GRANITE ROCK PLANT SUCCESSION

JOHN FORREST NATIONAL PARK

AN EXPLANATORY TEXT WITH FIELD EXERCISES FOR

SENIOR HIGH SCHOOL WEB OF LIFE BIOLOGY STUDENTS.

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GRANITE ROCK PLANT SUCCESSIONS

Granite outcrops are impressive and interesting features of John Forrest National Park. Large areas of exposed granite result from the erosion and removal of the original soil covering.

After the granite is exposed, it is subject to further erosion and weathering; you will notice that the surface of the rock is uneven as a result of the different types of rock wearing at different rates. The softer minerals are worn away first, leaving lumps of harder rock jutting out.

SUCCESSION OF VEGETATION

A most interesting feature of an exposed area of granite is the gradual change in the vegetation. This growth is very slow and starts with microscopic algae colonising small pits in the surface of the rock. To the casual observer this dark green film of algae is not usually visible. They start to break down the rock into soil through several factors, such as the release of chemicals capable of dissolving some of the minerals leaving others free to break away. Another factor is that water accumulates in some of the minute cracks in the rock. As the water volume increases with a rise in temperature, or freezing, enormous pressures are built up and the rock may split and crack even more.

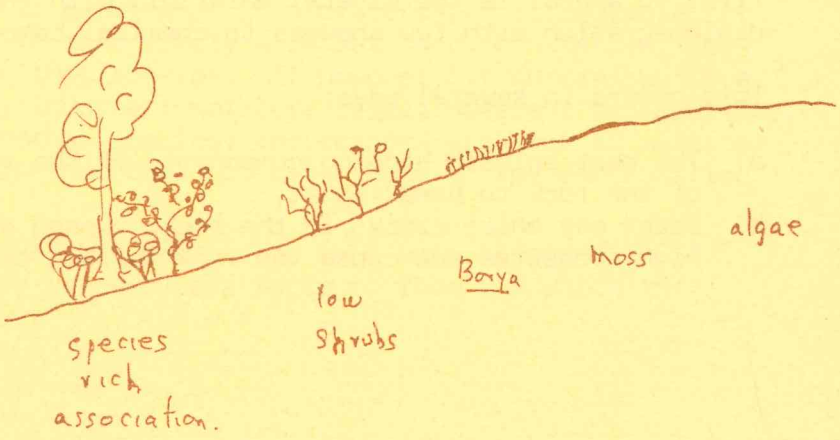
LICHENS

The first visible stage in granite rock plant successions are the lichens. These plants look like single identities in themselves but in fact, consist of both algae and fungi in close association. The two live together as a symbiotic unit; symbiotic meaning each one is beneficial to the other. The fungi act as a sponge in obtaining water but have no chlorophyl so are unable to synthesise food using sunlight. The algae do have chlorophyll and are able to provide themselves with organic food. The algae however, require a moist environment which has a supply of mineral nutrients and is protected from the elements. The algae provide food for the fungi and the fungi provide nutrients extracted from the rock and a suitable environment for the algae to inhabit.

The major types of lichens found on granite rocks in John Forrest National Park are:

Rhizocarpon sp. white or grey, 1cm high and with a minutely cracked surface.

Parmelia sp. yellow-green and often highly lobed or branched. Commonly forms concentric rings flat on the rock surface.



MOSS SWARDS

Mosses are the next stage of the succession. They occur where the soil has accumulated in the pits of the rock surface to a depth of a few millimetres. The large mats of moss are known as swards. They may be composed of several different species of moss and have a remarkably even surface for their varied composition. They are seen at their best only in winter.

Mosses catch wind and water born particles of soil and are highly water absorbant. These features mean that the mosses provide a good growing environment for the seedlings of higher plants.

HIGHER PLANTS

Often the first of these to appear are grass-like plants and small herbs such as trigger plants (Stylidium), orchids and the insectiverous sundews (Drosera).

