ENVIRONMENTAL PLANNING FOR THE PLATYPUS *IN* CLIMATE CHANGE

by

SUMMER WARNER CONSTANTINO

(Under the Direction of John Crowley)

ABSTRACT

The purpose of this thesis is to investigate how to better plan for platypus conservation in the face of climate change in Australia. First, the biology and habitat requirements of the platypus are investigated. The establishment, history, and climate change planning progress of the Commonwealth of Australia, the state of Queensland, the South East Queensland region, and local government areas are examined next. Case studies are then presented which include methods of platypus conservation in four different areas of Australia. Finally, climate change adaptation plans and platypus conservation methods are integrated and suggestions for future planning efforts are made. Possibilities for further study are included in the conclusion.

INDEX WORDS: platypus, environmental planning, platypus conservation, climate change, Australia, Queensland, South East Queensland, Brisbane, climate change adaptation plan, geographic information systems

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Master of Arts, Savannah College of Art and Design, 2010

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment

of the Requirements for the Degree

MASTER OF ENVIRONMENTAL PLANNING AND DESIGN

ATHENS, GEORGIA

2013

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August 2013

DEDICATION

This thesis is dedicated to love and family. My parents, Duane and Linda Constantino; my sister, Morgan Constantino; and my grandmother, Virginia Constantino have loved and supported me through three degrees. I am beyond grateful to each of them.

This work is also dedicated to the memory of my grandparents, Doris and Bill Warner Sr., both of whom passed away over the course of my studies at the University of Georgia and to my grandfather, Gus Constantino, without whom I would not have been able to attain this level of education.

In addition, I dedicate this thesis to my soon-to-be husband, Nick Carstens, and to successful careers and us sharing a happy life together, one day at a time, with Jean-Baptiste Brown.

Finally, I dedicate all the hours spent on this thesis to a better future for the platypus species and for all those affected by climate change.

ACKNOWLEDGEMENTS

I would like to thank all those professors and fellow students who have helped me along the way academically, including: my MEPD classmates, my thesis committee members, and the faculty and staff at the College of Environment and Design. Unfortunately, space and time will not allow me to mention each person specifically but I want to acknowledge a few of those great people from Athens and the University of Georgia.

Prof. Jack Crowley, Prof. Stephen Ramos, Prof. Alison Smith Bramlet, and Dr. Jason Evans – I appreciate your guidance and you sharing your expertise with me as I was writing my thesis, you have all be an integral part of my success at UGA and I thank you. Prof. Rosanna Rivero, and Prof. Umit Yilmaz, - your classes were some of my favorites and I truly enjoyed learning from you both. Michael Sims and Donna Gabriel – you both were calm and collected when I was not, thank you for all your help. Sara Farr and Melissa Gogo – you both helped me navigate through the thesis process, to think, and to go to The Grit for vegan cake if all else fails.

Thank you to the University of Georgia and the Master of Environmental Planning and Design program for accepting me and then inspiring me.

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

CHAPTER 1

INTRODUCTION

Statement and Purpose

Climate change is an international issue that becomes more pressing as each second passes, will continue to occur and have devastating effects on many species, whether humans make adaptation plans for the future or not. There is a cost for inaction and it is more expensive than the vast majority of politicians and decision-makers seem willing to publically acknowledge, both in the United States and in Australia.

Australia is home to many unique species that are being impacted by climate change, including the famous curiosity commonly known as the platypus. The platypus is an apex predator in its ecological sphere and is affected by water quality, temperature, drought, flooding, litter, human built development, domesticated animals, and other stressors. While they are not considered endangered by typical standards (such as those parameters outlined by the International Union for Conservation of Nature), the effects of climate change may put them at risk for a sudden mass extinction because they may be unable to adapt to the changes (especially in temperature) as quickly as those changes take place in the environment. The loss of a species is devastating both ecologically and emotionally, especially when it is preventable.

The platypus is not the first, the only, or the last animal to be negatively affected by climate change and lack of adequate planning. It is however, the focus of discussion here for several reasons. For starters, the platypuses' habitat is located in a relatively small, specific area of the world that is simultaneously experiencing record-breaking climate volatility and a

consistently increasing human population. Secondly, the platypus is an iconic species and progress in conserving its population and habitat would be progress for other species too. Thirdly, the Australian form of government and planning is reasonably comparable to that of the United States making the subject of this study fairly comprehensible to the average reader.

Chapters two and three are provided to illustrate in more detail the complexities of the platypus as a species and how exactly these animals are being impacted by international climate change.

The issue of how to plan for the platypus *in* climate change is taking place within the context of a series of larger systems. To better understand how to help the platypus survive climate change within these systems; chapter four describes how the Australian systems of government and planning operate and chapter five speaks to some of the specific aspects of the Commonwealth of Australia, the state of Queensland, the South East Queensland region, and local government areas within South East Queensland (see Figure 1.3).

The sixth chapter includes information from the foremost platypus conservation organization, the Australian Platypus Conservancy, on specialized methods for conservation and case studies are presented to show conservation plans in action. Chapter seven is an analysis of the information that was presented in previous chapters and contains some suggestions for the future of platypus conservation.

International Climate Change

Climate change is occurring internationally and there have been continuous efforts to agree upon methods for reducing the anthropogenic aspects of these changes.

The Kyoto Protocol, born from the United Nations Framework Convention on Climate Change (UNFCCC), is the first international agreement between nations to mandate greenhouse

gas emissions, which increase the rate at which climate change is occurring. The six greenhouse gasses that are targeted by the Kyoto Protocol (see Figure 1.1) are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), and sulphur hexafluoride (SF6) (United Nations Framework Convention on Climate Change, 2013).

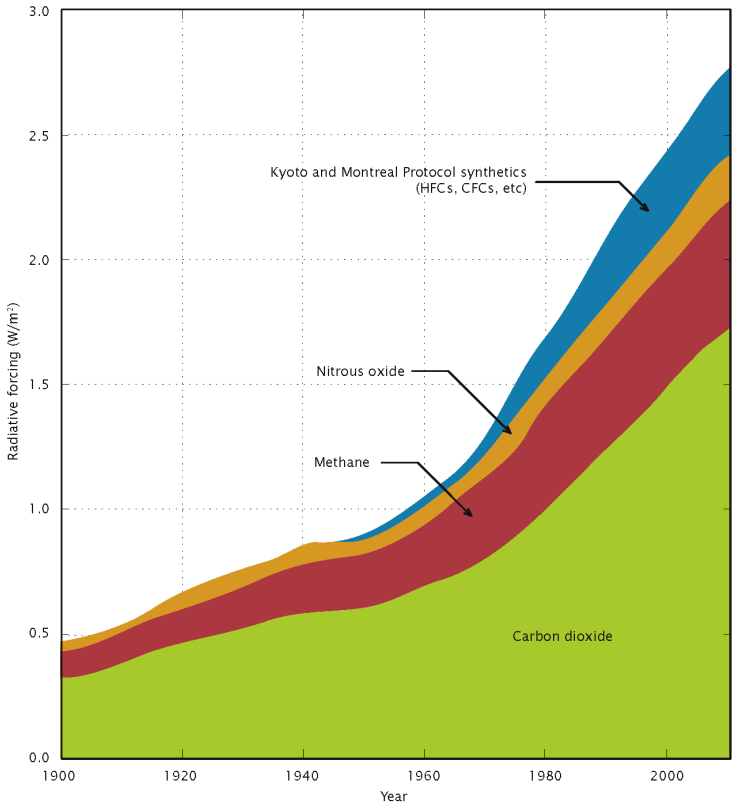


Figure 1.1 Global radioactive forces due to long-lived greenhouse gases from 1990 to 2009. Reprinted from "Climate Change: science and solutions for Australia", edited by H. Cleugh…[et al.], 2011, p. 19. Copyright 2011 by CSIRO PUBLISHING

This treaty was presented in 1992, signed in 1997, and put into action in 2005 (Henson, 2011). Australia signed the treaty originally and then refused to ratify it until 2007 (Harvey F. , 2012). During the first commitment period (1990 to 2008/2012), Australia's emissions target was +8 percent (United Nations Framework Convention on Climate Change, 2013).

The majority of the nations in the world, excluding the United States, ratified the treaty although some developing countries were not required to reduce their emissions. The treaty was

supposed to result in a 29 percent reduction in the emissions that would have typically been released globally from 1990 to 2012. Instead, emissions went up 40 percent between 1990 and 2009 (Henson, 2011). The increase in the United States' and China's emissions over the past 20 years have more than "compensated" for the reductions made by other countries.

Members of the Australian Government were involved with the 2012 Doha climate talks in Qatar regarding the continuation of the Kyoto Protocol in 2015. Australia's climate change and efficiency minister, Greg Combet, said that Australia would "commit to limiting its greenhouse gas emissions from 2013 to 2020 with a Kyoto target consistent with the bipartisan target of reducing emissions to 5 percent below 2000 levels by 2020" (Harvey F. , 2012).

The overwhelming majority of scientists agree that climate change is happening and that humans are exacerbating the problem. It is also clear that while there is a level of acceptance that this is happening, it has not yet become a common practice to take action towards mitigation.

Planning *In* Climate Change

Editors, authors, and planners Brendan Gleeson and Wendy Steele discuss the significance of climate change and how it is "still largely subsumed, even marginalized, as one of many areas of special-interest planning, policy and practice clamoring for political attention" (Gleeson & Steele, Planning in climate change, 2010).

They make a compelling case regarding three institutional frameworks: 1) planning *about* climate change, 2) planning *for* climate change, and 3) planning *in* climate change. The first framework, planning *about* climate change, is described as being conscious of climate change but still regarding it as peripheral to planning. The second framework, planning *for* climate change, includes climate change as an elective – it requires some action but, mainly as projects or policies that support individual adaptation in the short-term with the implication that the

matter will be addressed more thoroughly down the line. The third, planning *in* climate change, "emphasizes the immediate and lived in dimensions of climate change an intimately linked with planning praxis in all it's diversity" (Gleeson & Steele, Planning in climate change, 2010).

Gleeson and Steele argue that "re-conceptualizing planning *in* climate change does two important things: 1) shifts debates towards a direct and present engagement with the rich multiplicity of planning practices with climate change as the core agenda and 2) provides an overarching theme for the recasting of educational curriculum and professional development" (Gleeson & Steele, Planning in climate change, 2010). They go on to say that they believe Australia is mainly operating from the planning *for* climate change framework and that the focus must shift in order to stop "walking backwards into the storm of climate change" (Gleeson & Steele, Planning in climate change, 2010).

Reflecting on the origins of early planning - as a profession and process that was intended to help people to manage the urban environment in order to enhance their quality of life - it is not difficult to see that the time may have come once again for a "massive departure from a manifestly failed conventional wisdom" (Gleeson & Steele, Planning in climate change, 2010). Gleeson and Steele describe the difference is that this time, the departure is "an emergency that threatens our species, not simply some cities" and that "the great trek in search of urban, and therefore human, resilience will be directionless without planning" (Gleeson & Steele, Planning in climate change, 2010).

Land Mosaics

In his book, *Urban Regions: Ecology and Planning Beyond the City*, Richard T. T. Forman dubs the giant urban region (which describes the Greater Brisbane area) as "one of the great challenges of history" (Forman, 2008). Cities run on resources and "too often expansion

devours the city's closest and best resources, impoverishing both the land and the people" (Forman, 2008). As urban populations continue to increase, as they are in the Greater Brisbane area, the positive and negative aspects of the giant urban regions must be carefully considered.

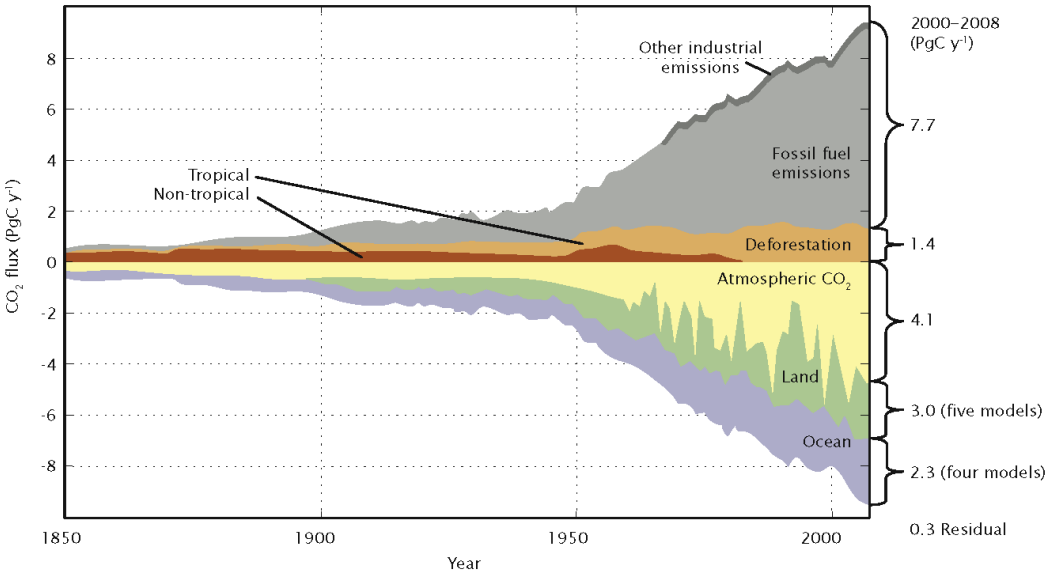
One of the barriers to ecology being more integrated into urban planning is that, according to Forman, "Unfortunately today most planners avoid emphasizing natural systems, and most ecologists avoid studying urban regions" (Forman, 2008). He also states that, this being the case, we might all be better off with no planning rather than planning which does not incorporate the available expertise of economists, engineers, architects, ecologists and planners (Forman, 2008).

Forman proposes that there *is not* one specific answer for all urban areas but that practicing urban-region planning for natural systems and humans *is* a solution to what seems like an untenable problem (Forman, 2008). He describes the pattern of these regions as a land mosaic.

Relevance of Australia and the Platypus

The South East Queensland region of the state of Queensland, Australia is an area on the east coast of the country that has a rapidly increasing population, is experiencing impacts from climate change, is home to thousands of plant and animal species (including the platypus), is dealing with limited natural resources, and will soon be facing an energy crisis. What is known is that the future will be rife with changes, what remains to be seen is exactly how the transition will progress. Ian Lowe, president of the Australian Conservation Foundation, describes the situation as such, "if we were looking ahead to these inescapable challenges, we could now be planning for a relatively smooth transition to a different future" and "if we persist in the current profligate and short-sighted policies, the transition will be a traumatic legacy from our generation" (Lowe, 2010).

In April and May of 2013, readings of the concentration of carbon dioxide in the atmosphere reached the 400 parts per million level – a "sobering milestone" which "should serve as a wake up call for all of us to support clean energy technology and reduce emissions of greenhouse gasses, before it's too late for our children and grandchildren" according to oceanographer and carbon cycle researcher, Tim Lueker (Vidal, 2013). Carbon dioxide levels have been rising steadily since the beginning of the industrial revolution over 200 years ago (see Figure 1.2), when the level was about 280 parts per million and levels have not been as high as they are now in millions of years, since the Pliocene epoch. In short, planning for climate change is an international issue, a human issue, and a platypus issue.



▲ ***Figure 2.5****: Sources and sinks of atmospheric CO_2. Those above the zero-line represent anthropogenic additions to the atmosphere (inflows); those below are sinks for CO_2 (outflows), together with the accumulation in the atmosphere. Units are in petagrams of carbon per year (Pg = petagram; 1 petagram = 10^{15} grams = 1 billion tonnes). The small residual reflects minor discrepancies in independent measurements of different terms.*[10]

Figure 1.2 Sources and sinks of atmospheric CO2. Reprinted from "Climate Change: science and solutions for Australia", edited by H. Cleugh…[et al.], 2011, p. 25. Copyright 2011 by CSIRO PUBLISHING

Summary

In light of international climate change data, it is clear that whether planners accept it or not, they are in fact, planning in the midst of climate change. Barriers (both real and perceived) to embracing the concept of "planning *in* climate change", as outlined earlier, are apparent in both the United States of America and the Commonwealth of Australia. Though these countries are dissimilar in many ways, they are similar enough that Americans can relate with the Australian system of government and planning when it comes to the subject of climate change adaptation and species-specific conservation planning.

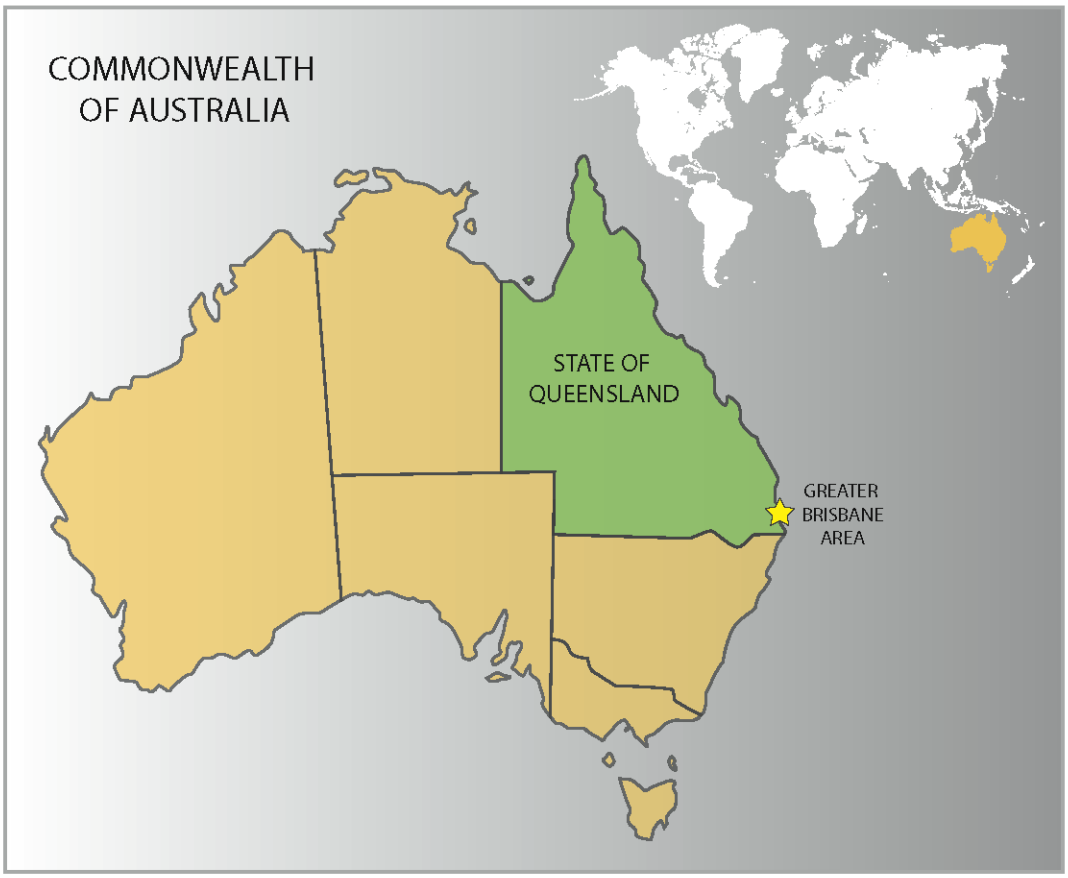


Figure 1.3 Context map of Australia, Queensland, and Greater Brisbane area

CHAPTER 2

ABOUT THE PLATYPUS

Once the object of wild conjecture, much more is now known about the platypus and its place in the ecosystems of Australia. In order to understand how the platypus is now affected by climate change and possibly will be in the future, it is essential that its' biology and habitat be investigated further. There have already been some interesting and valuable revelations arrived at through scientific study up to this point but, in order for this to continue, plans for conservation and adaptation are necessary.

Origin and History

The origin of the platypus is described in an Aboriginal Dreamtime legend where a female duck mates with a water-rat to produce an animal with a duck's bill and webbed feet and a water-rat's legs and fur. Anthropological records indicate that indigenous people knew that the platypus laid eggs and had poisonous spurs (Australian Platypus Conservancy). Calling the platypus an unusual animal is an understatement, it is found only in Australia and anyone who has seen this iconic and elusive animal in person should consider himself or herself very fortunate.

History

The platypus is also referred to as boondaburra, mallangong, or tambreet (names given by indigenous people around Yas, Murrumbidgee, and Tumat) and tohunbuck (in the Goomburra language around the Darling Downs area). Europeans recorded their first platypus sighting in 1797 and the British Museum in London still has the dried specimen it was given in 1799. There

is no longer a platypus population in South Australia but a group of platypuses has been brought over to Kangaroo Island and is reportedly doing well (Wildlife Preservation Society of Queensland, 2013).

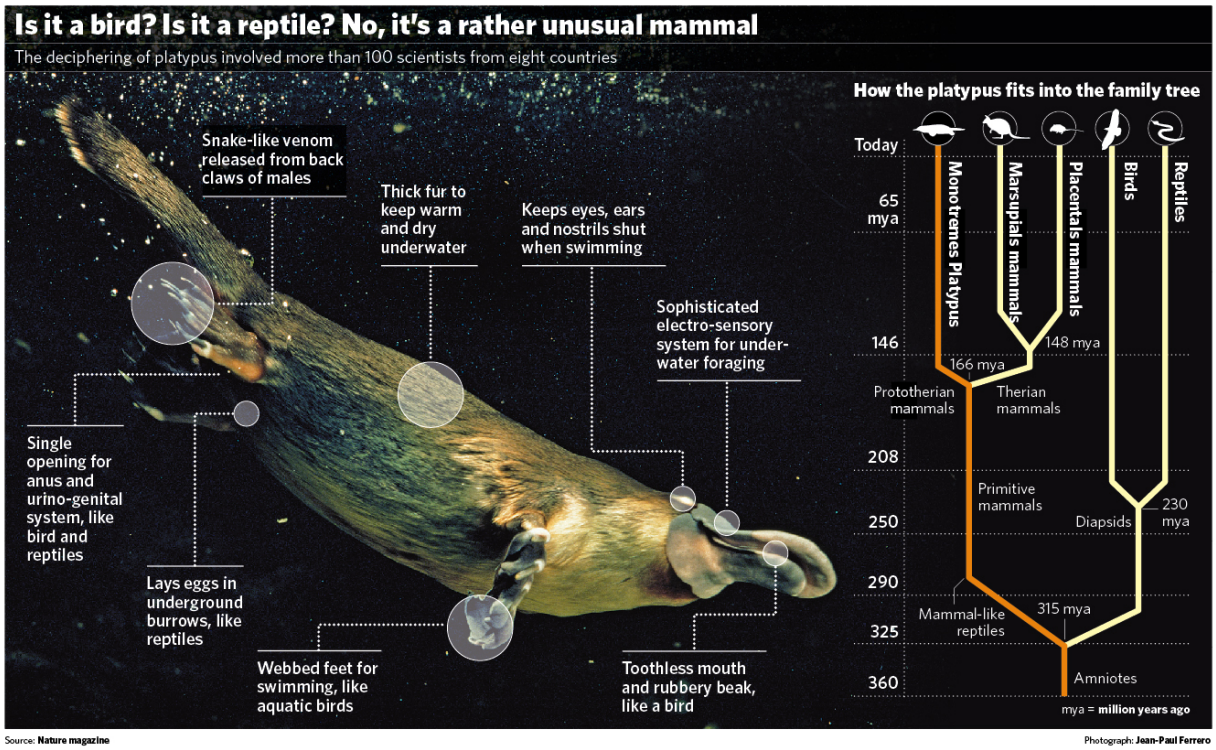


Figure 2.1 Deciphering the Platypus. Reprinted from "Is it a bird? Is it a reptile? No, it's a rather unusual mammal", by Nature Magazine, Photograph by Jean-Paul Ferrero. 2008. Retrieved from http://www.independent.co.uk/news/science/after-200year-quest-scientists-finally-unravel-the-bizarre-origins-of-the-duckbilled-platypus-822812.html?action=gallery.

