Case Study "Environmental change and management of the coastal environment"

Activity Sheet 12 "The impacts of land use changes on the coastal environment"

Introduction

With Australia's rising population, particularly in the eastern and southern coasts, the resultant changes to the surrounding land scapes due to urban development and a growth in agriculture have added additional pressures to the coastline. Along the west and north-west coasts changing land use as a result of resource extraction and the associated infrastructure has also created localised impacts. As noted in the report "Australia: State of the Environment – Coasts 2016" when discussing the pressures to the coast "Urban and agricultural land use causes habitat loss, habitat fragmentation, loss of nature biodiversity and contamination of coastal land and waterways. Resource extraction has increased in the past few years with the mining boom causing severe but highly localised habitat loss and degradation".

Activity Sheet 12 introduces students to these pressures and the associated impacts to the coastal and marine environment. As such you may wish to go into more detail about these pressures or introduce them via a specific case study.

The content of this activity sheet relates to the following Geographic Concepts and Skills and Geographic Knowledge.

Geographic Concepts and Skills

Place, space and interconnection

- Identify, analyse and explain significant spatial distributions and patterns and identify and evaluate their implications over time and at different scales.
- Identify, analyse and explain significant interconnections within places and between places over time and at different scales, and evaluate the resultant changes and further consequences.

Data and Information

- Analyse and evaluate data, maps and other geographical information using digital and spatial technologies and Geographical Information Systems as appropriate, to develop identifications, descriptions, explanations and conclusions that use geographical terminology.

Geographic Knowledge

- Environmental, economic and technological factors that influence environmental change and human responses to its management
- Causes and consequences of environmental change, comparing examples from Australia and at least one other country.

Introductory Activities

1. Go to "Australia: State of the Environment – Coasts 2016".
   https://soe.environment.gov.au/sites/g/files/net806/f/soe2016-coasts-launch-17feb.pdf?v=1488793015
   Page 49 of the PDF version contains useful diagrams that summarises the pressures mentioned in the introduction. It also links the content from Activity Sheet 3 regarding climate change to this topic.
   Discuss and use these diagrams as an introduction.

2. To provide a more specific, but introductory example of this diagram go to
   https://www.barrierreef.org/the-reef/the-threats/coastal-development
   Summarise the impacts that the changing land uses listed can have on the Great Barrier Reef.

Population growth and urban development

1. To show the extent of population growth and urban development occurring along the coast, select from the introductory activities below.

- Go to https://www.youtube.com/watch?v=AqUSo2hstHI and watch the example of google time lapse.
  Using google time lapse found at https://earthengine.google.com/timelapse/
  select specific locations to show the changes in development that have occurred to areas located on the coast .

  Alternatively go to https://www.theage.c.au/national/victoria/a-birdseye-view-of-melbournes-transformation-from-1945-to-2015-20150226-13pd5v.html for an example of the change that has occurred in Melbourne between 1945 and 2015.

  You could also select a specific location, such as Frankston, and find a current satellite image and one from the 1970's to compare and show the growth that has occurred.

- Divide the class into small groups. Without referring to resources each group is to write down the 10 largest cities or urban areas (according to population) in Australia, from highest to lowest. Prior to commencing this exercise ensure that students understand the concept of an urban area.
  After the allotted time each group is to write down their list on the whiteboard. One point is awarded for naming the correct city/urban area, two points awarded for naming the correct city/urban area and having it in the correct order.
  The order of the cities and their growth of the past 5 years, as at 2017 is shown below (15 cities or urban areas have been included if you wish to extend this activity).
  Alternatively, you may wish to do this activity for the largest cities of the world.

