To study the effect of fragmentation of woodland by human activity

School name:

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(Group 15)

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Content:

Reason of studying:

Development and ecotourism has been carried out in country sides at different parts of Hong Kong. These developments are to provide roads and facilities for visitors to use or access the wild environment. However, these developments lead to fragmentation of woodlands. Fragmentation describes the emergence of discontinuities in an organism's preferred environment (habitat). Habitat fragmentation can be caused by geological processes that slowly alter the layout of the physical environment or by human activity such as land conversion, which can alter the environment on a much faster time scale.

Does fragmentation has any effect on the habitat? If there is any, would the effect be harmful or beneficial? By studying the diversity and distribution of organisms at different areas in the woodland, the effects and their nature are likely to be found.

Objectives:

- To study the effect of fragmentation of woodland on the diversity and distribution of organisms in areas at the boundary of a woodland near the footpath and areas deeper inside the woodland.
- To evaluate whether the effect of fragmentation on the habitat is harmful or beneficial

Principle and Method of investigation:

Biodiversity refers to the vast variety of different life forms in an area. It reflects how suitable the area is for various organisms to live in. Generally speaking, the habitat should thus provide a better living environment for organisms if there are a larger variety of organisms.

To further prove whether an area is a good living environment for organisms to live in, the distribution of organisms should also be taken into account. The distribution of organisms measures the quantity or percentage coverage of each type of organisms in an area. It reflects whether the environment is favourable for a particular species. For instance, if a species which has low tolerance towards pollution in an area is found to be in large quantity, it could be concluded that, that area is less polluted.

It is, therefore, the two factors mentioned above could help study the suitability of an

area for organisms to live in.

By comparing these two factors of areas at the boundary of woodland near the footpath and those deeper inside the woodland, the effect of building the concrete road inside the woodland (fragmentation) could be estimated.

The diversity of organisms of an area by counting the number of species found. The types and abundance of vegetations within the 1m X 1m quadrat was counted. For small organisms, like insects and invertebrates, could be found out by observing the ground surface and digging the soil, so that organisms living underground could also be found.

To measure the distribution of organisms, just count the number of organisms of that species in an area. For organisms which are in large number but tiny in size or very difficult to be counted, like lichen, their percentage coverage is found instead.

Field trip equipment:

1. Transect Line(5m) X 1
2. 5.5 m measuring tape X 1
3. Metre rule X 2
4. Thermohydrometre X 1
5. Plastic Bags X 2
6. Forceps X 3 (blunt and fine)
7. Vial X 6 (large, medium and small)
8. Magnifying glass X 1
9. Compass X 1
10. Cotton Gloves X 4 (pairs)
11. 0.5m X 0.5m Quadrat X 4
12. Map X 1
13. Anemometer X 1
14. Tape X 1
15. Scissors X 1
16. Nylon String X 1 (roll)
17. Thermometer X 2 (Soil and air)
18. Leveller X 1

Time: 6th April,2008 (Sunday)

Venue: Rotary Club Park Nature Trail

Process:

1. Four quadrats of land with area 50 x 50 cm^2 were selected and bounded along the transect-line using 4 quadrats for investigation.

2. Number of vegetations within the chosen areas was counted with their photos taken.

3. Organisms on the surface of the soil were observed, photographed and recorded.

4. Soil was scratched to about 5 cm deep to see if any organisms living underground could be found. Any findings were photographed and recorded.

5. Soil sample of 15 cm^3 was taken for testing soil pH at every chosen area, stored in plastic vials.

6. Diameters of tree trucks of each tree were measured using a measuring tape.

7. Percentage coverage of lichen on each tree truck at 150 cm was recorded with a book as a reference area.

8. Wind speeds were recorded using an anemometer.

9. Wind directions were recorded using a compass.

10. Atmospheric temperatures were recorded using a thermometer.

11. Atmospheric humidity was recorded using a thermohydrometre respectively.

12. Temperature and humidity at soil surface were recorded.

13. Soil temperatures were measured by a digital thermometer.

14. Light intensity at 165 cm above the ground at every selected area was recorded using a digital Lux-metre.

15. Slopes of chosen areas were measured using a leveler and 2 metre-rules.

Result:

The fauna, flora and abiotic factors at the boundary of woodland near the footpath

(There were 2 areas, area 1 and area 2, being examined in this part)

The percentage of coverage of **fauna** in area 1

	Name	Size	Percentage coverage
1.	Weaver Ant (*Oecophylla smaragdina*)	1mm	10%
2.	Spiny Ant(*Polyrhachis dives*)	3mm	15%

