

Geography

HOMEWORK

8C 10 Spectacular Coral Reefs

Name

Tutor Group

Teacher

The homework booklet contains essential reading on
© **Ten spectacular coral reef systems from around the world** plus planning for your **coral reef essay**.

Your homework will be set and reviewed on ☒

☐ Monday ☐ Tuesday ☐ Wednesday

☐ Thursday ☐ Friday

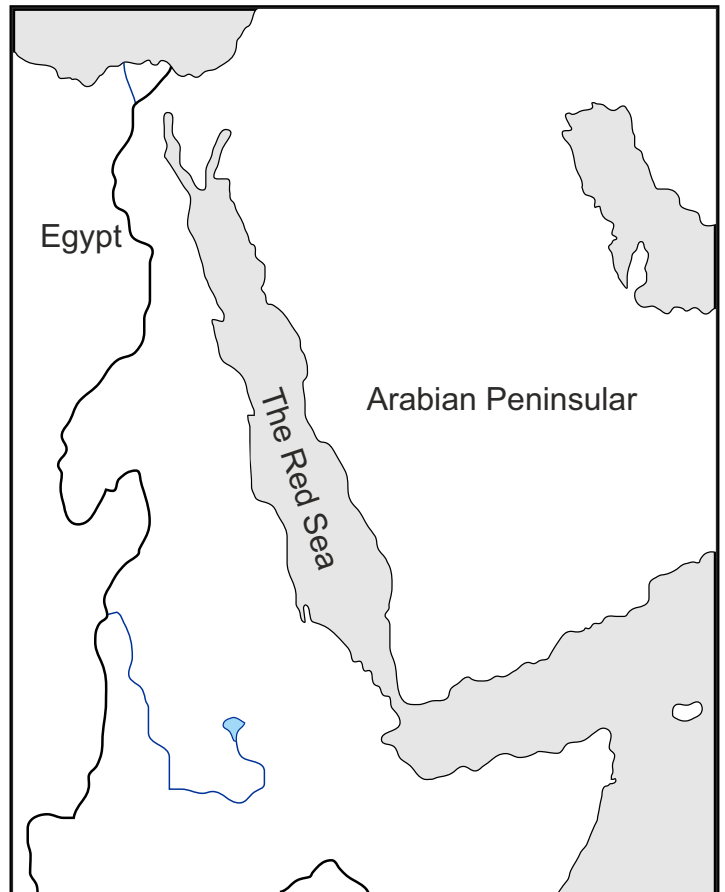
People ● Place ● Pattern ● Process

*Our planet's coral reefs have been described as the 'world's most fragile enviroment'. Covering less than 0.1% of the Earth's oceans but containing 25% of all marine life, coral reefs are **biodiversity hotspots**. But coral is very particular about the conditions in which it can live and thrive. In recent decades, human activity such as coastal developments, over-fishing and climate change have pushed many reefs to the brink of collapse.*

Some of the reefs you will read about in this booklet appear to be living on borrowed time. Some may collapse as functioning ecosystems within a few years or decades. Climate change may prove to be the straw that finally breaks the back of natural wonders such Australia's Great Barrier Reef. However, other reefs may hold the key to the survival of these natural aquatic wonders.

#1 The Red Sea 20° 23' N, 38° 7' E

The waters of the Red Sea separate the deserts of the Sahara and Arabian Peninsular. The lack of rivers flowing from these lands has resulted in the crystal clear, sediment-free waters of the Red Sea. The deserts have also kept human habitation to a minimum. While 150 million people live in the countries bordering the Red Sea, only six million actually live on its shores. As a result, damage caused by human activity has ben kept to a minimum, despite the sea having had a local human population for over 100,000 years.



The current coastline of the Red Sea was formed around 9,000 years ago as sea levels rose after the last glaciation. 365 species of reef building coral are found in the sea. Of these 19 species are endemic (found no where else). The Red Sea reefs support an abundance of other life forms including marine mammals such as dolphins through to many commercial fish species. **Each year around 2 million tonnes of fish are landed by fishers in the Red Sea.**

The narrow, shallow waters of the Red Sea have always been sensitive to changes in climate are now affecting surface water temperature. However, the

Homework N°1: continued

corals of the northern end of the sea appear to show considerably more tolerance to bleaching than corals on other reefs. Scientists believe that these northern reefs may provide a 'biological refuge' for Red Sea reef species as climate change intensifies.

