**Student questions for seminars in BIOL 510 Winter 2013**

As a group, students selected their 1st, 2nd and 3rd favourites as: 22, 16 and1 (bolded below)

**Grogan: What can biology tell us about our future?**

1. **There is often talk about society transitioning into a period of ‘sustainable growth’ to combat the problems associated with global change such as increased carbon emissions, depleting resources, and the loss of biodiversity. But if we are already living off the world’s natural capital, then can there be such thing as ‘sustainable growth’? Or are sustainability and growth mutually exclusive terms? Is ‘sustainable growth’ a socially constructed delusion to escape the realities of the current state of affairs? Or could it be a manifestation of our drive to compete, in which ‘sustainable growth’ provides justification to comfort our moral anxieties about the actual implications of our actions?**
2. Women may be more effective as leaders for the following reason. Women, as a general stereotype, tend to not compartmentalise their lives as men do. It isn’t something we think about, it just happens. As a result of this, our demise as a human race because of destruction of the Earth may affect other areas under the leadership of women. They won’t be able to ‘put it in a box’ and only deal with it when talking only about that specific topic. Everything is connected and blends together. The next question is: How do we get the general public to believe in women and trust their leadership when they are so used to males?
3. Our consumption is a vicious cycle between consumers, marketers and those manufacturing the products we daily consume. If we cut our consumption, what happens to the people that make it possible to fuel that consumption? Where do they find work? Their line of work will have been cut out of the equation.

**Smil: P in the Environment**

1. It is extremely shocking that over 40% of cereal harvest is used for feeding domestic animals. Smil suggests that “the most fundamental opportunity to minimise the inputs is to reduce the intake of animal foods whose production requires high inputs in growing the requisite feed, and then entails unavoidably large P losses in animal wastes (including bones). The nutritional status of people in affluent countries would not be compromised in the slightest if people were to consume 25% less meat and dairy productions than the current average.” Why is it that we consume such an animal-rich diet if it exceeds our dietary needs? Is this perhaps a manifestation of our consumer culture and overinvestment in acquiring resources despite their being no measurable benefit to us?
2. According to the article, one of the major contributors to excessive P in waterways is the release of untreated or inadequately-treated wastewater into streams or lakes from cities and industries. This fact brings to question the issue of accountability and responsibility. Should large organisations be held accountable for the introduction of excessive P into waterways, or is it our responsibility as consumers and citizens to the be proactive in responding to these issues, or is it the job of government to intervene when the environment is compromised?

**Childers: Sustainability Challenges of Phosphorus and Food: Solutions from Closing the Human Phosphorus Cycle.**

1. One of the first supplemental P fertilisers was bird guano. Economically viable deposits at the time were concentrated in only a few areas around the world, and were all exhausted by the late 1800s. It has been said that guano set the template for modern agriculture. Is this pattern of overexploitation one that we are doomed to repeat again? Is it human nature to repeat our mistakes despite the scientific information available? Is it possible that targeting social forces within our civilisation will be effective in the future?
2. It is only a matter of time before P, a requirement for food production with no viable substitute, becomes one of the most sought after and precious elements on Earth. Without it, a food crisis is imminent. If “90% of the global P supply is provided by five countries”, not only will food security be a concern, but more importantly international security. I think P reserves will become the new ‘oil reserves’, in terms of the power those countries with the resource will have over others that do not. I wonder how long it will take countries like Morocco to realise the leverage their P reserves will have on the global marketplace. And if they do, how will they use that leverage?
3. There appears to be a disconnect between science and business/politics. Is this due to a lack of education, or is it possible that people are in denial? From experience, living in denial is easy when there isn’t a constant bombardment of education… but eventually education makes the difference and people want to do something. Is it possible to implement the ‘easy’ less drastic solutions to the P problem while people are still in the denial phase, thereby buying time until people learn and accept the ‘harder’ solutions that will ultimately be required to resolve the P problem, or must both sets of solutions be implemented simultaneously?

