

Year 11 Biology

Ecosystem Dynamics @ Penrith Lakes

(Population Dynamics - includes depth study modelling)

Key Inquiry Question:

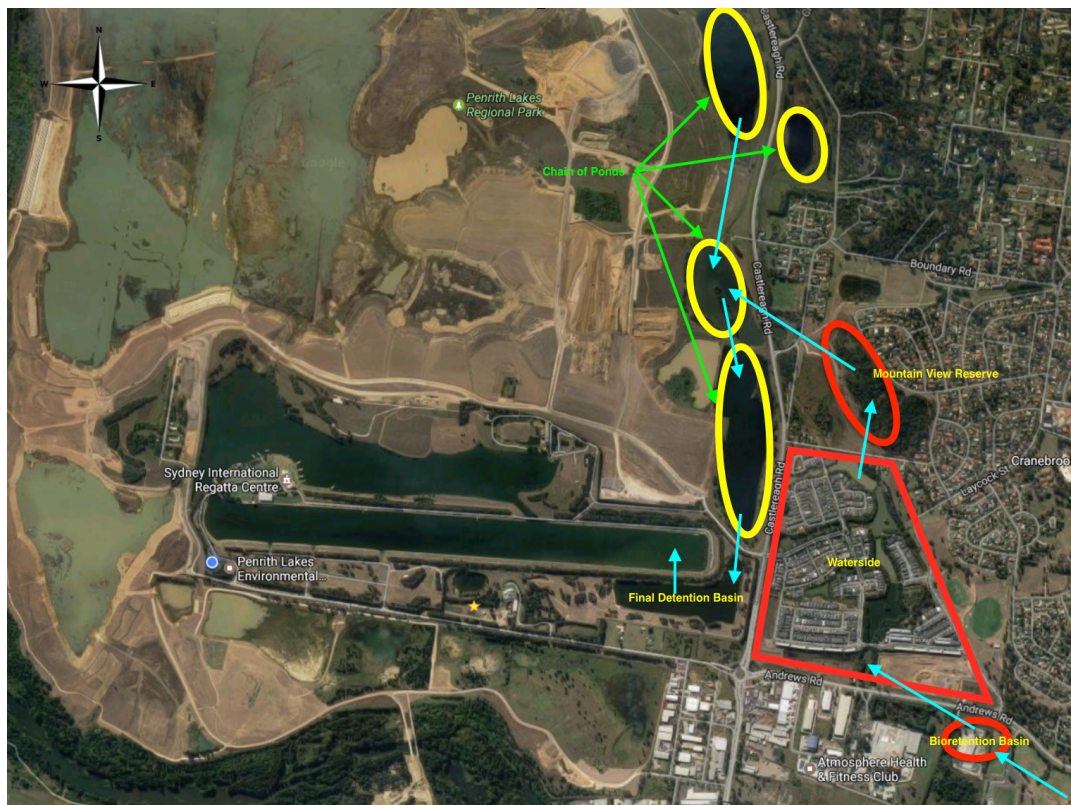
What effect can one species have on the other species in a community?

Students:

- investigate and determine relationships between biotic and abiotic factors in an ecosystem, including: (ACSBL019)
 - the impact of abiotic factors (ACSBL021, ACSBL022, ACSBL025)
 - the impact of biotic factors, including predation, competition and symbiotic relationships (ACSBL024)
 - the ecological niches occupied by species (ACSBL023)
 - predicting consequences for populations in ecosystems due to predation, competition, symbiosis and disease (ACSBL019, ACSBL020)
 - measuring populations of organisms using sampling techniques (ACSBL003, ACSBL015)
- explain a recent extinction event (ACSBL024)
- investigate changes in past ecosystems that may inform our approach to the management of future ecosystems
- investigate practices used to restore damaged ecosystems, Country or Place, e.g.:
 - mining sites
 - land degradation from agricultural practices

Name _____

Inquiry Question: How healthy is the Ecosystem at Penrith Lakes?



STATION 1 Abiotic Factors

Use water testing kit to collect abiotic data for this site.