Probably the most prominant herb on the deeper sections of the swards is Borya nitida, the Pincushion Plant. In summer its pointed leaves turn orange due to the production of heat protective pigments and loss of chlorophyll. The plant remains dormant until autumn when good rains occur and the temperature is lower when it again becomes green and resumes growth. It is a spring flowering plant with white flowers borne in heads about 1 cm across. The stems of Borya act as wind breaks, collecting blown particles of soil. They also collect water-carried particles which wash down the rocks in winter and trap seeds carried from more vegetated areas. With time the soil deepens as more accumulates in the depressions in the rock and on mosses, roots and stems of herbs.

One of the more abundant plants occurring at this stage of the succession on rocks in John Forrest National Park is Verticordia plumosa, the Granite Feather Flower. This is a low shrub with small crowded needle-like leaves and pink flowers. The flowers have short fringes on the calyx lobes giving them a feathery look. It flowers from late spring to early summer.

SOIL COMPOSITION AND FORMATION

Soils consist of three basic components:

1) Mineral matter which originates from rocks that have decomposed.
2) Organic residues from plants that have decomposed.
3) The soil solution consisting of water and soluble salts.

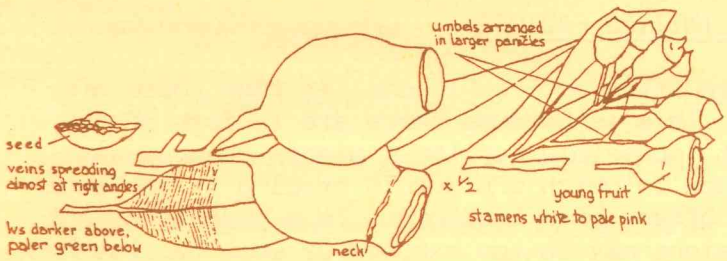
These three components originate at different stages of soil formation. The first to appear is the mineral material, with the rocks undergoing physical disintegration with few changes to chemical composition.

This occurs in several ways:

a) The most soluble binding components of the rock dissolve causing the rest of the rock to break apart.
b) Water may enter cracks in the rock, expand on heating or freezing, build up high pressures and cause the rock surface to crack and crumble.

c) The rock may split further as a result of pressure from expanding plant roots.
d) Water, at times carrying rock particles, flowing over the surface of the granite has an abrasive effect, causing it to erode.
e) The rock may break due to the pressure exerted by its different mineral components expanding and contracting at different rates through temperature changes.

There are many other causes of rock disintegration. As a rock particle gets smaller it is likely to wear at a higher rate. This is because it has a larger surface area per unit volume, exposed to eroding forces.



Marri
Eucalyptus calophylla.

Organic residues are deposited much more rapidly than are minerals. Once sufficient mineral element grains are deposited in hollows and start to catch water, they are capable together of supporting plant life which then dies and is quickly decomposed by the micro-organisms in the deposits. Where some of this plant matter accumulates, the soil contains more nutrients and is capable of supporting more plants which in turn decompose and the soil deepens.

Soil solution occurs immediately there is sufficient particulate matter to hold water and there is moisture. The soluble salts are obtained from both the mineral deposits directly and the organic matter.

NICHE SELECTION AND COMPETITION

Every plant species has to find its particular place in a community where the chance that it will survive and reproduce is the greatest. The PLACE* where a species has a survival advantage over other species is its ECOLOGICAL NICHE.

A plant species is most likely to continue to exist if the highest possible percentage of its members can successfully set and disperse seed, and this in turn is governed by physical growing conditions, competition from other plant species and by predation from grazing animals.

No individual plant can select is own niche but it can contribute to the selection of a niche for the species. If it germinates in a place which is suitable for a plant of that species to grow it most likely will set seed when mature, contributing to the continuation of that species. If however, it germinates in a place unsuitable for growth, ie. incorrect moisture level, nutrient availability, soil depth or in a thicket of another species; the chances are that it will not grow to maturity to set seed. It then does not contribute to the continuation of that species.

COMPETITION for available resources between plants is a very strong SELECTIVE PRESSURE. They compete for every resource available to them and which is necessary for growth and survival.

