Sulawesi School Training Course Activities Booklet 2020

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Wallacea Biogeographical Region

Sulawesi and the surrounding smaller islands of the Lesser Sundas and the Moluccas were identified as a unique biogeographic region by the naturalist Alfred Russell Wallace in the late 19th century. These islands are now known as the Wallacea region of Indonesia (defined by the area within the dotted line on the map below) and formed their unique fauna due to their isolation from other landmasses by the deep ocean channels that surround the islands. During past Ice Ages, sea levels here dropped by up to 100m. This led to the large 'Greater Sunda' islands to the west (Borneo, Java, Sumatra and Bali) being linked to mainland Asia by land-bridges, and therefore allowing large mammalian fauna to spread throughout this area. However, the deep ocean channel between Borneo and Wallacea remained impassable to large mammals, so few are found in the region. The islands to the east of Wallacea would have been linked to Australasia and have many species of marsupials and other Australian fauna. Again, the ocean channels between Wallacea and New Guinea were too deep for most mammals to cross. However, birds, reptiles and insects were able to cross the channels, and Wallacea has species of these taxa both Asian and Australian origin.

Figure 1. Location of the Wallacea biogeographical region

University of Haluoleo – Terrestrial Objectives and Conservation Outputs

Sulawesi is the largest island in the Wallacea region and has a high percentage of endemic species (those that occur nowhere else in the world other than in Sulawesi). Overall though, the forests of the Wallacea region remain one of the least biologically studied areas in the world, and one of the most likely places to discover vertebrate species that are new to science!

Buton Island is large and very close to Sulawesi and as a result has a fauna similar to of the mainland fauna. The Opwall teams have been helping to map the wildlife in the forests across the whole of Buton Island since 1995 and have compiled detailed species lists for a range of taxa and collected annual data using the same methods and survey sites for long periods of time so changes in different faunal communities can be determined. The biodiversity of these forests possesses an extremely high conservation value. To date, a

total of 53 mammal species,149 bird species, 64 herpetofauna species, 46 freshwater fish species, 194 butterfly species and 222 tree species have been recorded.

This diversity is remarkably representative of species assemblages across Sulawesi as a whole, given the size of the study area. Buton comprises only around 3% of the total land area of the Sulawesi sub-region, but 70% of terrestrial birds, 54% of snakes and 35% of butterflies known to occur in the region have been found here. Faunal groups in the forests of Buton also display high incidence of endemism; 83% of native non-volant mammals, 48.9% of birds, 34% of herpetofauna and 55.1%of butterflies found in the island's forest habitats are entirely restricted to the Wallacean biodiversity hotspot. Numerous organisms are also very locally endemic to the study area. Three species of herpetofauna are endemic to Buton, and another has its only known extant population here. Other currently undescribed species are also likely to prove to be endemic to Buton. Additionally, one primate, one bird, and 30 butterflies are represented here by subspecies endemic to SE Sulawesi's offshore islands. Several of these endemic species also act as important regional flagships for Wallacean biodiversity, such as the Lowland Anoa (*Bubalus depressicornis*), Booted Macaque (*Macaca ochreata brunnescens*), Maleo (*Macrocephalon maleo*) and Knobbed Hornbill (*Aceros cassidix*). If the objective is to ensure the long-term survival of the unique Wallacea fauna, then protecting the forests of Buton Island would go a long way towards achieving that aim. In addition, since the Buton forests are well studied they could be developed for wildlife encounter tourism that would provide year-round income for the local communities.

Figure 2. Key locations on Buton Island and the Wakatobi

There is a large nature reserve on Buton Island that incorporates the remaining forest in the north part of the island and along the spine of mountains running due north and south. Some of this nature reserve area has already been cleared by illegal loggers although most of the reserve remains intact. The remaining forested area is in the middle part of the island and this area known as the Lambusango forest is a mixture of wildlife reserve, limited production and production forests. Small areas of the Lambusango forests have been deforested but most of the area has intact forest. Apart from these areas on Buton island much of the rest of the forest has been cleared and deforestation rates have averaged 2% per annum as in many other parts of Indonesia. The Norwegian govt who are trying to become carbon neutral by 2030 even though they have a large oil and gas industry have invested in helping the Indonesia Forestry department to reduce the rates of deforestation across the country. The Norwegians have donated $1 billion to the Indonesian Forestry department in exchange for receiving carbon credits for the forest saved by reducing the deforestation rates across the country. This scheme which is known as Reducing Emissions from Deforestation and forest Degradation (REDD+) had an immediate impact in slowing deforestation rates and the objective now is to ensure those forests that have high carbon storage and wildlife value are protected long term by ensuring local communities that are suffering the opportunity loss of being able to take wood for building or to hunt in the forests, are compensated. In 2005, Opwall ran a project with the World Bank and GEF, which was aimed at protecting the Lambusango forests and their wildlife. The scheme that was implemented involved each of the communities around the forest, the opportunity of a contract whereby they agreed to no logging, hunting, or change in the forest/farm boundaries and in exchange they got investment in small businesses in their communities. Signing up to such a scheme was voluntary but all the villages became involved and the scheme was a great success in ensuring that the deforestation which had reached the boundaries of Lambusango was stopped at that point. Long after the World Bank funding finished this scheme continued to provide protection for the Lambusango forests.

