How Big Should the Economy Be?

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Introduction

The aim of geography education in the junior years is, '[t]hrough geographical inquiry', to 'develop an understanding of the interactions between people, places and environments across a range of scales in order to become informed, responsible and active citizens' (BOSTES NSW, 2015, p. 11). The question upon which this article is based is, How big should the economy be? Though simple, this question incorporates all of the geographical concepts, especially scale, environment, and, as will be explained, sustainability. Under certain circumstances, which will also be described below, it is also amenable to fieldwork.

The term sustainability is defined in the K–10 Geography syllabus (BOSTES NSW, 2015, p. 20) as 'the capacity of the environment to continue to support our lives and the lives of other living creatures into the future.' It elaborates by stating that

> An understanding of the causes of unsustainability requires a study of the environmental processes producing the degradation of an environmental function; the human actions that have initiated these processes; and the attitudinal, demographic, social, economic and political causes of these human actions.

Thus sustainability is a concept of environmental capacity. Since the environment is not a static thing, it is the capacity of what the environment *does*, rather than what it is, that is the object of sustainability. This puts the focus of sustainability on environmental functions, just as described above.

As the syllabus also describes, there are a variety of human actions which degrade environmental functionality, but are some of these causes of unsustainability more primary than others? The *Australia: State of the Environment* (SoE) reports provide a detailed, longitudinal account of the condition of the Australian environment. The first of these reports, published in 1996, cautiously refers to Australia's growing population and highly concentrated distribution as possible candidates for causing unsustainable environmental changes (State of the Environment Advisory Council, 1996, pp. 10–11). Five years on, the following report contains the repeated concern that population growth and also economic activity are putting pressure on the environment (Australian State of the Environment Committee, 2001, p. 1), as well as the comment that 'Australians face major problems of living sustainably in … a society in which agriculture and industry, population and the built environment all continue to grow' (p. 22). The next report, published in 2006, gives considerable attention to the interrelated issues of population growth and increases in energy, material, and water use and the resulting increase in environmental pressure (2006 Australian State of the Environment Committee, 2006, pp. 7–14). The more recent reports state the causes of environmental change more boldly. The 2011 report states that '[t]he principal drivers of Australia's environment…are climate variability and change, population growth and economic growth' (State of the Environment 2011 Committee, 2011, p. 42), and mentions the challenge of 'decoupl[ing] national growth from increased pressure on the environment.' Most recently, the 2016 report repeats the previous warning by saying '[t]wo drivers will continue to shape Australia's environmental challenges in the coming decades: population growth, distribution and composition; and economic activity' and goes on to say that '[g]rowth and change in our population and industries directly affect the Australian environment through the resources we use and the waste we produce' (Jackson et al., 2017, p. 9) (Jackson et al., 2017, p. 9).

Given the conclusions of the SoE reports, this article focuses on economic growth as a fundamental driver of the human actions that have not only initiated the degradation of many environmental functions, but continue to do so, since growth is enshrined worldwide in national government policy (see next section). As will be described below, economic growth is closely coupled with population growth – the other repeated concern of the SoE reports.

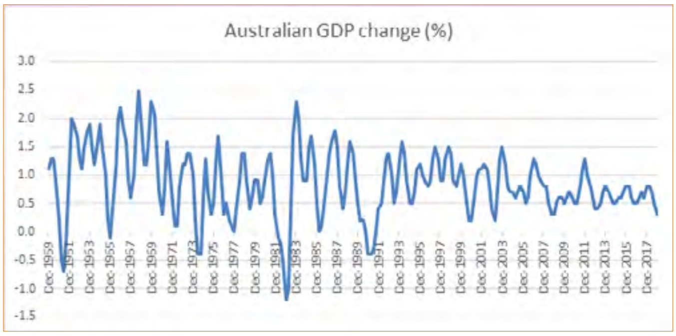
The next section surveys some basic economic theory on growth and shows how its implementation impacts the environment and opposes the goal of sustainability. Following that an economic model counter-posed to growth is presented, and in the final sections applications are made to the junior Geography syllabus with some suggestions for teaching for sustainability through an economic lens.