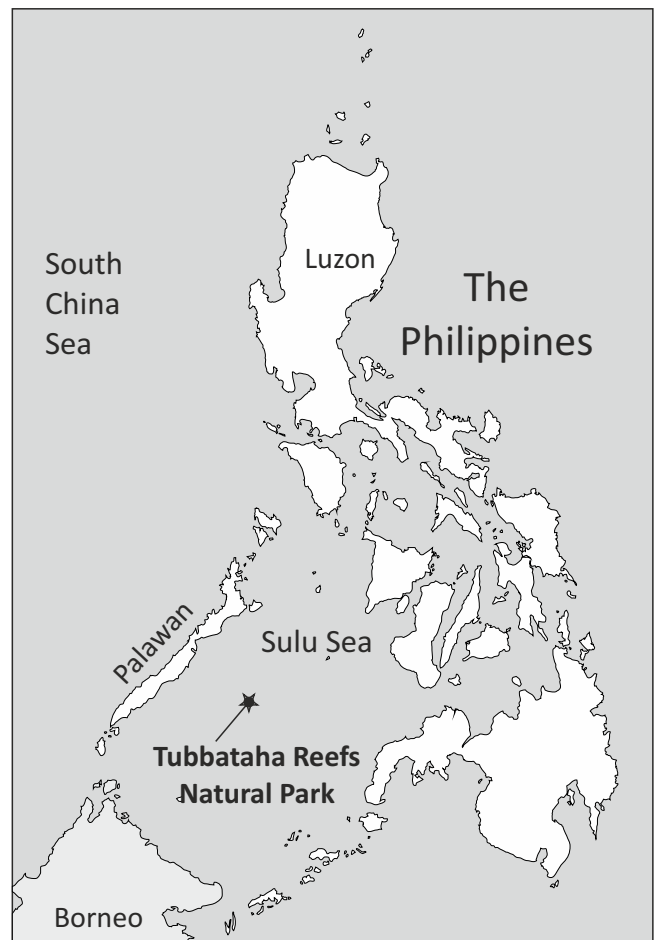
At the same time, this area is seeing an expansion of its coastal population. In addition there is a dramatic increase in shipping resulting from expansion of the Suez Canal waterway. Protection of the northern reefs is essential if they are to maintain their world class biodiversity and continue to feed so many people.

#2 The Tubbataha Reefs Natural Park, Philippines 8°55' N, 119°55' E

The Tubbataha Reefs Natural Park is a protected area of the Philippines located in the middle of the Sulu Sea. The marine and bird sanctuary consists of two huge coral atolls (named the North Atoll and South Atoll) and the smaller Jessie Beazley Reef. Covering a total area of 97,030 hectares the park is located 150 kilometres southeast of the island of Palawan. The distance from the nearest land has meant these uninhabited atolls and reefs have not suffered as much damage as those closer to South East Asia's inhabited islands.

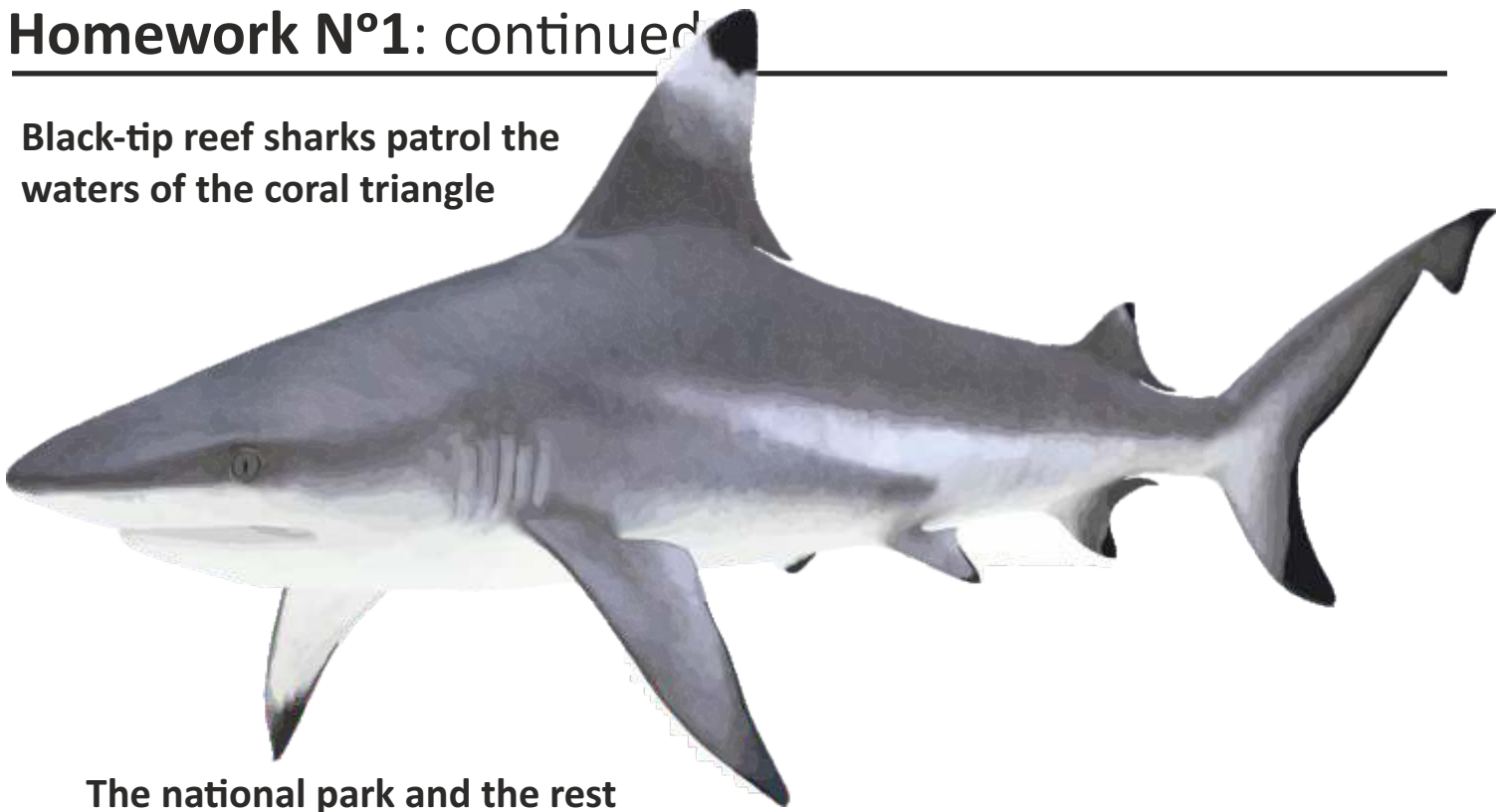
In December 1993, UNESCO declared the Tubbataha Reefs National Park a World Heritage Site. It was designated as a unique example of an atoll reef with a very high density of marine species. The site is an excellent example of a pristine coral reef. A spectacular 100 metre coral wall drops perpendicular from the reef into the deep waters of the Sulu Sea. Within the atolls there are extensive lagoons and two coral sand islands which are breeding sites for seabirds and green turtles.

