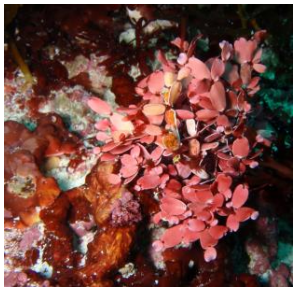
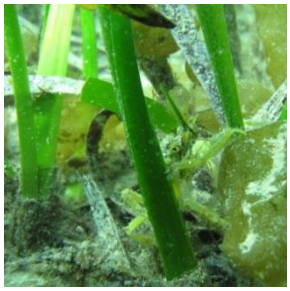
MARINE PROJECT PORTFOLIO
LEVELS 4 and 5

Projects suitable for:

HONOURS in MARINE SCIENCE
MASTERS in GEOSCIENCE
MASTERS in BIOLOGICAL SCIENCE
MASTERS in ENVIRONMENTAL SCIENCE
2021








The University of Western Australia
35 Stirling Highway
PERTH WA 6009

Marine Science, Marine Biology, Geoscience and Marine and Coastal Management at UWA

At UWA, a major in Marine Science is offered within the Bachelor of Science, taught across three Schools: the School of Biological Sciences, the School of Earth Sciences and the School of Agriculture and Environment. This is a three year degree with the possibility of a fourth, research focused year, Honours, for high performing students. There are two streams: Marine Biology and Marine and Coastal Processes, but with some overlap.

Students completing a major in Marine science may also choose a masters by coursework and dissertation degree which includes a research project identical to an honours project, but which also involves additional coursework units. Marine students can choose between the Master of Biological Science, with the Marine Biology specialization, the Master of Geoscience and the Master of Environmental Science with the Marine and Coastal Management specialization.

To be eligible for Honours or to do a research project within the Masters degree, student must attain an average of 65% over 4 core subjects at either Level 3 or 4. The availability of projects will depend very much on the areas in which staff are currently working and the funding they have available for research. Often, students are asked to join a research group and work on data already collected. Alternatively, students may be able to design their own project, set up the experiments and/or observations.

Students should seek a project well in advance of their start date. Research projects generally run over 1 year, so it is best to have your project settled before the year starts so you can hit the ground running on Day 1.

This booklet contains a list of potential projects for level 4 and 5 students available for 2021. It is important to realise that this list is not exhaustive; many of the projects are flexible and can be adjusted to your interests. We strongly suggest you use this booklet as a guide and contact potential supervisors to discuss the projects and your interests.

Use the provided projects to:
1) Gain an idea of the scope of appropriate projects
2) Be introduced to potential supervisors and their fields of study
3) Stimulate ideas about other similar projects that interest you

If you have further questions, please contact your Honours of Masters coordinators who are **Jane Prince** (jane.prince@uwa.edu.au) and Renae Hovey (renae.hovey@uwa.edu.au) for Marine Science Honours and the Master of Biological Science (Marine Biology), **Jeff Hansen** (jeff.hansen@uwa.edu.au) for Ocean and Coastal Processes projects and the Master of Geoscience or **Matthew Hipsey** (matt.hipsey@uwa.edu.au) for the Master of Environmental Science (Marine and Coastal Management).

RESEARCH PROJECTS AVAILABLE FOR MARINE STUDENTS IN 2021

A. Projects in Ocean and Coastal Processes

Project title	**Mass mortality of Exmouth Gulf's fringing reefs; timing, drivers, and future recovery**
Supervisors	Mick O'Leary, School of Earth Sciences, UWA Nicola Browne, School of Molecular Sciences Curtin University Joe Christensen, School of Humanities, UWA
Description	A low tide reconnaissance along the eastern shores of Cape Range have revealed an extensive fringing reef system comprising almost entirely of dead coral rubble. Given the areal extent of this reef structure, it is highly significant that this reef system is no longer ecologically functional, and the lack of reporting of a mass coral die-off along the eastern shores of Cape Range raises question around the timing of the event, what were the possible drivers of ecological decline (e.g., bleaching, cyclones, water quality), and if coral mortality occurred during a single event or if there was a gradual reduction in reef health. There are also questions as to why there has been no recovery of corals following the mass die-off. This project will attempt to answer these questions through a combination of surficial mapping, palaeoecological analysis, and radiometric dating of corals collected from boreholes that will be cored into the reef. In addition, the student has the potential to undertake historical research investigating the observed and written accounts of environmental change in Exmouth Gulf following the first charting of the region during early 19th century and accounts from the pearl divers and pastoralists which settled the region during the middle and late 19th century.
Start	Feb or July start
Requirements	Reef Coring; Drone Survey; U-Series Dating; Palaeoecology; Historical Research