Economic Growth: Theory and Practice

Just about every country in the world today has growth as a core principle of its macroeconomic policy. The Australian Treasury states that 'the challenge for Australia is to raise standards of living through economic growth' and that '[w]e must maintain the growing momentum in the economy' (Australian Government Treasury, 2016). Other countries have similar policies. The EU seeks to set itself 'firmly on the path to growth' (Council of the European Union, 2015) and Goal 1 of the US Treasury is 'Boost U.S. Economic Growth' (Department of the Treasury, 2018). Meanwhile Canada has prioritised 'sustainable economic growth' (Department of Finance Canada, 2018) and the UK's first priority is 'achieving strong and sustainable growth' (HM Treasury, n.d.). The policy extends to the international arena, with Goal 8 of the United Nations' Sustainable Development Goals being 'decent work and economic growth' (United Nations, n.d.). Clearly, governments are in the business of growing the economy.

Economic growth is measured by increases in the Gross Domestic Product (GDP), the sum of the final market value of all goods and services produced within a country in one year (Samuelson & Nordhaus, 2010, pp. 370-371). It is this metric that governments are so anxious to increase year after year. As Figure 1 shows, the Australian government has been quite successful in increasing GDP, without interruption, for over the last quarter century.

Figure 1. Annual GDP change (%) in Australia, 1959–2018.

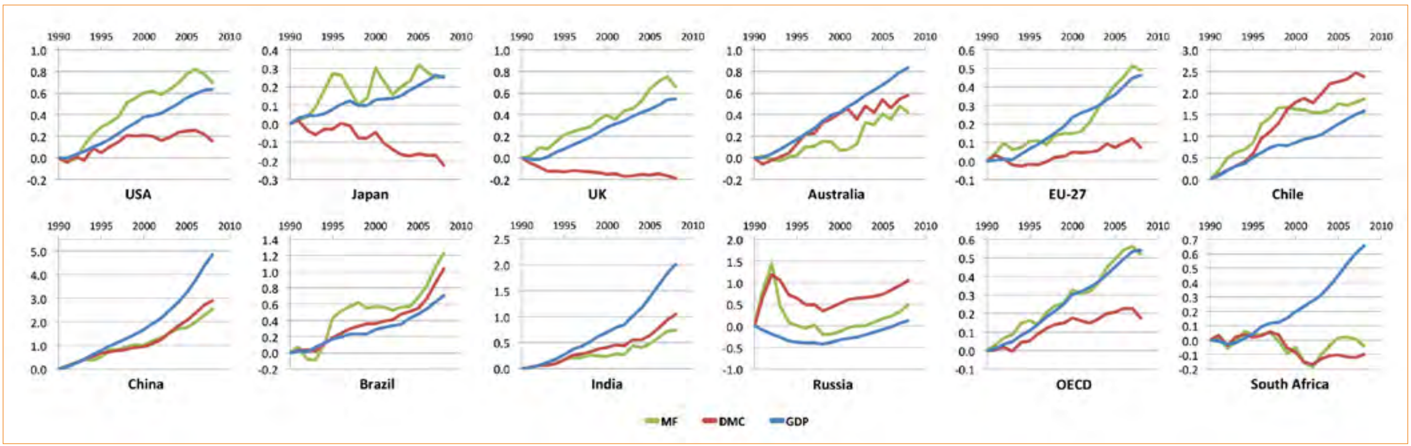


Source: Australian Bureau of Statistics (2019).

The standard model of economic growth comes from the work of Robert Solow. Although many refinements have been made to it, they all share the same premises that growth depends on three factors: capital, labour, and technological progress (see Samuelson & Nordhaus, 2010, pp. 501–518 for more detail). Despite land having been considered a factor of economic production, and thus growth, by all the classical economists, it, and the natural resources derived from it, are notably absent from Solow's model. The history of why land, and thus resources, was removed as a factor of production from economic theory is interesting and full of political intrigue, but beyond the scope of this paper (see Czech, 2013, pp. 80–101). For our purposes, a few points should be made: for one, the Solow model leads to the peculiar conclusion that because growth proceeds without physical resources, it has no limits. Also, because labour is a factor of production, having a growing population is, all else equal, good for GDP growth (though obviously not necessarily for growth per capita). And finally, it is only the *working* population that contribute to GDP. So for example, while stay-at-home mums are not good for growth, wage-earning day carers are; in fact doubly so, since both the day carer and the mum can then do paid work.