In 2008 the Tubbataha reef was nominated as a New Wonder of Nature. Research by scientists visiting the reefs since the 1980s have revealed a biodiversity hotspot. The reefs contain no less than 600 fish species, 360 corals, 11 shark species, 13 dolphin and whale species and over 100 different birds,



Homework N°1: continued

Black-tip reef sharks patrol the waters of the coral triangle



The national park and the rest of the Philippines archipelago form part of the Coral Triangle, recognized as a centre of marine biodiversity. The triangle contains 75% of all coral species and 40% of the world's reef fish. However, the area is under grave threat due to overfishing and destructive fishing practices, coastal development, pollution and climate change.

Over 1,000 species of marine life make this diverse ecosystem rivals the Great Barrier Reef – having 350 coral species and 500 fish species. In June 2009 an outbreak of the crown-of-thorns starfish caused concerns for the corals but overall the reef was not too badly affected.

Tourists can visit the park to dive on the reef for a fee of \$75. However, they must remain on their boats as the sand bars of the islets are considered out of bounds to humans. Around twelve marine park wardens inhabit a concrete and polystyrene base built at the southern-most tip of the North Atoll. Serving two month tours of duty, the wardens have the job of preventing illegal fishing and poaching within the park as well as monitoring its overall health.

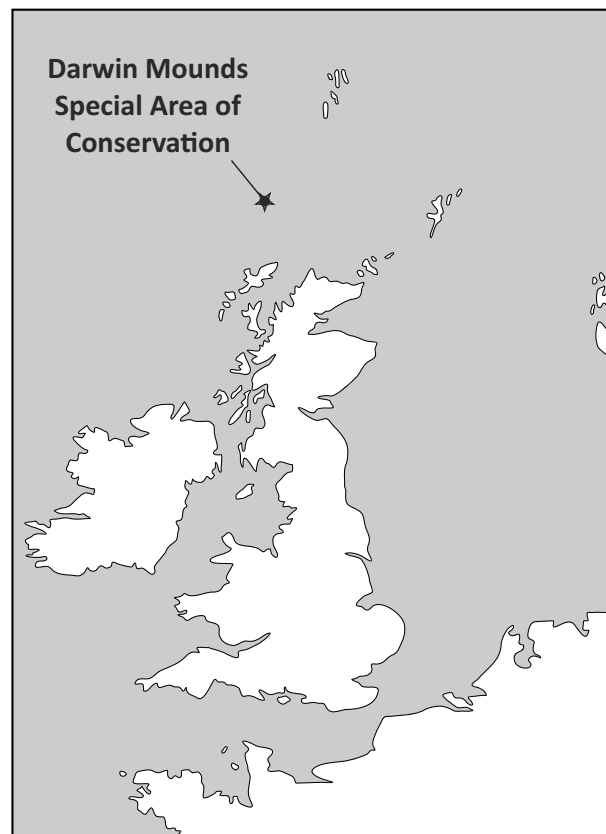


WORLD HERITAGE SITE

Homework N°1: continued

The Darwin Mounds, North Atlantic 59° 45' N, 7° 15' W

Until recently corals were considered to be organisms found only in warm and sunlit tropical seas. After all, tropical corals polyps rely on zooxanthellae algae living within their tissues to provide 95% of their energy. **Yet we now know that corals exist deep in the oceans, far below the *photic zone* where light can penetrate. Deep-water corals have no zooxanthallae algae and so must rely on food that drifts down from the surface into the cold waters of the abyss. As a result, deep water corals grow very slowly; a few millimetres each year compared to up to 40cm per year for some tropical species.** The development of deep-water submarines has allowed scientists to begin to study these corals without dragging them up to the surface where most die.



There may be many hundreds of species of deep water coral but they are not found together in the diversity of their tropical cousins. Rather than reefs these corals form mounds up to 100 metres across and 15 metres high. However, like tropical reefs these mounds support a wide variety of other deep water marine life.

Discovered in 1998, the Darwin Mounds lie 185 kilometres northwest of the northwest tip of Scotland. Lying at a depth of around 1,000 metres, the 225 mounds are each around 100 metres in diameter. The Darwin mounds, which are spread over an area of 100 km², have been mapped using low-frequency sonar. They look rather like 'large sand volcanoes'. Dominated by *Lophellia* species corals the ghostly white skeletons of this dominant coral rise above the mounds into the pitch black waters providing a habitat for other species.

The Darwin Mounds have been declared a *Designated Special Area of Conservation*. Trawling for fish in the area is now prohibited. However, other deep water corals have suffered significant damage as unwitting or uncaring fishers have dragged nets through the slow-growing coral. As surface fish stocks decline, the expansion of deep-water fishing is placing a strain on the slow-growing fish species of the deep ocean but also posing a serious threat to deep water corals.