Project title	**Drones for coral reef monitoring**
Supervisors	Dr Sharyn Hickey (sharyn.hickey@uwa.edu.au ; Dr Ben Radford (AIMS) (b.radford@aims.gov.au
Description	Increasing sea surface temperature (SST) is the single largest threat to coral reefs globally. Advancing remote sensing technological capabilities (e.g., drones) have the potential to provide relatively fine-scale information on a reef flat across a large spatial area. This project would utilise existing drone and infield data from the Rowley Shoals to model broadscale coral reef communities.
Start	Feb or July start
Requirements	Comfortable with big data, computer use, modelling

Project title	**Remotely monitoring mangroves**
Supervisors	Dr Sharyn Hickey (sharyn.hickey@uwa.edu.au ; Dr Ben Radford (AIMS) (b.radford@aims.gov.au
Description	Mangroves provide an opportunity for climate change mitigation and adaptation through their ability to store and sequester large quantities of carbon, and protect the coast from wave and storm surge, while sustaining fisheries through the provision of habitat. This project will utilise spatial modelling, cloud processing, and remote sensing techniques to develop a West Australian assessment of mangrove condition.
Start	Feb or July start
Requirements	on-line/remotely (potential for some fieldwork opportunity)

Project title	**Understanding the drivers of coastal morphodynamics in Western Australia using novel remote sensing techniques**
Supervisors	Jeff Hansen jeff.hansen@uwa.edu.au, Ryan Lowe ryan.lowe@uwa.edu.au
Description	The coastline of Western Australia (WA) is complex due to its geomorphology (e.g. many coral and rocky reef) and is exposed to a unique range of wave and water level conditions. For example, the south of the state is exposed to large waves and small tides with the opposite occurring in the north of the state. This project aims to develop a more detailed understanding of the coastal dynamics at a particular site or region of WA. Historical (1980s- to present) shorelines will be mapped using a combination of satellite imagery and aerial photography. The variability in the mapped shorelines over time will then be linked to records of waves and water levels to understand the primary drivers of coastal change. For example, during La Niña years, the Leeuwin Current is stronger than normal which causes sea levels to be elevated. Some existing research has suggested the elevated sea level associated with La Niña conditions results in additional beach erosion- but this link needs to be further explored at additional locations. A greater understanding of how the coastline responds to variations in sea level and waves will increase our ability to manage the coast and mitigate the effects of climate change.
Start	Flexible
Requirements	Comfortable with computer analysis

Project title	**Measuring the variability of the southwestern Australian coastline from oblique aerial imagery**
Supervisors	Jeff Hansen (jeff.hansen@uwa.edu.au), Michael Cuttler, (michael.cuttler@uwa.edu.au)
Description	The Western Australian coastline is well known to exhibit seasonal variability in morphology. For example, WA beaches are typically wider in summer and narrower in winter. Typical methods for surveying beach morphology require accessing the beach at multiple times throughout the year. However, WA is one of the most remote and rugged coastlines globally. Thus, there are vast stretches of coastline that have limited access which limit the applicability of typical survey methods. Recently, advancement in photogrammetry techniques have allowed aerial photography to be exploited for

	measuring coastal morphology with cm-scale accuracy. These advancements now provide an opportunity for measuring stretches of coastline previously unmeasurable with typical surveying techniques. UWA has partnered with the Peron-Naturaliste Partnership to capture oblique aerial imagery of the southwestern Australian coastline, from Rockingham to Cape Naturaliste. This project will employ photogrammetry techniques and 4 years of bi-annual oblique aerial photographs to measure coastal morphological change along 250 km of coastline. This large-scale analysis will identify erosion/accretion 'hot spots' and provide value insight into the interannual variability of this coastline.
Start	Flexible
Requirements	Comfortable with computer analysis

Project title	**Quantifying coastal morphodynamics through community-sourced imagery**
Supervisors	Jeff Hansen (jeff.hansen@uwa.edu.au), Michael Cuttler, (michael.cuttler@uwa.edu.au)
Description	With the proliferation of smart phones and social media, capturing and sharing images of the coast has never been easier. A new coastal monitoring program, CoastSnap, has recently been created to analyse community-sourced imagery to provide quantitative data on coastal morphology. CoastSnap was recently established at nine sites along WA's south west (between Rockingham and Busselton, see facebook.com/coastsnapwa). This project will involve analysing the imagery from each of the new CoastSnap WA sites to examine a range of coastal dynamics questions (e.g. magnitude of shoreline change) and social science questions (e.g. who is taking photos, what social media platform is the photo from, etc.).
Start	Flexible
Requirements	Comfortable with computer analysis