One of the confusions that arise from the measure of GDP that help misinform the argument that growth can and should continue without limit is that because GDP is a measure of value (in dollars, euros, yen etc.) it is not limited by physical constraints (Daly, 2014, p. 63). However, GDP is not simply a measure of dollars, but of dollars' worth of stuff. This is made abundantly clear by the Australian Bureau of Statistics (1998) calculations, which show that GDP is in fact a measure of the ***volume*** of goods and services, rather than value. With this confusion corrected, we are now in a position to make a biophysical analysis of economic growth. What changes in matter and energy use occur as economic growth proceeds? Figure 2 shows the change over time between GDP and the material footprint (MF) of a variety of countries, both developed and developing.

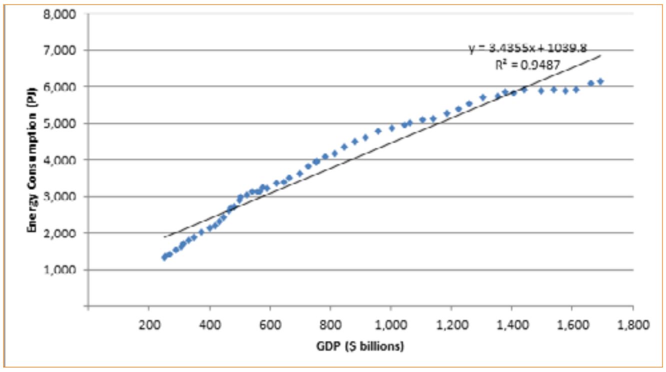
Figure 2. Relative changes in material footprint (MF), domestic material consumption (DMC), and GDP for selected countries, 1990–2010



Source: Wiedmann et al. (2015, 6274).

The MF accounts for all the raw materials embodied in a product and allocates them to the country where that product is consumed. Other resource flow accounting metrics also exist, like the domestic material consumption (DMC), which is also shown in Figure 2. However, the DMC does not capture all of the 'upstream' raw materials related to imports and exports originating from outside the country in question (Wiedmann et al., 2015, p. 6271), leading to the comforting but erroneous conclusion that some developed countries have 'decoupled' economic growth from resource use. The trend for the MF however is clear: with the exception of South Africa, every country has roughly a direct proportion between MF and GDP. That is, as their economies grow, so does the amount of material that they consume, which is what we would expect given that GDP is a measure of the volume of goods and services produced. The notable exception of South Africa is one that demands an explanation, but this has not yet been attempted in the literature (Wiedmann, 2019, personal communication). This could make for an interesting geohistorical analysis since the time frame in question begins roughly with the end of apartheid, after which tremendous changes occurred in all aspects of South African society, including its economy.

Figure 3. Energy consumption versus GDP, Australia, 1960–2017



Source: Department of the Environment and Energy (2018).

What happens to energy use while an economy grows? It too is of interest since it is a finite, physical resource. Figure 3 shows the change in Australia's energy consumption versus its GDP for the period 1960 to 2017.

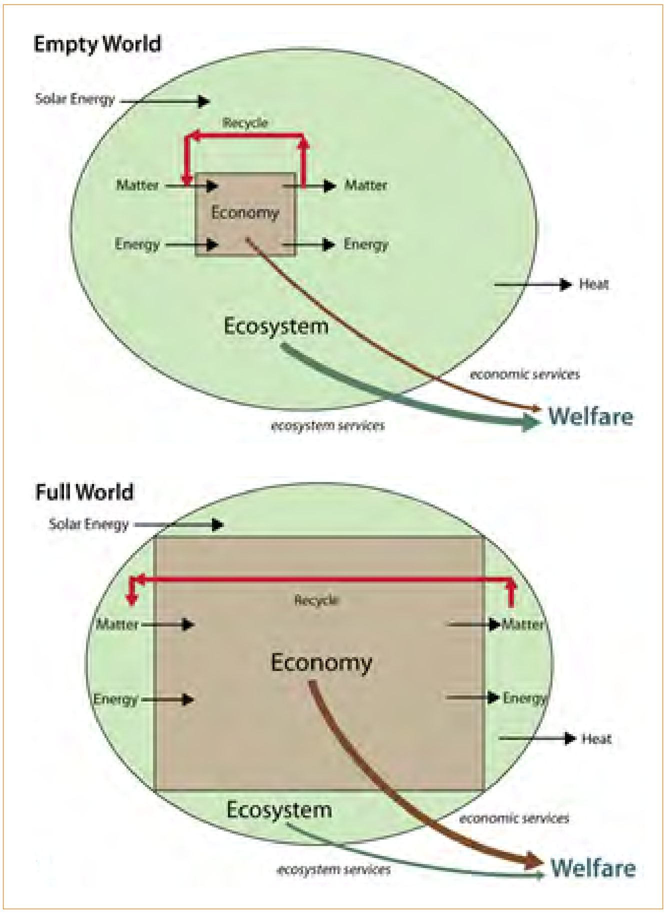
Note that Australia's GDP has been growing faster than its energy use, suggesting that as the economy grows, improvements in technology and economies of scale can use energy more efficiently. A different interpretation is that the financialisation of the economy has artificially inflated the GDP (Assa, 2019; Hudson, 2015). Similar results have been found for global analyses of the same sort. See Figure 1 at https://academic.oup.com/bioscience/article/61/1/19/303944 for a graph that shows a plot of the per capita energy consumption versus per capita GDP growth for 220 countries over 24 years. Each thin line represents the data for a single country while the thick black line that for the mean.