**Hong Guo et al: The removal of nitrogen and phosphorus from reject water of municipal wastewater treatment plant using ferric and nitrate bioreductions.**

1. The paper mentioned that by using microbial reduction of iron ore, ferrous ions can be produced and used to remove P from sewage waste water. Although this method seems wonderful initially, in reality we need to take into account how this will affect the whole ecosystem. I think as biologists, we need to plan our ideas and recommendations carefully, making sure that what seems like a great solution does not create another problem. In fact there are concerns that we are running out of iron ore reserves (-and this is one of the driving factors leading China’s current plans for huge mining activities on Canada’s Baffin Island). Solutions should be sustainable, but this is a challenge for scientists as we are now exploiting many different types of minerals, metals and other materials that are also becoming increasingly scarce.
2. The article states that the high cost of iron salts and lime is a disadvantage of the removal of P. However the alternative costs resulting from water quality problems include increased purification costs, decreased recreational value, loss of livestock, and the effect of algal toxins on drinking water, were all significant. With this in mind, can we afford not to pay? If these water-quality related costs were quantified and realised, would that lead to increased investigation of alternative technologies?
3. I am curious about the potential environmental impact that this purification process could cause since substantial CO2 is emitted. It appears that we cannot solve a problem without causing new ones or intensifying a previous problem. How do we quantify solving one problem over another?

**Adrian:** **What can an analysis of an individual’s ecological footprint for phosphorus tell us about the optimal ways to manage anthropogenic P use?**

1. The concept of biodynamic farming where crops are produced using no inorganic fertilisers is obviously beneficial in reducing anthropogenic impacts on the P cycle, and produces great tasting food. However, there are questions that need to be asked about crop yield and the ability to meet financial and social demands. Do these farms on average produce lower crop yields/ha compared to conventional phosphate fertilised farms? Also, with the world population still growing, will farms like these be able to meet the pressing food demands of the present let alone the future?
2. Being able to calculate your ecological footprint is informative and important to educating yourself about what aspects of your life need most reduction. In this way, creating a P ecological footprint calculator would be useful, but could discourage the ‘average joe’ from making any changes because it targets such a specific population. In the exercise where we had to change aspects of our daily habits to see how much it would reduce our carbon footprint, most of us found that the changes we were prepared to make didn’t make much of a difference to the footprint. Similarly, I feel that the model for P use calculation is based on recycling through three methods, and the most influential flux was that associated with farm P application to support food production. So how will this encourage someone living in the city to compost it they don’t see more than a 2% decrease in their P footprint, whereas a farmer altering one aspect of P application may see a 50% reduction? Possibly tailoring a P model that considers different lifestyles/occupations to make it more specific would encourage a broader range of individuals to participate.
3. Although agricultural practices may play a huge role in P run-off, individuals can also have a huge impact in reducing P use. For example, reducing the use of lawn fertilisers, conserving water so less is being treated in wastewater/sewage treatment plants, buying P-free household products, and composting food waste. I believe that long-term solutions will need to rely on both individual and community-based behavioural changes toward adoption of sustainable practices. The first step should be to improve community support and access to information. To be effective, this should be coupled with education and community-engagement so that it becomes the norm over time, and incentives should be included. For example in social psychology study, homeowners were told how much energy they used compared to their neighbourhood average. Subsequently, they tended to reduce their energy use if they were above average, and vice-versa. Going one step further, a smiley face was printed on their bill if their use was below average, and a sad face if the reverse. Perhaps this kind of approach can be applied to motivate communities toward more sustainable P use.

**Rees: Is Humanity Fatally Successful?**

1. Evolutionary selection pressure in the past has definitely rendered us ill-equiped to come together now and attempt to solve our P-limitation problem. Over the course of our evolution, in order to survive, humans have had certain traits selected for, including those associated with selfishness, greed and violence. The more selfish and better able to protect one’s resources, the more likely humans were able to survive. These genes are still present in us today, and prevent us from coming together as a whole to make decisions that will be best for all humanity.
2. **The author suggests that maladaptive socio-cultural and biological mutations can and will be selected out. However, one of the strongest genetic drivers is for traits associated with reproductive success. Individuals carrying genes that confer a strong drive to reproduce will pass those very genes on to the next generation. In a time where the ‘childfree movement’ is stronger than ever, and we know the world is over-populated, most of the next generation will be from individuals with particularly strong reproductive drives. The problem is that human genetic drives are completely focussed on the benefit to the individual, and not on humans as a species. Is it fair to say the people who want to have children are ‘selfish’? – I don’t think so. However, it is problematic that the individuals that will make up future generations will continue to have amplified reproductive drives in a time when we really need to reduce our population.**