Largest Australian Cities/Urban Areas by population (2017)

City	Population (2017)	5 year growth %
Sydney	4,741,874	10.1%
Melbourne	4,677,157	13.5%
Brisbane	2,326,656	9.6%
Perth	2,004,696	7.6%
Adelaide	1,315,346	4.4%
Gold Coast	663,321	11.4%
Newcastle-Maitland	481,183	5%
Canberra	447,457	8.2%
Central Coast	329,437	3.9%
Sunshine Coast	325,399	12.7%
Wollongong	299,203	5.5%
Geelong	260,138	12.3%
Hobart	208,324	4.4%
Townsville	180,346	5.5%
Cairns	151,925	6.8%

At the end of the activity discuss how Australia's population is concentrated on the coast (ie 80% of Australia's population live within 50 kilometres of the coast). Note and discuss the growth rates of the cities and urban areas listed in the above table.

- Down load an image showing Australia's population density. Describe the distribution pattern shown.
  Alternatively, on a base map of Australia show the location of the largest Australian cities/urban areas (as shown above). Ensure that this map is completed with the appropriate geographic conventions.
  Describe the distribution of the largest Australian cities/urban areas.

2. Go to “Australia: State of the Environment – Coasts 2016” https://soe.environment.gov.au/sites/g/files/net806/f/soe2016-coasts-launch-17feb.pdf?v=1488793015

Once at this site go to “Population growth and urban development”(page 5 of the PDF version). With reference to the content contained in this section answer the following questions.

a. Describe, with the use of statistics, the growth in population that has occurred along the coast. Which states are most impacted?
b. Describe the impacts of urban development and agriculture. Where possible provide examples of these impacts.
   The tasks below look at these impacts in more detail.

3. Go to the figure titled COA 10 “ % of remaining native vegetation in each sub region”(found on page 55 of the PDF version of the above report). As a class discuss
   - The areas that have lost the largest amount of native vegetation.
   - The reasons why some regions of Australia have had severe loss of native vegetation compared to others.
   - The extent which urbanisation and growth in agriculture on the coast has contributed to loss of native vegetation.
     An example showing the impact of agriculture can be found at https://www.theguardian.com/environment/2017/nov/22/queensland-land-clearing-shown-in-aerial-and-satellite-images

4. Go to the figure titled COA13 “Number of threatened species that occur within 50 kilometres of the coast” (found on page 69 of the PDF version of the above report)
   a. Describe the spatial association between Australia’s population density and the number of threatened species.
   b. With reference to the previous content and the information contained in the report, suggest reasons that may account for this association.

5. Go to the section of the above report titled “Coastal river and estuary pollution”(found on page 29 of the PDF version) and answer the following questions.
   a. Describe the link between urbanisation/growth in agriculture and river and estuary pollution.
   b. Provide examples of how these changes in land use can impact on rivers and estuaries.

6. Go to the section of the above report titled “Nutrient pollution”(found on page 30 of the PDF version) and answer the following questions.
    a. What are the two main ways nutrients enter coastal waters?
    b. What changes in land use have resulted in a higher level of nutrients?
    c. What impacts does higher nutrient levels have on the coastal environment?

Case Studies

Port Phillip Bay

Over the past 5 years Melbourne’s population growth has averaged 13.5%. Further, it was stated in the report titled “Draft Healthy Waterways Strategy 2018” that “Population modelling shows that Melbourne will undergo transformation rivalling the changes driven by the Gold Rush and post war booms as it adds 70,000 dwellings per year” Further this report states “If the communities of 2050 are to enjoy opportunities to connect with waterways and nature, there is a real need to take action to avoid an otherwise inevitable decline in waterways health” and “With current policy and levels of investment most catchments are expected to decline in environmental and social value”

The following tasks require students to analyse the health of the catchments surrounding Port Phillip Bay and to examine the relationship between the health of that catchment and changing land use. Whilst not specifically focussing on the coast, there is obviously a direct relationship between the health of the catchments and that of the coastal environment.

1. Go to Yarra and Bay website (https://yarraandbay.vic.gov.au/). Once at this site go to “Report Card 2016-2017” then to “Port Phillip Catchments”.
Before proceeding with the next tasks discuss with students what data is collected to provide an indicator of the health of the catchments. A simple explanation is provided at the analysis of each catchment. A more detailed explanation can be found on the initial “Report Card” page.

