

Soils, ecosystem fertility & salmon smolt production in Wester Ross

1. Much of **Wester Ross** is underlain by hard, insoluble Lewisian gneiss, Torridonian sandstone or Moine granulite, yielding very **little nutrients**.

5. Historically there were **bears and wolves**. Wolves eat deer, ingesting bone and recycling phosphates.

6. **Peat** has formed where sphagnum moss smothers the ground, acidifying the soil and preventing aerobic decomposition.

8. Similar green patches are found along river banks where otters defecate. In the autumn, these **otter 'spraint sites'** may contain salmon bones.

7. Look for **wee green knolls** in the peatlands where birds and mammals have enriched the soil: note the increased plant growth and biodiversity.

2. **Soil fertility** is therefore dependent upon the retention and cycling of nutrients, particularly phosphate, through the **ecosystem**.

14. Increasingly **heavy rain leaches nutrients from soils** and washes away ash from fires. Spates erode away the richest riparian soils notably where alder trees have died back.

3. Unlike many rivers in the east of Scotland, there is **little human habitation** within the catchments of local rivers so little added nutrient from human sources.

10. Given sufficient phosphate (e.g. bone meal in mammal faeces), **Alder trees** grow in symbiosis with symbiotic nitrogen-fixing bacteria, further enriching riparian soil fertility.

4. **In the past** there were more **people** living in river catchment areas. Without modern sanitation, they **contributed to nutrient recycling**.

11. Most plants develop **mycorrhiza networks** with symbiotic fungi which deliver phosphate to plant roots in exchange for carbohydrate.

15. Growth of **periphyton** is faster where the streambed is stable and stream fertility is naturally high.

17. **Salmon parr** growth rates are highest where the food supply is richest. Over-winter survival and smolt production may depend upon the supply of mayfly and caddisfly larvae.

16. Flat-headed 'Heptageniid' **mayfly larvae** scrape periphyton from the streambed. Other mayfly and **caddisfly larvae** gather or filter organic detritus including leaf and periphyton fragments.

18. **Well-nourished smolts** are better prepared for life at sea than emaciated smolts.

9. **Adult salmon** deliver nutrients of marine origin to headwater streams especially if their carcasses are scavenged by other animals.

13. **Heather burning** is carried out to convert woody matter to ash, thereby releasing nutrients to promote the growth of grasses and other leafy matter for grazing deer or livestock.

12. **Earthworms** help to recycle and retain organic matter and increase the porosity of riparian soils. In some areas invasive **New Zealand flatworms** have reduced earthworm populations, displacing **moles** with adverse consequences for soils.