Origin of the Name "Platypus"

Before being referred to commonly as a platypus, this animal was called a "water mole" or a "duckbill" by Europeans. British scientist Dr. George Shaw was the first to scientifically describe the platypus in 1799 and named the species *Platypus* (Greek, meaning "flat-footed") *anatinus* (Latin for "duck-like"). Unbeknownst to each other and simultaneously, German scientist Blumenbach came up with the scientific name *Ornithorhynchus* ("bird-like snout") *paradoxus* ("puzzling"). It was then discovered that *Platypus* had been in use since 1793 for a

group of beetles so the scientific name of the duck-billed animal was given a new name, a combination of both Shaw's and Blumenbach's names: *Ornithorhynchus anatinus* (Australian Platypus Conservancy). Eventually, the word "platypus" came to be the common term used for animal we now know today.

Biology

Physical Characteristics and Description

The platypus is the only member of the family Ornithorhynchidae and it shares the class Prototheria with four species of echidna (Klamt, Thompson, & Davis, 2011).

Although it is a warm-blooded mammal, it lays eggs and then provides its' young with milk (Scott & Grant, 1997). Platypuses weigh approximately four pounds and maintain a low body temperature, for a mammal, of 89.6 degrees Fahrenheit (Browne, 1997). The platypus is widely known as the only egg-laying, venomous, web-footed, duck-billed mammal in existence (see Figures 2.1 and 2.2).

The platypus is generally a solitary animal and territorial, their home range is usually about 2.5 hectares (about 6.18 acres) and can be up to 15 hectares (about 37 acres). They can travel up to 7 kilometers along streams (Wildlife Preservation Society of Queensland, 2013).

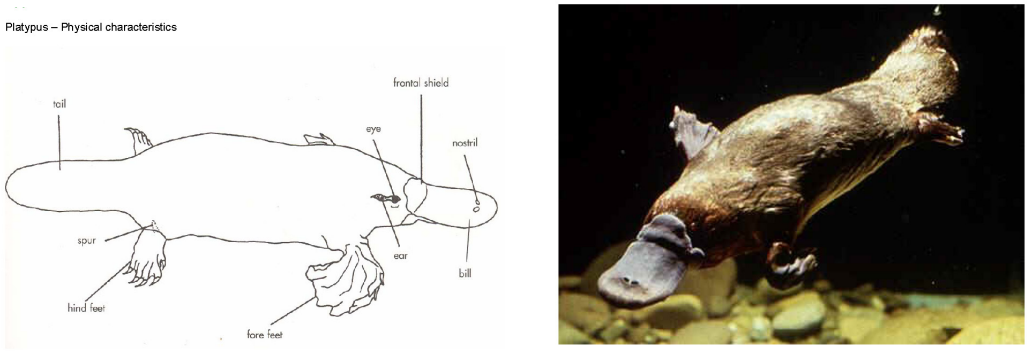


Figure 2.2 Physical characteristics. Reprinted from "Biodiversity Research Projects: Platypus", by Redland City Council. *Appendix 1: Platypus – Physical characteristics.* 2008. p. 14. Copyright 2008 by Redland City Council

Breeding and Development of Young

There is some variation in the breeding patterns of the platypus; eggs are generally laid in the beginning and middle of the spring. The female lays two and sometimes three eggs, then the eggs are incubated for approximately ten days, and after that the young are nursed for three to four months. They leave the burrow at about 80 percent to 90 percent of their adult length and they will not breed until they are at least two years old (the females may take longer and they do not breed every year) (Scott & Grant, 1997).

The breeding season for platypuses in Queensland is August. The female holds the young against her belly with her tail for the ten to eleven days of the incubation period. The newborn platypuses are about 1.5 centimeters in length (Wildlife Preservation Society of Queensland, 2013). Females develop a false, non-venomous spur that disappears before they are one year old.

Burrow and Nesting

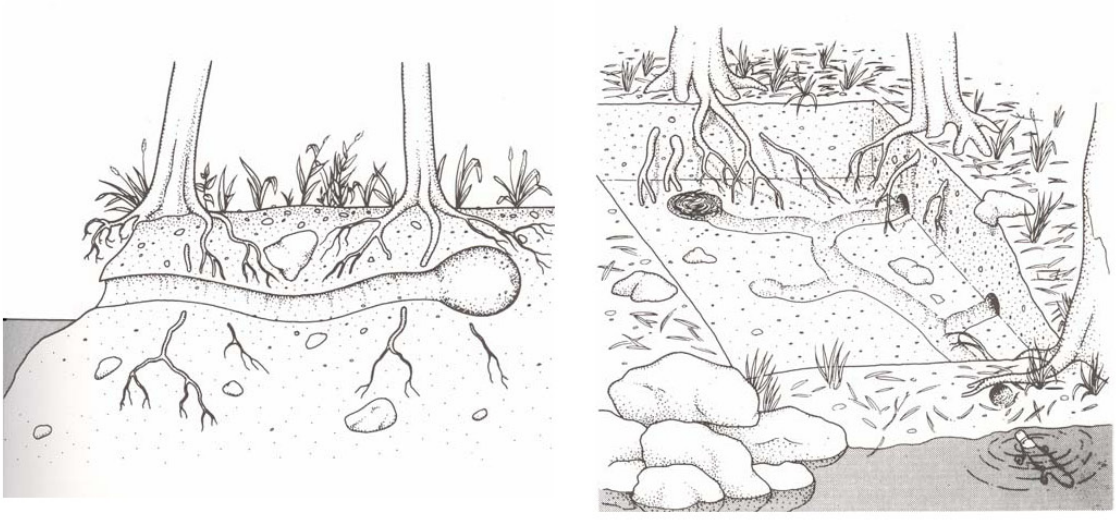


Figure 2.3 Platypus Burrow System. Reprinted from "Biodiversity Research Projects: Platypus", by Redland City Council. *Appendix 1: Platypus – Physical characteristics.* 2008. p. 16. Copyright 2008 by Redland City Council

Platypuses can travel across land but their ability to do so is rather limited (Klamt, Thompson, & Davis, 2011). They have multiple burrows, including several shorter (3 to 5 meters long) resting burrows that are used for refuge from predators and as a place to cool themselves (see Figure 2.3). The nesting burrow is dug on an upward incline to allow for rise in the water level and it can be anywhere from 3 to 30 meters long with several side branches (Scott & Grant, 1997).

Feeding

Feeding occurs most often between dusk and dawn in both the slow and fast-moving portions of streams where platypuses search out food along the bottom. The duckbill has touch receptors and electroreceptors that can alert the platypus to electrical impulses made by their prey's muscle contractions (Scott & Grant, 1997)(Gust & Griffiths, 2010).

Platypuses are carnivores and feed on fish eggs, worms, insects, crustaceans, mollusks, tadpoles, fly larvae, and shrimp. Though they forage underwater, they come up to the surface to eat what they catch (Wildlife Preservation Society of Queensland, 2013).

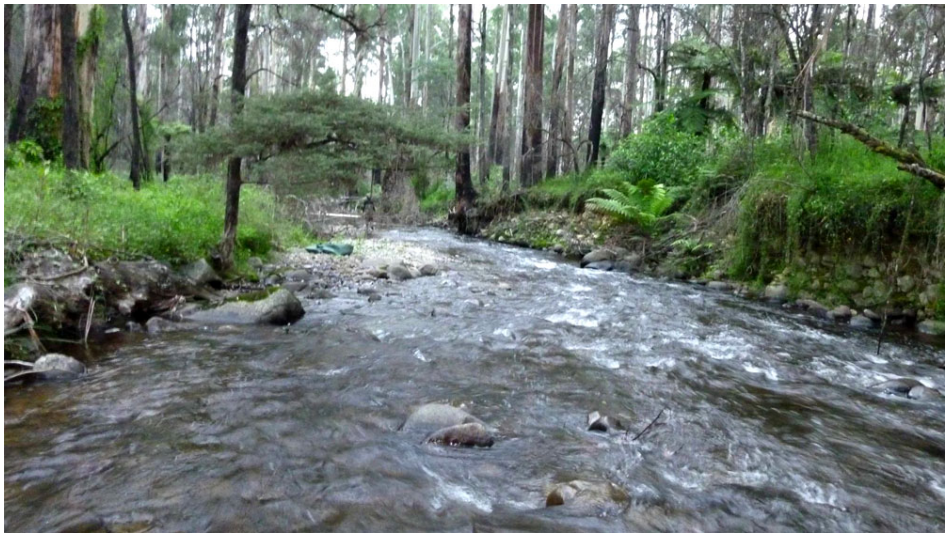


Figure 2.4 Platypus feeding habitat. Reprinted from cesar platypusSPOT, 2013. Retrieved from http://platypusspot.org/uploads/ckfinder/userfiles/images/slide01-ideal-habitat.jpg. Copyright 2013 by cesar Australia

Platypuses must eat enough food to equal 15 percent to 30 percent of their body weight daily. Shallow sections of rivers and creeks lined with pebbles are important areas for platypuses to forage at night, as they are busy getting in up to 17 hours of sleep during the day (Land for Wildlife).

Habitat

Platypuses require freshwater habitats that provide access to water for feeding and to (riparian) streamside land (see Figure 2.5) for their burrows (Klamt, Thompson, & Davis, 2011). Ideally, this habitat (see Figure 2.4) will consist of, "a fairly shallow river or stream with relatively steep earth banks consolidated by the roots of native vegetation and with its growth overhanging the bank" (Scott & Grant, 1997). It is possible for platypuses to live in both artificial and natural lakes provided that they are shallow enough to be conducive to benthic (bottom dwelling) invertebrate species (Scott & Grant, 1997).

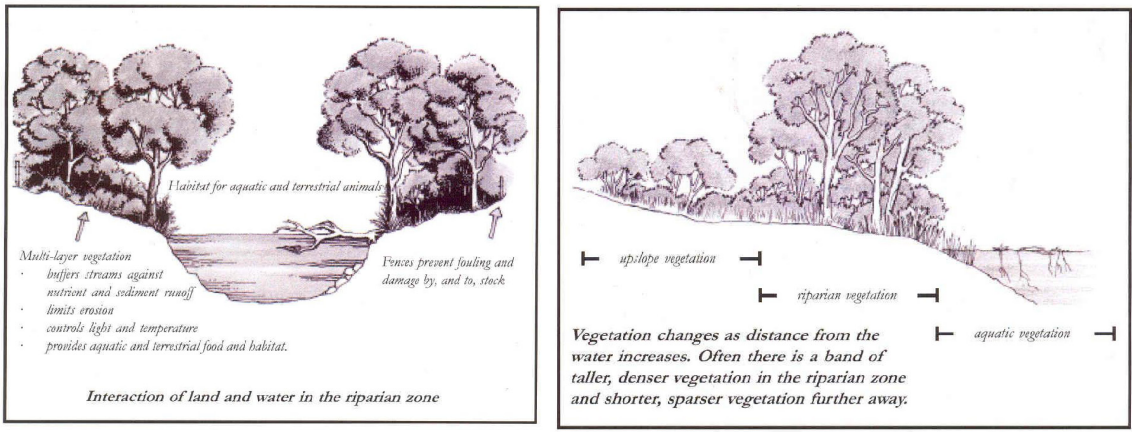


Figure 2.5 Riparian Vegetation. Reprinted from "Biodiversity Research Projects: Platypus", by Redland City Council. *Appendix 1: Platypus – Physical characteristics.* 2008. p. 23. Copyright 2008 by Redland City Council

Artificial Habitats and Captivity

Creating an artificial habitat to platypuses' liking is a serious undertaking. There are not many places where they have been made available for public viewing in Australia and there are

none in the rest of the world. A platypus named Barak, who was bred in captivity fifteen years ago, moved into a new $1 million facility at the Lone Pine Koala Sanctuary in Brisbane in 2010 (see Figure 2.6). Barak is a twin and he was born at the Healesville Sanctuary in 1998. He is now the father of two platypuses born in 2008, born to female platypus Binarri. There is only one other place in Queensland that features the platypus, that is Fleay's Wildlife Park in West Burleigh. This park was named for the first person to breed a platypus in captivity, David Fleay, who passed away in 1993 (Parsons, 2010).

Figure 2.6 Barak the platypus at Lone Pine Koala Sanctuary. Reprinted from Lone Pine Koala Sanctuary website. Retrieved from http://www.koala.net/platypus-photo.html. Copyright 2013 by Lone Pine Koala Sanctuary

As it has been mentioned previously, platypus conservation is essential. Because they are quite difficult to keep and breed in captivity, it is vital that their habitat is protected. According to the Healesville Sanctuary, it costs about $13,000 per year to feed a platypus (Zoos Victoria, 2012). While conducting their research, scientists realized that because platypuses are very sensitive to electronic fields, they must be shielded from these fields while they are being held in captivity (Browne, 1997).

The tactic of using a flagship species to raise awareness and public support of habitat conservation has the effect of leveraging more positive consequences for entire ecosystems (Gust & Griffiths, 2010). This tactic will be explored in greater detail through the examination of case studies.

Population Range

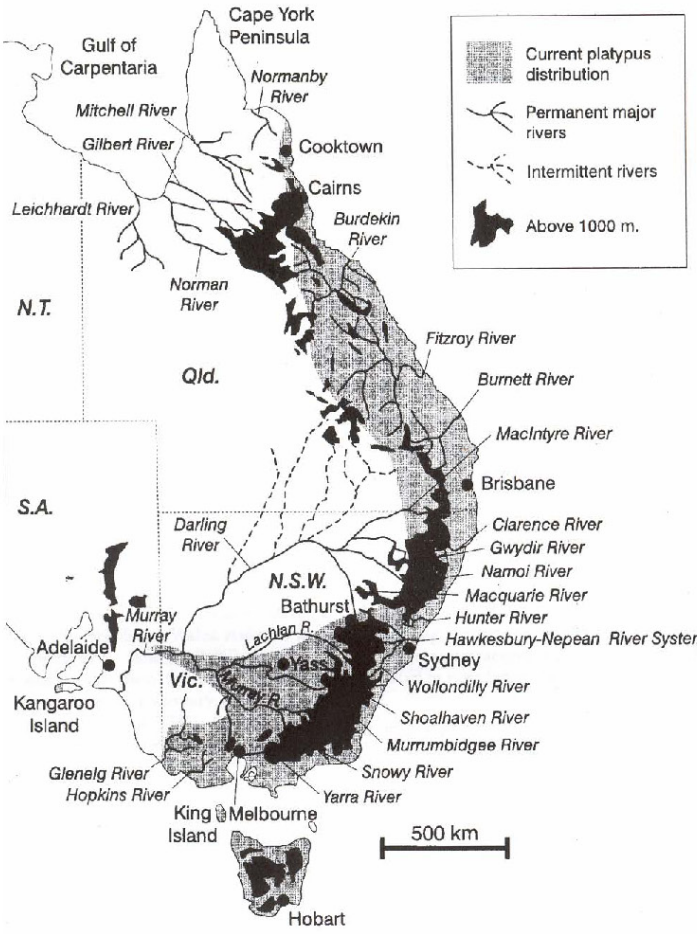


Figure 2.7 Platypus Range in Australia, with elevation and rivers. Reprinted from "Biodiversity Research Projects: Platypus", by Redland City Council. *Appendix 1: Platypus – Physical characteristics.* 2008. p. 15. Copyright 2008 by Redland City Council

Platypuses are found in waterways on the eastern side of Australia, ranging from Tasmania in the south to the Arran River near Cooktown in the north and up to the Great Dividing Range in west, as well as western Victoria (see Figure 2.7). It is suggested that there are

three discontinuous platypus populations within the state of Queensland (Wildlife Preservation Society of Queensland, 2013). The platypus range is approximately 3500 kilometers long and the species is found from sea level up to 1000 meters in altitude (Gust & Griffiths, 2010).

River Catchment Areas in South East Queensland

Waterways are sensitive to the effects of climate change in multiple ways and they are the nesting, breeding, and feeding habitat of the platypus. Human activity and development has a dramatic impact on the health of waterways as well.

There are fourteen main river catchments in South East Queensland, the largest being the Brisbane River catchment (see Figure 2.8). Altogether the catchments in SEQ are equal to a total of 21,220 kilometers squared and they flow into Moreton Bay, an International Ramsar Wetlands Site (Healthy Waterways, 2013). Moreton Bay can be compared to a semi-enclosed lagoon; it is rather shallow and tends to accumulate matter (both healthy and toxic) that is picked up by the rivers and creeks in the catchments. Many forms of aquatic life thrive in this area including sea turtles, dugongs, seabirds, and shellfish. According to non-government organization in partnership with the University of Queensland, Healthy Waterways, South East Queensland's catchments have a heath grade report card of "B" and it was reported that "overall, there was a small decline in freshwater grades and an improvement in the estuarine and marine grades" (Healthy Waterways, 2013).

SEQ Catchments Ltd. is a community-based, non-profit organization that is self-described as working "with all levels of government, community and the corporate sector to secure funding, coordinate activities, and provide technical and scientific advice to deliver measurable, long term outcomes for our region's natural resource assets" (SEQ Catchments, 2013). SEQ Catchments is able to do GIS mapping, property management planning, and to act as

a regional Landcare (community, government, business partnership for environmental protection) facilitator; all in an effort to manage the natural resources in the region and to meet the targets of the non-statutory *SEQ Natural Resource Management Plan 2009-2031* (SEQ Catchments, 2013). There are five work programs that are run by SEQ Catchments: Land, Biodiversity, Water, Planning and Services, and Community Partnerships. These programs involve projects that deal with issues such as weed management, water salinity, soil erosion, revegetate riparian areas, preserve landscape connectivity, and more (SEQ Catchments, 2013).

Though the overall Ecosystems Health Report Card for the South East Queensland region is good news, there are specific catchments within the Brisbane area that have received failing grades and must be addressed. 398 sites and the Moreton Bay are evaluated for the report cards on SEQ, 135 freshwater sites are monitored twice a year and the other 254 estuarine and marine sites are monitored on a monthly basis (Feeney, 2012).

The area that spans from the Wivenhoe dam wall to the Mount Crosby weir; which is in the Brisbane City Council, Somerset Regional Council, Ipswich City Council and Moreton Bay Regional Council areas; received a grade of "F". This catchment has some of the most intact regional riparian corridors and yet its' decline was attributed to increased nutrients and riverbed slumping. Professor Olley, who worked on the project and presented the results, said "the mid-Brisbane dropped from a 'D minus' to an 'F' – that's a fail, " and "that's the one all of us should be concerned about because it's a conduit for the water we drink here out of the tap" (Feeney, 2012). There are about 6000 kilometers of the catchment network that need to be fixed in order to protect the long-term health of Moreton Bay.

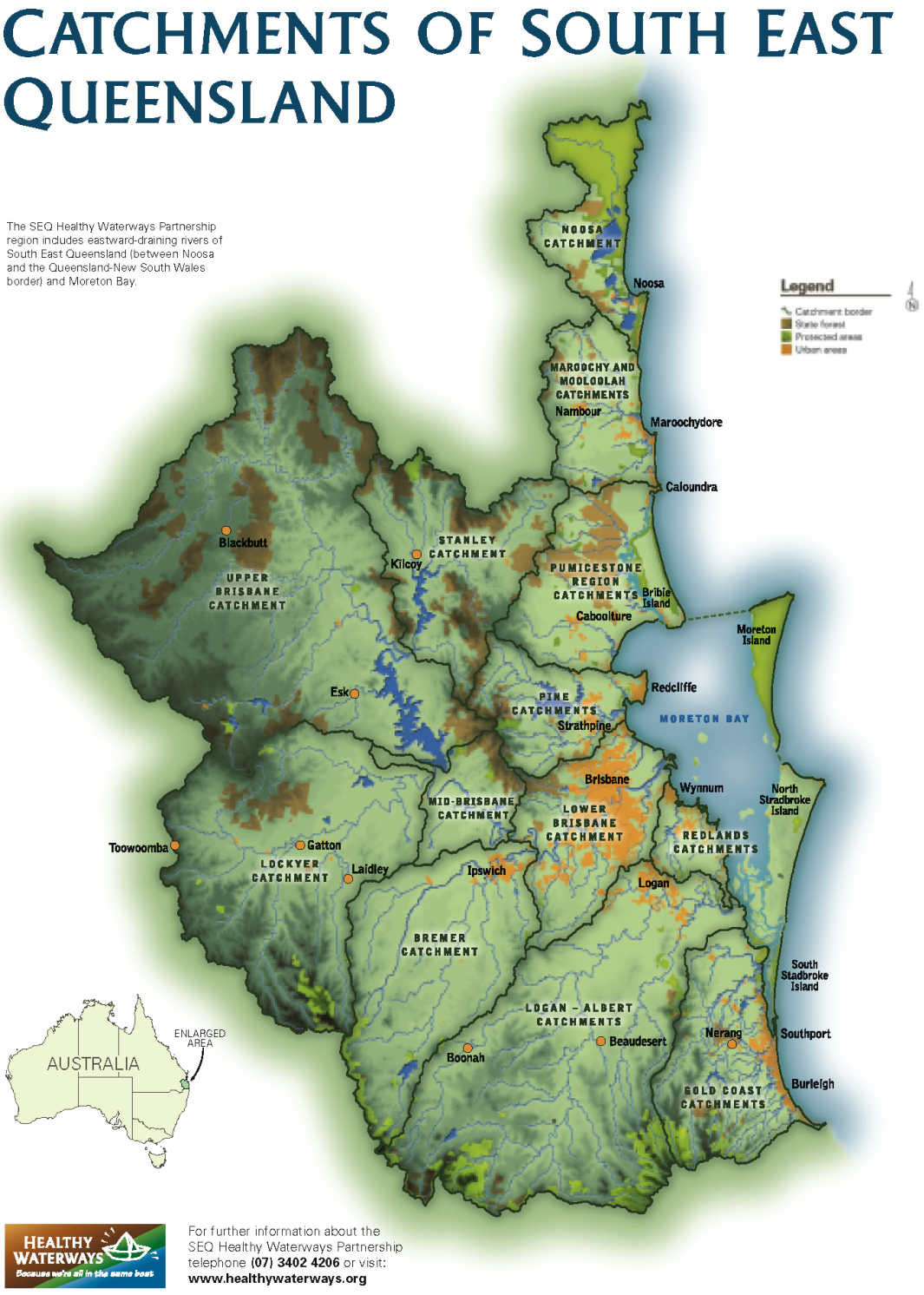


Figure 2.8 Map of river catchment areas in South East Queensland.
Reprinted from SEQwater. 2008-2013. Retrieved from www.upadrygully.com.au/res/FactSheets/HealthyWaterway/Catchments_of_seq.pdf. Copyright 2013 by Healthy Waterways

The Minister for Environment and Heritage Protection, Andrew Powell, said that the environmental, social, and economic value of the SEQ waterways is $5 billion and that the government is designating $4.6 million in cash and investments for the area. Brisbane Lord Mayor Graham Quirk added that the Brisbane City Council has allocated $6.75 million in this financial year's budget for creek mediation.