**Raustiala: States, NGOs, and International Environmental Institutions.**

1. A major challenge with policy implementation is that governments are generally in office for terms of just a few years. Therefore, they tend to focus on maintaining the status quo in the short term in order to look good and get re-elected, while long-term issues get the back-burner. I that this short term focus is able to override any efforts made by NGOs to address longer-term issues such as resource depletion. Other than significantly changing the political structure of a country like Canada for example, how can we effectively address this issue and provide NGOs with the power and opportunity they need to carry out global change agendas?
2. Clearly the way our government works makes policy-making and changing minds a numbingly slow process. Our methods for solving problems should be democratic, but also reactionary. Since limitations on P seems to be a newly emerging idea, there does not seem to be a need for an immediate solution, and that is why nothing much is being done. One analogy that comes to mind is if you put a frog in a pot of boiling water it will immediately jump out. If you put it in pot of water that is then slowly heated, it will not react so dramatically, and will remain and eventually die. In the case of unsustainable P use, it is not a ‘hot’ topic, and so we do not have the awareness or measures to respond to something that will happen over the next 50 years. – Of course, this is problematic for the frog (us).

**Schroder et al EU report: Sustainable strategies for improving phosphorus use management**

1. The document notes that there have been very few incentives in place to encourage improvements in the process and handling inefficiencies associated with P use. The authors suggest a potential solution is the stimulation of markets for renewable P fertilisers through subsidies, taxes, competition and investment grants. This solution requires careful thought because the economy and our consumptive habits, particularly in rich nations, are a part of the reason we are faced with looming elimination of P reserves. Is it dangerous to use economic incentives to help solve a problem driven by economic actions? Or does this reversal strategy in fact effectively address the issue of P recovery because it is contextualised in the current state of our consumptive culture? Will this put even more power in the hands of very few individuals? What consequences does this have for the longevity of such incentives as a solution?
2. The report argues that minimizing P losses from mining and fertiliser activities will require “reduction through improved technology *and* more sustainable management at all steps of the material flow”. There is a fundamental conflict here in that throughout human history, we have turned to technology as a solution to our problems. With this longstanding mentality, it will be difficult to encourage the implementation of better management as of equivalent importance to technological innovation. How can we shift from ‘technology as a solution’ to ‘technology as an aide’ so as to facilitate increased awareness of the equal importance of improved management protocols for our use of P and its recovery?
3. There is a strong psychological barrier that prevents the resuse of human excrement as a fertiliser. After seeing the whole treatment process at Ravensview, and how many stages the water and wastes go through, I feel like some of the negative feelings I had surrounding the issue are gone. Should it be recommended that more people visit their local wastewater treatment facilities to reduce some of the stigma surrounding this issue, and to promote public acceptance of the recycling of human wastes?

**Costanza: The value of the world's ecosystem services and natural capital**

1. **The economy can only exist if the earth does, but the opposite is not true. So why do we treat it as such? When we try to give the ecosystem a monetary value, this in itself degrades its value by assuming it can be measured in monetary terms. Similarly to human trafficking – how much is a young girl worth? Asking the question in itself degrades the value of a human life and reiterates the idea that some things are just not meant to be priced. So if we want to come to a solution, we must realise that monetary incentives impede and cloud our judgement. They keep us away from what should be the focus of our perspective: the earth is priceless and we should treat it accordingly.**
2. The article poses the question as to whether or not the valuation of ecosystems is unwise or impossible, and therefore that we should protect our ecosystems for purely moral or aesthetic reasons, and so do not need valuations. However, the morals of a majority have not come to rescue us yet. If this type of valuation sytesm allows the general population to understand the real worth of our ecosystems, isn’t it worthwhile? Perhaps our consumer culture has caused us to think of everything in monetary values and this type of valuation is more accessible to the general public.

**Carpenter: Resilience and restoration of lakes**

1. The paper illustrated the links between lake degradation, human demography and regional economics. It describes a cycle in which homeowners with land bordering water bodies create lawns and remove shoreline vegetation, leading to an increase in P inputs. As a result the lake degrades and becomes less attractive for recreation. Rather than investing in lake restoration, development shifts to new undisturbed lakes and the cycle continues. I can help but wonder why our society values short-term gains more highly than long-term advantages. Apparently our brain’s amygdalas are hard wired to react to emotions rather than intellect. In other words, our nervous system is designed to handle immediate problems and the long term effects of current behaviour are difficult for us to perceive. If it is true that the human brain has evolved to provide short-term solutions to immediate problems, this information suggests that in order to think about the long-term effects of our actions, we need to make a specific effort to think this way. It seems to be truly sustainable, we need to overcome our human nature.

