

Chapter 7

1. Match the following soil horizons with their descriptions and reorder these in the descending order from the top of the soil downwards.

Horizons: A, B, C, E, O

Descriptions:

- (i) – the bedrock or deposits from which the soil is formed.
- (ii) – the horizon from which nutrients leach into the subsoil.
- (iii) – a layer containing un-decomposed material such as leaf litter and other detritus.
- (iv) – the layer where biological activity is at its greatest.
- (v) – the subsoil containing minerals, nutrients and weathered bedrock.

Answer

O-iii, A-iv, E-ii, B-v, C-i

2. Describe three methods by which the nitrogen status of a nitrogen-poor soil can be increased, and set out the merits of each source

Answer

Fertilizer application - fertilizer may be added to boost the nitrogen levels.

This may be as conventional artificial fertilizers such as ammonium nitrate which is fast acting though rapidly lost, or slow-release forms (such as pelleted urea) which provide nitrogen over a number of weeks or months. These can be important in the early stages where the early plant community needs a readily available source of nitrogen.

Soil amendment - nitrogen-rich organic material (such as manure, sewage sludge or green manure) can be used to provide a nutrient-rich mulch.

This is particularly useful in situations where the soil has poor or non-existent structure, as it adds valuable organic material which can be incorporated into the soil. It also represents a slow-release source of nitrogen, and can therefore continue add the nutrient over some time.

Nitrogen fixation - nitrogen-fixing species (such as members of the legume family) can be established.

These fix atmospheric through the action of symbiotic bacterial within their root nodules. These can be supplied by adding a soil known to be rich in *Rhizobium*. These will, of course, provide the long-term nitrogen source that enable the community to be become self-sustaining.

3. Select the most appropriate response to the following statement and comment on your selected response.

Mycorrhizal fungi

- a. increase the availability of phosphorus and nitrogen to plants.
- b. fix nitrogen and increase the availability of water to plants
- c. occur as a result of the build up of salt in the soil.
- d. increase the availability of phosphorus and water to plants.
- e. fix nitrogen.

Answer

d. Mycorrhiza are a group of fungi that have evolved a symbiotic association with plants. The roots host the fungi (either around – ectomycorrhiza- or around and within the root – arbuscular mycorrhizal fungi). The plant benefits from the enlarged root network. This enables it to access more phosphates (scavenged and made available by the fungus) and water. The fungus benefits from the supply of carbon from the plant.

4. The following data were collected from a deciduous forest ecosystem in New England (Hubbard Brook) and gives the rate of uptake and loss of nitrogen and calcium by the trees and the mass of each element in the trees.

Calculate the turnover time for each element for the trees based on the amount taken up. Calculate the turnover time for each element for the trees based on the loss to the soil.

How do you account for the differences you observe between the two estimates?

	Nitrogen	Calcium
Uptake (kg/hectare/year)	79.6	62.2
Loss (kg/hectare/year)	60.4	43.9
Mass in trees (kg /hectare)	532.0	484.0

Answer

	Nitrogen	Calcium
Based on uptake:	6.7 years	7.8 years
Based on loss:	8.8 years	11.0 years

The turnover rates based on loss are lower in each case because the trees are slowly accumulating each element – so loss rates are less than uptake rates. This has been measured and, as these figures suggest, the annual increase in the mass of calcium is greater than that of nitrogen. The trees retain of their 13% calcium uptake compared to 11% for nitrogen.

5. Examine the map on page 268 and consider the following scenario.

The imaginary fishing village of Safe Haven is situated close to area prized for its wildlife and landscape value. A supertanker has run aground on rocks 6 km offshore and it could leak 100,000 tonnes of oil towards the coast driven by strong onshore winds. As coordinator of the emergency control centre what are your priorities?

Answer

Firstly, remember that prevention is better than cure. Seek to limit the amount of oil reaching the shore and sea bed - press for quick salvage work to pump oil off the ship and to create a containment areas on the sea surface. Use booms to contain the spill; where these are breached, use materials (chalk, sawdust, wool) to absorb oil for collection or sinking.

Divide the coastal area under threat into sections, according the shore type, wave energy, wildlife and amenity value. Wherever possible favour physical removal of the oil. Assign priorities and the most appropriate clean-up plans to each area. For example, high energy

beaches, with the abundant oxygen they introduce into the water, may be left to recover naturally. Seal Cove may have a high wildlife value and would perhaps need special attention, and perhaps protection. Sandy areas have high amenity value, but contaminated sand can be scraped up relatively easily.

Do not forget to plan for post-spill work such as the rehabilitation of injured wildlife and site monitoring.

6. Match the following conditions of spoil with an appropriate method of treatment:

Problem (a) High pH-
(b) Salinity-
(c) Low level of macronutrients-
(d) Too dry-
(e) Unstable-
(f) Low pH-
(g) High levels of heavy metals-
(h) Too compact-
(i) Too wet-
(j) Low nitrogen levels-

Treatment (i) mulch with organic matter.
(ii) drain.
(iii) add pyritic waste, organic matter, and allow to weather.
(iv) irrigate, allow to weather, use halophytic species to revegetate.
(v) rip or scarify prior to revegetation.
(vi) add fertilizer and lime.
(vii) stabilize, mulch, and possibly regrade prior to revegetation.
(viii) lime and/or allow to weather.
(ix) add nitrogen fertilizers/legumes.
(x) add organic mulch and vegetate with metallophytes.

Answer

a- viii, b-iv, c-vi, d-i, e-vii, f-iii, g-x, h-v, i-ii, j-ix

7. What is the value of removing bottom-feeding fish in our attempts to restore highly eutrophic lakes?

Answer

Eutrophic freshwater systems have high nutrients reserves held in the sediments, especially phosphorus. Fish that feed in these sediments, and stir them up, enable these nutrients to re-enter the food chain (via their feeding), and also to re-enter the water above. Removing such bottom feeders allows the sediments to remain undisturbed, helping to lock away these excess nutrients. Removing the fish also remove the nutrients they have accumulated in their tissues.

8. What is meant by success in ecological restoration? Suggest some criteria by which the progress or outcome of a restoration programme may be measured and monitored.

Answer

Success is achieving the goal of creating a self-sustaining, viable ecosystem on a damaged or degraded site. To do this commonly requires an acceleration of the successional processes to establish and develop an ecosystem, and we can use our understanding of these processes – and the plants associated with each stage – to gauge our success. Possible indicators include

Bare ground - one aim will be to establish vegetation cover.

The presence of large areas of bare ground indicates poor establishment.

Conversely, complete absence of bare ground suggests that certain species may be dominating and there may not be areas for species to re-colonise. Often there will be a percentage range of bare ground indicative of an appropriate level of establishment. If this level is exceeded, or there is a short fall, there may be problems with the design and management of the site.

Pernicious weeds - the presence of weeds either from existing land use, or brought in with the restoration process may be a sign of a problem.

Pernicious weeds growing on or near the site need to be identified and characterized. Monitoring must then be undertaken on a regular basis.

Structure of vegetation - the structure of vegetation will vary from habitat to habitat.

In woodland, there will be a complex multilayered structure of field layer, shrub and canopy. Grasslands too have a structure with the low growing cryptophytes and hemicryptophytes and taller-growing herbaceous species. There are established methods of measuring (and therefore monitoring) the structural components of vegetation, especially useful in monitoring the development of the plant community.

Target species - there will be key species associated with a restoration project.

These may be species introduced at the beginning of the project or those characteristic of an established ecosystem. Again, these can be used to monitor the effectiveness of the restoration programme.