Learning about the meaning and spelling of key plate tectonics words.

For **Homework 2** you must read the following key words and definitions and practise the spelling. You must be ready to spell these words and remember what they mean for next week's homework check.

Practise the spellings on the next page. Fold this page in half along the dotted line to hide the words while you spell them.

Coral Polyp (co-ral pol-yp)	Tiny, soft-bodied organisms related to sea anemones and jellyfish. Hard corals live in a hard, protective limestone skeleton.
Coral Head (co-ral head)	Community of genetically-identical coral polyps living in a colonies, called head.
Coral Reef (co-ral reef)	Offshore accumulation of coral heads, built up over the remains of earlier dead colonies.
Zooxanthellae (zoo-xan-thel-lae)	Single-celled algae that are able to live in symbiosis with marine invertebrates such as corals, jellyfish, and sea anemones.
Fringing Reef (fring-ing reef)	Reefs which grow near the coastline around islands and continents. Fringing reefs are the most common type of reef.
Barrier reef (bar-ri-er reef)	Reef running parallel the coastline but separated by deep, wide lagoon.
Atoll (at-oll)	Rings of coral, sitting atop sunken volcanic islands, to create a protected central lagoon.
Biodiversity (bi-o-di-ver-si-ty)	The variety and density of plant and animal life in a particular habitat.
Sustainability (sus-tain-a-bil-i-ty)	Meeting today's needs in such a way as to protect the environment and the resources for future generations.
Mangrove (man-grove)	Tropical, esturine species of tree, which act as breeding grounds for marine species and protect coral reefs from river sediments.

Practise your spellings

Practise your spellings on this page. Spelling the word on the line above the definition and then check. If you get it wrong you can try again.

Tiny, soft-bodied organisms related to sea anemones and jellyfish.

Community of genetically-identical coral polyps living in a colonies.

Offshore accumulation of coral heads, built up over the remains of dead coral.

Single-celled algae that are able to live in symbiosis with marine invertebrates.

Common reefs which grow near the coastline around islands and continents.

Reef running parallel the coastline but separated by deep, wide lagoon.

Rings of coral around a central lagoon sitting atop a sunken volcanic island.

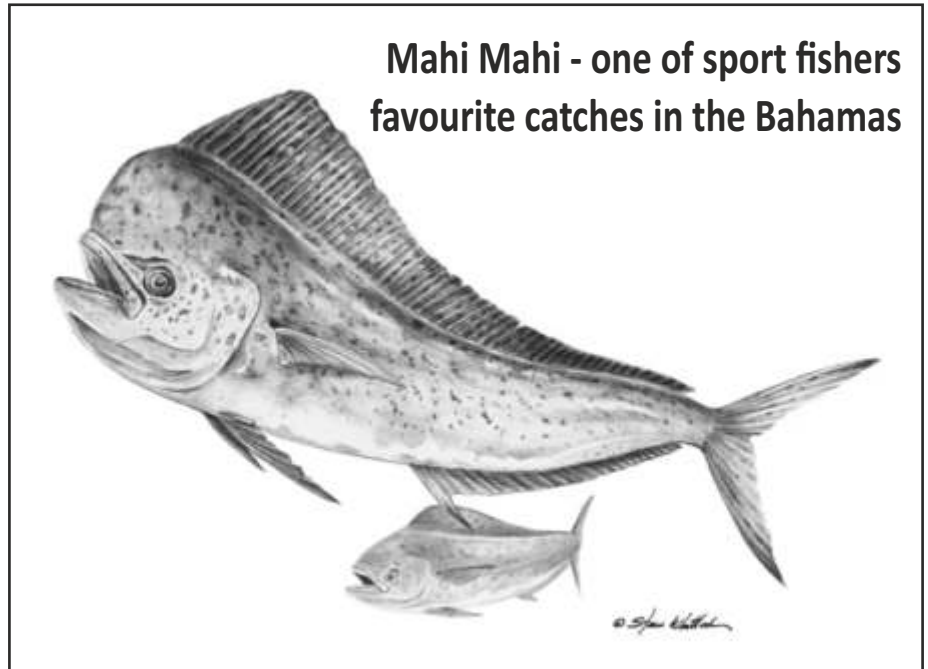
The variety and density of plant and animal life in a particular habitat.

Meeting today's needs in such a way as to protect the environment.

Tropical, esturine species of tree, which protect coral reefs from river sediments.

#7 The Andros Barrier Reef, Bahamas 24°26" N, 77°57' W

Stretching 300 kilometres beyond Andros Island in the Bahamas lies the Andros Barrier Reef. This reef, in the north-east Caribbean Sea, is part of the third most extensive coral system on the planet. Bordered by mangrove swamps and sea grass beds, a shallow 20 metre deep lagoon separates the barrier reef from the shore. On the outer edge of the reef an



Mahi Mahi - one of sport fishers favourite catches in the Bahamas

almost perpendicular drop-off plunges 2,000 metres to the deep ocean seabed.

Over 160 species of fish including impressive blue marlins, mahe-mahe and manta rays, share a habitat created by the many coral species interacting with smaller fish and invertebrates. The reef provides the background to a growing dive tourism industry, as well as more traditional commercial and sport fishing industries. With an increasing number of devastating hurricanes affecting the Caribbean Sea, the Andros reef provides an important defence for low-lying coastal villages against storm surges and hurricane-driven waves.