Site: <i>Final Detention Basin</i>	Conditions:	Date:	Time:
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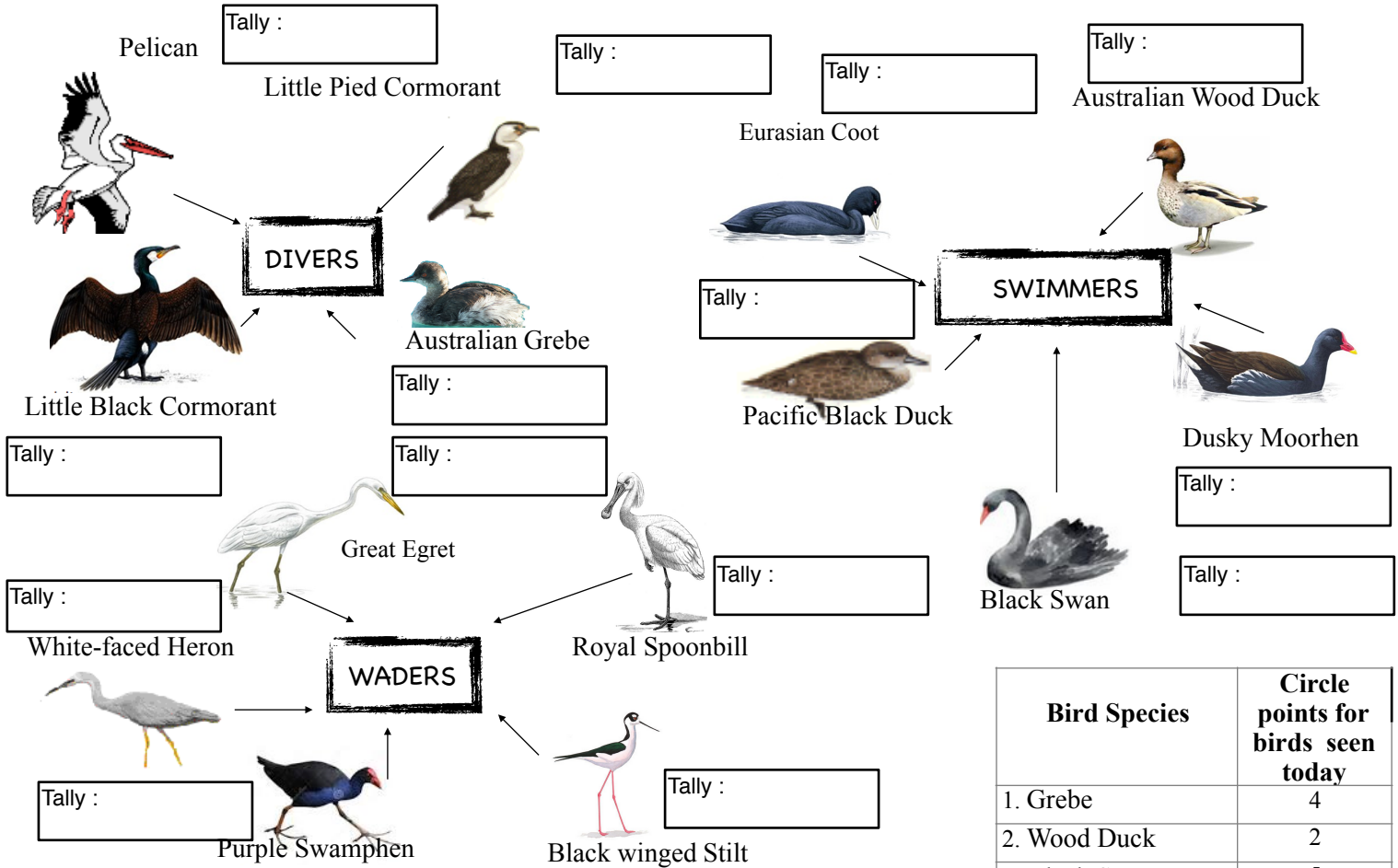
Factor	Equipment Used / Units	Your small group results	Average results for your group
1. Phosphate (Nutrient) - <i>Half fill tube. Dissolve tablet. Wait 5 mins. Compare water to chart.</i>	Test tablet kit - ppm (Parts per million)		
2. Water pH - (Blue box) <i>Fill tube. 3cm of paper in tube. Wait 1 min. Compare paper to chart.</i>	Universal Indicator Paper - a number		
3. Turbidity	Turbidity Tube - NTU's (Nephelometric Turbidity Units)		
4. Water Temperature	Digital Thermometer - °C (Degrees Celsius)		
5. Dissolved Oxygen - <i>mg/l is the reading on DO meter. Use conversion chart to get % sat.</i>	Dissolved Oxygen Meter (Milligrams per Litre)	mg/L	mg/L
	Conversion Chart - Temp, mg/L and % (% saturation)	% saturation	% saturation
6. Conductivity or Total Dissolved Solids (Salts)	Total Dissolved Solids (TDS) Scan- ppm (Parts per million)		
7. Light	Light / Lux Meter - Lux		
8. Slope	Clinometer - Degrees (°)		
9. Wind exposure (speed)	Anemometer - kph		
10. Water Depth	General knowledge of lakes.	4m	
11. Visual Pollution	Visual Assessment. Use your eyes.	Circle the appropriate result: LOW MEDIUM HIGH	
12. Water Source		Groundwater and run-off	