The first priority for the Brisbane City Council is to repair flood damaged areas and there are plans to put $20.4 million in the budget for the Norman Creek catchment over the next four years (Feeney, 2012).

Continuing to invest in the health of the waterways is to continue to invest in both platypuses' and humans' ability to thrive in South East Queensland and the Greater Brisbane area.

Insights Gained from Scientific Study

Platypuses are important to both humans and the environment in ways that are not initially apparent. Platypuses are an apex predator in numerous aquatic food webs and they are considered to play an essential role in maintaining the biodiversity of eastern Australian freshwater ecosystems, making the conservation of their species absolutely necessary (Gust & Griffiths, 2010).

The platypus genome has been sequenced and confirms "its evolutionary importance amongst amniote vertebrates" (Klamt, Thompson, & Davis, 2011). The platypus genome was first decoded and the findings were made public in early 2008, the scientific team financed by the National Human Genome Research Institute stated that this research offered, "many clues to the function and evolution of all mammalian genomes" and that they should, "inspire rapid advances in other investigations of mammalian biology and evolution" (Wilford, 2008). It was

determined that humans, mice, dogs, opossums, and chickens share 82 percent of their genes with platypuses. The scientists also learned that platypuses have genes for very sensitive odor receptors and they hypothesized that these are utilized for sexual communication or navigating and hunting underwater (Wilford, 2008).

The sleep patterns of the platypus have yielded some intriguing results as well. Platypuses are monotremes (considered to be the most primitive modern mammal), which are thought to represent an "evolutionary link between the reptiles and birds on one hand and the mammals on the other," (Browne, 1997). Prior to this study, it was assumed that platypuses did not experience Rapid Eye Movement (REM) sleep but it was determined that they do, it just originates from a different area of the brain, much like human infants' REM sleep. This may indicate that dinosaurs were also capable of REM sleep (Browne, 1997).

Summary

Platypuses' requirements for survival are specific and there are steps that should be taken to ensure that these requirements continue to be met in the future. Upon closer examination, it also becomes apparent that the elements of the environment the platypus is dependent upon have become threatened by both climate change and human activity.

The platypus is resilient though it may have a "breaking point" where its population has the potential to collapse if effective conservation plans are not put in place at all levels of government in Australia and international emissions are significantly reduced.

CHAPTER 3

CLIMATE CHANGE AND THE PLATYPUS

The platypus population has managed to cope with climate change impacts up until this point. A key part of planning for the future of the platypus is making forecasts, through the use of tools such as Geographic Information Systems (GIS), about how the changes in the climate could affect the species in the coming decades. A few methods for mitigating these impacts are mentioned and they will be expanded upon in later chapters.

Coping with Climate Change

In light of a warming climate, it is important to note that the platypus is a very well insulated animal and it has three ways of cooling itself: swimming in cool water, escaping into a burrow, and minimal sweating. In the event of an extreme temperature, platypuses will stay in their burrows, close to streams – the problem with this strategy is that it limits their ability to go out and obtain food. They are more resilient to cooler temperatures than hotter temperatures and they can handle hotter air better than hotter water (Klamt, Thompson, & Davis, 2011).

So far, the platypus has proven to be rather resilient in the face of its changing habitat, especially in comparison to the declining populations of other mammals in Australia. There is still a platypus population in the majority of its historical range with the exception of South Australia and notable downturns in portions of the Murray River in Victoria and the Murrumbidgee River in New South Whales (Klamt, Thompson, & Davis, 2011).

The aspects of climate change that are considered the most threatening to the platypus are drying and warmer water temperatures, the combination of these aspects may cause the

destruction of suitable aquatic habitats – to which the platypus is acutely vulnerable to because of their specific habitat needs and their restricted mobility (Klamt, Thompson, & Davis, 2011). Australia is known for having a highly variable climate and this island continent has become more and more arid over the last forty thousand years, which has led to a decrease in the hospitable areas for the platypus in the southern and eastern portions of the continent where the climate has retained greater wetness (Klamt, Thompson, & Davis, 2011).

Climate Change Modeling and Impacts on the Platypus

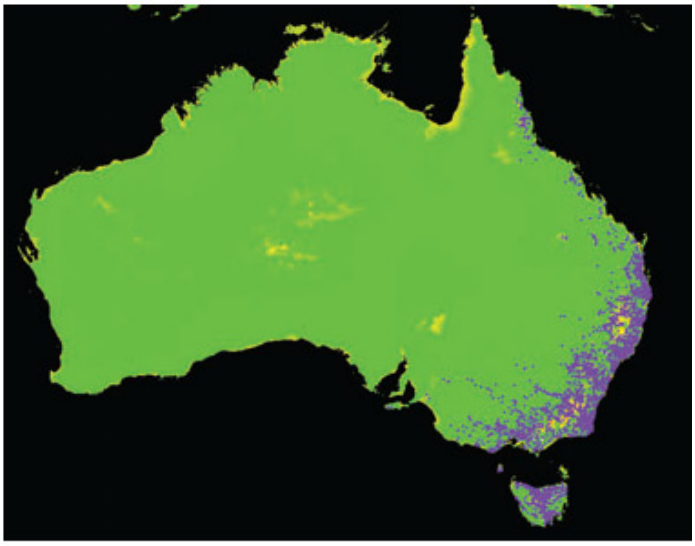


Figure 3.1 Platypus sighting records mapped on digital elevation model of Australia. Reprinted from "Early response of the platypus to climate warming", by M. Klamt, R. Thompson, and J. Davis. Global Climate Change Biology, 17. 2011. p. 3013. Copyright 2011 by Blackwell Publishing Ltd.

When it comes to modeling the potential impact of climate warming on the habitat of the platypus, the good news is that this modeling has been done with over two hundred years of platypus distribution records (almost 11,500 records). The availability of these records over a longer period of time allows for the identification of more accurate trends. The data was refined

and the platypus distribution was modeled with version 3.3.3e of MAXENT (Maximum Entropy Species Distribution Modeling Software) (Klamt, Thompson, & Davis, 2011).

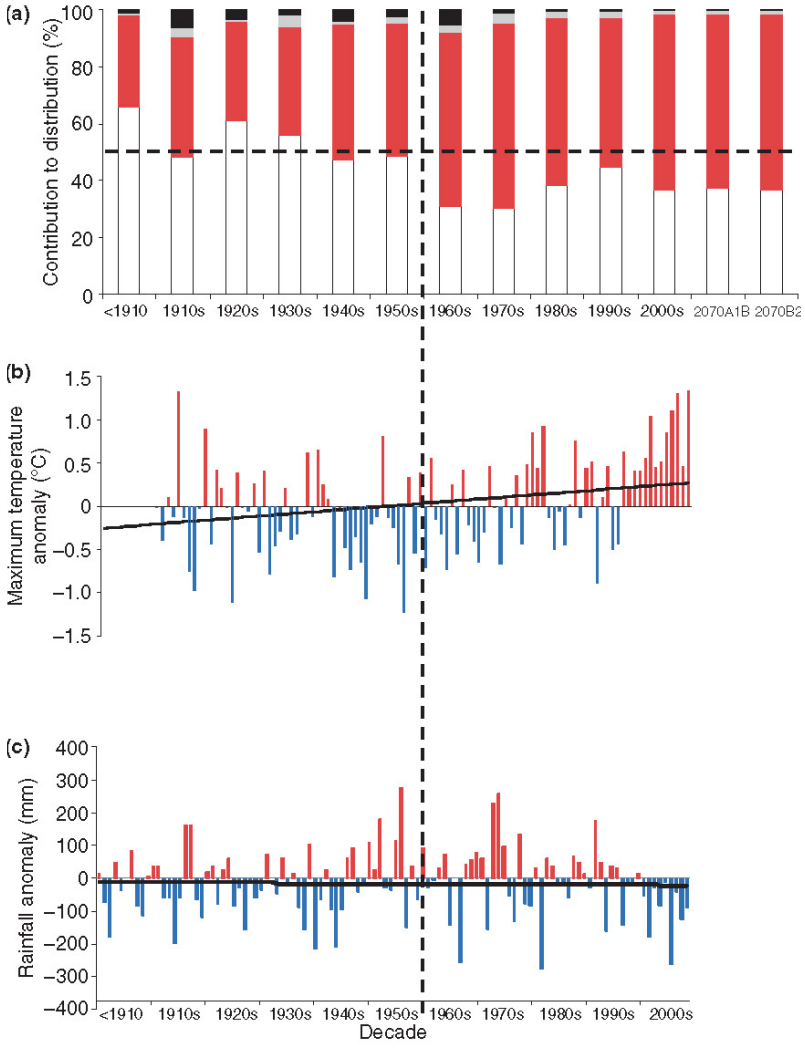


Figure 3.2 Environmental factors used in modeling. Reprinted from "Early response of the platypus to climate warming", by M. Klamt, R. Thompson, and J. Davis. Global Climate Change Biology, 17. 2011. p. 3014. Copyright 2011 by Blackwell Publishing Ltd.

For the climate portion of the modeling done by the faculty of the School of Biological Sciences at Monash University in Clayton, Victoria; total annual rainfall data and minimum air temperatures data (see Figure 3.2) from the Australian Bureau of Meteorology's National Climate Centre were obtained and averaged for each decade. Water temperature is closely related

to the maximum daytime temperature so this was included. Geoscience Australia provided the digital elevation model of eastern Australia (see Figure 3.1) (Klamt, Thompson, & Davis, 2011).

Different emissions scenarios for future climates were modeled with data from Commonwealth Scientific Industrial Research Organization (CSIRO) Mk 3.5 OzClim because "it represents a conservative scenario for warming and can be closely validated to historical data" (Klamt, Thompson, & Davis, 2011).

The chosen emissions scenarios were (see Figure 3.3): A1B (rapid economic growth, introduction of new technologies with a balance between fossil and non-fossil energy sources and technologies), A2 (more heterogeneous world, continuously increasing population), B1 (convergent world with the same population as scenario A1), and B2 (most optimistic - focused on sustainability, slightly lower population growth rate than A2, less rapid but more diverse technological changes than A1 and B1) (Klamt, Thompson, & Davis, 2011).

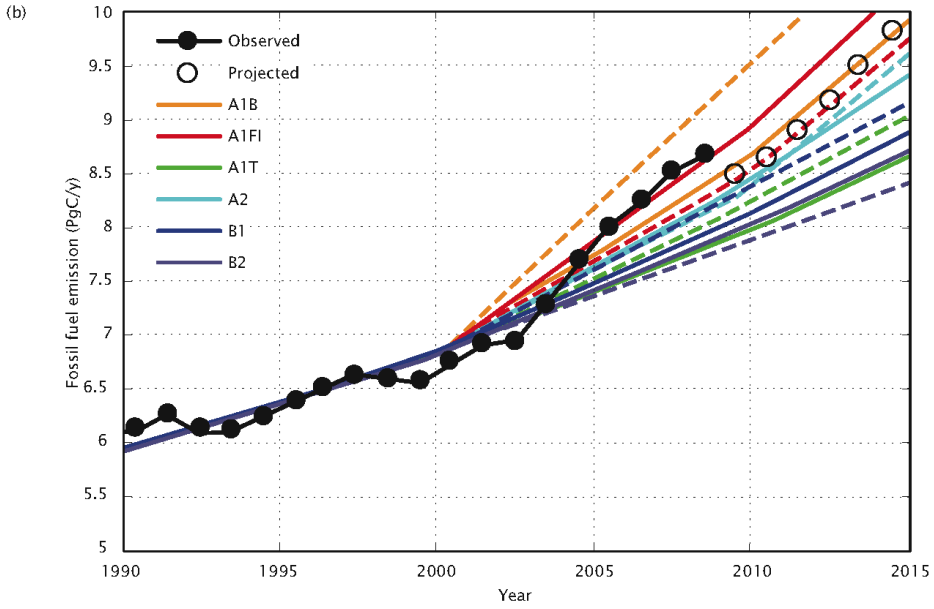


Figure 3.3 Trends in CO2 emissions. Reprinted from "Climate Change: science and solutions for Australia", edited by H. Cleugh…[et al.], 2011, p. 27. Copyright 2011 by CSIRO PUBLISHING

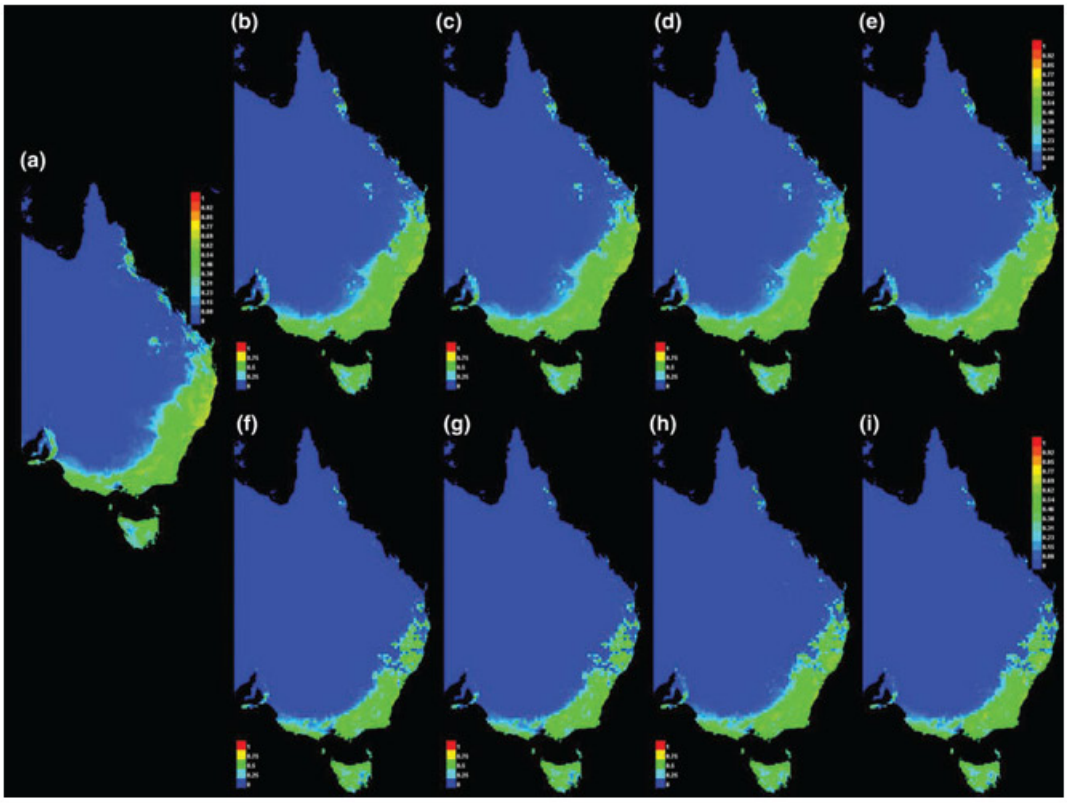


Fig. 3 Modelled platypus distribution based on presence records (2000–2009, n = 4232), elevation data and current or future modelled meteorological data (maxent): (a) current decade climatic conditions, (b) A1B emissions scenario for 2020, (c) A2 emissions scenario for 2020, (d) B1 emissions scenario for 2020, (e) B2 emissions scenario for 2020, (f) A1B emissions scenario for 2020, (g) A2 emissions scenario for 2070, (h) B1 emissions scenario for 2070 and (i) B2 emissions scenario for 2070. All scenarios used data with a moderate rate of global warming based on the CSIRO Mk 3.5 global climate model, obtained from Ozdim (CSIRO, 2010). Suitable habitat is indicated by warmer colours (orange, yellow, green) while unsuitable habitat is indicated in blue.

Figure 3.4 Modeled platypus distribution. Reprinted from "Early response of the platypus to climate warming", by M. Klamt, R. Thompson, and J. Davis. Global Climate Change Biology, 17. 2011. p. 3015. Copyright 2011 by Blackwell Publishing Ltd.

The results of this climatic envelope modeling demonstrated that the relationship between platypus distribution and climatic variables was quite close and that there has been a definite shift in the areas of suitable platypus habitat over the past two hundred years. Prior to 1950, the strongest contributing factor to platypus distribution was total annual rainfall, then annual maximum air temperature, annual minimum air temperature, and lastly elevation. Interestingly, in the 1960s the strongest contributing factor became annual maximum air temperature. The projected emissions scenarios for all four scenarios for 2020 and 2070 show a negative impact

for platypus distribution (see Figure 3.4). All scenarios predict approximately a 30 percent loss of suitable platypus habitat by 2070. The model shows the majority of the loss in the northern and inland areas of the current range (Klamt, Thompson, & Davis, 2011).

The combination of warming and drying means that what were once cooler rivers become a series of warmer pools (with poorer water quality) that platypuses are forced to travel in between where they will become much more vulnerable to predators such as cats, dogs, and foxes. What is unknown is the specific effect that this will have on the temperature of burrows, it is possible that their burrows will need to be dug deeper to stay cooler and it is unclear if the platypus has the capability to extend its burrows in this manner (Klamt, Thompson, & Davis, 2011).

Modeling the impacts of climate change becomes more complex with every variable that is included. These impacts become more dramatic in systems with multiple stressors. The technique of mitigating the effects of these stressors is a possible method of managing the effects of climate change on the platypus (Klamt, Thompson, & Davis, 2011).

Role of GIS in Conservation and Climate Change Planning

The article referenced extensively earlier in this chapter, *Early response of the platypus to climate warming*, demonstrates an exemplary use of a tool very commonly utilized by planners at all levels known as Geographic Information Systems or GIS. Specialists in other fields, such as veterinary medicine, also use GIS in different ways that could be applicable for use in achieving platypus conservation goals. GIS is frequently used on a more basic level as well to make maps that display the location of platypus sightings in conjunction with other data, such as river catchment areas or political boundaries.

Modeling methods, such as MAXENT (maximum entropy) “works by finding the largest spread in a geographic dataset of species presences in relation to a set of 'background' environmental variables” (Fridley, 2010). These programs are input with GIS data and the models they produce are undoubtedly useful but they do have some limitations and should be “considered as indicators of potential change, rather than accurate forecasts” (Klamt, Thompson, & Davis, 2011).

A ‘climate envelope model’ is defined as “a subset of species distribution models that use climate variables to make spatial predictions of environmental suitability for a species” (Watling, Brandt, Mazzotti, & Romanch, 2012). These models are used to make correlations between a species’ location and environmental conditions. Since climate varies more on a broader scale, these models would be more useful on a state or national scale in Australia. It must also be noted that these models are only as good as the data that is put into them and it is necessary to cross-reference the results for accuracy.

NatureServe Vista is a program that is compatible with ESRI’s ArcGIS program and is intended for use in conservation planning. NatureServe Vista can help “conduct conservation planning and assessments; integrate conservation values with other planning and assessment activities; and evaluate, create, implement, and monitor land use and resource management scenarios designed to achieve conservation goals within existing economic, social, and political contexts” (NatureServe Vista, 2012). This is an example of a GIS program that can be used by both GIS experts and beginners to aid in streamlining the conservation planning process. NatureServe Vista can also be utilized in conjunction with tools such as N-SPECT, which assesses and models water quality.

Other variables that could affect the platypus population, such as proximity to areas with rapidly increasing human population density or proximity to highways, could be included in models as well. Models made with data on other species living in the platypus range could potentially demonstrate previously unrealized connections between species. GIS programs could be used to identify linkages between platypus populations and catchment areas.

Site suitability for habitats, population density, GPS locations of sightings, environmental change detection, epidemiology, solar and wind energy potential, mapping carbon sequestration, and interactive online maps are just a few other examples of what types of maps can be created and they kinds of analysis that can be done through the use of GIS programs. For example, GIS could be used by a non-profit platypus conservation group to target financial donors or potential volunteers. As the equipment and technology used to generate data on both the platypus population and the effects of climate change on the environment continues to become more advanced, the analysis and correlation of this data continues to become more beneficial to conservation efforts.

Mitigating Impacts of Climate Change for the Platypus

One mitigation technique is to create microhabitats through habitat manipulation or artificial habitat restoration, this has definite potential to establish a local thermal refuge in the areas of the platypus range that are most at risk for warming in the north and west. Establishing predator-free islands could reduce predation on the platypus, especially by the notorious predator known as the red fox (Klamt, Thompson, & Davis, 2011).

According to the International Union for the Conservation of Nature, the platypus is of least concern when it comes to its global conservation status but; the researchers of Monash University state that their modeling shows that “their vulnerability should not be underestimated”

(Klamt, Thompson, & Davis, 2011). They explain that the switch from "aquatic habitat limitation to physiological limitation" demonstrates the early response of the platypus to climate change and that the next response could be a "catastrophic decline in platypus distribution and abundance" (Klamt, Thompson, & Davis, 2011). The researchers emphatic statement that, "Facing this scenario, climate adaptation strategies must give highest priority to ensuring the enduring conservation of this globally significant animal" (Klamt, Thompson, & Davis, 2011) is one that should be heeded by all Australians and by Australian planners at the national, state, regional, and local levels.