However, as with most reefs around the world the Andros Barrier Reef has suffered decades of neglect and over-fishing. Fish numbers were falling and biodiversity declining. This is now changing as large parts of the reef have been declared marine reserves, where fishing is banned or strictly controlled.

However, in recent years the reef has faced a new challenge; the lionfish. Native to the Indo-Pacific it is thought that the first lionfish in the Caribbean were released deliberately or by accident from aquariums around Florida. This voracious predatory fish found a Caribbean aquatic population where smaller fish didn't recognise it as a predator. Protected by poisonous spines Lionfish have been spreading through Bahamian waters at an alarming rate.

A great deal of research is now being conducted looking for a viable solution to control the outbreak of lionfish. The Bahamian government is doing

Homework N°3: continued

their part to educate the public. They are encouraging people to fish for lionfish. The lionfish is not poisonous to eat as the venom is confined only to their spines. When properly prepared, they are said to be rather tasty! It is believed that promoting a market for the consumption of lionfish might be the best plan of action against the spread of such a voracious invasive species.

#6 The Ningaloo Reef and Coastline, Australia 21° 55' 44" S, 114° 7' 24" E

Most people have heard of Australia's Great Barrier but far fewer have any idea that another coral gem lies over 5,000 kilometres away, on Australia's west coast. Ningaloo is the world's longest fringing reef, stretching along both coasts of the Exmouth Cape, a peninsular extending into the Indian Ocean, 1,200 km north of Perth.



Unlike the Great Barrier Reef, which is only really accessible by boat, most of Ningaloo's reefs are found in shallow water just a few metres from the coasts sandy beaches. The fringing reef stretches almost 300 km and contains over 250 species of coral and 500 species of fish. Six of the world's seven turtle species visit the reef, while Green and Loggerhead turtle females also laying their eggs on Ningaloo's sandy beaches. Ningaloo is one of the few places where the gigantic whale shark congregates in large numbers, mixing with 7 metre wide manta rays. Between June and November some 30,000 humpback whales migrate from the stormy waters of the southern ocean to spend their winter in the warm, sheltered waters off Ningaloo.

With such a diverse marine ecosystem so close to the shore, Ningaloo is fast becoming a centre for eco-tourism. The shallow water makes the area an ideal spot for those who wish to snorkel amidst the coral but may have a fear of deep water. Divers can swim with the whale sharks and interact with the curious and playful Manta rays. You can even swim with the humpback whales should you can pluck up the courage to plunge into the water alongside a 15 metre marine mammal weighing up to 30 tonnes. For those who want to stay on dry land a visit to a turtle nesting beach can be the experience of a lifetime.

The Ningaloo Reef was declared a marine park in 1987 in order to protect the unique environment and its inhabitants. In 2011, the Ningaloo Reef and Ningaloo Coast received UNESCO World Heritage listing, with the inception of the Ningaloo Coast World Heritage Area.

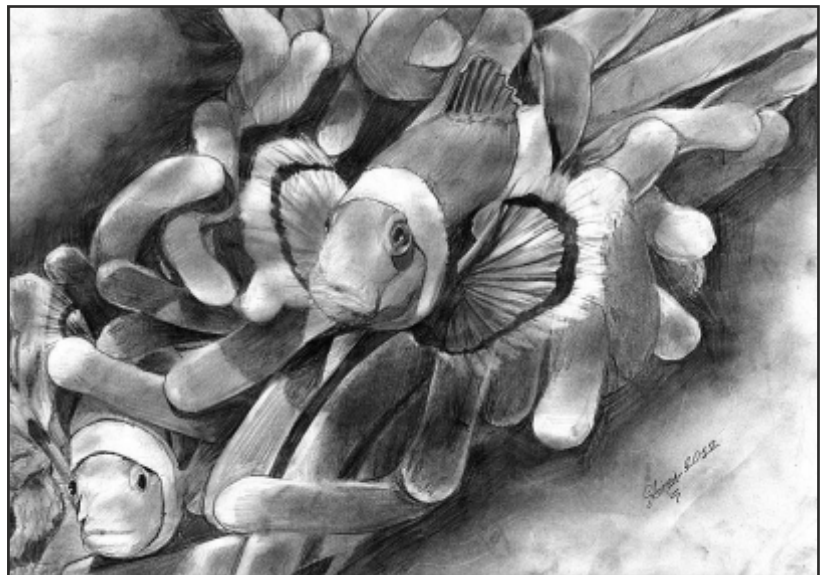
#5 Namena Marine Reserve, Fiji. 17° 50' 7" S, 177° 57' 48" E

Ten thousand kilometres to the east of Nigaloo lie the 300 islands of Fiji. Most of these islands are volcanic or atolls built by living coral on foundations of volcanic rock. Lying between the main Islands of Viti Levu and Vanua Levu is the tiny island of **Namenalala, surrounded by a barrier reef**. The seventy square kilometres of the Namena Marine Reserve were designated a marine protected area in 1997. The area is part of the traditional fishing grounds, of the Kubulau Community. This community had the foresight some years ago to better manage and conserve their natural marine resources. They sought to not only protect their fisheries from over-exploitation but also to develop the tourism sector as a means of providing sustainable livelihoods and benefits to the community.