STATION 2 Dipnetting

- Invertebrate population sampling - (Results given in wrap up)

STATION 3 Waterbird Observation

1. On your walk - Look at the bird pictures.
2. Keep a tally of the number of birds sighted for each species.
3. Using column 5, fill in the bird numbers seen today. The teacher will guide you. Use this to work out abundance/distribution and then a habitat/food supply point score.



Bird Species	Circle points for birds seen today
1. Grebe	4
2. Wood Duck	2
3. Black Swan	5
4. Stilt	5
5. Dusky Moorhen	3
6. Eurasian Coot	3
7. Great Egret	5
8. Black Cormorant	4
9. Pied Cormorant	4
10. Black Duck	3
11. Pelican	5
12. Purple Swamphen	4
13. Royal Spoonbill	5
14. Heron	5
15. Other	5
Total point score TODAY	<input style="width: 50px; height: 20px;" type="text"/>
Habitat total bird score? ↓	
0-10	Poor
11-18	Fair
19 - 25	Good
>25	Excellent

Waterbird Counts at 5 survey sites (Teacher will help you fill this out)							
Bird Species / Site No.	1	2	3	4	5*	Abundance	Distribution
1. Australian Grebe			1				
2. Australian Wood Duck	3	4	6	12			
3. Black Swan							
4. Blackwinged Stilt				2			
5. Dusky Moorhen							
6. Eurasian Coot			4				
7. Great Egret							
8. Little Black Cormorant							
9. Little Pied Cormorant		6		2			
10. Pacific Black Duck				8			
11. Pelican		1	1				
12. Purple Swamphen	4						
13. Royal Spoonbill							
14. White-faced Heron			1				
15. Other: _____							
Total Abundance per Site	<input style="width: 30px; height: 20px;" type="text"/>	11	13	24			
Total Species per Site	<input style="width: 30px; height: 20px;" type="text"/>	3	5	4			

Wrap Up

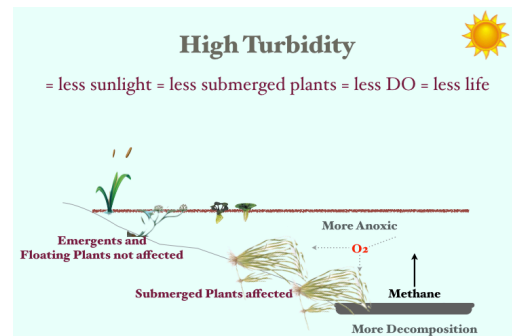
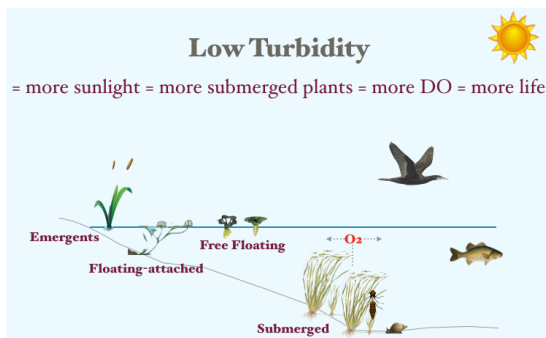
Analysis of abiotic and biotic key relationships

Turbidity, Light and Dissolved Oxygen

- The final basin has low turbidity (abiotic factor).
- An \uparrow sunlight (abiotic factor) \rightarrow \uparrow aquatic plants (biotic factor) \rightarrow \uparrow D.O.(abiotic factor) \rightarrow \uparrow invertebrates/aquatic life (biotic factor).