Summary

The platypus, referred to by experts as a "globally significant animal", is affected by the emissions being released and the climate changed occurring internationally. While platypuses have some capacity to be resilient to variations in their habitat, they are certainly not immune to them. These changes can be forecasted, which is helpful in some ways for conservation efforts. It is also telling because as it stands, for any given emissions scenario, the viable platypus habitat is expected to decrease significantly in the decades to come. To reduce the possibility of a catastrophic decline of the species, taking steps to help to mitigate the impacts of climate change is a vital undertaking.

CHAPTER 4

HISTORICAL OVERVIEW OF GOVERNMENT PLANNING IN AUSTRALIA

Planning is essential at all levels of government in Australia and it is taking place to some degree at the national, state, regional, and local levels. This chapter serves as an overview of the history and organization of government in Australia, including: the Commonwealth of Australia, the State of Queensland, the South East Queensland (SEQ) region, and Local Government areas and cities within the SEQ region.

The concepts and information presented in this chapter will lead to a better understanding of the current environmental and political systems in which planning for the platypus is taking place. Focusing in on Queensland to the South East Queensland region and then to the state capital of Brisbane is being used as an example because this is an area in which the human population is increasing, where climate change is occurring, and that is within the platypus range.

National Level

Creation of the Commonwealth of Australia

Australia is the sixth largest country in the world by land area. It covers 7,682,300 square kilometers and as of October of 2012 the population was approximately 22.7 million people. The majority of Australians live along the coast. The cities of Sydney and Melbourne are the country's largest and the capital city of Canberra is located between the two. Aboriginal peoples were the first to live in what we now call Australia, it is theorized that they came from Asia somewhere between 50,000 to 60,000 years ago. Though it was explored several decades prior,

the first European settlement was established by Capitan Arthur Phillip in January of 1788. Australia began to shift away from being primarily a penal colony in the 1830s and by 1868 prisoners were no longer being sent over from Europe (Australian Government, 2013).

Australian Government Structure

The Commonwealth of Australia, like the United States of America, is a federation of states and territories. These two countries are also alike in the fact that the states and territories have crucial governmental powers when it comes to land use planning, environmental management, and climate change adaptation. One difference is that the federal government in Australia is casually referred to as "Commonwealth" or "Federal Government" but it is properly referred to as the "Australian Government" (Blakley & Carbonell, 2012). Being originally organized by the British, Australia took on their system of government and law known as the "Westminster system" (Australian Government, 2013). Over time there has been more political "distance" between the Australians and the British Crown and there has been ongoing discussion of Australia becoming a republic.

The Commonwealth of Australia is comprised of ten territories and six states. The Commonwealth of Australia was formed in 1901 with a constitutional monarchy form of government, this means that there is a written constitution (the Australian Constitution) defining the scope and operations of the Australian Government and that the head of state is the monarch of England. The Australian Constitution gave birth to a federal system of government, dividing the power between the Australian Government and the individual states. According to Section 51 of the Constitution, there are three arms of the Australian Government: the legislative arm (parliament) debates and votes on new laws, the executive arm enacts and upholds laws (some members of parliament known as "ministers" are members of the executive arm as well), and the

judicial arm which is separate from the other two arms and is charged with both enforcing laws and determining that the other two arms are acting within their powers (Australian Government, 2013).

State and Local Government in Australia

Each of the six states has their own constitution and the same three arms of government as the Australian Government to make their own laws concerning anything that is not covered by Section 51 of the Constitution. The territories are essentially the areas of Australia that are unclaimed by the states and they can be governed by the Australian Government or run by self-rule (not unlike a state), though these areas can become an official state if the Commonwealth legislature agrees to it (Australian Government, 2013).

The head of each state government is called the "Premier" and a Governor in each state is designated to exercise the monarch's powers over that state. The six states in Australia are: New South Whales (NSW), Queensland (Qld), South Australia (SA), Tasmania (Tas.), Victoria (Vic.), and Western Australia (WA). The Australian Capital Territory (ACT), the Northern Territory (NT), and an island territory called Norfolk Island are all self-governed (the Australian Government limits this right) and have a locally elected parliament. Commonwealth law governs the other seven territories and in most cases they each have an Administrator appointed by the Australian Government (Australian Government, 2013).

The Parliament of Australia is in the national capital city of Canberra, in the Australian Capital Territory. The other state and territory capital cities include: Adelaide (SA), Brisbane (Qld), Darwin (NT), Hobart (Tas.), Melbourne (Vic.), Perth (WA), and Sydney (NSW). If there is a discrepancy between state law and Australian Government law, the Commonwealth law is to

be obeyed. Decisions by any state judiciary may be subject to review by the Australian Government judiciary (Australian Government, 2013).

The Northern Territory and the six states have local governments (also called local councils, cities, shires, towns, or municipalities). These local governments only have legislative and executive branches and their powers and specific geographical areas are defined by their state or territory. Town planning is considered to be a community need that is met by local governments (Australian Government, 2013).

State Level

How the State of Queensland was Formed

Aboriginal peoples and Torres Strait Islanders were the first known inhabitants in the area of Australia now known as the state of Queensland; their archeological sites have been dated to approximately 15,000 to 30,000 years ago. Though Europeans sighted it several years earlier, they didn't begin to settle in Queensland until 1825 when they developed a penal colony there. By 1839, the penal settlement was closed and the land was sold to free people. On June 6, 1859, Queen Victoria signed Letters of Patent establishing Queensland as a colony and an Order-in-Council granted Queensland it's constitution. Queensland was then a self-governing colony with a Governor, nominated Legislative Council, and an elected Legislative Assembly (Queensland Government, 2013).

The separation from New South Whales prompted the development of several new towns and the parliament to get to work on increasing the population (Queensland Government, 2013). The formal institutions of government were defined through the *Constitution Act 1867* and local government was created by the *Divisional Boards Act 1879*. It is believed that the first branch meeting (made up of sheep shearers on strike) of the Australian Labor Party took place in 1891

under a gum tree, referred to as the Tree of Knowledge, in Barcaldine, Queensland (Queensland Government, 2013).

Australia was unified to form the Commonwealth of Australia on January 1, 1901. Queenslanders voted to pass a referendum that resulted in Queensland joining the federation and becoming a state (Queensland Government, 2013). In 1922, Queensland dismantled the Upper House and became the only state to have one house. From 1961 to 1975, Lord Mayor Clem Jones' city council launched town planning and development programs that had major impacts on Brisbane. Important mitigation works were put into action in 1974 in response to the Brisbane Flood, including the Wivenhoe Dam. Both the Burdekin Falls Dam (the largest in Queensland) was completed and the Fizgerald Inquiry began, resulting in major reforms for public service (Queensland Government, 2013).

Planning in Queensland

Planning in Queensland has seen its share of attempts at reformation, especially over the past few decades, and some of them have been more successful than others. The people of Queensland, on whose behalf planning decisions are being made, number about 4.6 million people, as of September 2012 (Queensland Government, 2013).

In her essay titled *The legislative challenge*, Philippa England writes about the "dramatic birth of a state-directed planning system in Queensland over the space of less than two decades" including the *Integrated Planning Act 1997*, *Integrated Planning Act 2007, Sustainable Planning Bill 2009,* and the *SEQ Regional Plan 2005-2009* (England, 2010).

The Integrated Planning Act made some major reforms in planning (such as performance-based planning). These reforms proved to be a bit too ambitious at the time and ultimately more enforceable changes were made when the Labor Party led the changes at the

state level. Queenslanders continue to be, understandably, rather wary of government corruption and it remains to been seen whether a more state-centered planning system (as advocated by the *Sustainable Planning Act 2009*) will be "the servant of good planning rather than a tool for politicized discretion" (England, 2010).

Regional Level

About the South East Queensland Region

South East Queensland (SEQ) is a region within the State of Queensland with a land area of 22,433.6 square kilometers that is bordered by the Darling Downs region on the west, the region of Wide Bay Burnett to the north, the Coral Sea to the east, and the State of New South Whales to the south. The population of SEQ was estimated at 3,178,032 in 2012 and is projected to be 4,430,000 by 2031 (Queensland Government, 2010-2013).

SEQ covers 14 major river catchments and it is the most highly populated region in Queensland. Though built-up and urban areas make up only 2.3 percent of the total land area in SEQ, this region has the greatest concentration of urban development in the state (see Figure 4.1). The city of Brisbane is the capital. Currently, the Gold Coast and Sunshine Coast areas are experiencing widespread development but the most growth is expected to occur in Ipswich and Logan. It is anticipated that the following issues will come more to the forefront as the SEQ region grows: "adequate infrastructure, affordable housing, water security, and exposure to high-level impacts from climate change" (Blakley & Carbonell, 2012).

Within the SEQ region, there are ten distinct local government entities: Brisbane is the largest city in Queensland, Gold Coast City attracts both tourists and retirees and is the largest non-capital city in Australia, Ipswich City is a suburb of Brisbane and was a major industrial and mining area, Lockyer Valley Region is predominately agricultural and is known for its produce,

Logan City is a residential area to the south of Brisbane, Moreton Bay Region is the residential area to the north of Brisbane, Redland City is a residential and agricultural area on the coast, Scenic Rim Region is known for its mountains and countryside, Somerset Region to the northwest of Brisbane is home to two dams that supply the SEQ with water, and the Sunshine Coast Region to the north of SEQ is tourist and agricultural area (Blakley & Carbonell, 2012). A wide array of plant and animal species inhabit the diverse habitats of South East Queensland and grazing accounts for almost 50% of the land use, making it the dominant land use in the region (Blakley & Carbonell, 2012).

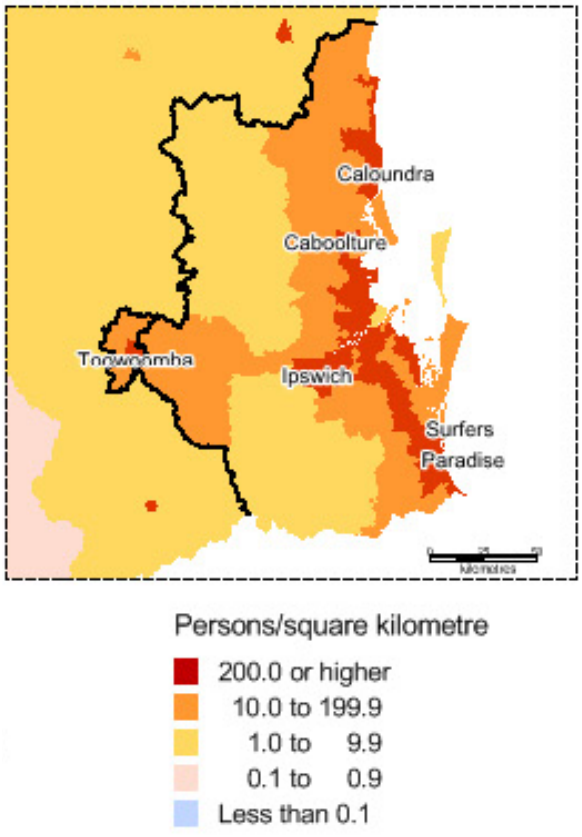


Figure 4.1 Population density by statistical area in Queensland, June 30, 2011. Reprinted from "Population Growth Highlights and Trends, Queensland 2012" by the Office of Economic and Statistical Research. 2012. p. 18. Copyright 2012 by Queensland Treasury and Trade

Local Government in South East Queensland

Those living in South East Queensland make up 69.4 percent of the Queensland population, which is equal to 3,178,030 people as of June 30, 2011(Queensland Treasury and Trade, 2012). The top five local governments areas in SEQ other than Brisbane, in terms of 2011 population, are Gold Coast (536,480), Moreton Bay (389,680), Sunshine Coast (335,270), Logan (287,470), and Ipswich (172,740) (Queensland Treasury and Trade, 2012).

Planning Reform in South East Queensland

The Queensland Government is working to reform the state's planning and development system. The goals of this comprehensive reform are to: "streamline assessment and approval processes, remove unnecessary red tape, and to re-empower local governments to plan for their communities" (Queensland Government, 2013). The draft *State Planning Policy* (SPP) was released on April 15, 2013 and the idea is that this will be one state planning policy that will clarify the state's interests and will replace the multiple state planning policies being used now. The draft states that this *State Planning Policy* will be used by local governments when they are: making a new planning scheme (legal planning document prepared by council), amending an existing planning scheme, and undertaking development assessment for certain types of development(s) in areas where the planning scheme isn't in line with the SPP yet. The state government will use the SPP for various purposes, not the least of which will be making a new regional plan, amending an existing regional plan, and designating land for community infrastructure (Dept. of State Development, Infrastructure and Planning, 2013). The draft introduces the concept of "Producing a prosperous Queensland" which includes 18 state interests organized into these five main categories: housing and livable communities, economic growth,

environment and heritage, hazards and safety, and transport and infrastructure (Dept. of State Development, Infrastructure and Planning, 2013).

Perspectives on Planning in South East Queensland

In between the 1920s and 1970s, the SEQ region is described as being a place dealing with the "interplay of tendencies towards centralized state government control and decentralized autonomy for local governments" (Minnery & Choy, 2010). An intriguing aspect of this is the development of Brisbane and the Brisbane City Council. Two cities, six towns, and twelve shires over a 970 square kilometer area formed the area now known as "Greater Brisbane" and the Brisbane City Council was granted significantly more power than other local governments in the state (Minnery & Choy, 2010).

One of the things that Queensland did that continues to influence the SEQ region today was to create the office of the Coordinator-General. This office is "extremely powerful" and coordinates "the activities of local governments and state governments through centralized control" (Minnery & Choy, 2010).

The takeaways from this period of time in SEQ history are that local government initiatives are more successful with the support of the state government, the importance of infrastructure (and the agencies in charge) in regional planning, and criticalness of "the mechanisms and administrative agreements" which allow for collaboration and coordination (Minnery & Choy, 2010).

The first statutory plan for South East Queensland was put into place in 2005. By this point; Brisbane, the Gold Coast, the Sunshine Coast, and other smaller coastal towns had effectively merged into one giant "200-kilometer city" and became "one of the world's longest urban coastal strips" (Spearritt, 2010). In 2009, a draft of a regional plan through the year 2031

was released; which Spearritt describes as “a public relations document full of the requisite platitudes, where some sound data and mapping is overlain with soft-core urban photography” and as being “long on description but so shy of prescription”.

Spearritt suggests that in order for the 200-kilometer city to make it through the next few decades of changes, huge investments must be made in infrastructure and that state and local governments need to support many more local sources of employment. His assessment of the 2009 regional plan is that its’ ambitions are admirable but that so far there is not much evidence of action (Spearritt, 2010).

Local Level

Brisbane

Results of the 2011 Census have revealed that the population of Greater Brisbane is 2,065,996; which is up 11.5 percent since 2006. The local government area with the most growth within Greater Brisbane is Brisbane with a population of 1,041,842; which is up 9 percent since 2006 (Australian Bureau of Statistics, 2012).

In 1925, Brisbane became the first local authority in Australia to appoint a town planner, WJ Earle, and create a Town Planning Department. The position of the town planner and the city engineer were merged in 1931. There was a draft metropolitan plan written in 1944, which showed a green belt surrounding a dense urban center with satellite towns outside the belt. This draft was approved by the City Council but they were not legally able to implement it. The first statutory town plan was not put in place until 1965. Transportation studies were done by Wilbur Smith and Associates in 1965 and in 1970. These studies were done without any guide for future land use patterns so, the consultants had to make their own land use plan. In 1976 the first structure plan for Brisbane was made which emphasized reviving inner–city areas and creating

regional business centers in the suburbs. By 1976, the Queensland Government had little interest in regional planning; the reason behind this is attributed to the change in the national government from reformist Labor administration to a conservative coalition (Minnery & Choy, 2010).

Today, Spearritt doesn't consider there to be any notable differences in the geography of what were once more distinct urban areas in and around Brisbane, he sees a gigantic coastal city that has developed around its highway system. Unlike other large Australian cities, neither geographical features nor national park areas have restricted Brisbane's growth. Prior to the 2005 regional plan, there was public outcry about the diminishing green space in the SEQ region. In response to this, the regional plan identified an "urban footprint" for future development. One caveat of this is that state and local governments own a small amount of green space with the boundaries of the urban footprint and over half of what they do own is designated for new development.

Spearritt's main argument is that the Greater Brisbane area created by the *Brisbane City Council Act* in 1924 "has ceased to exist and must now be considered in the context of the 200-kilometer city of which it is the largest – in population and budget terms – part, but now less than one-fifth of the total urban footprint" (Spearritt, 2010).

Planning in Brisbane

The Brisbane City Council has been crafting a new City Plan through the utilization of a five-stage process (see Figure 4.2): 1) create a statement of proposals - define the scope of the plan; 2) write the draft new city plan - strategic framework, updated planning rules, and infrastructure plan; 3) first state interest check – by Queensland Government; 4) consult the community – statutory public advertising and draft revision in response; and 5) finalize the new city plan – referring to state government for review (Brisbane City Council, 2013). City Council

is now in stage four and is consulting the community through "Talk to a Planner" sessions though July 30, 2013 and other community events over sixty business days, even though the legally required amount of time is only thirty business days (Brisbane City Council, 2013). During this time, formal written (by email or letter) submissions from the public will be accepted and reviewed as well.

Figure 4.2 Brisbane's new City Plan timeline.
Reprinted from Brisbane City Council. Retrieved from http://www.brisbane.qld.gov.au/planning-building/planning-guidelines-and-tools/brisbanes-new-city-plan/index.htm?utm_source=corphome&utm_medium=mega_nav&utm_term=-&utm_content=image-version&utm_campaign=mega_pb_pgt_ncp.

Prior to this new draft, the most recent city plan was the *Brisbane City Plan 2000*. Queensland, and Brisbane in particular, has been growing and changing over the past decade and a new city plan is needed to better guide the evolution of these parts of Australia. Under the Queensland Government legislation, specifically the *Sustainable Planning Act 2009*, a draft new City Plan is required and it must meet the specifications set out in the Queensland Government's *Queensland Planning Provisions* (QPP) (Brisbane City Council, 2013).

It is estimated that by 2031, Brisbane will need 40 percent more homes than were in Brisbane in 2006. The draft new City Plan proposes that new housing should be centered around

transportation hubs and that most of the new development will need to take place in already developed areas, as Brisbane is nearly out of undeveloped land. These transportation hubs are the city center and inner city, near universities and hospitals, eight major shopping centers, and along nine growth corridors (Brisbane City Council, 2013).

Every piece of property in Queensland is subject to two plans at minimum (and sometimes more, depending on the area): the *Queensland Government's South East Queensland Regional Plan* and the City Council's Plan. The draft new City Plan aims to generally protect the suburbs and would limit the size and density of new buildings in some areas while encouraging green urban spaces. Under this plan, some of the city's main roads will become subtropical boulevards. New homes will be required to be situated to make the most of cross-ventilation and solar orientation. New maps of the city will better show the potential environmental hazards property owners will face in that given area (Brisbane City Council, 2013).

The draft new City Plan describes Brisbane as "Australia's most biologically-diverse capital city with thousands of plant and animal species" (Brisbane City Council, 2013). In order to help keep it that way, the Council intends to restore 40 percent (not including Moreton Island) to native habitat cover by 2026 (Brisbane City Council, 2013). Wildlife habitat and movement corridors will be protected from future development. Maps with locations for wildlife crossing structures have been identified to help preserve wildlife networks (Brisbane City Council, 2013).

Water quality is addressed in the draft new City Plan for the health and enjoyment of both humans and the city's diverse species of plants and animals. In the past, all waterways were treated the same and development has not been allowed in any of the creeks or rivers. In the new draft, the waterways have been mapped more thoroughly and they have been put into three categories: local waterways, small tributaries where development can occur while maintaining

environmental integrity; city-wide waterways, larger creek systems where development could help with flood management and provide access for environmental and recreational uses; and the Brisbane River, where the existing character will be protected as it continues to be used for economic, cultural, transport, and recreational purposes (Brisbane City Council, 2013).

When it comes to natural hazards, the draft new City Plan mentions "our changing environment" but there is no explicit detail about climate change. The draft has mapped each property in the city, showing which natural hazards it is most susceptible to and explains "how development can occur in a safe and resilient manner within each category – for flood, landslides, and bushfire" (Brisbane City Council, 2013).

Summary

From its earlier beginnings as the home of Aboriginal people and later on as a penal colony of Europeans, the modern-day Commonwealth of Australia has an intriguing history with some parallels to that of the Unites States of America.

Australia is rich in natural resources, biodiversity, and carbon emissions. Australians have been slowly adjusting their planning process to adapt to the shifting needs of both the growing population and the declining health of their environment.

Unfortunately, upcoming elections and budget cuts are threatening to stall some of the climate change planning progress being made nationally, statewide, regionally, and locally. The positive aspect of that is that progress is in fact being made and its continued momentum is, without question, necessary for the future of Australia and the platypus.

CHAPTER 5

SPECIFICS FOR EACH LEVEL OF GOVERNMENT

Climate Change Plans and Policies

In a recent post on The Wheeler Centre, a Victorian Government initiative to support Melbourne's status as a UNESCO City of Literature, author Michael Green wrote about the apparent weakening of the controls on climate change planning in Victoria, Brisbane, and New South Whales (Green, 2013). He writes that, "Planning for a city's future involves many interconnected things: our food, water, power, waste and transport, our offices, homes, parks and gardens" and that "It is not possible anymore to consider these things – to consider the present or future – without considering climate change. If we don't prepare well, people will die. At the moment, we are not preparing well" (Green, 2013).

Addressing climate change in Australia began at the national level. Information put forth and action taken by the United Nations Development Programme and the Intergovernmental Panel on Climate Change (IPPC) helped the Council of Australian Governments (COAG), made up of Australia's federal and state governments, to formulate "mitigation and adaptation policies and action plans under the *National Climate Change Adaptation Framework*" (Blakley & Carbonell, 2012).

Commonwealth of Australia

At the present time, climate change adaptation planning and policy is fraught with political turmoil. More progressive plans have been put into place and then budgets were

renegotiated and reduced in many areas, which ultimately affected the amount of potential funding available for platypus conservation.

Currently, the Australian Government's climate change policy is concerned with three central concepts: 1) mitigation, reduction of greenhouse gas (GHG) emissions; 2) adaptation, becoming more resilient to climate change; and 3) international collaboration. The National Climate Change Framework was created to address the National Government's vulnerability concerns and the following subgroups were formed for more specialized purposes: National Climate Change Adaptation Research Facility, CSIRO' Climate Change Adaptation Flagship, and the Climate Change Adaptation Skills for Professionals Program. To assist local governments, the Local Adaptation Pathways Program and the Integrated Assessment of Human Settlements subprogram were designed (Blakley & Carbonell, 2012).