The Namena Marine Reserve is home to more than 1,000 species of invertebrates, 400 known corals, 445 documented marine plants and over 1,100 fish species. Three different sea snakes swim within the reefs. Namena is a migratory pathway for bottlenose and spinner dolphins, as well as pilot, minke, sperm and humpback whales. Four of the world's seven sea turtle species can be found in the park. Green and hawksbill sea turtles nest on Namena's beaches.

Along the edge of the barrier reef is the **Grand Central Station: a drop-off vertical wall frequented by tuna, barracuda, jacks, snappers, manta and marble rays and sharks, including five-metre hammerheads**. Close by are the Chimneys, pinnacles of coral rising towards the light. The crystal clear waters of Namena allow for a near perfect underwater visibility of over 30 metres. The chimneys are covered with over 100 species of colourful, soft corals which wave back and forth with the changing tide. **Namena has been described as the 'soft coral capital of the world.'**

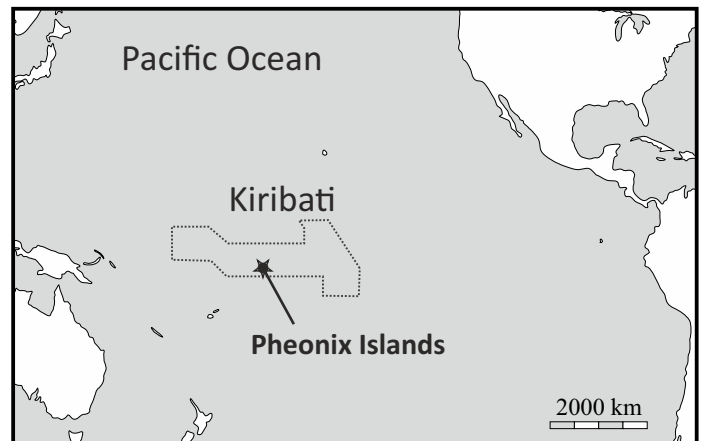
Divers travel across the world to visit Namena and report being thrilled by their encounters with sharks and rays, captivated by the beauty of huge shoals of colourful fish or the intensity and variety of the corals and amazed by the gigantic anemones swarming with clownfish.



Homework N°4: continued

#4 The Phoenix Islands 4° 2' S, 172° 39' W

Two thousand miles to the north east of Fiji lies one of the greatest areas for marine conservation on the planet. The Phoenix Islands Conservation Area (PICA) is part of the island nation of Kiribati and has protected an area almost twice the size of the UK. However, just 25km² are land while the rest of the 408,250 km² of this maritime protected area consists of deep ocean, 14 sea mounts and two sub-surface reefs. There are 8 coral atolls and only one which holds a small human population.



The key to the importance of the area for the whole Pacific are the 14 sea mounts. These are extinct volcanoes which have sunk beneath the waves, often with the remains of coral reefs on their flattened summits. The mounts act as barriers to deep ocean current creating an upwelling of nutrients from the deep sea bed. Once in the light (the photic zone, these nutrients feed the phytoplankton at the base of a dynamic and complex food chain. These food webs includes the plankton and over 150 species of coral but also includes fish, turtles, sharks, rays and eels, shellfish and mollusc, crabs, birds and more. There are 514 species of reef fish, including several new species recently discovered.

Five of the eight islands in PIPA are currently designated as **Important Bird Areas** by Birdlife International. Today there are 19 species of seabirds living on the islands. Many other seabirds migrate through PIPA, including shearwaters and mottled petrels from Australia and New Zealand. Prominent species include the endemic, endangered Phoenix petrel. **These birds populations have been helped by the eradication of non-native species such as rats, cats and rabbits, which we devastating the local bird populations. Since these invasive species have been removed bird populations have risen dramatically.**

Perhaps one of the most significant impacts for humans of the PICA was discovered recently by scientists who noticed the high concentration of tuna larvae in the water of the reserve. This confirmed that the Phoenix Islands are an important spawning ground for migratory tuna. **At the start of 2015 all fishing was banned within 60 miles of the shores of all eight atolls. Anyone found fishing illegally in the area faces minimum fines of US\$1 million.** Scientists hope to prove