Note: a minimum of 60% D.O is essential for gill breathers such as dragonfly nymphs.

- Farming past : \uparrow turbidity \rightarrow \downarrow sunlight \rightarrow \downarrow aquatic plants \rightarrow \downarrow D.O. \rightarrow \downarrow invertebrates.



A Key Submerged Aquatic Plant Species - Ribbonweed

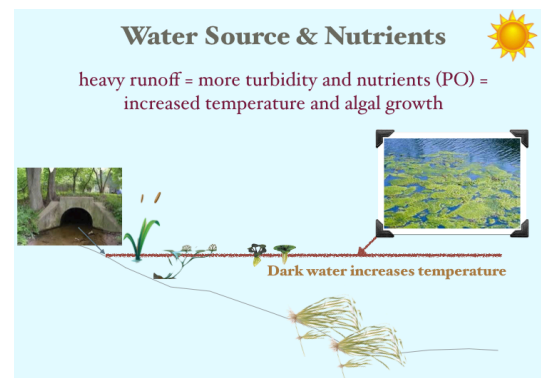
- \uparrow sunlight + low turbidity \rightarrow Ribbonweed \uparrow dissolved oxygen \rightarrow \uparrow aquatic animals.
- Long strands provide shelter for fish and food for snails and other invertebrates.
- Roots take up nutrients, such as phosphate.
- The presence of ribbonweed indicates the waterbody is in good condition.

Phosphate and Water Source

- Phosphate is an essential nutrient for plant growth. It is a plant food. Too much food can cause problems.
- \uparrow urban runoff (main water source for the lakes) \rightarrow \uparrow phosphate levels (>2) \rightarrow \uparrow risk of blue green algae outbreaks.

Note: A series of large detention basins/lakes has been constructed upstream so that the plants in those can remove excess phosphate (and other impurities) from the water prior to it being allowed into the main lakes.

- Farming past : \uparrow phosphate levels (>2) \rightarrow \uparrow algae \rightarrow \downarrow aquatic plants \rightarrow \downarrow D.O. \rightarrow \downarrow invertebrates.