**Harkin: The Business of Fashion - Cotton Wars**

1. This article brought up an important point – being environmentally aware and being environmentally intelligent are two different things. Although the majority of the public are environmentally aware, only a small proportion are environmentally intelligent. Many will agree that our environment has degraded in the past decade, and also feel that there’s nothing individuals can do to change it. In my opinion, the blame does not rest only on large corporations and governments. Every individual is involved in the active destruction of our environment, particularly via consumption. Consumers must be encouraged to be more aware of the ecological costs of the items they purchase. If we were supplied with details of the ecological costs and consequences of products such as the amount of energy used, waste produced, and the impact on the environment, consumers could choose between competing brands and would eventually become more ecologically intelligent, and better able to challenge producers to reduce their environmental impacts. For example, sustainable and organic food products are not equivalent, and there is no certification for the former. As organic certifications do not include sustainability issues such as fossil fuel consumed in food production and transportation, ecologically intelligent consumers should local sustainably produced food.

**Westheimer, and Simon. Why has life evolved to rely on P?**

1. Everything about P from its tribasic properties, its slow rate of hydrolysis as well as its negative charge clearly make it superior to other elements for certain fundamental biological processes in current life forms. However, when searching for life forms on other planets, we typically look for water and other conditions that might be suitable for life forms like us… and forget the myriad of other life forms that could exist. Apparently, early life forms were able to use arsenic to sustain metabolic activities in the thermophilic environment that Earth once was. In order to fully understand the origins and patterns of life on Earth and to investigate possibilities of life elsewhere, we need to move away from our human-centric perspectives.
2. Our dependence on a biologically scarce element could be nature’s evolutionary way of setting boundaries on a population’s size, almost like a carrying capacity spanning all living organisms. Accepting this concept may change how we perceive future sustainability plans and come to terms with the inconsistencies of a ‘sustainably’ growing population, as well as changing individual attitudes towards concepts like the ‘tragedy of the commons’.

**Reijinders: Quantification of the environmental impact of different dietary protein choices**

1. I found it interesting that the data in this paper proved that often being vegetarian is no better than eating organically/locally grown meat. At the very end, it is stated that a vegetarian diet will decrease our use of resources and therefore be better for the environment. I completely disagree with this. I think that eating locally grown food, vegetables and meat, is much more important and if they are grown organically, all the better. This eliminates all the packaging and transport costs that the environment pays. Eating locally also supports local farmers and is better for the local economy and therefore in my mind, is much more sustainable. Yes, this means not being able to eat everything we want year round, but even if we decrease the amount of imported food as well as food grown in heated greenhouses, our footprint will decrease. Being vegetarian is not the only solution.
2. The article indicates that “long distance transport of 1 kg of food has roughly the same environmental impact as the primary production of 1 kg of organic meat. So vegetarian food flown in by plane may well be at an environmental disadvantage”. It seems that the basic issue is less of a necessity to move from meat-based to vegetarian diets and more so to transition from a global food economy to one that is localised. For those who can afford to pay, there is a propensity to seek out not only meat-intensive diets, but also ‘exotic’ foods. Is it reasonable to ask individuals to forgo food items that require extensive transportation? Should the government be responsible for implementing a ban on food imports that yield high environmental impacts or should it repackage this idea within an economic framework that reorients society toward local jobs, local production, and local consumption?
3. According to this article, the input of rock-based P fertiliser in meat protein production is ~7 times higher than for production of soybean-based protein. There is no substitute for P in crop growth and food production (unlike oil which can theoretically be replaced with solar and wind energy). It is clear that our current global P use patterns are unsustainable, which is partly due to the high inefficiencies in our food production system that result in only a fraction of the mined P reaching the food we consume. Although P from our food waste and manure is one part of achieving sustainable P use, we should be focussing on the improving the efficiency of our mining and fertiliser sections as well as food processing and consumption. Perhaps if we are able to improve these efficiencies, fewer countries and their citizens will have their ‘freedom of food choices’ taken away.