The forests of Buton Island are one of the best studied and most published (over 70 papers in peer reviewed journals describing the forest flora and fauna – see https://www.opwall.com/research-library/?type=publication&date=&interest=terrestrial&country=275&search=) in the Wallacea region and as described above, provide good representation of the overall Sulawesi fauna. The objective is to utilise the data collected from these surveys to submit an application for some of the Norwegian REDD+ funding to be used to provide a similar approach to that used for the World Bank/GEF Lambusango project with village-based contracts providing protection of the forests in exchange for investment in businesses.
One of the main opportunities for Buton forest communities adjacent to remaining rainforest is to offer visitors cultural and wildlife encounter experiences. Over the last few years, a number of local staff have been trained up to be able to offer these experiences and in 2019 the entire project was handed over to the University of Haluleo in Kendari to run. The university now runs the annual programme and uses it to train participating international and local students in the survey techniques used for such biodiversity assessments. When you participate in this training programme, not only are you learning a series of survey techniques and encountering the unique Wallacea wildlife, but the data that are collected by the University-led scientists on each project are then compiled to give an overall assessment of the biodiversity of the island. At the moment there is virtually no tourism to Buton Island – indeed for many years the Opwall teams in north Buton have comprised 100% of the tourism visits! Yet with good flight connections to Bau Bau and Kendari, outstanding wildlife, and a trained local staff, development of some ecotourism income should be achievable. One of the 2020 objectives of this programme is to ensure that wildlife packages and a marketing system is in position to kick start some wider tourism visits to Buton Island and provide some year-round income for participating communities in the forest protection contracts.

Another opportunity for local communities is to establish rainforest tree nurseries. OWT (Operation Wallacea Trust in Indonesia) alongside local partners is trialling a scheme whereby local communities are

paid to establish nurseries from the collection of seeds/fruits of at least 30 different species of rainforest trees (or newly germinated plants) and growing them on. The idea is for each nursery to produce 40,000 saplings which can be used to plant up 100ha of marginal land with rainforest trees. Small farmer landowners will then be paid to plant these nursery-grown trees and to protect them during the early growth stages from attacks by pigs, by weeding in between the trees and by watering during dry spells. Each year the farmers will receive an annual payment per hectare for growing these trees. After 15 years they are allowed to then harvest 5% of the trees each year as long as the use is for non-carbon release (e.g. furniture or building materials) and that new saplings are replanted in their place. If they stick to these harvesting restrictions then the farmers will continue receiving the income from the annual payments,

The reason this scheme is being explored is to further the work of the scientists who published a paper in Science in 2019 (https://science.sciencemag.org/content/365/6448/76) that showed that by planting forest on 0.9 billion ha of under-utilised land (much in the Tropics) would start reversing the effects of climate change by removing about 60% of the carbon emitted since the Industrial Revolution. The paper didn't go into the costs or practicalities of doing this, so the schemes being developed at a number of the Opwall sites are designed to evaluate whether this transfer of income to poor rural farmers could be used as a practical way of reforesting. Aviation, which contributes 2% of the worlds' carbon emissions annually, emits 285 million tonnes of carbon each year. If the aviation industry wanted to reforest 2% of this 0.9 billion ha they would need to plant up 18 million ha of land. If a $10 a tonne carbon tax was levied on all flights that would generate enough money each year for a total of $495 to be paid per ha. The amount paid per ha per year has to be large enough to make it worth the farmers while to bring unused land into use, but not so great that it starts converting agricultural land to tropical rainforest. These trials are assessing the strike price for the land that would be received each year by the participating farmers and the practicalities of planting up such large areas. If successful, a scheme such as this, if implemented more widely, could have enormous implications for the income of poor rural farmers in the Tropics as well as cancelling out the impact of aviation carbon emissions.

The University of Haluoleo, Kendari (Unhalu) training programme will be run at the North, Central and South camps. The university staff will demonstrate a series of survey techniques and as a by-product of demonstrating these techniques will collect data needed for them to answer the objectives below. All information (data) collected as a by-product of the training programme is to be retained by and remain the property of Unhalu and Unhalu staff assigned to the project will oversee the compilation and management of any such data for either management and/or publication purposes.

Objectives:

1. To add to the amphibian, reptile, bird and non-volant mammal and bat species lists from the island
2. To gather additional data on forest structure and the amount of carbon in the forests around each of the camps. These data will then be used to make an estimate of the overall carbon storage value of the Buton forests
3. To identify locations for the collection of fruits and seeds to help local communities propagate a wide range of rainforest tree species
4. To collect data on the butterfly communities at the standard sites and determine whether those communities are changing
5. To collect data on the amphibian and reptile communities and determine whether they are changing over time
6. To collect data on the bird communities and determine whether they are changing over time

7. To collect data on the Anoa and Booted Macaque populations
8. To develop some wildlife packages for tourists outside the Opwall season and a marketing plan so that local communities can start developing ecotourism visits to the island
9. To provide all the data to the Forestry Department to help them in an application for REDD+ funding to protect the Buton forests

University of Hasanuddin - Marine Objectives and Conservation Outputs

The coral reefs in the area are less endemic rich than the terrestrial habitats because changing sea levels have little impact on the connectivity of reef species. However, the reefs in this part of the world (southern Philippines, Borneo, Sulawesi, Lesser Sundas, Irian Jaya) are known as the Coral Triangle and have around 30% of all the worlds reefs as well more than 75% of coral species and 37% of the word's coral reef fish. The map below shows the position of the Coral Triangle based on the species richness of hard corals.