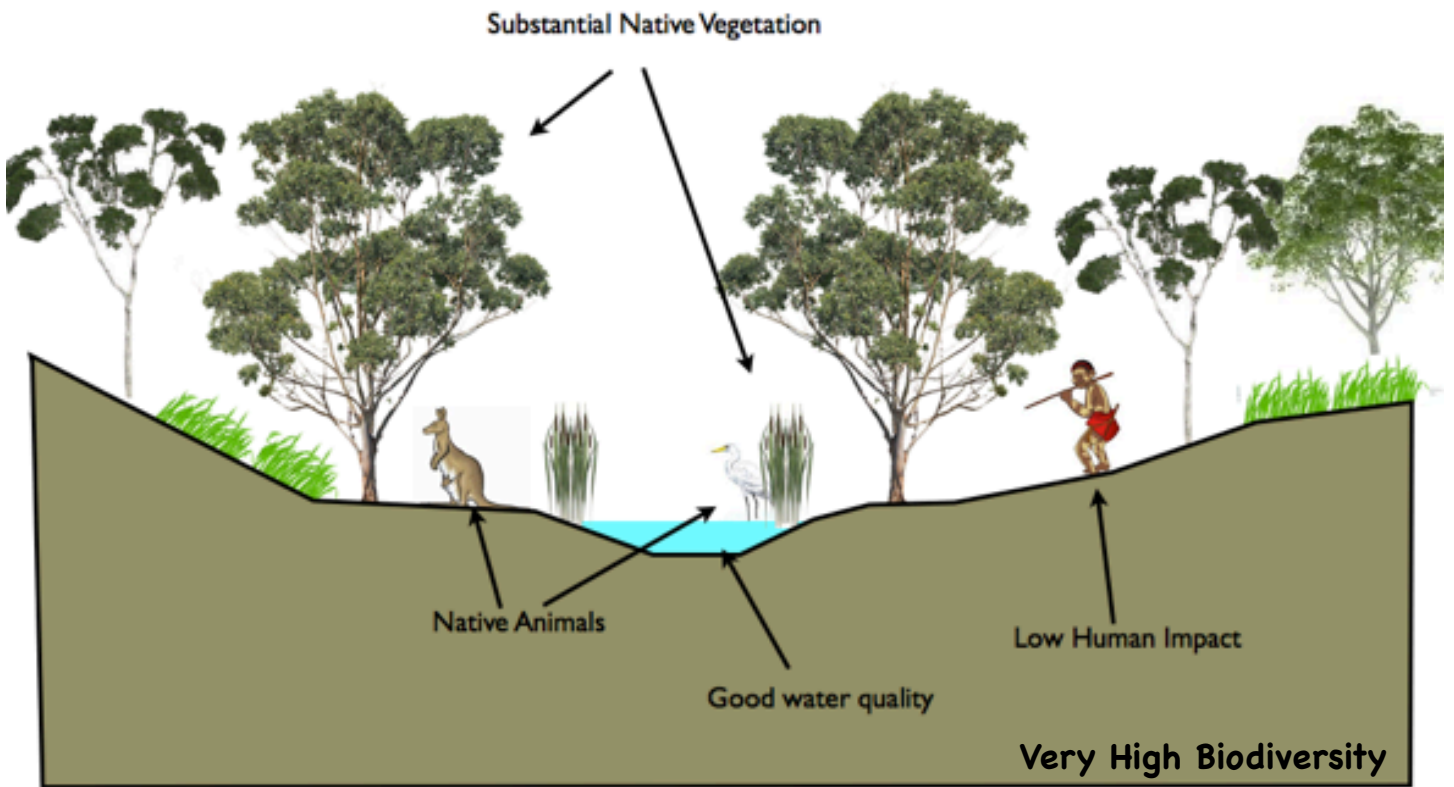
pH and Conductivity/Salinity

- pH is a measure of the hydrogen ion concentration in water. Most aquatic organisms can only survive in the 6-9 pH range. Low pH values are acidic and kill aquatic life.
- Conductivity/Salinity is the amount of dissolved salts present in the water. Higher salt levels \rightarrow \uparrow dehydration of freshwater organisms.

Temperature and Light

- Water temperature is directly dependent on sunlight availability, air temperature and turbidity.
- Temperature affects vital biochemical processes within aquatic organisms and ultimately their survival.
- Most organisms can only tolerate a narrow temperature range.
 - 10 - 30°C = optimal range for macro invertebrates.
 - In warmer water (20 to 30°C), the rate of photosynthesis and plant growth increases. Animal activity also increases .
- Farming past : \uparrow turbidity \rightarrow \uparrow heat absorption \rightarrow \uparrow water temps \rightarrow \downarrow aquatic organisms.