Project title	**Wave runup and rock fisher safety along the Great Southern coastline**
Supervisors	Jeff Hansen (jeff.hansen@uwa.edu.au), Michael Cuttler, (michael.cuttler@uwa.edu.au)
Description	The Great Southern region of WA is renowned for its rugged coastline, with common tourist attractions included locations such as 'The Gap and Natural Bridge'. A popular activity amongst locals and visitors to the Great Southern is rock fishing. However, this activity puts fishers in direct contact with the large Southern Ocean swells that are prolific along this coastline. When these large waves break, they cause up-rushes of water (wave runup) that surge over the rock platforms where fishers are located. In the worst cases, anglers can be knocked over, pulled into the sea, and drown. Furthermore, the remoteness of the Great Southern means that most common fishing spots are unpatrolled by lifesavers. Thus, there is a need to better understand the physical processes that drive wave runup along this coastline. This project will use video imagery collected at Salmon Holes (near Albany, WA) to develop a quantitative understanding of wave runup at rocky coastlines that will contribute to the development of a warning system for assessing rock fishing risk.

Start	Flexible
Requirements	Ability to go into the field

Project title	**Ocean drifters off Western Australia**
Supervisors	Prof C Pattiaratchi; chari.pattiaratchi@uwa.edu.au
Description	The Coastal Oceanography have deployed more than 50 surface current drifters along the West Australian coast over the past 12 months. Ocean drifters have a GPS locator that transmits their location every 5 minutes and from this information, we can track the paths of the drifters and calculate velocities. Surface drift patterns are used to define ocean circulation at the surface and used to define pathways of buoyant material such as plastics. The student(s) will be able to use selected ocean drifter data to identify and document different flow features in the surface ocean such as eddies and fronts.
Start	Feb or July start
Requirements	Computer literate

Project title	**Analysing fluorescence quenching in ocean glider data**
Supervisors	Prof C Pattiaratchi; chari.pattiaratchi@uwa.edu.au Dr Paul Thomson; paul.thomson@uwa.edu.au
Description	Measurements of chlorophyll as a proxy for phytoplankton biomass uses optical methods such as fluorescence sensors. Here, the sensors emit a light signal in a particular frequency that stimulates the phytoplankton to emit a light signal at a different frequency. Fluorescence quenching occurs when strong sunlight affect the light signals. This results in a diurnal signal in fluorescence and therefore in chlorophyll that is not correct. This project will use data collected from ocean gliders to develop and implement a methodology to correct the fluorescence quenching.
Start	Feb or July start
Requirements	Computer literate

Project title	**Analysing underwater light climate in Western Australia**
Supervisors	Prof C Pattiaratchi; chari.pattiaratchi@uwa.edu.au Dr Paul Thomson; paul.thomson@uwa.edu.au
Description	Underwater light is a critical parameter for primary productivity in the water column. In Western Australia, due to an absence of large sediment input from land we have very clear water that penetrate to water depths > 150 m. An almost a decade of underwater light data from ocean glider deployments that will allow for the definition of the light climate at seasonal and inter-annual time scales as well as examining the impacts of different events such as storms, marine heat waves and cold water episodes.
Start	Feb or July start
Requirements	Computer literate

Project title	**A climatology of sea breezes in south west Australia**
Supervisors	Prof C Pattiaratchi; chari.pattiaratchi@uwa.edu.au Dr Jatin Sala; J.Kala@murdoch.edu.au
Description	Sea breezes or the 'Fremantle Doctor' dominates the weather conditions along south-west Australia. It also has a strong influence on the oceanography. This project will analyse a long-term (~30 years) simulation of winds along the WA coast to determine the exact nature of the sea breeze and year-to-year changes.
Start	Feb or July start
Requirements	Computer literate

Project title	**Physical and biological oceanography of the Perth canyon**
Supervisors	Prof C Pattiaratchi; chari.pattiaratchi@uwa.edu.au Dr Paul Thomson; paul.thomson@uwa.edu.au
Description	Perth Canyon, located to the west of Rottnest Island is the largest undersea topographic feature along the WA coast and one of the most productive. Over the last 2 decades a large amount of data on physical and biological oceanography have been collected from different cruises, ocean gliders and oceanographic moorings. This project will analyse data to determine the links between physical processes, nutrients and biological production within the canyon.
Start	Feb or July start
Requirements	Computer literate