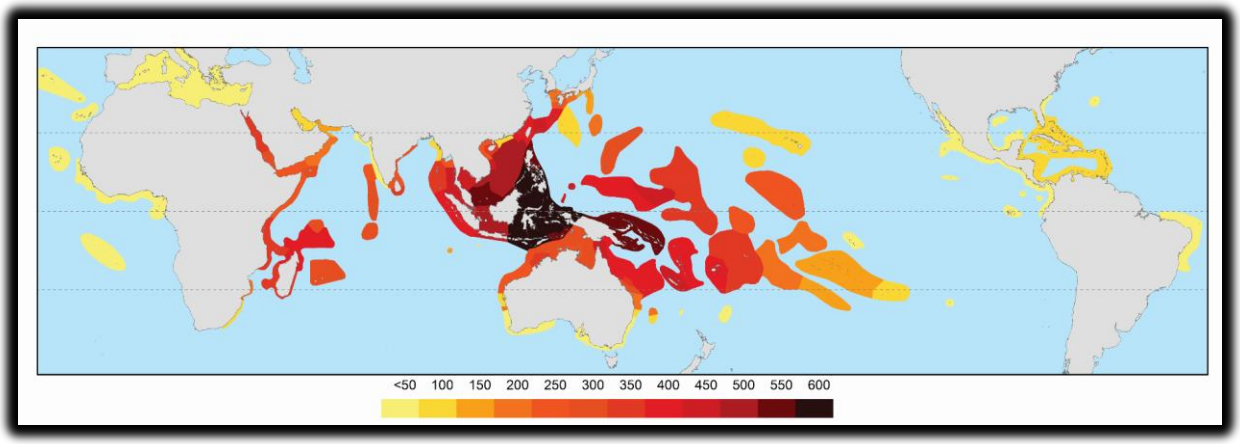

Figure 3. Map of coral reefs of the World showing the most diverse reefs in the Coral Triangle

Over the last few years Operation Wallacea has been building up a Dive and Marine Education Centre on Hoga Island in the Wakatobi Marine National Park and a second Centre at Pantai Nirwana on Buton Island. These Centres are the most productive marine locations in the Coral Triangle with more than 180 papers published (https://www.opwall.com/research-library/?type=publication&date=&interest=marine&country=275&search=). The University of Makassar, the leading marine science university in Indonesia. runs an annual marine biology course for western and Indonesian students at these two sites. The course teaches students how to identify the main species of corals, macro-invertebrates and reef fish as well as training students in new technology and more traditional methods used to quantify different aspects of reef ecology. The data collected as part of this course are used by scientists at the University of Makassar for further publications.

The Hoga site is the longer running of the two sites and annual data on the reef fish, macroinvertebrate, benthic composition and reef rugosity have been gathered for a long time series. The surveys will be repeated in 2020 and University of Makassar scientists are then analysing changes in the reefs based on these long-time series. In addition, there are a series of more specialist studies being completed, as well as a major reef restoration project, in areas where previous bomb fishing or storm damage has caused significant decline in the reef quality. Fortunately, these areas are relatively small and most of the reefs are in excellent condition despite being subjected to much higher temperatures than those on the Barrier Reef where high temperatures have caused so much bleaching. Here in the Wakatobi, bleaching is relatively

uncommon; it is thought that the influence of the Indo-Pacific Warm Pool (IPWP, the largest heat reservoir in the world, has enable the corals in this region to become more resilient.

The Hoga Centre is in the world famous Wakatobi Marine National Park. However, the reefs off the southern coast of Buton Island, where our Pantai Nirwana centre is located, are just as species rich as those inside the protected area. The Pantai Nirwana centre was established to provide information on these reefs and for the University of Makassar researchers to lobby for the extension of the Marine National park to include them.

The University of Hasanuddin training courses will be on Hoga Island and at Pantai Nirwana. The university staff will be demonstrating a series of survey techniques and as a by-product of demonstrating these techniques will collect data needed for them to answer the objectives below. All information (data) collected as a by-product of the training program is to be retained by and remain the property of Hasannudin University and that Hasanuddin University staff assigned to the project would oversee the compilation and management of any such data for management and/or publication purposes.

Objectives

1. To complete the stereo video, benthic intercept and 3D mapping surveys on a series of sites in the Wakatobi to determine whether the reefs are changing.
2. To complete studies on the viability of the spider frameworks being used to restore reefs in other parts of Indonesia
3. To gather data on the species found on the reefs off the south coast of Buton island to provide evidence that these reefs should be included in an extended Marine National Park.

Camps and Travel to Sites

Figure 4. Map of camps and travel routes

Camp Combinations

There are 5 set combinations that make up the itineraries that school groups follow in Sulawesi. If a particular camp or marine site was requested at the time of booking, then the school has been allocated these options. If no preference was expressed, then the schools have been allocated to one of the combinations. All groups will gather in Makassar on the Saturday before their expeditions start and from there will follow one of 5 different itineraries outlined below:

Camp Combination 1: South Camp and Pantai Nirwana - these groups will overnight on the Saturday in Makassar and on the Sunday will fly to Bau Bau (1 hour). They will then be driven north to South Camp which involves a 2-hour drive in convoy of vehicles and then a 2 – 3-hour trek to the camp. At the end of the first week the group will trek out of camp (2-3 hours) and then be driven in a convoy of vehicles down to Bau Bau and onto the Pantai Nirwana marine camp (2- 3 hours) where they will be based for the second week. On the Saturday at the end of their second week the group will be taken to Bau Bau airport and will take the early morning flight directly back to Makassar (1 hour).

Camp Combination 2: North Camp and Hoga Island – these groups will fly to Kendari on the Saturday evening (1 hour) and will overnight in the Plaza Inn, in Kendari. On the Sunday they will be driven south (2 hours) to take a ferry to Ereke (1 hour). There will then be a 1-hour vehicle transfer followed by a trek to camp (1 hour) arriving in time for dinner in the camp. At the end of the forest week they will reverse the travel back to Ereke where they will take a ferry for 4 hours to Wanci. The group will overnight on the ferry in the harbour and then take a chartered ferry at first light to Hoga Island (2 hours) arriving on the Sunday morning for a late breakfast. On the Friday afternoon the group will take a chartered boat back to Wanci and overnight on the boat in the harbour before taking the early morning flight from Wanci to Makassar via Kendari (2 - 3 hours).