Before White Settlement

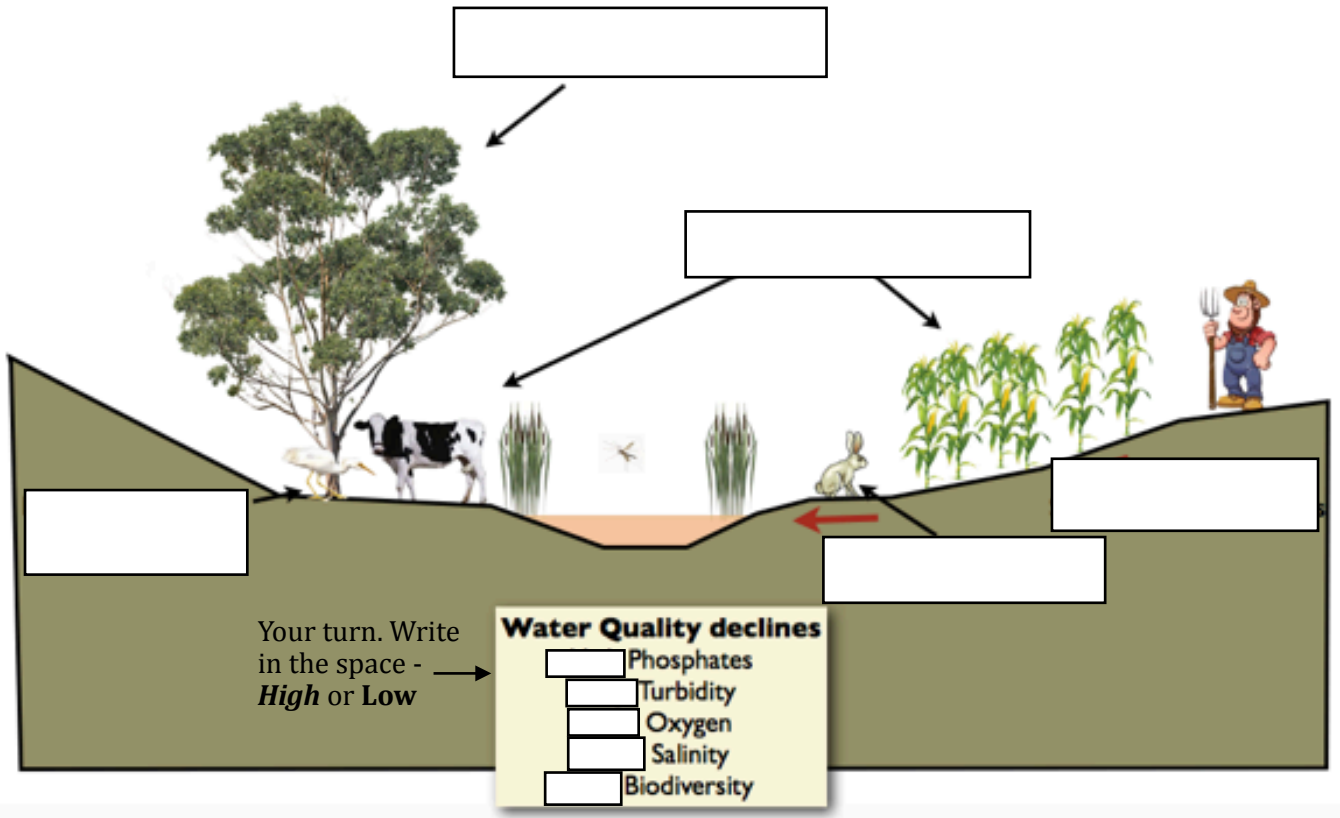


Before White Settlement - Pristine ecosystem (hypothetical measurements)

Turbidity (clarity): <10 ntu				pH : 7			
<10 ntu	10 - 20 ntu	20 - 50 ntu	>50 ntu	6.5 - 8.5	8.6 - 9.0	6.0 - 6.4	<6 or >9.0
8	4	2	0	8	6	4	0
Light: 25,000 lux				Conductivity (salts): 80 ppm			
> 15,000	10k - 15k	5k - 9,999	< 5,000	<250 ppm	251-650 ppm	651-1000 ppm	>1000 ppm
8	4	2	0	8	6	4	0
Dissolved Oxygen: 90%				Phosphate (nutrients): 0.5 ppm			
>60%	50% - 60%	40% - 49%	<40 %	0 - 1 ppm	>1 - 2 ppm	>2 - 3 ppm	>3 - 4 ppm
8	6	2	0	8	6	2	0
Overall Rating	Excellent	Good	Fair	Poor			
Score : 48	40+	32 - 39	31 - 20	less than 20			

Summary - Low turbidity High oxygen Low salinity
 Low phosphates High native biodiversity