As these figures indicate, economic growth undoubtedly demands more energy use, which is, again, like the MF, what we would expect given that GDP is a physical measure of the production of goods and services. With this biophysical analysis in view, clearly economic growth cannot continue forever on a finite planet. Our affinity for growth has led from what Daly (2014) calls an empty world to a full world – where the world is now full of people and our stuff. Figure 4 helps depict these circumstances.

Notice that the economy grows into ecosystems, displacing them as it does so, and that while the services provided from the economy grow, those from ecosystems diminish. Ecosystem services are broadly defined as things that ecosystems do which benefit people (see for example Department of the Environment, Water, Heritage and the Arts, 2009; Millennium Ecosystem Assessment, 2005). As such, they are closely related to environmental functionality as described above in the introduction. This conflict between economic growth and ecosystem services is elaborated on below.

So, since the economy cannot grow forever, we should ask the question we began with: How big should the economy be? To help refine the question, and make it more directly an object of geographical inquiry, we might pose it as: How big should the economy be relative to the containing ecosystem? The next section addresses this question.

Figure 4. Economic growth causing the transition from an empty world to a full world, diminishing ecosystem services along the way



Source: Daly (2015).

Ecological Economics and the Steady-State Economy

There is a transdisciplinary field called 'ecological economics' which draws on principles and concepts from a variety of fields including physics, biology, ecology, history, anthropology, and economics and synthesises them in its work (Costanza, 2010). Some of its seminal contributors are Nicholas Georgescu-Roegen, Herman Daly, and Kenneth Boulding. Both the journal Ecological Economics and the International Society for Ecological Economics were established in 1989 by Robert Costanza, who now works at ANU. With Geography's broad integral concepts of interconnections, sustainability, environment, scale, and change, it has much to contribute to ecological economic inquiry and vice versa.

What unites ecological economics are three hierarchical goals, the first of which is called 'sustainable scale'. The second and third goals are fair distribution and efficient allocation respectively, but they are beyond the scope of this article. Sustainable scale attempts to answer the question upon which this article is based: How big should the economy be relative to its containing ecosystem(s)? and makes suggestions for putting this answer into practice. As mentioned above, this question is completely absent in standard economics, which advises unlimited growth instead. Before answering the question just posed, we might first ask: How big is the economy? In dollar terms the gross world product is about US$80.7 trillion (World Bank, 2019), but ecological economists are interested in providing a biophysical answer to this question. One way to do this is by considering what percentage humans appropriate of the earth's potential net primary production[1] (HANPP). This is currently 25% and it may only grow to about 27–29% by 2050, but large increases in bioenergy might see it increase to about 44% (Krausmann et al., 2013).

How big should the economy be is a question that has no definite answer, but a few things can be said with some certainty. For one, two more doublings of HANPP would leave no bioenergy available for any species other than humans and our domesticated animals. Because crucial ecosystem services depend on these other species, HANPP should not grow to such levels (Daly, 2014). Also, globally over the last century HANPP per dollar has declined by more than a factor of eight (Krausmann et al., 2013), suggesting that further economic growth in dollar terms might be possible, even while HANPP remains relatively stable. However, this has occurred because of the enormous increase in the use of fossil rather than bioenergy (Smil, 2017). Not only are such non-renewables limited at the waste end by contributing to climate change, but they are increasingly limited at the source end too (Hall, Lambert, & Balogh, 2014). Because energy is an essential resource for economic production – indeed for doing anything at all – this suggests that further economic growth will soon begin to reach earth's biophysical limits. Some research suggests that this is already happening, not only in terms of climate regulation, but also in biodiversity loss and overextension of the nitrogen and phosphorus cycles (Rockström et al., 2009; Steffen et al., 2015). Thus, the precautionary

1 Net Primary Production (NPP) is the energy captured by plants via photosynthesis minus that which they use during respiration. This energy is the basis for virtually all food chains in the biosphere.

principle suggests that the economy should probably not encroach upon the biosphere anymore, and that we need to change our pro-growth policies.