Camp Combination 3: Central Camp and Hoga Island – these groups will fly to Kendari on the Saturday evening (1 hour) and will overnight in the Plaza Inn, in Kendari. On the Sunday they will be driven south (2hrs) to take a ferry to Ereke (1 hour). There will then be a 1-hour vehicle transfer followed by a trek to camp (2 hours) arriving in time for dinner in the camp. At the end of the forest week they will reverse the travel back to Ereke where they will take a ferry for 4 hours to Wanci. The group will overnight on the ferry in the harbour and then take a chartered ferry at first light to Hoga Island (2 hours) arriving on the Sunday morning for a late breakfast. On the Friday afternoon the group will take a chartered boat back to Wanci and overnight on the boat in the harbour before taking the early morning flight from Wanci to Makassar via Kendari (2 - 3 hours).

Camp Combination 4: Central Camp and Pantai Nirwana – these groups will fly to Kendari on the Saturday evening (1 hour) and will overnight in the Plaza Inn, in Kendari. On the Sunday they will be driven south (2 hours) to take a ferry to Ereke (1 hour). There will then be a 1-hour vehicle transfer followed by a trek to camp (1 hour) arriving in time for dinner in the camp. At the end of the forest week they will take vehicles to Bau Bau (5 hours) and the marine site at Pantai Nirwana. On the Saturday at the end of their second week the group will be taken to Bau Bau airport and will take the early morning flight directly back to Makassar (1 hour).

Camp Combination 5 (Marine Only): Pantai Nirwana and Hoga Island – these groups will overnight on Saturday in Makassar and on the Sunday will fly to Bau Bau (1 hour) before being transferred to the Pantai Nirwana site. At the end of their first week on the Saturday they will travel by vehicle to Kamaru on the east coast of Buton island (3 hours) and then take a car ferry to Wanci Island (4 hours) where they overnight. On the Sunday morning they will take a chartered ferry at first light to Hoga Island (2 hours) arriving on the Sunday morning for a late breakfast. On the Friday afternoon the group will take a chartered boat back to Wanci and overnight on the boat in the harbour before taking the early morning flight from Wanci to Makassar via Kendari (2 - 3 hours).

Camp Combination 6 (Marine Only, 1 week): Pantai Nirwana – these groups will overnight on Saturday in Makassar and on the Sunday will fly to Bau Bau (1 hour) before being transferred to the Pantai Nirwana site. At the end of the week the group will be taken to Bau Bau airport and will take the early morning flight directly back to Makassar (1 hour).

Expedition Itineraries

Week 1 - Forest Itinerary (Camp Combinations 1 – 4)

School groups will follow the example timetable below. The groups will be split into 5 groups of 5 – 6 students who will rotate between each of the different activities. The timetable below is for one of these groups and the other groups will complete the same activities albeit in a different order. Timetables will also vary slightly dependent on group size, and depending on fitness of students, weather conditions or operational issues.

Table 1. Example timetable in week 1 for Camp Combination 1

Day	Activity
Sunday pm	Arrive at camp and lectures on the survey plans and activities over the week plus H&S talk and site orientation
Monday am	Butterfly van Sommeren trap and Pollard surveys
Monday pm	Forest fruits and seeds search
Monday evening	Lecture 1 – Introduction to Indonesia and Wallacea Field practical – Bats or spotlighting for amphibians
Tuesday am	Forest structure and carbon quadrat surveys
Tuesday pm	Forest structure and carbon quadrat surveys
Tuesday evening	Lecture 2 – Plant and insect biodiversity Nocturnal survey – Bat harp trap, mist nets or sound recording
Wednesday am	Bird point count surveys
Wednesday pm	Herpetofauna pit line surveys
Wednesday evening	Lecture 3 – Vertebrate biodiversity Nocturnal survey – Spotlighting for amphibians
Thursday am	Jungle skills
Thursday pm	Jungle skills/canopy access
Thursday evening	Lecture 4 - Impacts and invasives Nocturnal survey – Tarsier surveys
Friday am	Megafauna – patch occupancy and Distance based surveys
Friday pm	Megafauna – patch occupancy and Distance based surveys
Friday evening	Lecture 5 – Conservation in the Wallacea region Social Night
Saturday am	Depart to marine site

Activities

The activities are described in more detail below:

Jungle Skills - These practicals provide an introduction to life in forest camps, and how to identify and reduce risks throughout the forest. Each group will learn how to live in hammocks, how to select a safe camp site, make fires, shelters, field cooking, etc. During their walks into and out of the camp they will have constant reinforcement of the health and safety messages and identifications of common trees, birds and reptiles encountered.
Forest Structure and Carbon Survey Techniques - The groups will learn how to set out a 50m x 50m forest quadrat and then determine the size class structure of the trees from circumference at breast height measurements, the amount of regeneration from 5m x 5m quadrats and counts of poles and saplings, the level of disturbance of the forest by taking canopy scope measurements and the amount of ground vegetation from touch pole surveys.
Butterfly Survey Techniques - In this practical the groups will learn how to set and use baited van Sommeren traps to sample butterflies in the canopy and at mid canopy heights. In addition, they will learn how to use transect-based timed Pollard counts to monitor the butterflies at ground level.
Bird Survey Techniques - In this practical the groups will learn how to complete an early morning point count for birds using a 10-minute count and recording all birds heard or seen around the point count site. All birds recorded will be identified by an expert ornithologist, their distance from the point count estimated and the time each bird was recorded will be noted.
Herpetofauna Survey Techniques - In this practical the students will be helping to check pitfall traps for amphibians and reptiles and small mammals.
Megafauna Survey Techniques - In this practical students will learn how to complete patch occupancy surveys for signs of large mammals such as Anoa, deer or wild pig. In addition, they will learn how to complete Distance sampling for observable species such as Cuscus, Reticulated Pythons, ground birds and Hornbills. Encounters with troops of Booted Macaques require the students to stop the standard transects and then spend a few minutes getting as close up the macaque group as possible to get a count of the maximum number of animals seen.
Nocturnal Amphibian Survey Techniques - This practical will involve spotlight surveys of river systems after dark with a herpetologist to monitor frog communities and opportunistically sighted reptiles. Species encountered will be identified and the main identification features explained.
Nocturnal bat survey techniques – This practical will demonstrate how to set and empty harp traps and/or mist nets. The captured bats will be identified, and the main identification features explained.
Canopy Access – This is an optional training course (see https://canopyaccess.co.uk/opwall/) and has an additional cost. The students will learn how to ascend into the canopy with Canopy Access Ltd and is fitted into the schedule by dropping one of the half day practicals listed above.
Wallacea Wildlife and Conservation Lecture Series – This is a series of 5 lectures, written by Professor Martin Speight from Oxford University, based on the last 5 years of published papers from the Wallacea region. The course is written at second year undergraduate level, but the lectures are delivered as a series of stories whilst the full lecture series with the primary referenced source material are available for the accompanying teachers to take back and use for teaching at their school. The lectures are delivered in camp after dinner and include lectures on an Introduction to Indonesia and Wallacea, plant and insect diversity, vertebrate diversity, impacts on wildlife and invasive species and conservation in the Wallacea region.