Homework N°4: continued

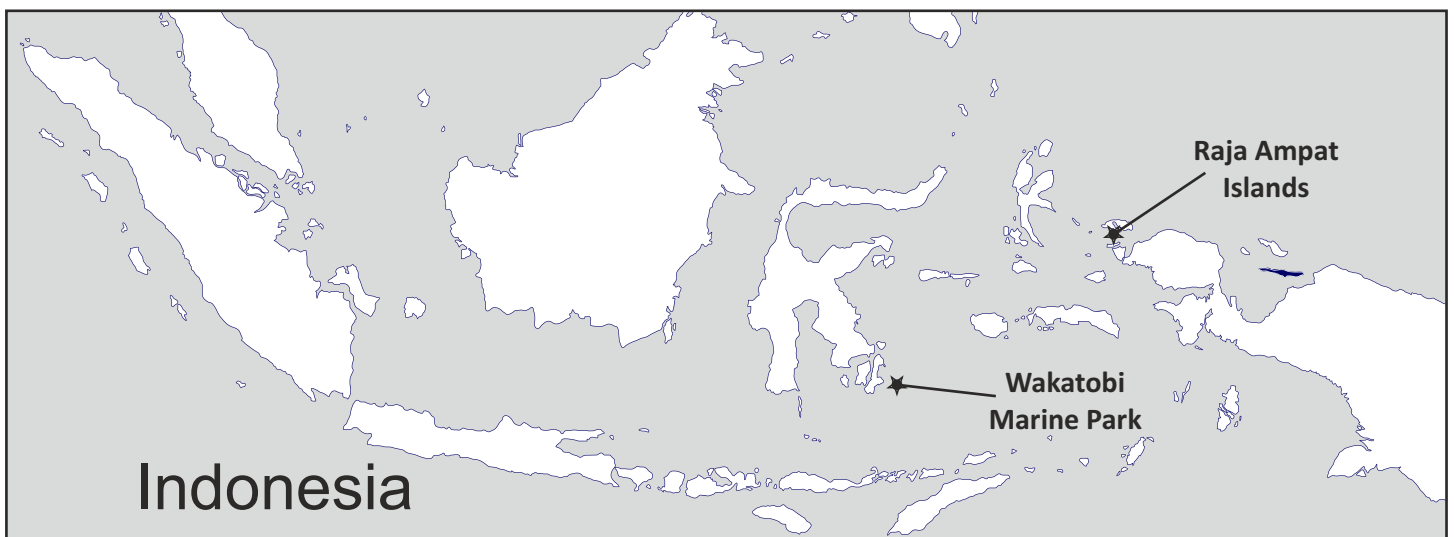
that protecting the spawning and feeding grounds will result in more tuna being caught elsewhere, as the fish 'spill-over' into surrounding areas. The Phoenix Islands may be the largest Marine Reserve in the world but if we are to protect our oceans diversity and productivity many more such reserves will need to be designated and protected world-wide.

#3 Wakatobi National Park Indonesia. 5° 39' 27" S, 124° 2' 2" E

Thirty times smaller than the Phoenix Islands Protected Area and lying some 7,000 kilometres to the west is Indonesia's Wakatobi National Park. This marine park covers 1.4 million hectares, of which 900,000 hectares host tropical coral reefs. Wakatobi has the highest number of reef and fish species in the world. It is the habitat of large and small fish species, dolphins, turtles and whales. The island group comprises 143 islands, of which only 7 are permanently inhabited.

Located in the Asia-Pacific 'Coral Triangle' in the Indonesian province of Southeast Sulawesi, the Wakatobi Islands offer clear waters and a super-rich biodiversity of life. Wakatobi hosts 942 fish species and 750 hard coral species (of 850 globally). This compares with just 50 in the Caribbean and 300 in the Red Sea.

The human population, at 100,000, is around 2,000 times larger than that of the Phoenix Islands. Most notable are the Baja communities, seafaring nomads who inhabit many of Indonesia's remote islands. With such a high human population the park cannot simply ban all fishing as they have done in the Phoenix Islands. Instead the park authorities are working with others, such as WWF (Indonesia), to create sustainable management policies which aim to strike a balance between human needs and that of nature. Conservationists hope to create a network of marine reserves along the islands of the Banda Sea. This would create safe refuges for migratory fish and secure breeding grounds for the reef species.



#2 Great Barrier Reef, 24° 8' S, 152° 59' E

Australia's Great Barrier Reef has been described as the largest living structure on the planet. Stretching for 2,300 kilometres along the coast of Queensland, the reef spans 14° of latitude. In reality, the Great Barrier Reef is made up of some 3,000 individual reef and 900 islands, as well as inshore mangrove islands and swamps. While most of the inshore reef has depths no greater than 35 metres on its outer, eastern edge the reef drops off 2,000 metres to the floor of the Coral Sea.

The Great Barrier Reef started life around 20 million years ago. But as sea levels have risen and fallen over the years so the exact location of the individual reefs and islands have changed. The current active reef system stems from around 9,000 years ago, when sea level stabilized after the last glaciation. Today, the Great Barrier Reef is home to 450 species of hard corals, 150 species of soft corals, 1,625 species of fish, 3,000 species of molluscs and 30 species of whales and dolphins.

Despite effective management by the Great Barrier Reef Marine Park Authority the reefs are facing their greatest ever threat. Climate change is raising sea surface temperatures and resulting in severe bleaching episodes along the reef. As temperatures rise the stressed coral expel their symbiotic *zooxanthellae* algae which deprive them of 95% of their food. Without a fall in temperatures the coral polyps simply starve to death. Bleaching events since 2016 have affected almost all of the individual reefs.

Added to bleaching are issues such as ocean acidification which may threaten the ability of corals to regrow after bleaching. Pollution running off in to the sea from agricultural land can cause algal blooms in the ocean, changing the ecological balance of the reef. In addition, regular outbreaks of Crown of Thorns starfish are also threatening the reefs. The explosion of these coral-eating starfish has been linked to algal blooms. These blooms act as a food source to the young starfish boosting their numbers. In addition to this problem is the long-term decline of the Crown of Thorns predator, the Triton's Trumpet. This large snail was heavily harvested for its beautiful shell in previous decades. Now protected, its population on the reef has yet to recover to their previous numbers.