For about 50 years now Herman Daly has been promoting the steady-state economy (SSE) (Daly, 1993, pp. 325–363). While there are many nuanced arguments supporting the SSE, it has four defining characteristics:

1. A constant or mildly fluctuating human population.
2. A constant or mildly fluctuating stock of human-made things.
3. The levels at which 1 and 2 are held steady are sufficient for a good life and sustainable into the future.
4. The rate of matter and energy (collectively referred to as 'throughput') which sustain 1 and 2 are kept as low as possible.

Readily apparent is that the SSE is in direct opposition to the biophysical results of a growth economy, where, as we have seen, both matter and energy increase as the economy expands. Also notable is that a zero-growth economy need not have any negative connotations; this is because development can still occur, independently of growth. Growth is specifically a quantitative, biophysical phenomenon. It occurs as throughput increases. Development on the other hand entails qualitative changes that occur with throughput held constant. These include changes in information, technology, fashion, and income and wealth distribution. A good analogy to our economy is a human body: a baby grows but eventually stops accreting matter and demanding more energy, but a grown adult can continue to develop by education and experience throughout her life without any growth at all.

Applications for Junior Geography

There are significant opportunities for the conflict between economic growth and ecological sustainability to address each of the seven geographical concepts, and as such the conflict could be used as a unifying theme throughout the study of geography. Stage 5 of the Geography K–10 Syllabus in particular lends itself to this purpose. With the understanding that the nominal reason for economic growth is to improve human wellbeing (Samuelson & Nordhaus, 2010, pp. 501–502), this can include the Human Wellbeing unit. The World Happiness Reports, the editors of which are all economists, can provide ample data for that unit. The focus here however is on the biophysical nature of the conflict, and this is perhaps most thoroughly covered in the Environmental Change and Management unit.

For that unit's Content, the first dot point is that students 'investigate the role and importance of natural environments' (BOSTES NSW, 2015, p. 76). For this, an overview of some salient ecosystem services would be helpful. These are show in Table 1 below.

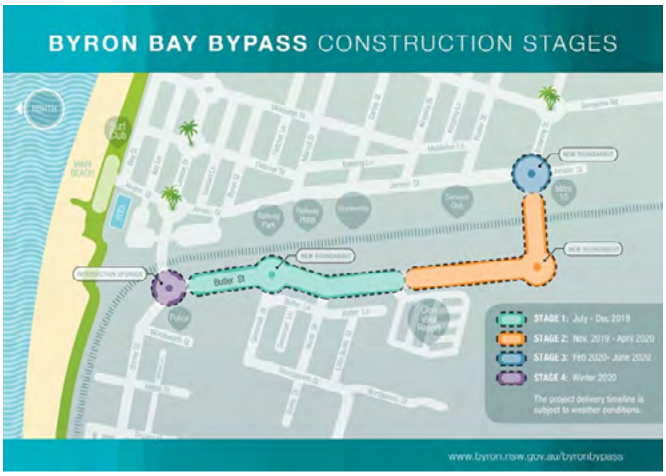
Number	Ecosystem Service	Examples of benefit to humans
1	Gas regulation	CO2/O2 balance and O3 (ozone) for UV protection.
2	Climate regulation	Greenhouse gas regulation.
3	Disturbance regulation	Storm protection, flood control, drought recovery controlled by vegetation structure.
4	Water regulation	Provisioning of water for agriculture
5	Water supply	Provisioning of water to catchments, reservoirs, and aquifers.
6	Erosion control and sediment retention	Prevention of soil loss due to wind and rain.
7	Soil formation	Weathering of rock and accumulation of organic matter.
8	Nutrient cycling	Nitrogen fixation and N, P and other mineral cycling.
9	Waste treatment	Detoxification and pollution control.
10	Pollination	Provisioning of pollinators and reproduction of plants.
11	Biological control	Predator control of prey species.
12	Refugia	Habitat for resident and migratory species.
13	Food production	Provision of crops, fruit, nuts, fish, and game.
14	Raw materials	Provision of timber, fuel, and fibre.
15	Genetic resources	Medicine and provisions for genetic research.
16	Recreation	Sport fishing, hunting, and any outdoor recreational activity.
17	Cultural	Aesthetic, artistic, educational, spiritual, and scientific values of ecosystems.