Week 2 - Marine Itinerary (Camp Combinations 1 – 4)

The second week will be based at the Pantai Nirwana site (camp combinations 1 and 4) from Saturday evening to very early Saturday morning or at the Hoga Island site (camp combinations 2 & 3) from Sunday lunchtime to Friday afternoon. At these sites the students complete a PADI Open Water dive training course, or an Indo-Pacific Reef Ecology Course (with the practical's done either by diving or snorkelling). In the

evenings there will be a series of lectures on the Marine Ecology of the Coral Triangle talks including talks on the Coral Triangle reefs, mangroves and seagrass, coral reef species association, impacts of reefs and examples of marine conservation in the Coral Triangle. This is a series of 4 lectures, been written by Professor Martin Speight from Oxford University, and based on the last 5 years of published papers from the Coral Triangle region. The course is written at second year undergraduate level, but the lectures are delivered as a series of stories whilst the full lecture series with the primary referenced source material are available for the accompanying teachers to take back and use for teaching at their school. On the Thursday night on Hoga Island and the Friday night at Pantai Nirwana there will be an end of expedition party and barbecue on the beach.

PADI Open Water course - This course consists of three different elements of learning; dive theory (knowledge development), 5 confined water sessions which are done in the shallows adjacent to the centres and where the students learn the in-water skills needed in safe conditions. After completion of the theory and confined water training each student then completes 4 open water dives to a maximum depth of 18m. Please be aware that as a part of the PADI Open Water Course, all students will be required to complete some basic stamina tests on site. Student divers will need to demonstrate that they can comfortably maintain themselves in water too deep in which to stand by completing a 10-minute swim/float without using any swimming aids. Instructors will also have students complete a 200m continuous surface swim or a 300 m swim with mask, fins and snorkel. Please note, those completing the Open Water course will also complete the Reef Ecology lectures outlined below but won't have time to complete the practicals.

Indo-Pacific Coral Reef Ecology Course – This course comprises a series of lectures, land-based practicals, and in-water practicals completed by diving, if qualified, or by snorkelling. The course is designed for students to understand coral reef ecology, be able to identify some of the more common species or families and understand some of the survey methods used. The course has the following lectures and practicals:

Lecture 1: An Introduction to Coral Reefs
- Coral biology; growth, development, feeding and reproduction
- Importance of the symbiotic relationship between corals and photosynthetic microalgae
- What are coral reefs and where are they found?
- Introduction to the Indo-Pacific

Land-Based Activity: Reef zonation activity
In-Water Activity: Check dive/snorkel & PPB

Lecture 2: The Blue Planet
- Quick fire facts to excite students about the marine world
- Who would win in a fight between a great white shark and a killer whale?
- Why is the sea blue and salty?
- Why are whales so important?
- Where did life originate?

Land-Based Activity: Presentation briefing
In-Water Activity: Reef zonation & coral growth forms

Lecture 3: The Diversity of Coral Reefs
- An introduction to taxonomy

- Classifying a green alga
- Classifying a sea cucumber
- Classifying the stoplight parrotfish

Land-Based Activity: Build a fish activity
In-Water Activity: Fish ID dive/snorkel (practicing hand symbols)

Lecture 4: Conservation of Coral Reefs
- The value of coral reefs
- An introduction to macroalgae
- Competition between macroalgae and hard coral; phase-shifts
- Local threats to coral reefs that stimulate phase-shifts; i. Destructive fishing, ii. Coral mining, iii. Overfishing, iv. Water pollution, v. Coastal development, vi. Disease,
- Potential management solutions

Land-Based Activity: Build a reef & HAS Assessment Score
In-Water Activity: Valuing a coral reef

Lecture 5: The Diversity of Coral Reefs II
- Coral reef food webs
- Fish herbivory
- Invertebrate herbivory
- Filter feeding
- Predation

Land-Based Activity: Invertebrate hunt
In-Water Activity: Invert ID (key health indicators)

Lecture 6: Mangroves, Seagrasses & FADs
- Mangrove adaptations
- Seagrass adaptations
- Ecosystem services and functions
- Importance of habitat connectivity
- Threats to mangroves and seagrasses

Land-Based Activity: Exploring Bubu traps as a traditional fishing method
In-Water Activity: Artificial reef survey

Lecture 7: The Diversity of Coral Reefs III
- An introduction to behaviour
- Parasitism
- Commensalism
- Symbiosis
- Camouflage
- Fish sensory systems

Land-Based Activity: Beach time & traditional canoes
In-Water Activity: Observing feeding rates

Lecture 8: How to Survey a Coral Reef

- Coral reef assessment techniques and methods of assessment
- Benthic habitat quality, fish and invertebrate sampling

Land-Based Activity: Field transect activity
In-Water Activity: Assessing levels of coral bleaching using PADI's 'Coral Watch' guideline

Open Water referral course combined with Indo-pacific reef ecology course – This option is open to students who have completed a referral course which includes both the dive theory and confined water sessions prior to expedition. The students will first complete a check dive with their instructor to demonstrate that they remember and can confidently perform the necessary skills to progress on to complete their open water dives. If they pass this then the students go onto complete the 4 Open Water dives and gain their PADI qualification. This only takes 2 – 3 days and for the rest of the time the students join the Indo-Pacific reef ecology course.