* PLACE in this context means a position in both time and space.

These include nutrients, light, water and space. Everything and anything which can be used by more than one species or even more than one plant is competed for.

A plant has a SELECTIVE ADVANTAGE over another if it can make more efficient use of, or exclude another plant from using a resource.

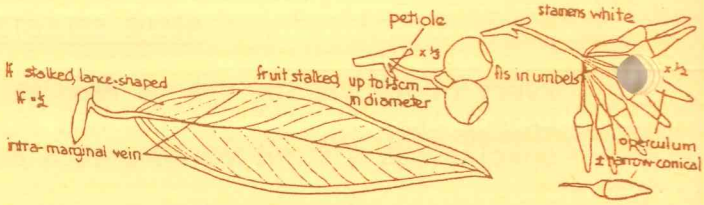
On granite rocks, in the early stages of plant succession, where the nutrients are fewer and space is limited there is great competition for these resources. The resultant community has a few dominant species at each stage, e.g. Borya nitida. In the late stages where granitic soils have built up to a fair depth, the nutrient availability is high and space is not so limited. This means competition is reduced giving an area of greater SPECIES RICHNESS.

GROWTH LIMITING FACTORS

On granite outcrops many plants are often noticeably smaller than those of the same species found elsewhere. This is because there are factors of the physical environment which make it impossible for those plants to grow any larger. These may be that the crack in which a plant is growing is too small to support a larger root system. Often, if a tree grows to a certain height any branches growing above that height may be too exposed or weak to live and may blow off in strong winds. Other factors including chemicals in the soil may influence the height. Of all the various requirements to growth of a plant, only one will generally be the component which prevents further enlargement although all other components may be present. This influence is referred to as the GROWTH LIMITING FACTOR.

BIOLOGICAL TERMS WHICH MAY BE NEW TO YOU

ECOLOGICAL NICHE
COMPETITION (Biological)
SELECTIVE PRESSURE
SELECTIVE ADVANTAGE
SPECIES RICHNESS
GROWTH LIMITING FACTOR



FIELD WORK

Jarrah
Eucalyptus marginata

Exercise 1)

Count the number of plant species in a 1m x 1m area of early succession and an equal area of late succession.

Q.1) What did you find? Explain why.

Q.2) Do you think this is representative of the entire area? Why, or why not?

Now have a close look at the plants in both your areas.

Q.3) Do the plants in any one area have any common features? Can you suggest a reason for this?

Q.4) Are there any features common to both the plants in your first area and those in your second? Why do you think this is so?

Exercise 2)

Take a walk around the granite rocks and make notes on the following questions.

Through the succession:

Q.1) What happens to the height of the plants?

Q.2) What happens to the depth of the soil?

Q.3) Is there an increase or decrease in the number of species?

Q.4) Is there a change in the abundance of individuals? If so, what is the change?

Q.5) Can any of the first four answers be related to another?

Exercise 3)

Using the key, which your teacher will explain to you, try to identify as many of the plants as you can.

Key to plants found in granitic soil and not mentioned in text

1) TREES (above 15 ft)

2) prominant margin on leaves small nuts, bark stringy — - Eucalyptus marginata Jarrah

2) bark roughly broken up into small squares, red sap, large nuts — - Eucalyptus calophylla Marri

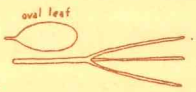
(see diagrams in text)

1) SHRUBS (less than 15 ft)

2) leaves needle-like — go to Section 1

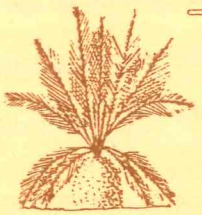
2) leaves flat and broad — go to Section 2