The percentage of coverage or numbers of individuals of **fauna** in area 2

	Name	Size	Percentage coverage/ numbers of individuals
1.	Weaver Ant (*Oecophylla smaragdina*)	1mm	13%
2.	Spiny Ant(*Polyrhachis dives*)	3mm	10%
3.	mites	1mm	1
4.	Spider	5cm	1

The percentage of coverage or numbers of individuals of **flora** in area 1

	Name	Size	Percentage coverage /numbers of individuals
1.	Yellow Cow Wood (*Cratoxylum cochinchinense*)	Diameter: 23.8cm	1
2.	lichen	---	10% on the tree
3.	Rusty-haired Rospberry (*Rubus reflexus*)	Height: 40cm	1
4.	Creeping Psychotria (*psychotria serpens*)	---	2

The percentage of coverage or numbers of individuals of **flora** in area 2

	Name	Size	Percentage coverage /numbers of individuals
1.	Rough- leaved Holly (*Ilex asprella*)	Diameter: 48.3cm	1
2.	lichen	---	15% on the tree
3.	Rusty-haired Rospberry (*Rubus reflexus*)	Height: 40-50cm	4
4.	Dicotomy Forked Ferm (*Dicranopteris pedata*)	Height: 10-15cm	2

Abiotic factors in area 1 and area 2

	Area 1	*Area 2*
Soil surface temperature	29℃	26℃
Soil temperature	22.2℃	23.1℃
Tree temperature	23.3℃	23.8℃
Soil surface humidity	50%	58%
Air humidity	92%	92%
Wind speed	$3ms^{-1}$	$3ms^{-1}$
Wind direction	340°	340°
Light intensity at 165cm	405 x 10	1437 x 10
Slope	0.18	0.18

The fauna, flora and abiotic factors at the areas deeper inside the woodland

(There is 2 areas , area 3 and area 4, being examined in this part)

The percentage of coverage or numbers of individuals of **fauna** in area 3

	Name	Size	Percentage coverage/ numbers of individuals
1.	Weaver Ant (*Oecophylla smaragdina*)	1mm	10%
2.	Spiny Ant(*Polyrhachis*	3mm	12%

	dives)		
3.	Black-tipped leafhopper(*Eucriotettix oculatus*)	1.5cm	1

The percentage of coverage or numbers of individuals of **fauna** in area 4

	Name	Size	Percentage coverage/ numbers of individuals
1.	Spiny Ant(*Polyrhachis dives*)	3mm	13%
2.	Weaver Ant (*Oecophylla smaragdina*)	1mm	11%
3.	Grasshopper	1.5cm	1
4.	Spider	---	1
5.	home fly	---	1
6.	Oriental Cockroach (*Opisthoplatia orientalis*)	2cm	1

The percentage of coverage or numbers of individuals of **flora** in area 3

	Name	Size	Percentage coverage /numbers of individuals
1.	Yellow Cow Wood (*Cratoxylum cochinchinense*)	Diameter: 51.0cm	1
2.	lichen	---	3% on the tree

The percentage of coverage or numbers of individuals of **flora** in area 4

	Name	Size	Percentage coverage /numbers of individuals
1.	Rusty-haired Rospberry (*Rubus reflexus*)	Diameter: 29.2cm	1
2.	lichen	---	22.5% on the tree
3.	Rough-leaved Holly (*Ilex asprella*)	---	4

Abiotic factors in area 3 and area 4

	Area 3	Area 4
Soil surface temperature	25℃	25℃
Soil temperature	22.8℃	22.8℃
Tree temperature	23.1℃	23.1℃
Soil surface humidity	56%	58%
Air humidity	92%	92%
Wind speed	$3ms^{-1}$	$3ms^{-1}$
Wind direction	340°	340°
Light intensity at 165cm	552x 10	212x 10
Slope	0.18	0.18

Discussion:

Result interpretation:

Concerning the physical quantities, generally, area near the footpath, i.e. area 1 and 2, had a higher soil surface temperature, tree temperature and light intensity, but a lower soil humidity, compared with the area deeper inside, i.e. area 3 and 4. This was because the outer area had less dense population of trees, due to the building of the footpath. More sunlight could reach the outer area, increasing temperatures and

decreasing soil humidity through more rapid evaporation of water.

There were more types of fauna in inner area than outer area, with 7 and 4 species in total respectively. For flora, there were 6 types in the outer area, more than 4 types of species in the inner area.

The areas deeper inside had a lower soil surface temperature and had a lower light intensity. Average tree and soil temperature were also lower. This prevented the plants from a too high rate of transpiration and animals would not be dehydrated easily. As a result, the area deeper in the woodland accommodated a more diversified population of species. However, flora usually had a higher tolerance than fauna. Therefore, population of flora was higher in the outer area. But it could be observed that flora in inner areas was more flourished, indicating the effect of human disturbances on flora was not favourable. Fauna preferred inner area to outer one, because of fewer disturbances and a milder environment.