Marine Only Expeditions (Camp Combination 5)

The students on the marine only expeditions (camp combination 5) will be based at Pantai Nirwana for week 1 and will either complete the PADI Open Water dive training course or if they are already dive trained or want to snorkel, they will complete the Indo-Pacific reef ecology course described above. Alternatively if they have completed the PADI referral scheme before they arrive on site (the theory and pool training elements) then they will complete their Open Water dives in the first couple of days and then move onto the remaining parts of the Indo-Pacific reef ecology course.
The second week will be spent at the Hoga Island site. Those who completed their dive training course in week 1 will complete the Indo-Pacific reef ecology course. Those who completed the Indo-Pacific Reef Ecology Course in week 1 complete the Advanced Marine Survey Techniques course which will include the following elements:

- The use of 3D mapping of reefs to determine rugosity
- How to use coral intercept transects to determine coral cover
- How to conduct macro-invertebrate transect surveys
- How to use stereo video fish surveys to quantify fish communities, size class structure and biomass
- How to install and monitor coral growth on 'reef spiders'
- How to use changes in butterfly fish communities to assess underlying changes in reef structure
- How to monitor behaviour of species of cleaner fish
- How to set up projects to assess thermal, oxygen and salinity tolerances of fish and corals

Links to Exam Specifications

The following two tables highlight how your Opwall expedition relates to the AS and A level syllabuses across all exam boards, as well as the AP and IB syllabuses. The red and blue blocks indicate that the

keywords listed are covered on our expedition (through lectures, practicals or in discussion topics) and that these keywords are also within AS or A level topics as shown.

Topic	Biology	AQA		C	CCEA		C.Int		Ed/Sal		OCR		SQA		WJEC		AP	IB
	Levels: S=AS 2=A2 H =Highers	S	2		S	2	S	2	S	2	S	2	H	AH	S	2		
Evolution, Classification and DNA	Evolution; Speciation; Species; Endemism; Gene pool; Allopatric; Sympatric; Isolation; Variation; Adaptive radiation Adaptation; Wallace; Darwin		◆	◆		◆		◆	◆		◆		◆	◆		◆	◆	◆
	Classification; Taxonomy; Binomial system; Dichotomous Keys	◆		◆	◆			◆	◆	◆	◆			◆	◆			◆
Ecology and Ecosystems	Ecology; Habitat; Niche; Abiotic; Biotic		◆	◆	◆		◆		◆	◆	◆					◆	◆	◆
	Biome; Ecosystems; Rainforests; Deserts; Coral reefs; Mangroves; Marine; Coasts; Hot arid; Semi-arid; Woodland Bush; Tropics; Tropical		◆	◆		◆	◆					◆				◆	◆	◆
	Populations; Competition; Interspecific; Intraspecific; Predator Prey; density dependent; independent: Symbiosis		◆	◆		◆	◆					◆				◆	◆	◆
	Succession; Climax community		◆			◆				◆	◆	◆				◆		◆
	Biodiversity	◆		◆	◆			◆	◆	◆	◆				◆		◆	◆
	Practical work; Field techniques; Ecological sampling; Random sampling; Transects; Capture, mark, release and recapture; Biodiversity indexes; Data handling and presentation; Quadrats; Statistical testing; Measuring; GIS; Research tools		◆	◆		◆				◆	◆	◆	◆	◆		◆	◆	◆
	Written reports; Research project; Report; Case studies			◆					◆				◆	◆		◆	◆	◆
Agriculture, Human activities, Conservation and Sustainability	Sustainability	◆		◆					◆	◆		◆				◆		
	Agriculture; Agricultural impact; Agricultural exploitation; Cultivation crops; Food production; Sustainable agriculture; Sustainability; Forestry; Timber; Deforestation; Fisheries; Over fishing; Deforestation; Human management; Human effects; Human activities	◆				◆							◆	◆			◆	◆	
	Fair-Trade; Coffee; Rain Forest Alliance; Ecotourism; Tourism; Carbon trading; Greenhouse gas emission control (REDD+)															◆		
	Indicator species; Pollution; Climate change; Global warming Carbon footprint; Fossil fuels		◆	◆		◆				◆	◆		◆				◆	◆
	International conservation; Endangered species; Invasive species; Biological control; Pests; CITES; Ethical, Local; Global	◆	◆	◆		◆		◆			◆	◆	◆			◆		◆
	National Parks; Wildlife reserves							◆										◆
	Environment; Environmental monitoring; Environmental impact; SSSI																	
Behaviour	Animal behaviour; Primate Social behaviour; Courtship; Territory; Co-operative hunting; Herbivores; Grazing	◆		◆	◆			◆				◆	◆	◆		◆	◆	◆

Table 2: Highlighted in Black are topics you might experience at your research site

Key: C = Cambridge. Pre-U, C.int = Camb. Int. CCEA = N. Ireland; Ed/Sal = Edexcel Salters, S= SQA ; Edex = EdExcel ; IB = International Bacc; AP=Advanced Placement (v. 20/11/14)

Topic	Environmental Science APES and ESS	IB ESS	APE S	UK Geography A Levels AQA, Edexcel, eduqas and OCR