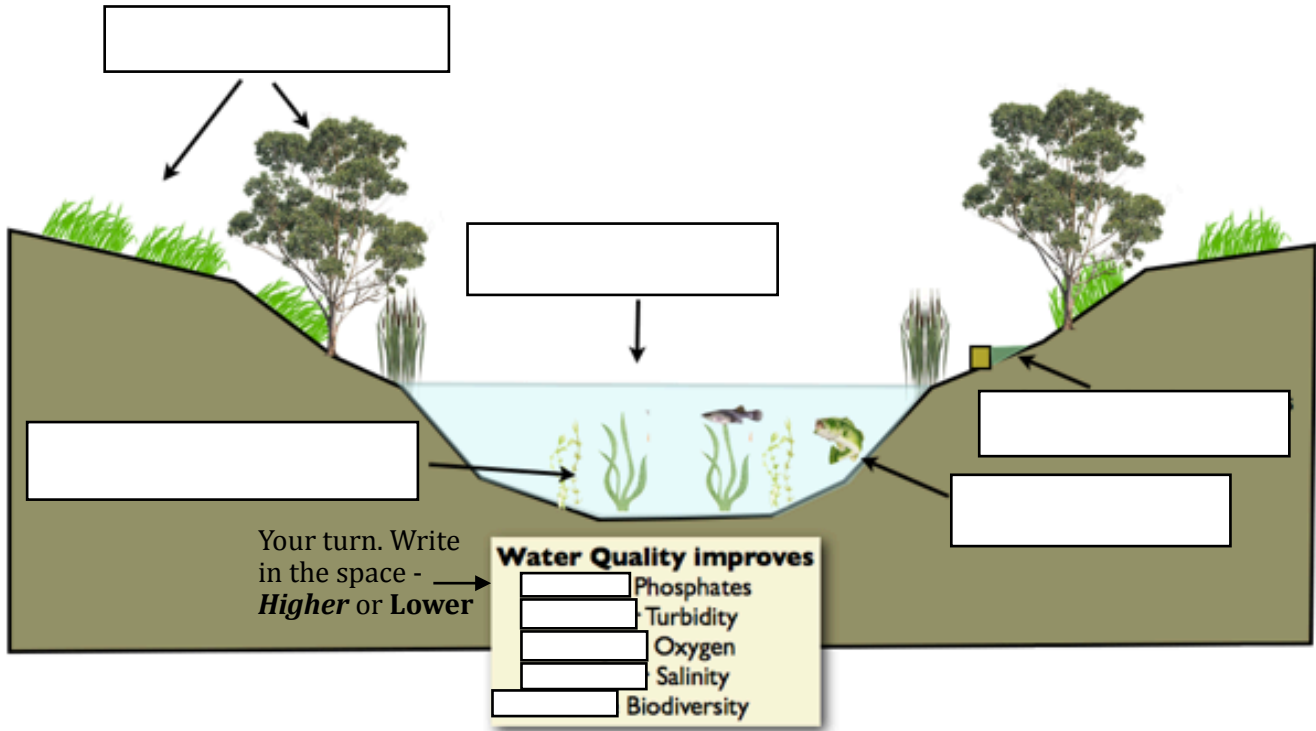
During Farming Era



During the Farming Era

Turbidity (clarity): 250 ntu				pH : 8.6			
<10 ntu	10 - 20 ntu	20 - 50 ntu	>50 ntu	6.5 - 8.5	8.6 - 9.0	6.0 - 6.4	<6 or >9.0
8	4	2	0	8	6	4	0
Light: 3,800 lux				Conductivity (salts): 950 ppm			
> 15,000	10k - 15k	5k - 9,999	< 5,000	<250 ppm	251-650 ppm	651-1000 ppm	>1000 ppm
8	4	2	0	8	6	4	0
Dissolved Oxygen: 25%				Phosphate (nutrients): 2.5 ppm			
>60%	50% - 60%	40% - 49%	<40 %	0 - 1 ppm	>1 - 2 ppm	>2 - 3 ppm	>3 - 4 ppm
8	6	2	0	8	6	2	0
Overall Rating	Excellent	Good	Fair	Poor			
Score : 12	40+	32 - 39	31 - 20	less than 20			

After Quarrying - Now & Future



After Quarrying - Now and the Future

Today's results

Turbidity (clarity): _____ ntu				pH : _____			
<10 ntu	10 - 20 ntu	20 - 50 ntu	>50 ntu	6.5 - 8.5	8.6 - 9.0	6.0 - 6.4	<6 or >9.0
8	4	2	0	8	6	4	0
Light: _____ lux				Conductivity (salts): _____ ppm			
> 15,000	10k - 15k	5k - 9,999	< 5,000	<250 ppm	251-650 ppm	651-1000 ppm	>1000 ppm
8	4	2	0	8	6	4	0
Dissolved Oxygen: _____ %				Phosphate (nutrients): _____ ppm			
>60%	50% - 60%	40% - 49%	<40 %	0 - 1 ppm	>1 - 2 ppm	>2 - 3 ppm	>3 - 4 ppm
8	6	2	0	8	6	2	0
Overall Rating	Excellent	Good	Fair	Poor			
Score :	40+	32 - 39	31 - 20	less than 20			

Conclusions from waterbug sampling

Step 1 - With the help of the instructing teacher-fill out the table of the total waterbug survey results.