2. Divide the class into small groups and allocate them a catchment area as shown on the map at this website. These catchment areas are
    - Bellarine Catchment
    - Werribee Catchment
    - Maribyrnong Catchment
    - Yarra Catchment
    - Dandenong Catchment
    - Mornington Catchment

If you wish you could also investigate the Westernport Catchments.

Using the content contained on this site, each group is to complete the following task for their designated catchment area.

a. Construct a pi-chart showing the % of the catchment that falls into each scoring category. What is the overall rating for this catchment?
b. Refer to the graph titled “Water Quality Index History”. Describe the broad trends shown regarding water quality. Note whether the data for 2016-17 fits into these broad trends or whether it is abnormal.
c. Refer to the section “What does this mean”. With reference to the examples discussed, describe how land use impacts on the health of the catchment.
d. Discuss with reference to the above content the accuracy of the following statement “ Waterways closer to the coast tend to be more heavily impacted by changes in land use, in particular urbanisation”
e. Describe other events that contributed to the health of the catchment for 2016-17.
f. Outline the main management strategies that have been put in place to improve the health of the catchment area? What other management strategies are planned to be introduced?

3. Each group is to present and share their finding with other class members.

As an alternative to the above structure you may choose to focus on one of the catchments, especially if your students live in and are familiar with the specific catchment.
You may also consider whether these tasks are done in groups, pairs or individually.

As an extension to the above, download a base map from the Yarra and Bay site showing the catchment areas surrounding Port Phillip Bay. Using an appropriate key, show the overall rating for each of the catchments. Ensure that this map is completed with the required geographic conventions.

With reference to the content from each of the group reports complete a table similar to that shown below.

Name of catchment	Key factors contributing to catchments health rating
Bellarine	
Werribee	
Maribyrnong	
Yarra	
Dandenong	
Mornington	

Great Barrier Reef

The following tasks provide an example of the content covered in Questions 5 and 6 above.

1. As an introduction watch the clip http://www.abc.net.au/radionational/programs/backgroundbriefing/rivers-of-red-threaten-great-barrier-reefs-future/6723280 "

2. Go to https://www.qld.gov.au/environment/agriculture/sustainable-farming/canefarming-impacts

Using the content at this site, answer the following questions.

a. How do nutrients and pesticides from farms entering the reef system?
b. What impacts do nutrients and pesticides have on the reef system?
c. Outline the key strategies that could be implemented to reduce nutrient runoff from farms.
d. As an extension, discuss the factors that may limit the effectiveness of the above strategies.

3. Go tohttps://www.qld.gov.au/environment /agriculture/sustainable farming/grazing-impacts.

With reference to the content contained at this site answer the following questions.

a. How can farming practices cause sediment to enter the reef system?
b. How does an increase in the amount of sediments affect the reef system?
c. Outline the strategies that could be implemented to reduce the amount of sediment from farming practices.
d. As an extension discuss the factors that may limit the effectiveness of the above strategies.

Clips that provide a good insight into the issues and strategies introduced by farmers to minimise these problems are

- https://www.qld.gov.au/environment/coasts-waterways/reef/preserve-the-wonder/sediment-runoff
- https://www.huffingtonpost.com.au/2016/04/23/project-catalyst-great-barrier-reef-farmers_n_9755290.html

Energy and resource extraction processing

1. Go to "Australia: State of the Environment – Coasts 2016" https://soe.environment.gov.au/sites/g/files/net806/f/soe2016-coasts-launch-17feb.pdf?v=1488793015

Once at this site go to "Energy and resource extraction/processing" (page 13 of the PDF version).
According to this document what are the main activities associated with mining and resource extraction and processing that affect the coast?

2. Watch the clip https://www.csiro.au/en/Research/Environment/Biodiversity/Biodiversity-book/Chapter-8 discussing the broad strategies to manage mining activities. Take notes on the three main strategies to minimise the impacts of biodiversity that may occur from mining activities.

For more detail regarding the impacts of mining activities on the coast (as discussed above) refer to Activity Sheet 13. This work sheet also contains further discussion on management strategies and case studies.