Evolution, Classification and DNA	Evolution; Speciation; Species; Endemism; Gene pool; Allopatric; Sympatric; Isolation; Variation; Adaptive radiation Adaptation; Wallace; Darwin	◆		There has been a complete revision of UK Geography A levels. Although our expeditions are possibly not going to be as relevant to Geographers as they are to Biologists there are a significant number of topics covered by the various examination boards in which matching occurs with reference to: • human impact on ecosystems • ecosystems in general • biodiversity • sustainability • fair trade • work of NGOs • deforestation • GIS • carbon trading • climate change • case studies linked to biomes such as rainforests. All exam boards expect experience of field investigation techniques, statistical use and data manipulation which are very relevant to their experiences whilst on location at their expedition site. Almost all boards now require an independent investigation by students which fits really well with the present IRPs although the topic chosen must relate to their exam syllabus so topics such as the REDD scheme are possible choices. Their IRPs are between 3,000 and 4,000 words and should take up 4 days minimum to achieve. AQA have defined primary data as "Primary data is defined as unmanipulated data, either collected in the field or a raw dataset" which will work well with past data sets and the research data they help to collect when on their expedition. Specific detailed exam board matching is available on request.
	Classification; Taxonomy; Binomial system; Dichotomous Keys			
	PCR; Genome sequencing; Genetic fingerprinting; DNA profile			
Ecology and Ecosystems	Ecology; Habitat; Niche; Abiotic; Biotic	◆	◆	
	Biome; Ecosystems; Rainforests; Deserts; Coral reefs; Mangroves; Marine; Coasts; Hot arid; Semi-arid; Woodland Bush; Tropics; Tropical	◆	◆	
	Populations; Competition; Interspecific; Intraspecific; Predator Prey; density dependent; independent: Symbiosis	◆	◆	
	Succession; Climax community	◆		
	Biodiversity	◆	◆	
	Practical work; Field techniques; Ecological sampling; Random sampling; Transects; Capture, mark, release and recapture; Biodiversity indexes; Data handling and; presentation; Quadrats; Statistical testing; Measuring; GIS; Research tools	◆	◆	
	Written reports; Research project; Report; Case studies	◆	◆	
Agriculture, Human activities, Conservation and Sustainability	Sustainability	◆	◆	
	Agriculture; Agricultural impact; Agricultural exploitation; Cultivation crops; Food production; Sustainable agriculture; Sustainability; Forestry; Timber; Deforestation; Fisheries; Over fishing; Deforestation; Human management; Human effects; Human activities	◆	◆	
	Fair-Trade; Coffee; Rain Forest Alliance; Ecotourism; Tourism; Carbon trading; Greenhouse gas emission control (REDD)	◆		
	Indicator species; Pollution; Climate change; Global warming Carbon footprint; Fossil fuels	◆	◆	
	International conservation; Endangered species; Invasive species; Biological control; Pests; CITES; Ethical, Local; Global	◆		
	National Parks; Wildlife reserves			
	Environment; Environmental monitoring; Environmental impact; SSSI	◆		
Behaviour	Animal behaviour; Primate Social behaviour; Courtship; Territory; Co-operative hunting; Herbivores; Grazing			

Table 3: Highlighted in Black are topics you might experience at your research site
Key: IB ESS = Env Systems and Societies; APES = Advanced Placement Env. Science (v. 20/11/14)

Australia Specifications

Topic	Biology and Environmental Science	International IB		Australian State Education Authorities				
	Years 11 and 12	ESS	Bio	NSW	QSS	VCE	WA	SA
Evolution, Classification and DNA	Evolution; Speciation; Species; Endemism; Gene pool; Allopatric; Sympatric; Isolation; Variation; Adaptive radiation Adaptation; Wallace; Darwin		◆	◆	◆	◆	◆	◆
	Classification; Taxonomy; Binomial system; Dichotomous Keys	◆	◆		◆	◆	◆	◆
	PCR; Genome sequencing; Genetic fingerprinting; DNA profile		◆	◆	◆	◆		◆
Ecology and Ecosystems	Ecology; Habitat; Niche; Abiotic; Biotic	◆	◆	◆	◆	◆	◆	◆
	Biome; Ecosystems; Rainforests; Deserts; Coral reefs; Mangroves; Marine; Coasts; Hot arid; Semi-arid; Woodland Bush; Tropics; Tropical	◆	◆	◆	◆	◆	◆	◆
	Populations; Competition; Interspecific; Intraspecific; Predator Prey; density dependent; independent: Symbiosis	◆	◆	◆	◆	◆	◆	◆
	Succession; Climax community	◆	◆		◆		◆	◆
	Biodiversity	◆	◆	◆	◆	◆	◆	◆
	Practical work; Field techniques; Ecological sampling; Random sampling; Transects; Capture, mark, release and recapture; Biodiversity indexes; Data handling and; presentation; Quadrats; Statistical testing; Measuring; GIS; Research tools	◆	◆	◆	◆	◆	◆	◆
	Written reports; Research project; Report; Case studies	◆	◆	◆	◆	◆	◆	◆
Agriculture, Human activities, Conservation and Sustainability	Sustainability	◆	◆	◆	◆	◆	◆	◆
	Agriculture; Agricultural impact; Agricultural exploitation; Cultivation crops; Food production; Sustainable agriculture; Sustainability; Forestry; Timber; Deforestation; Fisheries; Over fishing; Deforestation; Human management; Human effects; Human activities	◆			◆	◆	◆	◆
	Fair-Trade; Coffee; Rain Forest Alliance; Ecotourism; Tourism; Carbon trading; Greenhouse gas emission control (REDD)	◆					◆	◆
	Indicator species; Pollution; Climate change; Global warming Carbon footprint; Fossil fuels	◆	◆	◆	◆	◆	◆	◆
	International conservation; Endangered species; Invasive species; Biological control; Pests; CITES; Ethical, Local; Global	◆	◆		◆	◆	◆	◆
	National Parks; Wildlife reserves	◆	◆		◆		◆	
	Environment; Environmental monitoring; Environmental impact; SSSI	◆	◆		◆		◆	◆
Behaviour	Animal behaviour; Primate Social behaviour; Courtship; Territory; Co-operative hunting; Herbivores; Grazing		◆			◆		◆