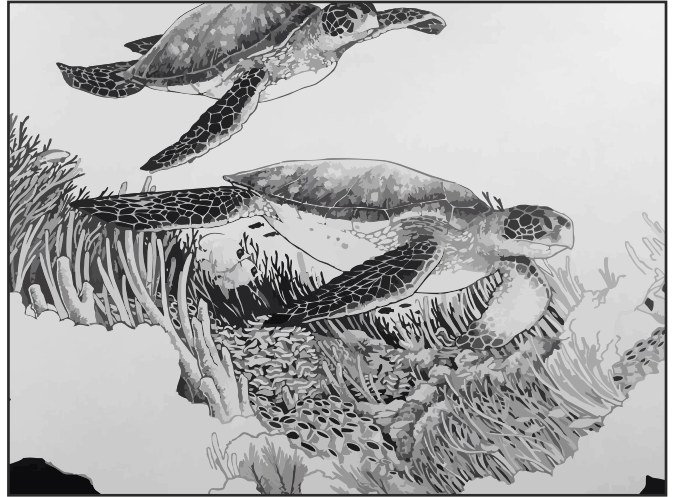
#1 Raja Ampat Islands, Indonesia. 0° 0' N, 130° 31' E

With so many of the world's reefs under threat from bleaching and over-fishing there are relatively few reasons to celebrate. But one cause for celebration lies 1,700 km north-west of the northern end of the Great Barrier Reef. At the

Homework N°5: continued

western tip of the island of New Guinea are the Raja Ampat islands. And the seas around them may hold the key to the future of the planet's reefs.

At the heart of the Coral Triangle, Raja Ampat is one of the most biodiverse places on earth. Encompassing around 4.5 million hectares of land and sea, the archipelago is home to more than 1,400 species of fish and 75% of the world's known coral species.



This has earned it the nickname 'species factory'. As well as being a globally-significant biodiversity hotspot, the nutrient-rich waters surrounding the islands provide a vital source of nutrition for the local population. Protecting Raja Ampat's ecosystems from unsustainable fishing practices, overexploitation and climate change are a regional and global priority.

Straddling the Pacific and Indian Oceans, Raja Ampat's coastal and marine ecosystems are jaw-droppingly biodiverse. They include a vast range of habitats from fringing, barrier and atoll reefs to deep channels. Studies have found Raja Ampat to be home to the world's highest known diversity of reef corals for an area of its size. In addition to the 1,427 species of fish, there are 17 species of marine mammals, including dugongs, whales and dolphins and 25 species of mangrove.

Since 2004 nine marine protected areas have been established in the archipelago and the world's first shark and ray sanctuary was declared in 2010. The result has been astonishing. In under a decade, shark numbers have risen by 1,000% and fish numbers have increased by over a quarter. Outside the reserves, fishers report catching more fish as the ecological balance in the marine reef ecosystem is restored.

But what makes Raja Ampat so important is that its corals seem more resistant to coral bleaching than elsewhere. Papua's shallow seas, lying under the Equatorial Sun, have always been warm. It appears that the corals here have evolved tolerance to temperatures over 30°C. With ocean currents mixing the species of the Pacific and Indian Oceans this region may not only be a 'species factory' but a 'heat training gym'. Could corals grown in the waters of Raja Ampat be used to reseed and protect the Great Barrier Reef and so many of the other reefs under threat in the Indo-Pacific? Or will the seemingly inexorable rise on global temperatures ultimately put an end to this coral paradise as well?

Hwk 1 – 8C Spectacular coral reefs	
Coral reefs have been described as the world's most fragile...	
Coral reefs cover less than 0.1% of the ocean, but how much of its marine (sea) life?	
Which two deserts does the Red Sea separate?	
How many million tonnes of fish are landed in the Red Sea each year?	
Which country are the Tubbatah Reefs in?	
In 1993, UNESCO declared the Tubbatah Reefs National Park a...	
Total	/6

Hwk 1 (part 2) – 8C Spectacular coral reefs	
Which shark patrols the Waters of the coral triangle (page 4)	
The Darwin Mounds are found off the coast of which country?	
The Darwin mounds were discovered in what year?	
How deep are these corals?	
Which coral reefs grow slower, tropical or deep water reefs?	
The Darwin Mounds have been declared a Special Area of Conservation – what is now banned in this area?	
Total	/6

HWK 2 Complete the spellings on page 7

Score /

Hwk 3 – 8C Spectacular coral reefs	
What sea is the Andros Reef in?	
How many species of fish share the habitat?	
What do the marine reserves ban at Andros Reef?	
Where did the invasive lionfish originally come from?	
On which coastline of Australia is the Ningaloo Reef found?	
What very large 'shark' can divers swim with in Ningaloo?	
Total	/6

Hwk 4 – 8C Spectacular coral reefs	
Which tiny island does the Namena Marine Reserve surround	
How many coral species are found in the Marine Reserve?	
Which fish can be found in anemones?	
Which island nation contains the Phoenix Islands?	
What are the 14 sea mounts sunk beneath the waves?	
Turn over to page 12 – Which reef national park in Indonesia has the highest number of reef and fish species in the world?	
Total	/6

Hwk 5 – 8C Spectacular coral reefs	
What has the Great Barrier Reef been described as?	
When did the Great Barrier Reef start its life?	
Which issue is reducing the reef's ability to regrow after bleaching?	
How many fish species are in Raja Ampat?	
What % of the world's known coral species are found in Raja Ampat?	
After the establishment of the world's first shark sanctuary, how much have shark numbers increased by?	
Total	/6

GEOGRAPHY Homework

9C

COASTS AND CORAL

**Ten spectacular
coral reefs**



People ● Places ● Pattern ● Process