2) both needle-like & flat on same plant



- Hakea trifurcata

2) palm-like plant



- Macrozamia riedlei Zamia Palm

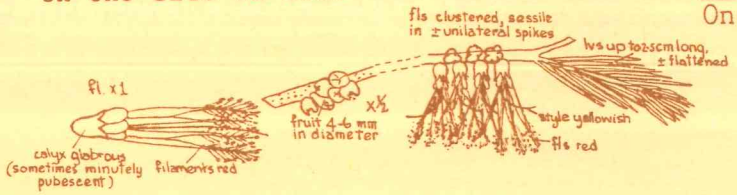
SECTION 1

1) LEAVES SIMPLE

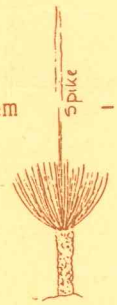
2) has distinct cones

- Casuarina humilis

2) has flowers or fruit mostly on one side of stem — - Calothamnus quadrifidus One-sided Bottlebrush



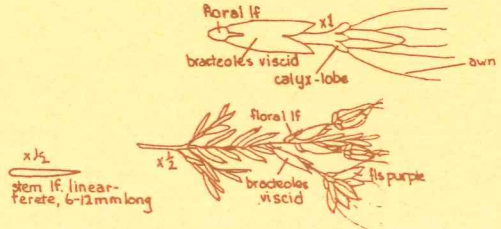
2) has large black trunk with leaves skirting top occasional tall single flower stem



- Xanthorrhoea preissii Blackboy

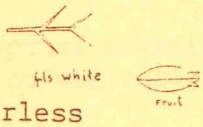
2) has tiny leaves (0·5 -1 cm) on low shrub lilac-pink flowers with star-like calyx in Spring.

- Calytrix glutinosa



1) LEAVES COMPOUND (Branched)

2) leaves set almost at right angles to stem. Leaves finely hairy (brown) fruit beaked and tuberculate



- Hakea lissocarpha

2) leaves upright & fine hairless in relation to above, fruit not beaked.

- Hakea trifurcata (see above).

SECTION 2

1) LEAVES SIMPLE (Unbranched)

2) Has woody fruit

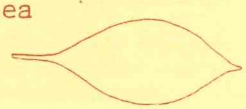
3) leaves large, broad & spiked fruit large with horny crest

- Hakea cristata

3) leaves large (40mm) broad, lightly spiked wavy variation prominant fruit small

- Hakea undulata

3) leaves large (40mm), elliptic fruit large, flowers sea urchin like



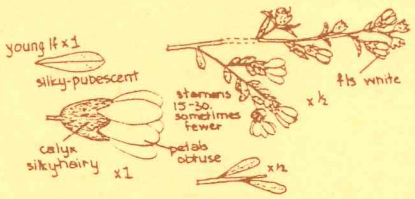
- Hakea petiolaris
Granite Hakea

3) leaves narrow, long (40mm) curly & often twisted

- Hakea stenocarpa

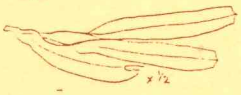
3) leaves minute (2-5 mm) fruit (5mm) with five (5) openings

- Leptospermum erubescens
Ti-tree



2) Has no woody fruit

3) leaves narrow seem to be cut off at ends yellow flowers



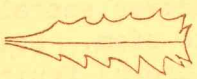
- Hibbertia glaberrima

3) leaves upright hugging stem bell like flowers hanging in winter & spring

- Phylanthus calycinus
False Boronia

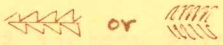
1) LEAVES PINNATIFID

2) leaves 5-10 cm
dense bushy plant



- Dryandra armata

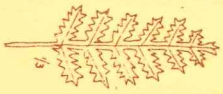
2) leaves narrow 20cm
plant low to ground



- Dryandra nivea
Honey pot

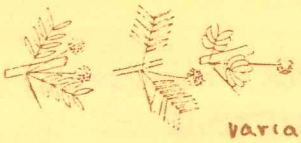
1) LEAVES COMPOUND (Branched)

2) leaves bipinatafid



- Grevillia bipinatifica
Fuschia Grevillea

2) leaves small (1-2 cm)
spikes on stems



- Acacia pulchella
Prickly Moses

2) leaves in three main segments
each again divided
leaves prickly, large
woolly flowers

- Petrophile biloba