Name, picture & Sensitivity Rating	No. Bugs	Circle S.R.	Name, picture & Sensitivity Rating	No. Bugs	Circle S.R.
Back Swimmer		4	Water Beetle		3
Caddisfly Larvae		6	Water Boatman		4
Damselfly Nymph		6	Water Mite		5
Dragonfly Nymph		6	Water Scorpion		3
Freshwater Shrimp		6	Water Spider		4
Giant Water Bug		4	Water Treader		4
Leech		3	Worm		2
Mayfly Nymph		7	Mosquito Fish (vertebrate)		1
Pond Snail		3	Other		
Total Bug SPECIES caught = (This is a TAXA RICHNESS)		A	Total Sensitivity Rating (S.R.) = This is a POLLUTION INDEX		B
Calculate a SIGNAL SCORE (S.S.). Signal Score = Pollution Index (B) ÷ Taxa Richness (A)					S.S. =

Interpreting your results using an **UNWEIGHTED** Signal Score.

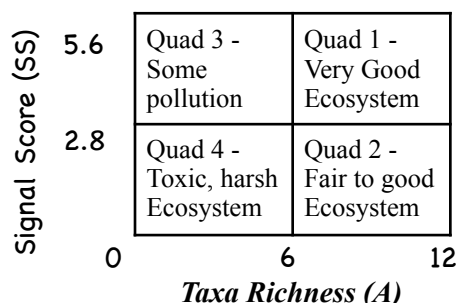
Step 2

Using your signal score, determine a pollution rating. Use the table below.

Signal Score	Pollution Rating
> 3.5	Healthy Habitat
2.8 to 3.5	Mild
2.1 to 2.7	Moderate
< 2.1	Severe

Step 3

A pollution indicator graph. Use your Signal Score and Taxa Richness to plot a point on the graph below.

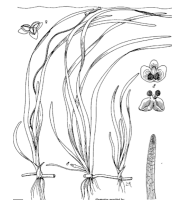


Summary from Farming to Now		
	Past farming	Now and Future
B I O T I C	Edge plants dominate	
	Low oxygen waterbugs	
	Wading birds dominate	
	Few Mosquito Fish	(In warmer months)
	Low biodiversity	
A B I O T I C	High phosphates	
	High turbidity	
	Low dissolved oxygen	
	High salinity	

Keystone Species

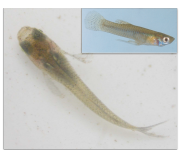
- Submerged aquatic plants
 - E.g. Ribbonweed

These plants take nutrients out of the water. When they carry out photosynthesis the oxygen goes directly into the water. The plants are a source of food (a producer) and oxygen.



A local extinction event - due to predation

Mosquito Fish



Green and Gold Bell Frog

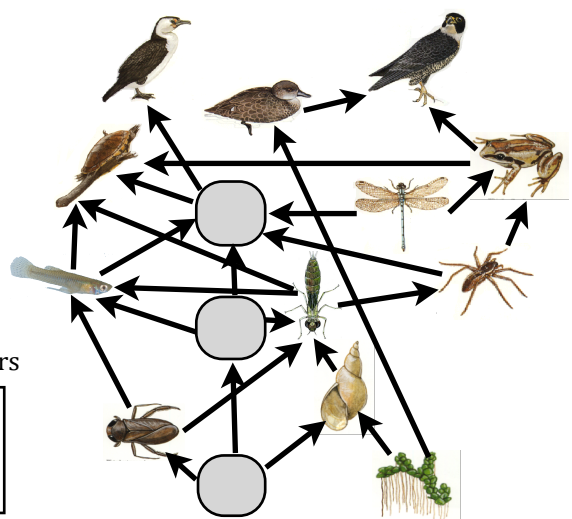


Vs

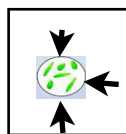
Mosquito Fish

- * Brought in to control _____.
- * Eats a range of _____
- * Responsible for _____ loss (frogs).
- * Tolerates _____ water quality.
- * _____ quickly.
- * Difficult to _____.

Food Web - Place the letter of the 3 missing species



Decomposers



A - Shrimp  B - Bass  C - Ribbonweed 