There are significant fieldwork opportunities to investigate these and other ecosystem services in students' local environment. In order to make the conflict of economic growth with ecological sustainability an object of geographical inquiry, teachers and students can choose an ecosystem service and attempt to measure any reduction in it while economic growth occurs in a particular environment. This addresses the next syllabus dot point which states that students 'investigate human-induced environmental changes across a range of scales'. Note that some ecosystem services, like gas and climate regulation, are not localised and would escape simple measurements conducted by a class in their local environment. For these, studies would depend on secondary data. Others however, like refugia and disturbance regulation, are localised and degradation of them during economic growth can be observed and directly attributed to that growth, making them amenable to primary data and thus fieldwork. Note that like ecosystem services, some economic projects are diffuse, whereas others are localised. Some projects, like the NBN network being rolled out across Australia for example, are not amenable to high school fieldwork, whereas a particular construction project is. An example of such growth and its impact on an ecosystem service comes from the author's home town of Byron Bay.

Byron Bay: A Case Study

Despite its small population of about 30,000 people, Byron Shire is one of the most common tourist destinations in all of Australia, receiving over two million visitors each year; these numbers have been growing and are projected to continue growing (Delta Pearl Partners, 2019). Such dramatic increases have resulted in, among many other problems, traffic congestion. One of the ways the local council has decided to cope with this growth has been to construct a bypass around the town centre. A map of the project is shown in Figure 5.

Figure 5. Map of the Byron Bay bypass



Source: Byron Shire Council (2020.

The cost of the project is $24 million, with close to half the money coming from a state government Growing Local Economies grant (Byron Shire Council, 2019). Naturally, this will contribute to GDP growth and thereby to the fulfilment of Australia's macroeconomic policy objectives. However, the bypass will go through wetlands which provide the habitat of a number of threatened species, including Mitchell's Rainforest Snail, Common Planigale, and Black Bittern, thereby reducing the ecosystem service of refugia for these and other species, since they will not live on or near the bypass (Lovejoy, 2019). The wetlands will be directly affected by Stage 2 of the bypass construction, as shown in Figure 5. The beginning of the existing wetlands is shown in Figure 6.

Figure 6. The beginning of the wetlands which will be affected by the bypass. Stage 2 of the bypass will extend the existing road straight ahead.

Source: Google Maps (2020).

While the conclusion that this example of growth reducing the ecosystem service of habitat provision is completely obvious, that does not make it trivial, nor irrelevant. In response to the anthropocentric worldview that we can and must afford the reduction and extinction of other species to make room for more of us and our stuff, there are many examples of trophic cascades – that is, amplification of disturbances in food chains – which demonstrate the myopia of such thinking. The reintroduction of wolves to Yellowstone National Park is one example (Ripple & Beschta, 2012), the possible rise of Lyme disease due to the human-induced extinction of the passenger pigeon is another (Blockstein, 1998; Farley, 2012). In the case of the Byron bypass, the Black Bittern is an apex predator and thus supplies biological control (see Table 1) to the trophic structure of the wetlands through which the bypass is planned. While proving that continual economic growth will cause catastrophic dysfunction of ecosystem services is probably impossible for one specific case, the precautionary principle suggests that limiting growth in the aggregate would be prudent. This is the conclusion of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) in their recent Global Assessment Report. Therein they note that about 1 million species are threatened with extinction, many within decades, and suggest 'steering away from the current limited paradigm of economic growth' (IPBES, 2019).

The investigative study of the Environmental Change and Management unit requires that students compare one type of Australian environment with one in another country. What has just been described for the Byron Bay wetlands would suffice for the 'explanation of how the biophysical processes operating in the [Australian] environment maintain its functioning', namely the ecosystem services of refugia and biological control; as well as for the 'examination of the causes…of change to the environment', which in this case is economic growth. What remains to be discussed is the investigation of 'the management of the environmental change' (BOSTES NSW, 2015, p. 77). This can be linked to the aim of junior geography education described at the outset of this article, which ends with students becoming 'informed, responsible and active citizens'.