The chair of urban design and regional planning at the University of Canberra, Professor Barbara Norman notes that all three of the eastern states have become more lax on climate change. Norman states "If you have flexibility in policy and flexibility in process than you really don't have planning at all" and that "In the context of climate change, it means you open the door too widely for development on land that could be subject to environmental risks" (Green, 2013).

The Planning Institute of Australia announced their position on climate change in a statement released in October of 2007. Their position was that regardless of the cause (natural or anthropocentric) climate change is occurring and they went on to cite scientific evidence from CSIRO and the IPCC that these changes will definitely impact Australia. In this document, PIA stated that "the planning profession is in a unique position to assist the community in understanding and adapting to the unexpected consequences of climate change" and that

"planners are also in the position to actively work on mitigation issues and guide changes to environmental behavior such as, promoting energy and water efficiency, sustainable land management practices, incorporating efficient energy use in buildings, and including climate change information in environmental assessments" (Planning Institute of Australia, 2007). This document contains a list of practices that the PIA supports for planners to help them address the projected impacts of climate change and speaks to the likely probability that policies addressing the planning and management of cities and regions will need to adapt in order to better guide decision making in the future. In order for planners to respond effectively, they must work with climate change experts and others to have a better understanding of what is to come. PIA voices their support for continuing education for planners and has partnered with several science organizations and the Australian Government in order to do so (Planning Institute of Australia, 2007).

It is clear that climate change regulations, policy, and planning are crucial for the country of Australia, both immediately and in the future. Putting forth effort and taking action to help steer the course of climate change can and should be facilitated at all levels of human organization, from global summits all the way down to individual neighborhoods.

Australia's New Carbon Tax System

According to a report by Clean Energy Future, the Australian Government has been advised by scientists that, "Australia has more to lose from climate change that all other developed countries" and that the main cause of climate change by humans is the release of carbon into the atmosphere (Clean Energy Future, 2011). Australia is one of the top 20 polluting countries in the world and it is responsible for 1.5 percent of the total global emissions. Australians produce more carbon per person than any other developed country, including the

United States, with electricity being the source of over one third of Australian carbon pollution. The Australian Government has pledged to reduce emissions 80 percent by 2050. The Government's comprehensive plan to transition to clean energy has four elements: a carbon price, renewable energy, energy efficiency, and action on the land (Clean Energy Future, 2011).

This has prompted the development and adoption of introducing a carbon price into the Australian economy. Associating a cost with each tonne (1000 kilograms) of carbon pollution gives businesses a financial incentive to reduce their output. In order to mitigate some of the price increases that will be passed on to the Australian people by companies paying the carbon tax; tax cuts, higher family payments, and increased pensions and benefits were put in place. Upon ten years of review by the Treasury, economists, and independent institutions; it has been demonstrated that the economy will continue to grow and that this type of market mechanism is one of the cheaper ways to reduce carbon pollution (Clean Energy Future, 2011). It is anticipated that through the Government's Renewable Energy Target and the carbon price that about $20 billion will have been invested in renewable energy by 2020 (Clean Energy Future, 2011).

The carbon price affects the country's 500 or so biggest polluting companies in that they have to buy a permit from the Government for each tonne of carbon they create. The price will remain fixed for the first three years and then on July 1, 2015; an emissions trading scheme will be put in place. The three years of the fixed price of $23 per tonne began on July 1, 2012 and will go up at 2.5 percent per year in real terms (Clean Energy Future, 2011).

The tax reform will result in raising the tax-free threshold and in over one million people no longer needing to file a tax return. Over half of the revenue gained by the carbon price will be used for households and fuel used for personal transportation will not be included in the carbon price. The creation of the Clean Energy Finance Corporation will cost about $10 billion and this

corporation will be charged with investing in, “renewable energy, low pollution, and energy efficient technologies” (Clean Energy Future, 2011).

Though emissions from agriculture will be exempt from the carbon price, farmers and land managers who chose to take climate change action and support biodiversity; will be aided by the Carbon Farming Initiative, the Carbon Farming Futures Program, and the Biodiversity Fund. Local governments will be supported through Low Carbon Communities and the Low Income Energy Efficiency Program (Clean Energy Future, 2011).

2013 National Budget Update

“The budget has axed $2.4 billion from climate programs as the government compensates for a likely big drop in revenue from the carbon price from 2015” apparently because the Australian Government is planning to connect the carbon tax with the European system which is pricing carbon permits at a much cheaper rate (Alexander, 2013). Funding has been shelved, though not eliminated, to the tune of $370 million for the Australian Renewable Energy Agency’s projects and $225 million for the Biodiversity Fund. The nation-wide Caring For Country program’s budget has been cut by $141 million over the five years and $98 million has been reduced from the Low Carbon Communities program that guides energy efficiency efforts for communities. $500 million was reduced from the funding for clean coal and the Australian Government removed $271 million from the coal sector’s carbon tax compensation package (Alexander, 2013).

The budget has also been reduced by $240 million by incorporating new research, which reduces the estimated environmental damage from specific greenhouses gases. There has also been a change in which emissions are counted in the land sector, which will cut the Australian Government $389 million in costs. There are no hard and fast rules for emissions accounting

internationally but obviously, the more that countries continue to emit, the worse climate change will become (Alexander, 2013).

Though none of this is great news for the climate, there are some plans that have not suffered cut backs, such as the Clean Energy Finance Corporation, and those that have are still at least partially funded. In the case that the conservative Coalition party wins the upcoming federal election in 2013, there will likely be much larger cuts to come (Alexander, 2013).

Andrew Gilkson, an Earth and paleo-climate scientist as Australian National University, describes the current political atmosphere best when he writes," In Australia the language has changed from 'the greatest moral issue of our generation' to controversy over a carbon tax'" (Gilkson, 2013).

State of Queensland

As more extreme climate events are taking place in the state of Queensland, more political attention is being paid towards preventing and mitigating the causes and effects of these types of disasters.

In the Climate Change Commission's *The Critical Decade: Extreme Weather* report, several examples of "wild weather events" in Queensland over the past five years were described: "underwater heat waves" contributing to coral bleaching in portions of the Great Barrier Reef, record-breaking rainfall and flooding in December of 2010 and 2011, record river heights at over 100 observation station in December 2010, over three-fourths of the state was declared a disaster zone which affected 2.5 million people and cost over $5 billion, Cyclone Yasi and Cyclone Oswald (2013) and their impact on the agricultural industry, and heat waves equal to the hottest record of 45 degrees Celsius (Moore, 2013).

Regional Planning is crucial to the continuing success of the state of Queensland. The Queensland Government is currently working on new statutory and regional plans that focus on economic growth, infrastructure, managing environmental impacts, anticipating urban growth, and resolving land use disputes. The new statutory regional plan will be the result of working together with local governments, major industry groups, and other regional stakeholders in the greater community. There is also new statutory land use mapping that is designed to give local governments a framework for planning in their communities. Queensland's twelve regional planning areas are (see Figure 5.1): Cape York; Far North Queensland; Gulf Regional; North West Queensland; Central West Queensland; Mackay, Issac and Whitsunday; Central Queensland; South West Queensland; Maranoa Balonne; Darling Downs; Wide Bay Burnett; and South East Queensland (Queensland Government, 2010-2013).

In 2007, the Queensland Government (along with other state governments) worked together with the Australian Government to create the Working Group on Climate Change and Water and the *National Climate Change Adaptation Framework*. This same year, the Queensland Office of Climate Change (OCC) was formed. The OCC made the *ClimateSmart Adaptation 2007-2012* plan (Australia's first climate action plan) and *ClimateSmart 2050* (Queensland's climate change strategy). The policy document *Climate Q: Toward a Greener Queensland*, was put into place in 2009 and speaks to five major actions: reducing GHG emissions, investing in energy efficiency, investing in technologies for a carbon-constrained world, protecting the state's natural wonders, and adapting to the impacts of climate change. Because each region has its' own set of variables, Climate Q contains a series of individualized regional assessments (Blakley & Carbonell, 2012).

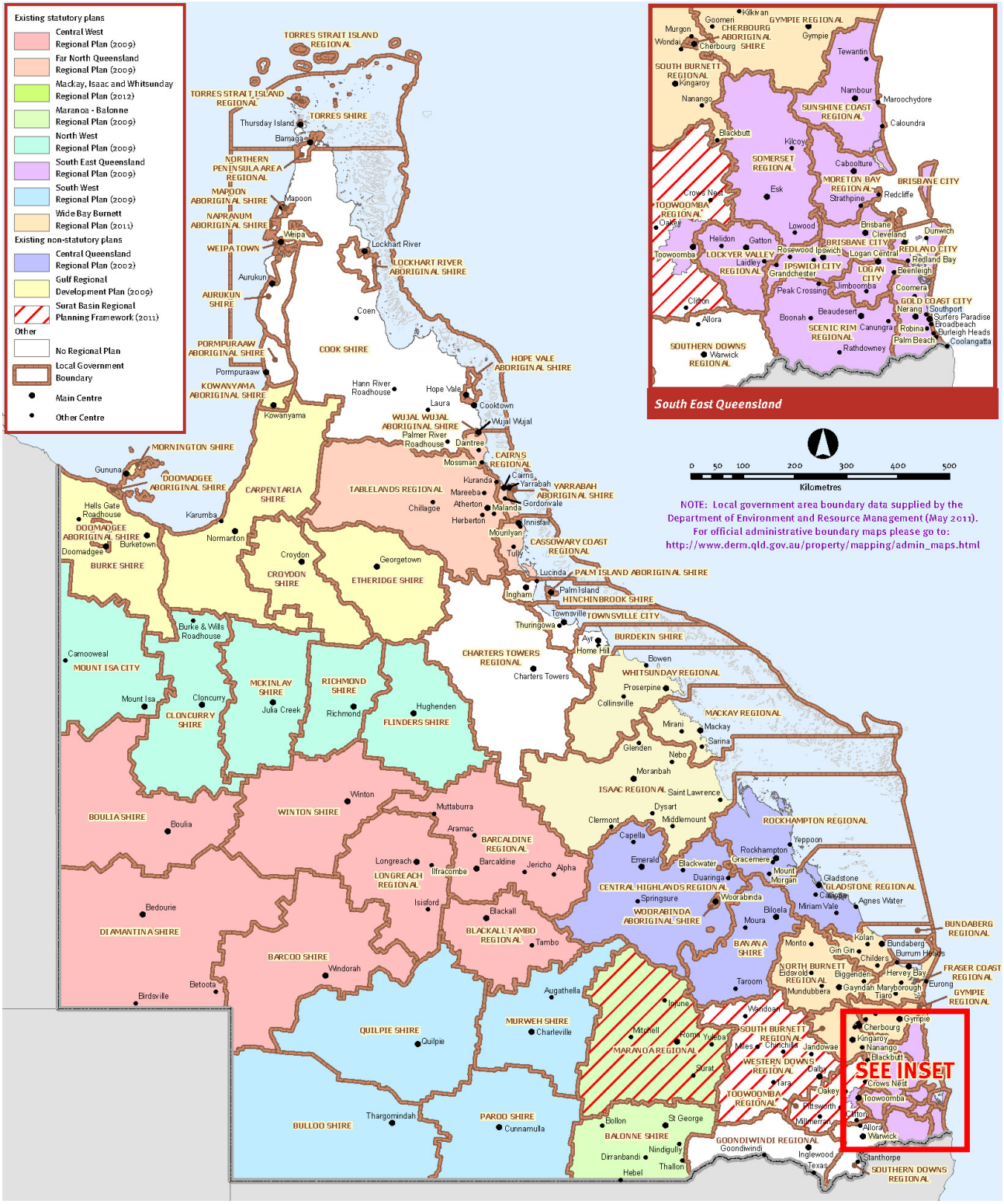


Figure 5.1 Regional Plan Areas and Local Government Authorities in Queensland. Reprinted from "Regional Plan areas and Local Government Authorities". Map produced by the Department of Local Government Planning, Spatial Services Unit, 2012. Copyright 2012 by the State of Queensland (Dept. of Local Government and Planning)

Queensland's ClimateSmart 2050 strategy includes short, medium, and long term strategies to mitigate climate change in the areas of energy, industry, community, planning and building, primary industries, transport, adaptation, and government leadership (Australian Green Development Forum, 2013).

The Queensland Plan: A 30 year vision for Queensland is being developed during the year 2013 and the stated intention is that "the Queensland plan will not be a government vision; it will be Queensland's vision" (Queensland Government, 2013). The planning process will have three stages: defining the process, engaging communities, and delivering the plan; summits will be held in Mackay and Brisbane.

The Climate Commission released a report entitled *The Critical Decade, Queensland climate impacts and opportunities* that offers some additional information about the current state of affairs in Queensland and how to address future climate changes a bit more thoroughly than some previous reports by the Australian Government. The first section of the report is dedicated to the details of exactly how the climate is changing in Queensland, namely temperature, rainfall, tropical cyclones, and sea-level rise. The second section focuses on the impacts of these changes for Queensland: human health (including the extension of the geographic region suitable for transmission to mosquito-borne disease), agriculture (beef and dairy, sugar, fruit and vegetables, cotton, winter and summer cereals, and fisheries and aquaculture), coastal areas (where 85% of the population lives), and plants and animals (Queensland is home to the Great Barrier Reef as well as the platypus, koala, and many more) (Steffen, Hughes, Sahajwalla, & Hueston, 2012).

The third section of the Climate Commission's report revolves around what kind of opportunities there are to "minimize the risks of climate change while providing extra benefits for our health, community, economy, and environment" (Steffen, Hughes, Sahajwalla, &

Hueston, 2012). It is acknowledged that there will be some up front costs to becoming more energy efficient but these costs are lesser than the costs that would be incurred by further climate change and the costs of delaying action. An example of this is the more that $800 million in annual energy costs that Australia's top 252 energy-consuming businesses have saved through the utilization of energy efficient measures (Steffen, Hughes, Sahajwalla, & Hueston, 2012). Just as the physical climate is changing, the business climate will change.

The Australian Centre for Sustainable Business and Development compiled the following list of greenhouse gas reduction targets for the State of Queensland (Zeppel, 2011):

- Queensland Government target: 30% below 2000 levels by 2020
- Reduce Queenslanders' carbon footprint by one-third of 2007 levels by 2020
- Achieve carbon neutral government-owned office buildings by 2020
- Purchase 5% of energy used in govt. buildings from renewable energy sources
- Reduce emissions of govt. vehicle fleet 15% by 2012, 25% by 2012, and 50% by 2017
- Offset emissions from the Qld. Govt. vehicle fleet 50% by 2010 and 100% by 2020
- 20% of Australia's electricity supply to come from renewable energy sources by 2020
- Support national greenhouse gas emissions target of 60% below 2000 levels by 2050

In 2012, Australia's greenhouse gas emissions from electricity generation were at the lowest point in ten years. The amount of renewable energy in Australia's National Electricity Market (NEM) was over 12 percent. Hugh Grossman, the executive director of the energy and carbon research firm known as RepuTex, explained that when it comes to emissions "renewables are basically cancelling out coal" (AAP, 2012). He remarked that that carbon tax has helped to reduce coal generation but that it may be rejuvenated when the fixed-price period ends in 2015 and then go back down again after 2017, when the federal government will no longer be compensating the coal industry.

Queensland has set commendable goals for itself in the process of planning for climate change. It is a national election year for Australia and there is a possibility that more progressive actions, such as the carbon tax, will be repealed. Hopefully, that will not be the end result and planning and policy will continue to gain momentum towards shaping the future with the survival of all species in mind.

South East Queensland Region

"Climate proofing" is described as "the suite of actions needed to make areas and assets resistant to climate variability and change and to make communities and people more resilient" (Blakley & Carbonell, 2012). Climate proofing efforts in the SEQ region (see Figure 5.2) are being supported through the SEQ Climate Proofing Demonstration Project which is a group comprised of natural resource management groups and the Climate Change, Coasts, and Catchments program at the University of the Sunshine Coast. This project is detailed and has three main parts: "1) fostering integrated approaches to climate change adaptation through risk reduction; 2) identifying and developing tools and techniques for integrated vulnerability assessment and management that address regional, local, and site-specific environmental conditions; and 3) initiating and supporting community awareness and capacity variability and projected climate change and sea level rise" (Blakley & Carbonell, 2012). This bottom-up strategy has proven effective in helping to develop a regional strategy for SEQ at a low cost by drawing on inherent strengths in the regional community.

SEQ Regional Plan

The *South East Queensland Regional Plan 2009-2031* (SEQ Regional Plan) was created to plan for growth in the region over the next twenty years (Hinchliffe H. S., 2009). It is explained in the plan that the strategy for dealing with climate change is to reduce greenhouse gas emissions and

to protect at-risk areas through adaptation actions. New development will become more compact and urban by allowing for increased density and more mixed-use development. The natural landscape will be protected from urban development and sprawl with the improvement of bioregional corridors which will conserve biodiversity and offset the carbon emitted by increased urban development. This plan also encourages infill development and more efficient use of urban land area in close proximity to infrastructure (Hinchliffe H. S., 2009).

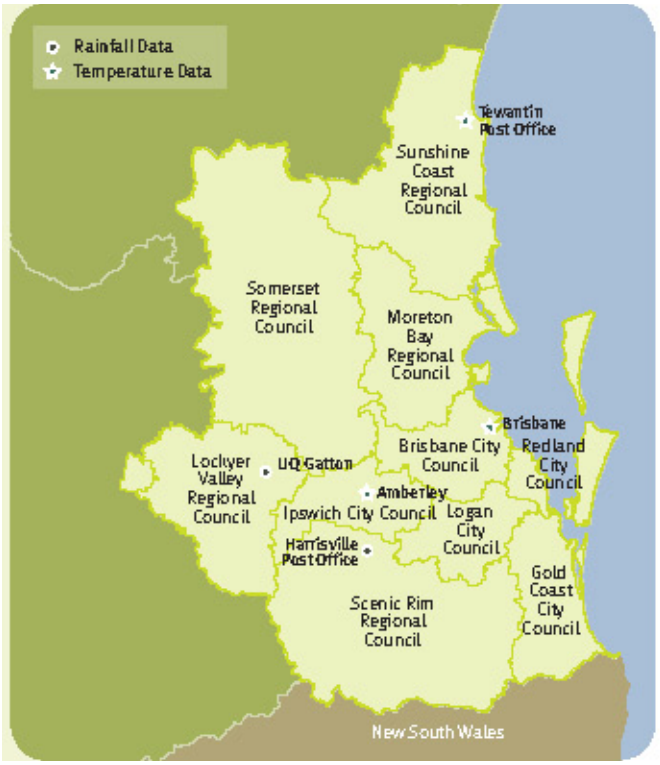


Figure 5.2 Map of Local Government areas in South East Queensland. Reprinted from "ClimateQ: toward a greener Queensland" by Queensland Government. 2009. p. SEQ 1. Copyright 2009 by The State of Queensland (Dept. of Environment and Resource Management)

In addition to regional land-use policies, the plan sets forth regional policies and desired regional outcomes in these areas: sustainability and climate change, natural environment, regional landscape, natural resources, rural futures, strong communities, engaging Aboriginal

and Torres Strait Islander peoples, compact settlement, employment location, infrastructure, water management, and integrated transport (Hinchliffe H. S., 2009). It should be noted that while there is a Koala Conservation Plan, as part of the SEQ Regional Plan - there is not a Platypus Conservation Plan.

The Growth Paradox

SEQ is the fastest growing region in Australia and it is experiencing a phenomenon described as a "growth paradox" (Gleeson & Steele, Introduction, 2010). More infrastructure is needed but building it will increase greenhouse emissions. Immigration rates from other regions and other countries remain high and there is no easy way to maneuver though the concept of slowing population growth from a political standpoint. There is also the issue of how to foster stronger planning practices when the climate is changing (see Figure 5.3) and therefore planning practices must have the ability to adapt.

Troubling Trends in SEQ Planning

Editors of the book *A Climate for Growth, Planning in South East Queensland,* Brendan Gleeson and Wendy Steele argue that planning in SEQ "appears to be characterized by a number of key features: 1) employment prioritized over sustainability, 2) mobility over accessibility (car-based projects easier to privately finance), 3) development velocity over quality, 4) project – not process –led planning, 5) circumscribed community involvement (as shareholders/stakeholders not citizens), 6) sections of planning moving into shady wings beyond scrutiny (commercial in-confidence provisions of public-private partnerships), and 7) dubious and possibly self-serving planning processes and techniques – most especially the traffic modeling and forecasts that go to the core of private financing and which have proven grossly inadequate in other contexts" (Gleeson & Steele, Introduction, 2010).

South-East Queensland

* Less water for cities, industries, agriculture, and natural ecosystems.
* Less frost damage to crops, higher wheat yields but lower wheat quality, increased pest and disease risk.
* 20% increase in intensity of a 1-in-100-year rainstorm could, for example, inundate 7000 properties in the Nerang catchment in southern Queensland.

Bruce Miller/CSIRO

Brisbane	Present average (1971–2000)	2030 average (mid emissions)	2070 average (low emissions)	2070 average (high emissions)
Annual temperature (°C)	20.5	21.5 (21.2–21.9)	22.1 (21.6–22.8)	23.6 (22.6–24.9)
No. days over 35°C	1.0	2.0 (1.5–2.5)	3.0 (2.1–4.6)	7.6 (4–21)
Annual rainfall (mm)	1192	1109 (978–1230)	1133 (978–1300)	1085 (799–1395)

Figure 5.3 Climate change projections for South East Queensland. Reprinted from "Climate Change: science and solutions for Australia", edited by H. Cleugh…[et al.], 2011, p. 40. Copyright 2011 by CSIRO PUBLISHING

All that being said, Gleeson and Steele have noticed that planning at the SEQ level is improving due to stronger belief and support for planning at the Queensland and local levels. The essays in their book examine the regional planning process in South East Queensland in an effort to better understand how it can be improved.

Local Government Area

Brisbane

The Brisbane City Council put the Climate Change and Energy Taskforce together in 2006, with Ian Lowe as the chairman. This taskforce made three recommendations to the city council for dealing with climate change (and peak oil): set a goal of reducing oil consumption by 50 percent by 2026 at minimum, lead by example by example in tackling these difficult issues – especially though the Council of Mayors and community partnerships, and to partner with the state and national governments to make policy changes (Lowe, 2010).

