechanisms:

* **by air** – flying (birds, insects) or passive transportation (lightweight seeds or spores)
* **by sea** – swimming or floating on a log

**by animal** – travelling (or hitchhiking) inside or attached to animals that swim or fly (plant seeds and animal larvae).

**Jump dispersal**: long-distance dispersal to remote areas by one or a few individuals  
This dispersal mechanism explains widely distributed species in geographically isolated areas. It can be used to explain the aerial spread of plants, insects and microbial organisms over huge distances. The colonization of the Galápagos Islands by finches from mainland South America is an example of this type of dispersal.

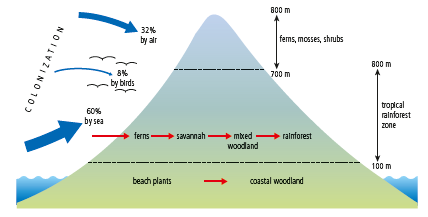
**Diffusion**: slower than jump dispersal, diffusion involves populations, rather than individuals  
Diffusion describes the spread of species at the edge of their ranges into new areas; it often follows jump dispersal events.

**Secular migration**: dispersal over geological timescales (thousands to millions of years)  
This is diffusion taking place so slowly that the diffusing species undergoes evolutionary change during the process. It includes the diversification and spread of flowering plants, and the evolution of South American llamas and vicuñas that are descended from the now extinct North American members of the camel family that migrated during the Pliocene.

Primary succession

The formation of an ecosystem from bare rock (as on Krakatau) is called a primary succession. The succession always follows the same sequence with the arrival of different organisms in turn (Figure 2).

* Pioneer species arrive (e.g. lichens, algae, bacteria) and colonize a bare or disturbed site. As these organisms die, soil is created.
* Growth in plants causes changes in the physical environment (e.g. light, moisture).
* New species of plants arrive that need soil to survive. They displace existing pioneer plants because their seedlings are better able to become established in the changed environment.
* The growth of roots enables soil to be retained and not washed away.
* Newly arriving species alter the physical conditions (e.g. increased shade; more minerals and nutrients in the soil as plants die and decay, and nitrogen-fixing plants arrive), allowing other species to become established.
* Animals come in with or after the plants they need for food.
* Eventually, a climax community that is more or less stable is established.
* Disturbances start the process of succession again.



**Figure 2** Succession on Krakatau began with blue–green bacteria and then ferns (the pioneer species) followed by grasses and shrubs. Next came mixed woodland (smaller trees) and finally the climax community of tropical rainforest (including tall hardwood trees).

Soil depth, moisture, and species diversity increase through the succession, reaching their maximum in the climax community (the last stage of the succession). Greater habitat diversity leads to greater species and genetic diversity.

Secondary succession

When succession occurs in an area that already has soil, it is called a secondary succession. Human activities, such as forest clearance (logging or burning), can cause this type of succession, providing no further disturbance occurs. Succession can be modified (i.e. halted at an early stage) through activities such as grazing, where climax species (e.g. trees) are not allowed to become established.

The set of communities that succeed one another over the course of succession at a given location is called a sere.