Before moving to this final section however, worth recalling is that, as indicated in the SoE reports at the outset, economic growth is the prime driver of the decline of the state of Australia's environment. This is true not only in terms of biodiversity decline, which the Byron Bay bypass will help contribute to, but for climate change too. Why? We saw above that economic growth is coupled with increased energy usage. Despite the push toward renewable sources of energy, the global economy still relies predominantly on fossil fuels (about 81%) (International Energy Agency, 2018), and anthropogenic global warming is being driven to a large extent by carbon emissions from fossil fuel use.

Weighing against the hope that renewables will quickly replace fossil fuels in a growing economy is the fact that biofuels comprise the majority of renewable sources of energy (about 70%, or about 10% of total global energy supply); as suggested above, expanding our use of biofuels will increase the HANPP and thereby reduce the habitat for species other than humans and our domesticated animals. Also, such increases must compete with agricultural land, putting increased food pressures on a growing global population.

So climate change, biodiversity loss, as well as the hole in the ozone layer, colony collapse disorder, plastics in the ocean, and the decline of an array of other ecosystem services, are all a result of the growth economy. As described, the economy grows ***into*** these ecosystems, degrading their services as it does so and compromising the goal of ecological sustainability. No economy will survive extreme ecological disservice, much less any society.

Environmental Management and Active and Informed Citizenship

Everything that has been said has implications for our management of the environment and students' roles as active and informed citizens. As described above, the SSE is directly opposed to the growth economy. Because of the current existence of nation states, their national income and productivity accounts (from which GDP is calculated), as well as their macroeconomic policies, the transition from a growth economy to a SSE can only be made effective at a national level. As such, students can fulfil their role as active and informed citizens by pressing their representatives, as well as their fellow citizens, to adopt it. This would address the part of the investigative study which 'investigate[s] the management of the environmental change' (BOSTES NSW, 2015, p. 77). As for a 'discussion of the factors influencing the management responses in each country', teachers could lead a discussion of why there is such worldwide governmental allegiance to economic growth. Though delving into this topic is important, it is beyond the scope of this paper. Here all that can be said is that economic growth has not always been a central focus of economic policy – it is specifically a post-WWII phenomenon (see Blyth, 2002, pp. 91-95), and there is no 'natural law' which dictates that economies must grow forever. This would dovetail naturally with an 'investigat[ion of] environmental management, including different worldviews and the management approaches of Aboriginal and Torres Strait Islander Peoples'. Gammage (2011) reviews the worldview and culture of Aboriginal people which allowed them to live sustainably prior to 1788.

There is no question that the growth economy cannot continue forever, there is only the question of how it will end. Through our role as active and informed citizens, hopefully teachers and students can help make the transition a smooth, rather than abrupt one.

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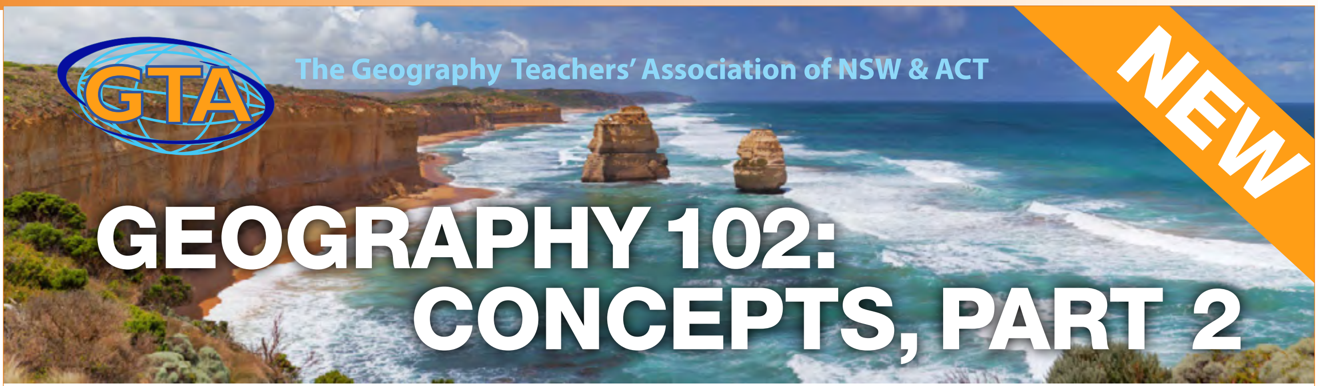

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