Table: Specification matching (but NOT all topics at all expedition sites)
Key:. Int. IB = International Bacc (2016); IB ESS = Env Systems and Societies (2017); QSS – Queensland Biology Senior Syllabus (2019); NSW – New South Wales (2018+); VCE – Victorian Curriculum Assessment Authority (2015 for 2016-20); WA – Western Australia (2017+), SA – South Australia (2020)

n.b The table above shows topic areas covered which a student might encounter when taking part in an Opwall Expedition. A number of exam syllabuses have been examined to see how relevant an Opwall expedition might be to support their learning in and out of the classroom. One of the strongest matches is the opportunity to undertake written reports or research projects. Although this does not include personal investigations which requires a student to collect their own primary data for analysis. They will be collecting data as part of established research projects and protocols and have access to data collected and past data sets.

Reading and Research Questions

In the last few years an increasing number of students joining our research programmes use the opportunity to undertake Independent Research Projects (IRPs). These research projects take many different forms, but what they all have in common is the need to pose and answer a research question. Examples of these include Extended Project Qualification (EPQ), Extended Essay (EE) for IB, as well as many different projects specific to various education systems worldwide.

We can support a selection of different topics for either essay-based research projects or data-led research projects that are tailored towards what the students will experience on site. It is a fantastic opportunity for students to witness first-hand many of the aspects of their research question and, in many cases, they will have access to samples of past datasets for their project. Students may also have the opportunity to talk with the actual scientists involved which will give them a convincing 'slant' to the way in which they answer their research question.

For success with IRPs, careful planning is needed by the student and a lot of the work will be done prior to their expedition. They will need close guidance from their school supervisor, and the scientists in the field need to be briefed so that support can be provided where possible. If you or your students are interested in undertaking a research project with us please contact schoolresearchprojects@opwall.com.

For more information visit the Opwall website - https://www.opwall.com/schools/educational-benefits/independent-research-project/

Useful Reading

- Malay Archipelago, Alfred Russell Wallace (1850) – Available in Kindle format from Amazon for £6-57. The whole text is also available online here: http://www.papuaweb.org/dlib/bk/wallace/cover.html
- Song of the Dodo, David Quammen (1997) - Best description of island biogeography
- A Naturalists Guide to the Tropics, Marco Lambertini (2000) - Best introduction to tropical forests
- Coates, Brian J. and Bishop, K. D. - A Guide to the Birds of Wallacea: Sulawesi, the Moluccas and Lesser Sunda (1997) - Best bird ID guide for Sulawesi and the surrounding islands, Indonesia
- de Lang, Ruud and Vogel, Gernot - The Snakes of Sulawesi: A Field Guide to the Snakes of Sulawesi with Identification Keys (2005)
- SAS Survival Guide Wiseman, J. (1999) Collins GEM - Best overall guide to field survival
- Robson, Stuart and Millie, Julian (2004) Instant Indonesian: Everything You Need to Speak Indonesian in 100 Key Words and Phrases.

Research Areas and Activities Being Carried Out in Indonesia:

- Examining the roles of NGOs and government in improving natural resource management in Indonesia.
- Bird point count surveys.
- Pollard walks for butterflies.
- Forest plot measurements to understand the role of disturbance.

- Influence of habitat structure on herpetofaunal assemblage composition on Buton Island. Night-time frog and reptile transects.
- Factors affecting bat assemblage composition in lowland forests of Indonesia.
- Density and distribution of Sulawesian megafauna.
- Bat netting: evening to set and empty mist nets.
- Assessing the impacts of tourism in the Wakatobi Marine Park, Indonesia.
- Supporting fisheries management policies in the Wakatobi
- Quantifying the resilience of marine dependent communities to climate change and resource depletion in Indonesia.
- Environmental impact and feeding habits of the Crown of thorns starfish *Acanthaster planci* in a low-density population in the Wakatobi, Indonesia.
- The importance of different coral growth forms for reef biodiversity in Indonesia.
- Physiological adaptations of the unique salt-water frog.
- The physical and biological structure of a light-limited coral reef.
- Environmental driven variations in reef architecture.
- Environmentally driven changes to the primary causes of coral mortality.
- Wakatobi Culture, Community and Environment.
- The sustainability of fisheries activities within the Wakatobi.
- The environmental impact of fish fences within the Wakatobi.
- Niche partitioning of Fiddler crabs in biodiverse and highly competitive environments in Indonesia.
- Mangrove habitats of the Wakatobi, Indonesia.
- Seagrass habitats of the Wakatobi.
- Ecology and behaviour of fiddler and sentinel crab populations.
- Sponge ecology and coral reef phase shifts in Indonesia.
- Competitive interactions between sponges and other reef organisms in Indonesia.
- The diversity, distribution and abundance of Nudibranchs in Indonesia.
- The role of territorial Damselfish in sculpturing coral reef biodiversity in Indonesia.
- Resource utilisation of reef fish across environmental gradients in Indonesia.
- The ecology of Anemonefish in Indonesia.
- The ecological impact of smothering sponge and ascidians on coral reefs in Indonesia.
- The behaviour and functional role of reef fish cleaners in Indonesia.
- The abundance and impact of coral bio-eroding invertebrates across environmental gradients in Indonesia.
- The ecology and biology of shallow subtidal patch reefs in Indonesia.
- Methods of reef assessment and the effect different survey techniques have on estimations of reef fish abundance and functional biomass in Indonesia.
- Conservation of herbivore biomass and functional biology of reef systems.
- Opwall Coral Reef monitoring programme underpinning scientific research - focus 2014 on Crown-of-thorns starfish.
- The eco-physiology of juvenile reef fish: preparing for future climate change.
- Are animals living in extreme environments the best equipped to deal with climate change?

- Thermal induced rapid coral mortality in Indonesia.