Though some of these recommendations were adopted, significant changes are yet to take place. Lowe brings up two important points, one is that decisions being made now can make needed changes in the future more difficult to achieve and two, that "it is morally indefensible to continue approaches that we know are not sustainable, as these condemn future generations – our own descendants – to a poorer quality of life" (Lowe, 2010).

Summary

As demonstrated by platypus population data and climate change modeling, the platypus is currently being affected by climate change and this trend will continue without positive interference from humans. In order to increase the effectiveness of future platypus conservation plans; a working understanding of how the larger systems came to be, how they operate, and some knowledge of the specifics at each level are paramount.

CHAPTER 6

PLATYPUS CONSERVATION AND CASE STUDIES

The platypus is now legally protected in all of Australia. The Australian Platypus Conservancy has made specific conservation recommendations for agencies and groups, urban areas, and planners. Other organizations have made additional recommendations as well. Case studies of platypus conservation plans for Tasmania, Queanbeyan City, Redland City, and Brisbane are included in this chapter for comparison and analysis.

Legal Protection

Historically platypuses were hunted for their fur, causing a decline in number from which they have since recovered (Scott & Grant, 1997). Another threat to the platypus has been the freshwater fishing industry, specifically with platypuses getting caught in nets (restrictions on the mesh size of the nets have been put in place). The Fisheries Act of 1995 states that "offenders detected, possessing or using an opera house net in or close to inland waters can be issued with a penalty infringement notice or charged under summons to appear in court and face a maximum fine of $11,300" (Zoos Victoria, 2011). Killing a platypus carries a maximum penalty of $5,500 and/or six months imprisonment under the Wildlife Act of 1975 (Zoos Victoria, 2011). They became legally protected in Victoria in 1892, in New South Whales in 1901, in Queensland in 1906, and in South Australia in 1912 (Scott & Grant, 1997).

The platypus is legally protected in Australia and it is illegal to capture (other than for scientific research) or kill them. As of 2008, the platypus has been listed with a conservation status of "least concern" by the International Union for Conservation of Nature (IUCN) (Divljan,

2011). However on the IUCN's Red List website, more nuances about this status are provided. The species is described as common but, "many local populations are known to have declined or disappeared within the last few decades, and in general there is a surprising lack of knowledge about its abundance" (Lunney, 2008).

The conservation actions for the platypus, as described by the IUCN, include "its listing as a legally protected species in all states in which it occurs and its incidental inclusion in some national parks and reserves" and" legislation prohibiting or controlling problematic fishing activities has been enacted in New South Wales and Victoria, but regulations concerning illegal netting and trapping are often poorly enforced" (Lunney, 2008). The Australian Platypus Conservancy's coordination of field monitoring is cited as the most widespread. The IUCN states that more population numbers are obtained and further monitoring needs to be done and that this is crucially important especially for this species because "a long-lived species such as the Platypus where a lack of recruitment can be masked until a dramatic population crash occurs as adults reach the end of their lifespan" (Lunney, 2008).

Government Protection for Platypuses in Queensland

The Queensland Government evaluates platypuses in the wild in Queensland as one of the species in the *Back on Track* species prioritization framework initiative, the first initiative of this kind to be implemented in Australia. *Back on Track* is designed to: "prioritize native species to guide conservation management and recovery; strategically allocate limited conservation resources for achieving greatest biodiversity outcomes; and increase the capacity of government, Natural Resource Management (NRM) bodies, and communities to make informed decisions by making information widely accessible" (Dept. of Environment and Heritage Protection, 2012). The Queensland *Nature Conservation Act 1992* (NCA) and the Commonwealth *Environment*

Protection and Biodiversity Conservation Act 1999 (EPBC) classify some species but, *Back on Track* prioritizes all species based on a different set of criteria that is more specific to Queensland (Dept. of Environment and Heritage Protection, 2012).

Platypus Conservation Methods and Guidelines

For Agencies and Groups

The Australian Platypus Conservancy has published a list of fourteen Platypus Conservation Guidelines for management agencies and environmental groups. There is more detailed information for each of these main categories: 1) Planning for platypus, 2) Maintaining or restoring bank and channel stability, 3) Managing storm water drainage, 4) Weed control and revegetation, 5) Providing in-stream woody habitat (logs and branches), 6) Maintaining adequate flow in managed river systems, 7) Providing refuge areas during drought, 8) Designing platypus-friendly lakes and ponds, 9) Use of heavy machinery along the banks and channel, 10) Walking tracks, viewing platforms, bridges and street lighting, 11) Culverts, pipes, gates and grilles, 12) Weir walls and drop structures, 13) Pumps and small-scale hydro-power generators, and 14) Promoting awareness of platypus conservation needs (Australian Platypus Conservancy).

For Urban Areas

For those in cities and more densely populated (Australian Platypus Conservancy) areas near platypus habitat, the Australian Platypus Conservancy has several recommendations for "Helping Platypus in Urban Areas" (Australian Platypus Conservancy). Care should be taken not to build recreational paths too close to the edge of waterways because this can make the platypus more accessible to predators and it can lead to bank erosion. A minimum buffer of 30 meters from the bank should be respected, though viewing platforms can be build where the water is deeper and the bank is quite steep. Retaining buffer zones to keep development from

encroaching from the margins of creeks or rivers is essential and secure fencing of at least two meters in height is recommended. Street lights and bright security lights within 100 meters of waterways should be directed away from the water and light globes that produce minimum insect-attracting light should be used. Responsible pet ownership is necessary because domestic cats and dogs are potential predators of the platypus and they need to be kept on a leash when near waterways. Reducing household water consumption is another way in which the platypus can be supported in urban and suburban areas, especially by replacing grass lawn with indigenous plants that require less water and no fertilizer.

Figure 6.1 Photo of a human-modified waterway that could negatively affect platypus habitat by impeding the natural flow of water. Reprinted from cesar platypusSPOT, 2013. Retrieved from http://platypusspot.org/uploads/ckfinder/userfiles/images/slide01-modification-of-waterways.jpg. Copyright 2013 by cesar Australia

For Planners

Another key recommendation by the Australian Platypus Conservancy is to "Ensure that local planners and councilors consider the needs of platypus whenever a new development is

proposed near a waterway (see Figure 6.1). Platypus conservation is not necessarily incompatible with a reasonable level of development - provided that sensible precautions are taken to protect (and ideally strengthen) freshwater habitats" (Australian Platypus Conservancy).

Additional Preservation Actions

Land for Wildlife has also listed actions that can be taken to help the platypus, those that have not been referenced earlier include: restricting livestock access, controlling weeds, retaining or installing logs in and along watercourses, carefully disposing of fishing line and jagged objects (fish hooks and barbed wire), avoiding placing barbed wire fences across fence lines, and covering pumps with a grille or mesh cover to prevent platypuses from being sucked into intake pipes (Land for Wildlife).

The data that is collected through PlatypusWatch is used to raise public awareness, in addition to providing date to local and state planning authorities so that land and catchment practices can be improved (Land for Wildlife).

Case Studies

The case studies in this chapter on Tasmania, Queanbeyan City, Redland City, and Brisbane will serve as examples with valuable information about methods and tactics, upon which future platypus conservation plans can be designed and executed more effectively. Some additional conservation methods that are specific to the area in which they are being applied or by whom they are being applied are also included.

Tasmania

Tasmania has many ideal areas for platypuses to live and they often grow to larger sizes here compared to mainland Australia, adult males are two to three times heavier in Tasmania. According to the *Tasmanian Threatened Species Protection Act of 1995*, platypuses are not

considered threatened due to their assumed to be large population but in reality their exact population is unknown (Gust & Griffiths, 2010).

The fact that both human and platypus populations are the most dense in the same geographic areas is a possible threat to platypuses, and this could increase as the strain on water resources increases.

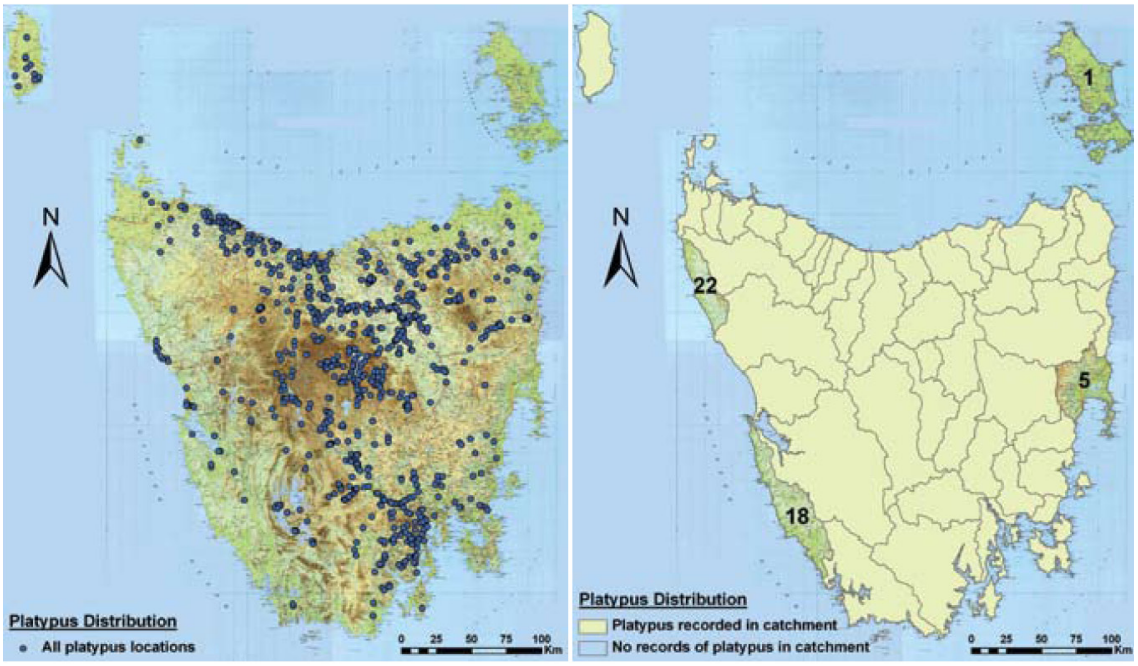


Figure 6.2 Platypus distribution records in Tasmania, 1901 to 2009. Reprinted from "Tasmanian Platypus Management Plan March 2010", by N. Gust and J. Griffiths. 2010. p. 11. Copyright 2010 by State of Tasmania

There are numerous legal protections in place that apply to the platypus at different levels of government. Prior to being granted legal protection in Tasmania in 1907, they were named as a protected species in all of Australia. The *Tasmanian Nature Conservation Act of 2002* states that "platypuses or platypus products cannot be captured, kept, bought, sold, or exported without appropriate licenses or permits". It is crucial to note that this act includes burrows as "platypus products" and protects them through conservation and riparian zone restrictions. Tasmania also

has the *Animal Welfare Act*, which applies to the "treatment and welfare of domestic, agricultural, and wild animals" (Gust & Griffiths, 2010).

Tasmania is known as a prime platypus sighting location (over 2000 public observation records in the past century, see Figure 6.2), as compared to the rest of Australia and there are numerous Tasmanian businesses whose survival hinges on the species' ability to continue to thrive (Gust & Griffiths, 2010).

Tasmanian platypuses have been separated from the mainland for about 12,000 years and have become genetically different from other platypuses. Only in Tasmania are platypuses subject to the fungal disease known as mucormycosis, which can result in skin lesions, morbidity, and death. It is unclear how it spreads but it is believed to have come to Tasmania from frogs that were infected on mainland Australia (Gust & Griffiths, 2010).

During conservation meetings and workshops organized to discuss the issues and to recommend how to proceed in the future with a platypus management plan. The main topics of discussion were identifying the positive aspects and assets of Tasmania, identifying key threats, creating a list of actions, and population monitoring. In comparison to mainland Australia, Tasmania has a low population density, high public awareness of environmental issues, and large areas of suitable platypus habitat. Tasmanian platypuses are threatened by habitat loss and degradation, climate change, disease and introduced species, and other direct mortality (such as being hit by cars and becoming caught in fishing nets) (Gust & Griffiths, 2010).

Step 1 – Determine the *Spatial Scale* at which the threat will act

Definition	Spatial Scale
Less than 20% of the total area of Tasmania affected.	Local
Between 20% and 50% of the total area of Tasmania affected.	Regional
More than 50% of the total area of Tasmania affected.	State-wide

Step 2 – Determine the *Potential Impact* the threat may have on platypus populations over the spatial scale at which the threat occurs

Definition	Potential Impact
Population decline in affected area of less than 10%.	Low
Population decline in affected area of between 10% and 30%.	Moderate
Population decline in affected area of more than 30%.	High

Step 3 – Combine the Spatial Scale and Potential Impact to determine the *Consequence* of the threat (The consequence of the threat to the overall population of platypus in Tasmanian will be a combination of the spatial scale of threat and the potential impact of that threat over that scale)

		Potential Impact			
		Very Low	Low	Moderate	High
Spatial Scale	Local	Negligible	Negligible	Minor	Medium
	Regional	Negligible	Minor	Medium	Major
	State-wide	Minor	Medium	Major	Severe

Step 4 – Use the Risk Rating to determine the Action Required

Risk Rating	Action Required	Action Description
Severe	Action critical	Immediate intervention required. Management strategies need to be developed, implemented, and monitored as a priority.
Major	Management required	Management action required. Detailed conservation strategies need to be developed, implemented, monitored and managed.
Medium	Research recommended	Research to determine mechanisms of decline and extent of impact. Intensive monitoring at key sites recommended.
Minor	Monitoring	Baseline population monitoring.
Negligible	None	No action required.
Unknown	Unclear	Currently insufficient evidence to assess risk, research may be warranted to evaluate the magnitude of risk posed.

Figure 6.3 Tasmanian Platypus Management Plan – Risk Assessment.
Reprinted from "Tasmanian Platypus Management Plan March 2010", by N. Gust and J. Griffiths. 2010. p. 24-25. Copyright 2010 by State of Tasmania

Table 6. Predicted risk assessment results for threatening process over the next 25 years.
(Threats with an increased risk rating are indicated in bold type.)

Threats	Predicted changes over the next 25 years	Risk rating
Forestry	Increase in the spatial extent of forestry plantations, particularly private forest reserves, impacts may be partially offset by improved forestry practises.	Medium
Urbanisation	A population increase of 12-14% is likely to cause a small expansion in the extent of urban areas. (source: http://www.dcac.tas.gov.au/)	Medium
Mining/ Industry	May increase with demand for resources, but extent of impacts depend on mining practices and it is unclear if they will change.	Medium
Agriculture	Possible small increase in area, however likely increase in intensity in existing areas and therefore impacts, may be partially offset by better farming practises.	Medium
Salinity	Not predicted to significantly increase in extent or impacts (www.anra.gov.au/topics/salinity/overview/tas.html).	Negligible
Climate change	Predictions for Tasmania indicate an overall water deficit, rainfall to remain similar but evaporation and temperature to increase significantly; higher frequency of extreme storm and drought events. Increased degradation and loss of habitat, habitat fragmentation, likely to intensify effects of other threats.	Medium
Mucormycosis	Unclear whether distribution and/or prevalence will increase. Depends on pathogen dynamics in the environment, and platypuses developing immunity.	Medium
Other diseases or pathogens	Unknown – potential increase in novel pathogens due to increased human movements and climate change.	Unknown
Introduced feral predators	Probable increase in both fox distribution and abundance, resulting in higher platypus mortality. No major changes anticipated in dog or cat numbers and their impacts.	Medium
Introduced competitors	Amount of competition with other aquatic species unknown, trout already wide-spread and abundant, currently considered to have a negligible impact.	Minor
Introduced habitat-altering species	Likely introduction of new species such as Didymo, impacts of which could be widespread and severe, but will depend on the species and its distribution and abundance.	Medium
Fisheries by-catch	Depends on fishing practices, but could decrease with further legislation and public awareness.	Minor
Road-kill	May increase with more roads and increased vehicle traffic.	Medium
Population genetics	Probable increased risk of fragmentation.	Unknown

Figure 6.4 Tasmanian Platypus Management Plan – Predicted Risk Assessment. Reprinted from "Tasmanian Platypus Management Plan March 2010", by N. Gust and J. Griffiths. 2010. p. 26. Copyright 2010 by State of Tasmania

The process used to assess the risks currently threatening the Tasmanian platypuses included four steps (see Figure 6.3): 1) determine the spatial scale (local, regional, state-wide), 2) determine the potential impact the threat may have on platypus populations over the spatial scale at which the threat occurs (low, moderate, high), 3) combine the spatial scale and potential impact to determine the consequence of the threat (negligible, minor, medium, major, severe), and 4) use the risk rating to determine the action required (action critical, management required,

research recommended, monitoring, none, unclear). The current risk and the predicted risk for the next twenty-five years were assessed; all threats are expected to increase in the future (Gust & Griffiths, 2010).

Short-term and long-term risk management actions were recommended. Short-term actions include: reducing road-kill by providing safe crossings, reduce predation by keeping domestic animals on leashes and indoors at night, reducing litter and pollution (especially plastic rings, fishing line, and wire), prevention and control of invasive species (cleaning gear when going from one water body to the next), disease management, and the standardization of research methods and data reporting protocols (Gust & Griffiths, 2010).

Long-term management actions are as follows: responsible land management (preservation of large, continuous areas of riparian habitat), responsible fishing practices, and sustainable land use within catchments (Integrated Catchment Management) (Gust & Griffiths, 2010). Recommendations were also made for public education and engagement, platypus monitoring, and prioritizing research. There are multiple challenges to putting the Tasmanian Platypus Management Plan into action, such as: funding for research and conservation, limited knowledge of platypus ecology, current techniques available for measuring platypus abundance, low capacity for keeping platypuses in captivity, obtaining and maintaining community support and engagement with platypus management, ethical treatment considerations of the animals, and support from all the stakeholders involved in Integrated Catchment Management (Gust & Griffiths, 2010).

The Tasmanian Management Plan concluded with an emphasis on the need for specific research and diligent management efforts to conserve the platypus population. The plan also made it clear that the threats discussed, including climate change (see Figure 6.4), must be

eliminated or mitigated to ensure that the platypus thrives both in Tasmania and mainland Australia (Gust & Griffiths, 2010).

Queanbeyan City

Queanbeyan City is located east of Canberra, in the state of New South Whales. The Queanbeyan City Council (QCC) commissioned a report called *The Queanbeyan Platypus Awareness and Conservation Strategy 2012 (PACS)*, by Eco Logical Australia and the Australian Platypus Conservancy (Serena & Williams, 2011). This report was funded by the Australian Government's Water for the Future initiative through the Strengthening Basin Communities Program.

This report is thorough and up-to-date and could serve as an excellent example for platypus conservation planning in Brisbane, South East Queensland, and the rest of the country. Currently, the platypus is not considered threatened in the Queanbeyan River and wider upper Molonglo catchment area (though there are only about 60 platypuses in the area), this report will be used to better plan for the future because urban growth and climate change are guaranteed to continue. There are three major themes to the PACS: "making provision for platypus in works protocols and management of public land, making provision for platypus in planning procedures, and developing the role of platypus as a biodiversity 'flagship' in community education and investigating ecotourism opportunities" (Serena & Williams, 2011). The PACS is divided into sections for use by specific departments of the QCC: background information, platypus status and distribution in Queanbeyan. Threats to platypus survival in Queanbeyan, Platypus conservation recommendations, works protocols for management of public land, planning protocols to protect platypus habitat, community education and ecotourism development, and action plan (Serena & Williams, 2011).

For this report, a live-trapping survey was not considered to be effective for the intended purposes so information about the platypus population was gathered from platypus by-catch records from fish surveys (1973 to 2006), observation records from Platypus Count and other surveys (March 2009 to February 2011), and evaluation of suitable platypus habitat areas by biologists (March 16-17, 2011) (Serena & Williams, 2011).

Threats to survival of the platypus in the Queanbeyan City area include loss or degradation of riparian vegetation, impacts of development, infrastructure in stream or river channels, litter, inappropriate angling practices, predation, drought refuges and climate change, and inadequate awareness of platypus conservation needs (Serena & Williams, 2011).

Since platypuses reside along all of the Queanbeyan River in the QCC area, it is crucial that their well-being is taken into account by both public and private landowners and/or management. In addition to protecting and restoring native riparian vegetation, carefully designing and managing public facilities, restricting fishing to platypus-safe practices, and reducing the risk of predation by domestic animals – maintaining drought refuges and environmental flows will help protect the platypus. During a drought, the main Queanbeyan City weir (essentially a small dam) should be treated as a platypus refuge. Enough water should still be released from the Googong Dam to keep the platypuses going downstream (Serena & Williams, 2011).

In Queanbeyan City the platypuses happen to live extraordinarily close to human development and it is essential that they be considered to be a stakeholder in the planning process. Environmental Significance Overlays (ESO) are recommended for the entire Queanbeyan River and the lowest one to two kilometers of each of the river's major tributaries. Applications for development in these areas must be evaluated with the potential impact to

platypus conservation in mind and if an Environmental Impact Statement (EIS) is required, direct and/or indirect impacts to the platypus must be addressed (Serena & Williams, 2011). Special considerations for lighting, riparian vegetation buffer zones, drainage, infrastructure in channels, and pet ownership in these ESO zones must be made.

There are several measures that are recommended for improving community education and ecotourism development. One of the ways in which this can be done is to create a Platypus Conservation Zone, which would include a suspension bridge and a "no swimming or loose dogs" area with a viewing point and educational signage. A community awareness program (leaflets, poster, website) would provide information on how to report a platypus sighting, how to help a sick or injured platypus, reporting behavior that is dangerous to platypuses, and specific advice on how platypuses maybe impacted by human activity (Serena & Williams, 2011). Organizing an annual Platypus Group Watch event could lead to more significant (though properly conducted) ecotourism in the area.

The prescribed Action Plan for the QCC addresses eight areas that are broken down into specific actions: general co-ordination (create a position for a coordinator to implement the PACS within the QCC), works protocol and management of public land (coordinator ensures implementation), planning (coordinator ensures implementation), Platypus Conservation Zone Project, education (leaflet, poster, website, schools, drainage stencil, dam visitor information, integration with other programs), monitoring (coordinator develops and maintains procedures and records), ecotourism (pilot study, spotting session), and liaison with local businesses (coordinator develops collaborative program) (Serena & Williams, 2011).

More detailed information is provided in the report. Photographs of specific areas with tailored recommendations are provided; along with an aerial map, project briefs, visual and

descriptive examples of what other areas have done for platypus conservation, platypus facts, and extensive sources of further reading are provided as part of the report as well.