Fragmentation describes the emergence of discontinuities (fragmentation) in an organism's preferred environment (habitat). Habitat fragmentation can be caused by geological processes that slowly alter the layout of the physical environment or by human activity such as land conversion, which can alter the environment on a much faster time scale. The former is suspected of being one of the major causes of speciation. The latter is causative in extinctions of many species.

Fragmentation and destruction of Great Ape habitat in Central Africa, from the GLOBIO and GRASP projects.

Habitat fragmentation is frequently caused by humans when native vegetation is cleared for human activities such as agriculture, rural development or urbanization.

It removes the trees or vegetations on the roads or the site of facilities. This would lead to a lower reproductive rate for plants. It is because, many of the roads are pressed heavily by humans or machines, so that the space between soil particles are very little which in turns leads to very few oxygen stored. When the seeds of the plants fall onto the roads, it is hard for them to germinate since there will not be enough water and oxygen in the soil. As those seeds of plants at the boundary will have a high chance to fall onto those roads or facility sites, their germination rate may be lower which leads to a lower reproductive rate.

Fragmentation would also lead to a higher intensity on the soil surface. It is because

there would be fewer trees to block the sunlight from above. More light would be able to reach the ground which would lead to a higher intensity on the ground surface. Some small organisms may have low resistance towards dehydration, so that they may choose to move to areas deeper inside the woodland which has relatively lower light intensity to prevent dehydration.

Sources of Error:

1. Sampling error
   The transect line including parts of the woodland to be investigated was randomly chosen. The chosen part might not be able to present the whole picture of the woodland.

2. Nocturnal behaviour of organisms cannot be investigated
   The nocturnal animals would not show up during daytime when we carried out

our investigation. Only the data of the diurnal animals could be collected.

3. Change in abiotic factors during investigation
   Physical factors like wind speed, wind direction and light intensity changed over time during our investigation, making the data recorded not accurate.

4. Season and weather
   Some animals would not show up in certain seasons, like snakes in winter. Besides, alternation of seasons and weather changes the content of soil and litter. For instance, water content of soil would increase after raining and there would be more fallen leaves in the litter in autumn.

5. Human disturbance
   When walking in the woodland and along the trail, certain species of organisms would be frightened by our sound or smell to hide them or escape. Also, turning over of leaves on the ground would cause materials splitting out and scare some organisms away. Investigation over their abundances would not be accurate.

6. Human error in measurement
   It was very difficult to obtain accurate numerical data of the physical factors. Leaves of trees would affect light intensity measured at areas beneath the trees. And some trees were too tall for their height to be measured accurately. Some estimation was made here.

Limitations:

1. Small investigation area
   The area of woodland examined was too small to be representative compared to the whole woodland. The findings of certain organisms within the transect line might be only by chance and the whole picture could not be shown.

2. Distribution of lichen affected by texture of trees
   The percentage coverage of lichen on trees would be affected by texture of trees, i.e. there should be more lichen on smooth tree trunks. Therefore, the distribution of lichen we investigated was not necessarily affected by the human activities near peripheral areas.

3. Some organisms were too small to be observed

Some organisms such as soil mites were too small to be observed. As a result, investigation over their abundances might not be accurate.

Suggestions for improvements:

1. Increase number of samples
   More areas of the woodland should be studied and an average result can be made to improve the reliability of the investigation. The effects of various errors can be minimized as well.

2. More advance equipment used
   More advanced and accurate equipment can be used, for example, digital thermohygrometre should be used, instead of thermohygrometre, to reduce human error in taking readings.

Further investigations:

1. Night investigation
   The change in population of organisms during night time in the same site should be investigated. Any special characteristics concerning nocturnal animals should be noted. Then, a more complete view on the biodiversity of woodland can be obtained.

2. Seasonal investigation
   Change in population and characteristics of organism in the same site should be investigated in different seasons. Then, effects of seasonal change of physical factors on organisms and plants in woodland can be better understood.

Recommendations:

1. Reduce fragmentation
   Fragmentations in natural woodland should be reduced and rural areas should not be developed at too fast a rate, so that chances and effects of human disturbance on organisms can be minimized.

2. Regulation on woodland
   The government can set up trial plots and monitor the growth performance of various species in different environment, so as to review the extent of human intrusion on natural woodland.

Conclusion:

From the results above, it could be concluded that fragmentation leads to a decrease in diversity and distribution of organisms. It is found that the inside area of the woodland has more organisms compared with the boundary. The human impact on the woodland is significant. The effects brought by fragmentation are harmful. Developments of country sides should be reduced. The objective of the investigation is fulfilled.

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Index:

Photos of field trip