Redland City

Redland City is located to the south east of Brisbane and the Redland City Council area includes several islands in addition to a portion of land on the mainland. Redland City Council released a report on their Biodiversity Research Project as part of their *Biodiversity Policy and Strategy 2008-2012* specific to the platypus in the Redland City region, which includes habitat requirements and recommendations for dealing with the impacts that affect platypus survival (Redland City Council, 2008). Since becoming protected by Queensland law in 1906, the amount of platypus research being done in Australia has increased but not much of this has taken place in Queensland specifically. The community–based platypus sightings program, PlatypusWatch, started by the Australian Platypus Conservancy (APC) as PlatypusCare in 2002, has been helpful in collecting some desperately needed data. The APC has learned valuable information about platypus behavior and preferred habitat. For example, there is more platypus activity in areas where native trees such as eucalyptus and wattles grow along a channel, as opposed to willows.

Water quality recommendations made by the Australian and New Zealand Environment & Conservation Council (ANZECC) are included in the Biodiversity Research Project report and indicate at what levels of dissolved oxygen, salinity (electrical conductivity), turbidity (muddiness), temperature, nitrogen, and phosphorous that aquatic organisms, and therefore the platypus, will be able to thrive.

There were no platypus surveys conducted specifically for the Redland City Council report but historical sightings and available second hand data on sightings were included. The

Queensland Wildlife Preservation Society had recorded 1157 sightings in 56 local government areas in Queensland at the time of this report (Redland City Council, 2008).

The impacts that were evaluated in the Redland City are were water quality (directly affecting food resources), riparian vegetation removal, salinity, flooding, drought, bank stability (erosion), bank stability (clearing for increased urban development and growing population), pollution, man made structures (culverts, etc.), and predators (Redland City Council, 2008).

In general, the recommendations were that "the Redland City Council must adopt a catchment-wide management plan to manage land and water resources" and that "actions should be undertaken to manage, mitigate or remove land uses, activities and environmental factors that are affecting the areas where platypus are present or could be present" (Redland City Council, 2008).

Brisbane

In June of 2005, Brisbane City Council released their *Platypus Conservation Action Statement* as part of the *Brisbane City Biodiversity Strategy*, which is presented in the council's *Living in Brisbane 2010* vision for the city. The platypus in particular has been recognized as a significant species within Brisbane, according to the City Council's *Natural Assets Planning Scheme Policy* set forth in 2000 (Brisbane City Council, 2005). It is the written intention that this Statement will be updated every two to five years but, the 2005 Statement is the only one provided for the platypus on the Brisbane City Council website and it is not evident that an update has actually been made in the past eight years.

The purpose of this Statement is to manage the long-term conservation and protection of the platypus in Brisbane by collecting existing data, identifying threats, determining where there

are gaps in existing knowledge, and "detailing practical and affordable strategies and actions that support" the Statement's purpose (Brisbane City Council, 2005).

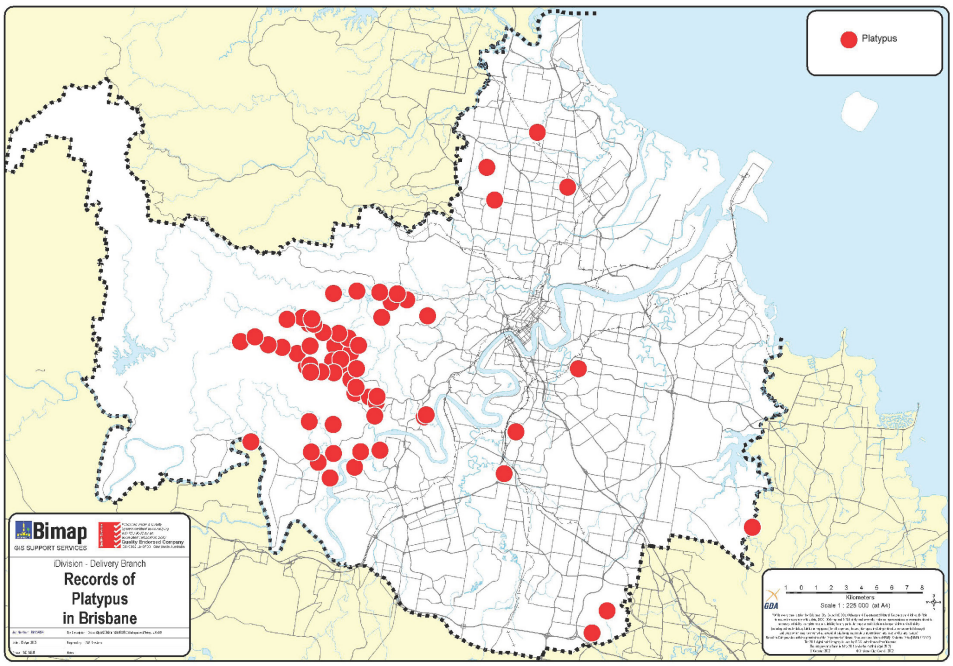


Figure 6.5 Platypus Sightings in Brisbane. Reprinted from "Platypus: Conservation Action Statement", by Brisbane City Council. 2005. p. 6. Copyright 2005 by Brisbane City Council

The platypus distribution has been observed in waterways throughout Brisbane in at least 25 different locations (see Figure 6.5), although the majority of confirmed sightings have been in the western part of the city (Brisbane City Council, 2005). The eastern, suburban part of the city has had very few sightings due to the degradation of waterways in this area. The threats identified were waterway modifications, poor water quality, predation, recreational access, and litter (Brisbane City Council, 2005).

Some of the main conservation efforts through the Brisbane City Council biodiversity initiatives involve the Bushland Acquisition Program (city purchased 1900 hectares of lowland habitat for conservation), Conservation Partnerships with private property owners in significant platypus habitat areas (750 hectares), Conservation Reserve Estate (12,500 hectares), Natural Assets Local Law better protects 42 percent of city from pre-emptive clearing, and protections offered by the Brisbane City Council Plan (Brisbane City Council, 2005). The Great Queensland PlatySearch, conducted in 2001, recorded 173 platypus sightings in the greater Brisbane area (Brisbane City Council, 2005).

Table 3: Management Actions

Management Aspect	Action	Timing	Lead Agent and Key stakeholders
Habitat Protection	Conserve and protect important platypus habitat on privately owned land within Brisbane, through Council acquisition of significant habitat (Bushland Acquisition Program) and through conservation partnerships (Voluntary Conservation Agreements and Land for Wildlife).	Ongoing	Brisbane City Council (BCC)
	Investigate and identify cross-catchment platypus movement corridors.	Commence 2005	BCC; Queensland Parks and Wildlife Service (QPWS); Community conservation groups
Habitat Management	Prepare platypus habitat management guidelines for land owners.	2006	BCC; QPWS; Community conservation groups
Information Management	Establish a long-term monitoring program of Brisbane's platypus population.	2006	BCC; QPWS; Universities; Community conservation groups
	Identify and map significant waterway reaches for platypus in Brisbane.	Commence 2005	BCC
Community Involvement	Support a biennial community-based platypus survey event.	Commence 2006	BCC; Community conservation groups

Figure 6.6 Management Actions for Brisbane. Reprinted from "Platypus: Conservation Action Statement", by Brisbane City Council. 2005. p. 10. Copyright 2005 by Brisbane City Council

In addition to supporting further research and more conservative land management practices, the City Council also stated their support for statutory and voluntary measures to further protect the platypus in public and private areas. The council also wrote of their intention to ensure "the timely availability of accurate, adequate, and contemporary information for policy, planning, and management decisions" (Brisbane City Council, 2005).

As part of this Conservation Action Statement, a table of Management Actions (see Figure 6.6) and Habitat Management Guidelines were made – including the Management Aspect, Action, Timing, and Lead Agent and Key stakeholders. The City Council made the provision that these actions will be made as the budget allows and that the timing of their undertaking must also be considered along with all the other needs of the city. Examples of some of the notable actions the council aspired to are identifying cross-catchment platypus movement corridors, mapping significant waterway reaches for platypuses, and supporting a biennial community-based platypus survey event (Brisbane City Council, 2005).

Case Studies Matrix

The matrix (see Figure 6.7) shows which elements are included in each of the platypus conservation plans presented in the case studies. It is notable that the two most recent case studies (Tasmania and Queanbeyan City) discuss climate change and the others do not. Also, all four case studies incorporate recommendations for planners.

Case Studies Matrix	Tasmania	Queanbeyan City	Redland City	Brisbane
Year:	2010	2011	2008	2005
PlatySearch (2001)			X	X
PlatypusWatch / Platypus Care (APC):			X	
Water Quality:	X		X	X
Workshop:	X			
Action Plan:	X	X		X
Current Risks and Threats Assessed:	X		X	X
Future Risks Assessed:	X		X	
Climate Change Discussed:	X	X		
Planning Recommendations:	X	X	X	X
Plan Coordinator Position Recommended:		X		
Further Study and Research Recommendations:	X	X		X
Management Actions:	X	X	X	X
Distribution and Habitat:	X	X	X	X
Public Education:	X	X	X	X
Distribution and Habitat:	X	X	X	X
Monitoring Recommendations:	X		X	X

Figure 6.7 Case Studies Matrix

Summary

The platypus is one of many beloved, iconic animals that are unique to Australia and it is also one that merits a concerted effort on the part of humans to be protected in the face of climate change, especially by planners and other decision-makers. While the Australian Government

currently protects the species, statutory support for the platypus and their habitat could be strengthened.

Effective tactics and strategies for conservation learned from case studies and previous plans, along with advanced tools - such as habitat modeling based on projections for future environmental shifts - will serve to inform and improve conservation efforts for platypuses.

In the next chapter, the information presented up until this point will undergo a more critical examination and analysis. In the case studies presented, there is a persistent emphasis on designing conservation plans in a manner that is beneficial to the ecosystems in which they exist and for the overall health biodiversity in Australia. This is commendable and this perspective can also be taken a step further and platypus conservation planning can be viewed through a global lens.

CHAPTER 7

ANALYSIS

Platypus conservation must be included in climate change adaptation plans on the local, regional, state, and national levels in Australia in order to be most effective. Planners, ecologists, and other experts must also combine their efforts to better design and administer these plans. However, what will make the greatest overall, long-term impact will be the action that takes place on the international level to reduce greenhouse gas emissions. Even if Australia were to become carbon neural today, it would still be affected by the emissions released by the rest of the world.

In this chapter, threats to the platypus will be identified, along with some possible methods of addressing these threats. The "bigger picture", or larger system, in which platypus exists and in which climate change is occurring will be included in this analysis as well.

Future climate change adaptation plans that include platypus conservation would be beneficial to the health and prosperity of Australians, platypuses, and the greater systems in which they exist.

Identification of Major Threats and Impacts of Climate Change

Finding the Platypus

One of the barriers to obtaining a greater amount of data about the platypus is the fact that they can be rather difficult to see. Both professionals and the average citizen can be of assistance in furthering platypus research if they are well schooled in how to spot a platypus.

When attempting to spot a platypus, there are several telltale signs that can help to confirm a sighting. There may be footprints on the riverbank and near a burrow. If the burrow entrance is above the surface of the water, there will be a well-worn slide mark leading to the water. The burrow will be ten to fifteen centimeters in diameter and five centimeters to one meter above the waterline. Concentric rings will be visible on the surface when a platypus dives or comes up to feed. There will be a trail of air bubbles trailing from the platypus as they dive as well. What is most commonly seen is the "bow-wave" that appears when platypuses are swimming on the surface (Wildlife Preservation Society of Queensland, 2013).

Threats to the Platypus

Figure 7.1 Threats to Platypus Health and Survival. Reprinted from "Tasmanian Platypus Management Plan March 2010", by N. Gust and J. Griffiths. 2010. p. 17. Copyright 2010 by State of Tasmania

In the preceding chapters, various threats to the platypus population have been described. The matrix of threats (Figure 7.2), identifies which of these threats are recognized by each of the case studies.

Land for Wildlife has also identified several specific threats to the platypus from human activity: decreased stream flow due to dam construction and drainage works, pumping water from creeks, entanglement in fencing wire and litter, vegetation clearing, home and agricultural chemical pollutants (such as pesticides, fertilizers, detergents, and urban storm water), disturbance to banks (from activities such as heavy machinery and vehicle use) which can cause burrow collapse, and the proliferation of water weeds which can choke waterways (preventing the platypus from swimming, feeding, and burrowing) (Land for Wildlife).

There are a total of twenty-six diseases and parasites to which the platypus is vulnerable (see Figure 7.1), most of which seem to have no marked effect on them (Gust & Griffiths, 2010).

Matrix of Threats Identified in Case Studies

Of this litany of real and possible threats to the platypus, many of them can be addressed through comprehensive climate change adaptation planning that includes public engagement and updated conservation strategies and tools.

Identified Threats:	Tasmania	Queanbeyan City	Redland City	Brisbane
Disease	Medium			
Animal predators	Medium	X	X	X
Lack of standardized research methods and data reporting protocols	X			X
Lack of responsible land management	X		X	X
Fishing practices	X	X	X	X
Better public education and community support	X			X
Low capacity for being kept in captivity	X			
Limited knowledge of platypus ecology	X	X	X	X
Ethical animal treatment considerations	X			
Need for Integrated Catchment Management	X		X	X
Climate change	X	X		
Forestry	Medium			
Urbanization	Medium	X	X	X
Agriculture	Medium			X
Salinity	Negligible		X	
Introduced competitors	Minor			
Introduced habitat-altering species	Medium			
Fisheries by-catch	Minor			
Road-kill	Medium			
Litter	X	X	X	X
Degradation of riparian vegetation		X	X	X
Lack of drought refuges	X	X	X	
Water quality / Pollution	X		X	X
Flooding	X	X	X	

Figure 7.2 Identified Threats Matrix

Possible Methods of Addressing Threats to and Impacts on the Platypus

An analysis of the research gathered for this study has demonstrated that there are solutions to the issues the platypus is facing. The question then morphs into one of feasibility and prioritization. For example, while it may be best to establish a fully-funded platypus conservation department, it might actually be feasible to require that an ecologist with particular knowledge about the platypus be involved with all state and regional plans in areas within the platypus population range.

For platypuses to have a fighting chance their future must be planned for and the sooner and more extensively that this can be done - the more beneficial it will be for the species.

Planning for Conservation and Adaptation

Knowing that the platypus has already begun to be affected negatively by the impacts of climate change, coupled with the understanding that this is projected to continue at a catastrophic rate, planning for climate change adaptation is a process that must be undertaken with a balance of care and haste.

The chair of urban design and regional planning at the University of Canberra, Professor Barbara Norman, cites the combination of flooding, high water level in the rivers, and a king tide (an especially high tide) in Brisbane this past year as an example of a "coincidence of events" and advocated for improved discussions across disciplines to better prepare for disaster scenarios, now and in the future. Norman described a good adaptation plan as one that includes specific measures, costs, and timelines - which focus on mitigation of risk and adaptation to change (Green, 2013).

Cost of Adaptation Verses Cost of Inaction

The Climate Q report states that "unmitigated climate change will impose greater economic costs on Queensland than on any other Australian state or territory" but goes on to say that "by avoiding climate change impacts through mitigation actions, the benefits far outweigh the costs" (Australian Green Development Forum, 2013). Modeling the costs of both taking action to mitigate climate change and the cost of continuing on the current trajectory provides much more comprehensive data and allows for more enlightened decision-making. These models show a far greater economic impact to Queensland, in comparison to other states, of unmitigated climate change and this impact increases dramatically through the end of the century (Australian Green Development Forum, 2013).

In short, when developing a plan for platypus conservation *in* climate change, costs must be considered and the cost of waiting might well be higher than the cost of launching an action plan more immediately.

Public Awareness and Engagement

Cross-disciplinary discussions regarding climate change planning must include experts and the public. As outlined in Figure 7.3, a diagram of the process of a climate change workshop in South East Queensland, creating an effective plan involves a series of interactions and actions – the process of this type of planning is complex because making decisions about future actions based on today's knowledge (with its' implied limitations) is a complicated undertaking. Public education about the biology, habitat, and conservation of the platypus; along with a public platypus sighting program can go along way towards raising awareness and influencing people's habits.

Figure 7.3 South East Queensland climate change workshop. Reprinted from "Climate Roundtables Southeast Queensland – Short Report 2012" by H. Ross, S. Shaw…[et al.]. 2012. p. 3. Copyright 2012 by Global Change Institute, The University of Queensland

Need for Updated Conservation Strategies and Tools

Conservation strategies must be adapted to life in climate change; traditional methods of conservation no longer adequately serve the current conservation needs. Effects of climate change on the environment can cause species to move to a more suitable habitat that is outside of

the preserved habitats that have been set up. There is also the issue of a lack of migration corridors because it was not projected that they would be needed and the landscape my have become too fragmented for successful movement. The increasing rate of change in the climate will probably occur too quickly for many species to adapt at the genetic level so they can stay in their current habitat (Harvey, Brandt, & Mazzotti, 2012).

The Intergovernmental Panel on Climate Change (IPCC) has defined climate change adaptation as "initiatives and measures designed to reduce the vulnerability of natural and human systems against actual or expected climate change effects" (Harvey, Brandt, & Mazzotti, 2012). In order to differentiate from the ecological meaning of adaptation, the IPCC definition of climate change adaptation can be referred to as "planned" or "managed" adaptation to climate change.

A thorough climate change adaptation strategy includes a short-term and long-term strategies and they should cover the range of options for action, from the more conservative to the less cautious; including:

- "Reduce non-climate stressors such as habitat loss, invasive species, and pollution
- Expand networks of protected areas
- Increase landscape connectivity with habitat buffer zones and wildlife corridors to facilitate species dispersal
- Manage for ecological function and protection of biological diversity
- Restore degraded habitats and ecosystems
- Implement proactive management and restoration strategies to enable ecosystems and habitats to accommodate climate change
- Consider translocation or "assisted migration" for species with limited dispersal ability or small, isolated ranges
- Expand monitoring programs and facilitate management under uncertainty" (Harvey, Brandt, & Mazzotti, 2012)

What these strategies have in common are the themes of system resistance, "ability to withstand environmental change", and resilience, "the ability to bounce back from, or absorb, environmental change" (Harvey, Brandt, & Mazzotti, 2012).

Figure 7.4 Summary of perspective shift needed for climate change adaptation, based on literature reviews. Reprinted from "Climate Change Adaptation: New Perspectives for Natural Resource Management and Conservation", by R. Harvey, L. Brandt, and F. Mazzotti. 2012. p. 2. Copyright 2012 by University of Florida, Institute of Food and Agricultural Services

According to literature on climate change adaptation, changes need to be made regarding how the conservation community operates (see Figure 7.4). Climate change needs to be better integrated into planning and conservation measures and there needs to be more streamlined collaborations between key players, especially at the regional level. Due to limited resources; it is apparent that a triage system will need to be used to prioritize different species based on "their ecological or societal value, severity of climate impact, and feasibility of management" (Harvey,

Brandt, & Mazzotti, 2012). Vulnerability assessments can be utilized to collect and analyze more detailed information about individual species. In order to better plan for the future, modeling tools are crucial. These tools are constantly being improved and the climate data they use is becoming more precise, this also makes the data more useful at the local level. Applied research, adaptive management ("an organized system of learning that allows for continual incorporation of new information"), and incorporating scenario planning are all recommended actions for the future (Harvey, Brandt, & Mazzotti, 2012).

Best Practices from Case Studies

The case study on Tasmania provides a great example of the usefulness of designing a system of assessing risk level for platypuses through a combination of the spatial scale of the threat, the potential impact of the threat, the consequence level of the threat, and the action required over the next 25 years. The Tasmanian conservation plan also addresses short-term and long-term risk management and emphasizes responsible land management practices, the value of further scientific study of the platypus, and the advantages of a public monitoring system.

The Queanbeyan City case study is an excellent source of tools planners can promote including: Environmental Significance Overlays, Environmental Impact Statements, and Platypus Conservation Zones. What is especially compelling about this case study is the Action Plan, which describes the need for the development of a "Platypus Conservation Plan Coordinator Position". The person in this position would be responsible for ensuring that the conservation plan would be implemented by planners, that education programs are implemented, for developing and maintaining monitoring procedures and records, and more. This case study also contains recommendations for specific areas of Queanbeyan City; complete with photographs, maps, project briefs, case studies, and extensive sources of further reading.

What is most notable about the Redland City case study is the recommendations for water quality made by the Australian and New Zealand Environment & Conservation Council, which indicate at what levels of dissolved oxygen, salinity (electrical conductivity), turbidity (muddiness), temperature, nitrogen, and phosphorous that aquatic organisms (and therefore the platypus) will be able to thrive. Catchment-wide platypus conservation plans are advocated for as well.

In the Brisbane case study; the ideas of the government purchasing property containing suitable platypus habitat to be put into conservation, strong statutory support for platypus conservation, and identifying cross-catchment movement corridors are all worth recognizing and applying to other areas.

Practices from these case studies can be copied and adapted, if need be, in other areas of Australia. However, what would be helpful for all areas within the platypus population range would be some standardization when it comes to collecting species' population data, habitat requirements (including water quality values), proven conservation planning methods (such as platypus conservation zones and stream buffer distances), and statutory protection.

The Bigger Overall Picture

The platypus lives within a relatively small area of the Earth and yet the species is being impacted quite seriously by activity taking place in all areas of the world. Reducing the amount of greenhouse gas emissions being produced by Australia would be a step in the right direction but a major reduction in overall global emissions is what would be required to produce truly significant and positive results for the platypus.

Emissions and Climate Change Projections

According to the *Climate Q* document, "Queensland is the highest emitter of greenhouse gases in Australia and its per capita emissions are the highest of all Australian states" (Australian Green Development Forum, 2013). It is explained that the main causes of this are the use of fossil fuels for energy, major mining and mineral processing, and a widely dispersed population that needs a great deal of transportation and energy-related infrastructure. The flip side of this is that Queensland has had higher economic growth than any other area of Australia for over ten years and this is expected to continue even with emissions reductions (Australian Green Development Forum, 2013).

Contrary to the trend for the majority of Australia, rainfall in the Queensland area has been decreasing since 1900. The central, southern, and coastal regions have experienced the most significantly drier conditions since 1950. Climate change projections from the Climate Change in Australia report show a 0.8 to 1.8 degree(s) Celsius increase in the annual mean temperature of Australia by 2050 and a 1.0 to 5.0 degree(s) increase by 2070. A wide range of rainfall projections were also made, along with up to a 40 percent increase in the number of drought months in eastern Australia by 2070, an increased fire risk, increased risk of storm surges, an increase in severe weather such as tropical cyclones and hail, and an overall rise in the global mean sea level of 18 to 59 centimeters by 2011 (melting ice sheets may add 10 to 20 centimeters to this level) (Australian Green Development Forum, 2013).

Since 2005, four (out of a total of seven) of the hottest decades on record in Queensland have occurred. When it comes to future projections, there is not much variation until 2030; after that the projections vary more greatly depending on the level of emissions. South East Queensland in particular will have to deal with serious impacts from climate changes resulting in

drier and warmer conditions, according to the climate change summaries (Australian Green Development Forum, 2013).

Additional Impacts of Loss from Climate Change

Of course there are social costs of climate change that result from the environmental and physical impacts. The Climate Q report identifies "those living in vulnerable areas such as low-lying coastal regions, tropical and sub-tropical population centres, areas with high dependence on agricultural or eco-tourism activities, and remote indigenous communities, particularly in far north Queensland" to be the most at-risk populations. In addition to physical health and financial difficulties, psychological and mental health issues (for example stress and depression) caused by the loss, disruption, and displacement could occur and the fact that these traumas will continue to occur will not help the recovery process. There could also be emotional costs for indigenous people if they were to lose their culturally significant ecosystems to climate change. Global security could become a serious issue as well; scarce resources throughout the Australian and Asian resources could cause regional instability. The loss of the natural would be an immeasurable social cost for Queenslanders, as it would to all humans (Australian Green Development Forum, 2013).

What to do about the Bigger Overall Picture

Biodiversity as a Buffer Against Climate Change

Not only do native ecosystems provide the platypus with all it needs to thrive, these biodiversity systems can "act as a buffer against a harsh and variable climate by binding and nourishing soils, and filtering streams and wetlands" (Clean Energy Future, 2011).

In a report entitled *Biodiversity conservation research in a changing climate*, in *Appendix 1: Climate change and inland aquatic and semi-aquatic ecosystems* by Professor Richard

Pearson of James Cook University, the issue of water management impacts portrayed in future climate scenarios are identified as a potential threat to the platypus population (Dept. of the Environment and Water Resources, 2007). In the process of determining which issues were of the highest priority and what research was essential to manage inland waters with respect to climate change, the following broad areas of action were identified: collation and evaluation of current knowledge, generation of new information, development of predictive models from current and new information, and development of appropriate management approaches. It is predicted that changes in quantity, intensity, and occurrence of rainfall will continue to occur in Australia; which is already the world's driest inhabited continent. In order to properly plan for the future of Australia, comprehending the dynamics and possible changes of water in the landscape is crucial for planners and the conservation of biodiversity (Dept. of the Environment and Water Resources, 2007).

In order to identify the management needs of the habitat for species such as the platypus, the biophysical requirements of the species must be understood. It is stated in Appendix 1 that, while there are inventories of specific species, "we appear to have little systematic understanding of the biota, including water availability, seasonality or quality and co-occurrence of other species" and because of this, "we have no regional or continent-wide conceptual or numeric models of the responses of the aquatic biota to climate change scenarios, and no targeted case studies that examine the likely outcomes of climate change" (Dept. of the Environment and Water Resources, 2007). This makes the consequences or both specific and cumulative impacts very difficult to predict.

There are many gaps the need to be filled to formulate an effective strategy to plan for the conservation of species, while these lists of needs are rather extensive, it is very important for the

full understanding of what is truly required to accomplish this type of planning. To fill the information gaps and research needs specific to the management of inland aquatic and semi-aquatic ecosystems the following is needed: hydrological classification of Australian inland aquatic systems, an understanding of changes in water allocation, an understanding of changes in the periodicity or wetland inundation and important flows, an investigation into how to include rivers in reserves, and an understanding of climate change in relation to restoration (Dept. of the Environment and Water Resources, 2007).

In order to fill the information gaps and research needs with commonalities with other objectives, the following list must be completed: strategic case studies on impacts of climate change; a review of river and wetland research to guide the selection of case study sites; strategic research on key issues such as migratory capacity of selected biota and habitat links; elucidated biophysical requirements of key taxa, communities, and processes; collation of data on species' distributions; determining likely effects of carbon dioxide increase on inland aquatic systems; to identify and quantify likely interactions between key processes and climate change and between current human stressors and climate change; to determine the role of reverse management; to identify resilient and vulnerable species and assess risk; and to develop socio-ecological approaches to forward planning (Dept. of the Environment and Water Resources, 2007).

Biodiversity Fund

The Biodiversity Fund (funded by the carbon tax) is of particular interest when it comes to planning for the conservation of the platypus and its' habitat. The Biodiversity Fund will disperse $946 million over the course of the first six years to landowners who start projects that "establish, restore, protect, or manage biodiverse carbon stores" (Clean Energy Future, 2011). This includes: "reforestation and revegetation on areas of high conservation value including

wildlife corridors, rivers, streams, and wetlands; management and protection of biodiverse ecosystems, including publically owned native forests and land under conservation covenants or subject to land clearing restrictions; and action to prevent the spread of invasive species across connected landscapes" (Clean Energy Future, 2011).

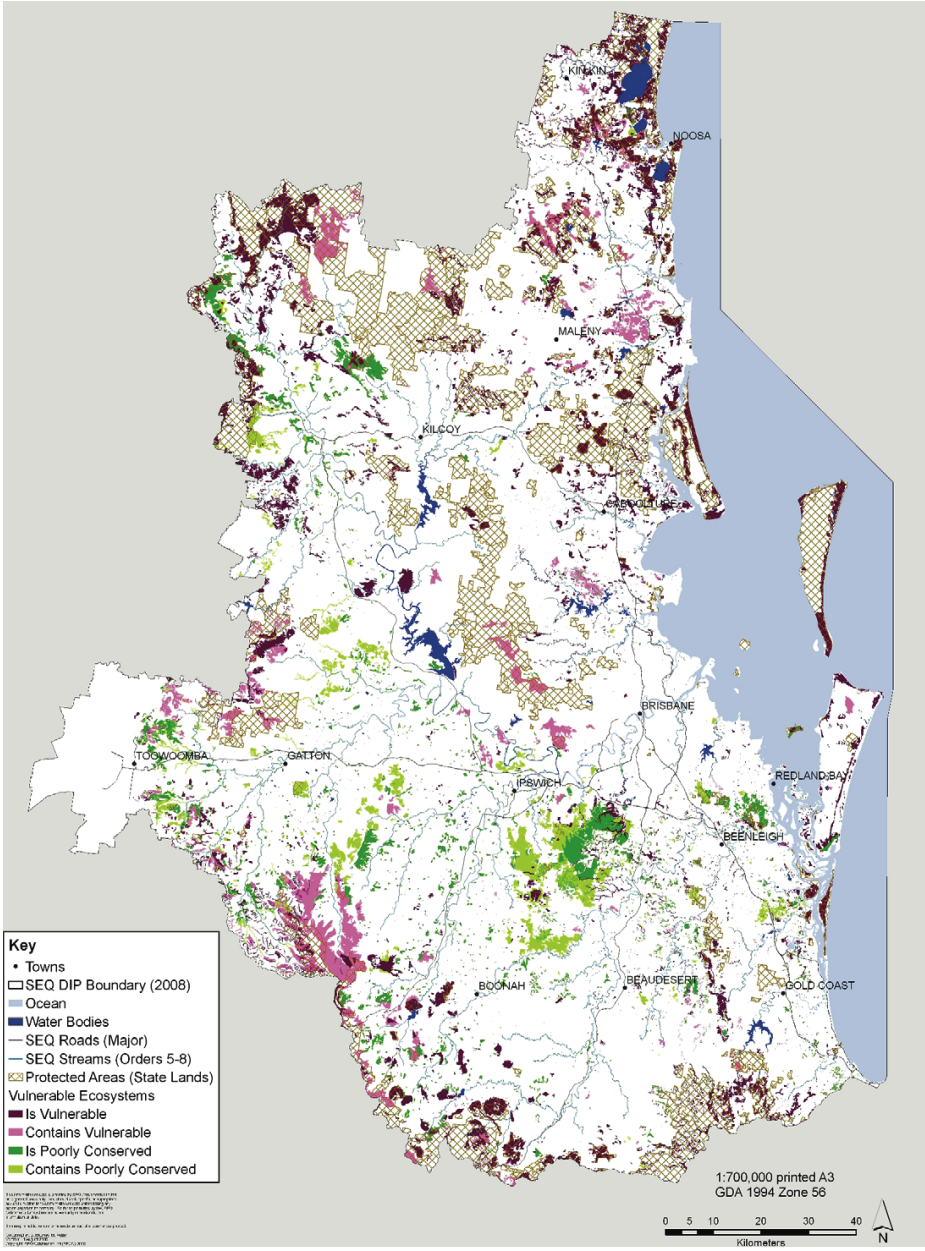


Figure 7.5 Vulnerable Ecosystems in South East Queensland. Reprinted from "Map: Vulnerable Ecosystems (2001 Remnant Vegetation)" by SEQ Catchments. Retrieved from http://www.seqcatchments.com.au/gis-mapping/map-9-vulnerable-ecosystems. Copyright by SEQ Catchments

Renewable Energy and Reducing Emissions

Disappointingly, it has proven extremely difficult for all countries to agree to significantly reducing emissions (and becoming more reliant on renewable energy sources) and thereby slowing the rate of climate change. While the effort to come to an international agreement is ongoing and continually becoming more imperative, there is still great value for platypus conservation in launching climate change adaptation plans at other levels.

Some of the best opportunities for renewable energy are with solar energy, of which Queensland has one of the world's most abundant supplies. Queensland has high solar exposure and low solar variability levels. Solar energy use has more than doubled in less than two years through the use of solar photovoltaic (PV) installation, ranging from small scale to large-scale installations. The University of Queensland has Australia's largest PV array. Concentrated solar thermal (CST), which uses mirrors to reflect sunlight to heat fluids or salt to drive an engine that converts the energy into electricity, also has great potential for creating electricity efficiently.

Upon its completion, the 44 MW Kogan Creek Solar Boost Project (providing a solar thermal addition to the current 750 MW coal-fired power station), will be the largest solar integration project in the world. Approximately 14 percent of households in Queensland use solar hot water systems, which can lower household water heating emissions from 60 to 90 percent (Steffen, Hughes, Sahajwalla, & Hueston, 2012).

In Queensland, there are 44 biomass plants, which are capable of producing over 100kW and run mostly on sugar cane waste, some landfill generation, and some sewage methane gas. Overall, Queensland's "installed capacity for producing electricity from waste products totals 429 MW, which is about 55 percent of the total capacity across Australia" (Steffen, Hughes, Sahajwalla, & Hueston, 2012).

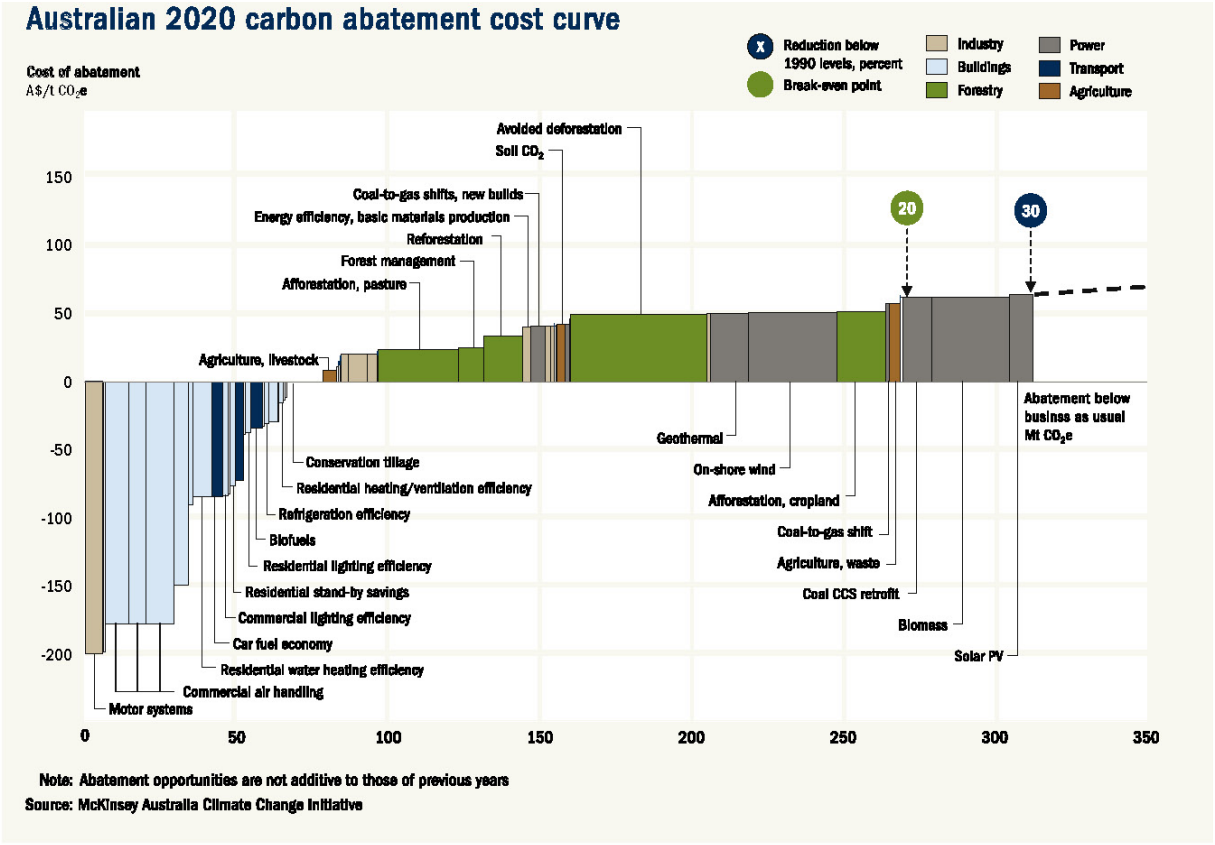


Figure 7.6 Australian 2020 carbon abatement cost curve. Reprinted from "Issues Paper: Review of the Queensland Government climate change strategy" by Queensland Government. Information Source McKinsey Australia Climate Change Initiative. 2008. p. 5. Copyright 2008 by The State of Queensland (Environmental Protection Agency)

Adjusting business practices to become more energy efficient can result in savings in many was for all sizes of companies, including coal mining companies (see Figure 7.6). This includes updating processes and equipment, using green building practices, and more. One area in which employers, employees, and citizens of all walks of life can participate in reducing emissions is to increase the use of public and active (such as walking or riding a bike) transport. At present, 13 percent of Queensland's greenhouse emissions are caused by transport; with personal vehicles causing six times the amount of emissions of public transport during peak periods. In Brisbane in particular, the city council has taken several measures to promote public

transportation services and cycling, both of which have been quite successful (Steffen, Hughes, Sahajwalla, & Hueston, 2012).

As the state in the midst of confronting increased human population, threats to the platypuses' survival, and the effects of climate change; an uncompromising adaptation plan is essential to Queensland and all other regions of Australia.

Reducing Emissions Locally

Some methods for reducing emissions more locally are to design housing that enables citizens to use mass transit, as opposed to individual vehicles and to build and operate this needed housing in a more energy efficient manner. Interestingly, in an effort to better plan for climate change (and peak oil) there has been a renewed interest in transit-oriented development (TODs), especially in subtropical Queensland. The city of Brisbane actually originated as a TOD and now planners are designing ways to integrate subtropical design and TODs into new development schemes, also known as climate-responsive-TOD (Bajracharya, O'Hare, & Byrne, 2010).

Zero Carbon Emissions Plan for Australia

There are several ways in which Australians can support platypus conservation. The rich biodiversity of the country needs to be embraced as an asset and as the lifeblood for the platypus and other animals unique to Australia. Supporting the Zero Carbon Australia 2020 plan would be a tremendous step forward in reducing the negative effects of emissions for platypuses and their habitat.

Beyond Zero Emissions, Inc., a not-for-profit research and education organization, and the University of Melbourne Energy Research Institute have developed the Zero Carbon Australia 2020 plan (ZCA2020). This is a ten-year transition plan for Australia to have zero

emissions by 2020. This plan is currently being financially accounted for and will cover six sectors: energy, buildings, transport, land use, industrial exports, and coal exports. The ZCA2020 is based on the current scientific findings that climate change has already gone past the threshold of what is safe and that immediate action is necessary (Beyond Zero Emissons, Inc.).

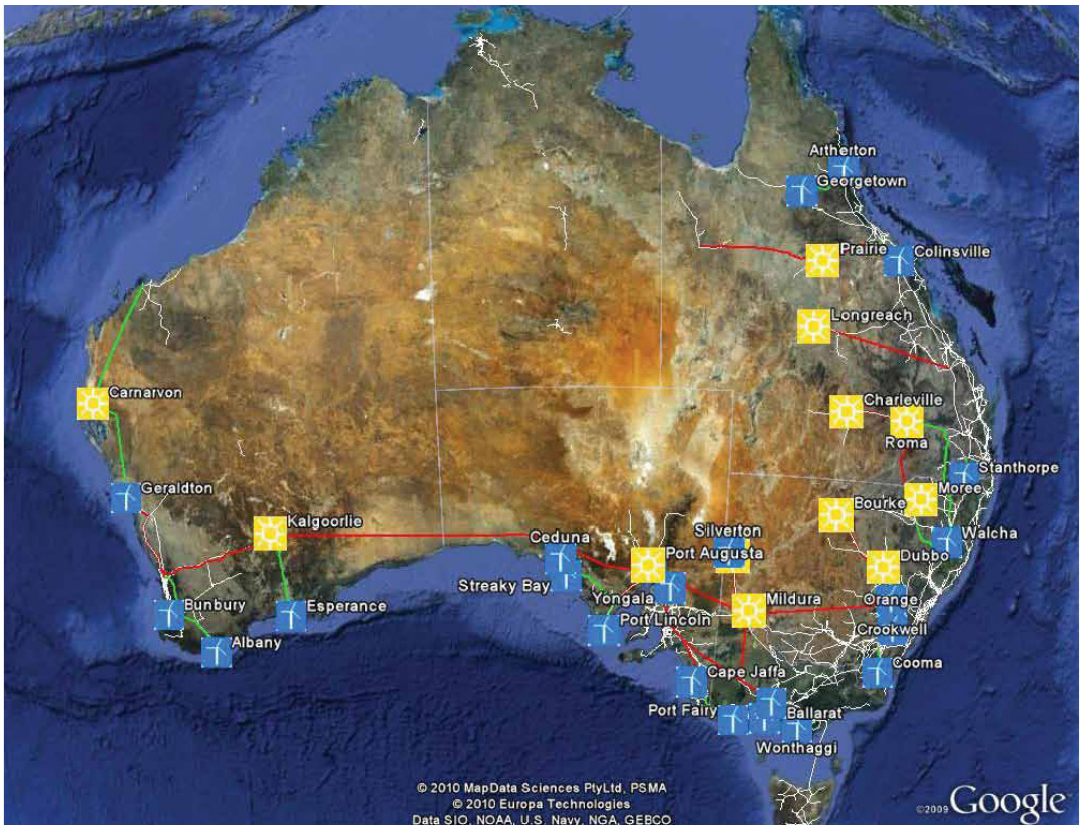


Figure 7.7 Proposed power grid for 100 percent renewable electricity. Reprinted from "Zero Carbon Australia Stationary Energy Plan: Synopsis" by The University of Melbourne and Energy Research Institute. 2010. p. 5. Copyright 2010 by Beyond Zero Emissions

The Stationary Energy Plan was launched in June of 2012 and demonstrates (costs included), through a detailed system of solar thermal plants and large scale wind farms, that running Australia on 100 percent renewable energy is both technically and financially possible (see Figure 7.7). The Buildings Plan is set to be released in mid to late 2013 and will contain a step by step plan for building retrofits, onsite renewable energy and new buildings standards. In late 2013, the Transport Plan will come on the scene with plans for light rail, electric vehicles, freight transportation, and biofuels. The Land Use, Forestry, and Agricultural Plan will be

presented in late 2013, as well, and it will show how to eliminate agricultural emissions and maximize carbon sequestration. The Industrial Processes plan is scheduled for 2016 and it will provide alternatives to the steel, aluminum, and iron industries. Lastly, in late 2016, the Coal Export Plan will arrive to pave the way for Australia to no longer rely on coal exports (Beyond Zero Emissions, Inc.)

Summary

While the threats and climate change impacts that the platypus must continue to combat in order to survive are numerous, the vast majority of them are predictable to some degree and can be planned for right now. This conservation and adaptation planning process is made more comprehensible and feasible when it is viewed as a plan of action that will benefit the larger system, humans included. In other words; planners, ecologists, politicians, and the public can work on this process with the knowledge that their efforts will directly benefit not only themselves but billions of others as well.

CHAPTER 8

CONCLUSION

Climate change and the impacts it has and will continue to have on the environment and the species that inhabit the Earth is an international issue affecting how planning is done. Examining the process by which planning for climate change and species conservation has taken place and how it could be improved in the future, through the lens of the platypus in South East Queensland, can serve to help others better understand the complexities of this process and why it is an important undertaking.

The platypus' origin, biology, habitat, protection, and how it has been affected by climate change were discussed first to better understand the complexities of the species. An overview of the history of how Australia was formed, developed a government system, planned for the future, and addressed climate change were then presented to grasp the larger system in which the platypus lives. Four case studies, along with other conservation recommendations, were examined and analyzed.

The information gleaned from these previous chapters was then applied to the future of platypus conservation planning *in* climate change. Recommendations for how to utilize this information within the greater system were then made.

What became very clear in the research process was the lack of standardization of data collection and monitoring protocols for the platypus and the need for this to be rectified. Without thorough, detailed, standardized monitoring data it is impossible to make the best possible use of the information that is collected.

There is also what can be described as a lack of respect for the fact that climate change is occurring and that humans are playing a major role in compounding the impacts it is causing. It is not something that can be tacked on to an existing plan; it must be viewed as central to planning efforts from the start. It is not a political issue; it is a human issue and, from the perspective of this study, it is a platypus issue.

While the major recommendation of this study is climate change adaptation planning for platypus conservation, there are other options. Though it would be considered radical by some, there is possibly another place in the world that would be more easily inhabitable by the platypus in the future. In other words, perhaps they could be relocated.

There is certainly room for improvement and expansion when it comes to the study of the platypus – especially when it comes to their capacity to adapt to more severe impacts of climate change. It could also be beneficial to study conservation methods and plans utilized for other species to see where conservation efforts could benefit multiple species at once.

If there is one overarching takeaway from all of this, it is that first of all as humans, and secondly as environmental planners; the world as we know it is changing faster than it ever has and it is imperative that we adapt to this and help others to do the same.

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