B. Projects in Marine Biology

MARINE ECOLOGY GROUP – FISHERIES RESEARCH

Project title	**Using fishers' Local Ecological Knowledge to understand Western Australia's marine systems**
Supervisors	Dr Tim Langlois (tim.langlois@uwa.edu.au) Dr Matt Navarro (matthew.navarro@uwa.edu.au)
Description	Recreational and commercial fishers possess an abundance of untapped knowledge about marine environments. Recognising and incorporating this knowledge into management can address critical scientific knowledge gaps and has been shown to increase acceptance of management. In this project, you will work with commercial and recreational fishers, conducting workshops to document knowledge about marine ecosystems in Western Australia. You will also work to validate this knowledge against scientific understanding.
Start	Feb start
Requirements	Outgoing personality, excellent communication skills

Project title	**Monitoring recruitment habitats of the western rock lobster**
Supervisors	Dr Tim Langlois, tim.langlois@uwa.edu.au Dr Anita Giraldo anita.giraldoospina@uwa.edu.au Dr Simon de Lestang Simon.deLestang@fish.wa.gov.au Dr Jason How jason.how@fish.wa.gov.au
Description	What are the habitat requirements of juvenile western rock lobster? The western rock lobster fishery is the highest value single species fishery in Australia, worth over $500 Million per annum. An important metric used by fisheries scientists to monitor the health of this resource is the abundance of post-larvae (puerulus) that recruit along the coast of WA. We have a project to evaluate patterns in settlement, recruitment and habitat change that occurred after the 2010/2011 marine heatwave. This project will include a large amount of time on the water using novel methods to surveys shallow water habitats where juvenile lobster are found.
Start	
Requirements	Experience on boats would be beneficial

Project title	**Inferring environmental change through cross shore and long-shore abundance distribution pattern in macroinvertebrate assemblages associated with western rock lobster puerulus collectors**
Supervisors	Dr Tim Langlois, (tim.langlois@uwa.edu.au) Dr Jane Prince (jane.prince@uwa.edu.au) Dr Simon de Lestang (Simon.deLestang@fish.wa.gov.au) Dr Jason How (jason.how@fish.wa.gov.au)
Description	The western rock lobster fishery is the highest value single species fishery in Australia, worth over $500 Million per annum. An important metric used by fisheries scientists to

	monitor the health of this resource is the abundance of post-larvae (puerulus) that recruit each year to artificial collectors located along the coast of WA. In 2008 the historic settlement pattern of puerulus changed, with settlement occurring at lower numbers, further north, and in later months each settlement season. In addition to puerulus, the collectors also collect samples of a wide range of macroinvertebrate species. We have a project to evaluate patterns in the abundance distribution of the macroinvertebrates, investigate how these patterns may relate to puerulus counts and develop additional indicators based on species of macroinvertebrates that typically occur simultaneous to western rock lobster puerulus.
Start	Any
Requirements	

Project title	**Fertilization ecology and implications of sperm limitation in the western rock lobster**
Supervisors	Dr Tim Langlois, tim.langlois@uwa.edu.au Prof Leigh Simmons leigh.simmons@uwa.edu.au
Description	The western rock lobster fishery is the highest value single species fishery in Australia, worth over $400 Million per annum. Very little is known about the occurrence of sperm limitation for the fertilization ecology of western rock lobster, however it is assumed that the selective removal of larger males from the fishery could result in the occurrence of sperm limitation.This study will involve conducting mating trials to establish the mechanics of fertilization within western rock lobster. In addition, both laboratory and field investigations will be used to investigate the relationship between sperm abundance and spermatophore size, using methods to count sperm isolated from spermatophores and relate this data to field surveys of spermatophore size across areas of the fishery with contrasting adult body-size distribution.
Start	Any
Requirements	

Project title	**Monitoring highly targeted mesophotic fish populations: optimising stereo-video monitoring of large offshore no-take marine reserves**
Supervisors	Dr Tim Langlois, tim.langlois@uwa.edu.au Dr. Matt Navarro matthew.navarro@uwa.edu.au Dr. Jacquomo Monk jacquomo.monk@utas.edu.au
Description	Large offshore no-take marine reserves have recently been created around Australia and New Zealand. This project will involve field work to collect baited remote stereo-video samples within no-take areas within the Ningaloo and South-west Capes region. Existing data sets will be provided from New Zealand. This project will use novel methods of power analysis to design optimal future monitoring plans to detect differences in highly targeted mesophotic grouper populations (e.g. hāpuku Polyprion oxygeneios) that may occur after the cessation of fishing. The student will develop skills in field work and novel statistical analyses applicable to marine park monitoring design.
Start	Any
Requirements	

Project title	**Designing recreational fishing policies using representative fisher preferences**
Supervisors	Dr Matt Navarro, matthew.navarro@uwa.edu.au Dr Tim Langlois tim.langlois@uwa.edu.au Dr Dave Fairclough David.Fairclough@fish.wa.gov.au
Description	Whilst recreational fishing policies are designed to meet biological based management objectives, fishers preferences are also incorporated into these decisions. At present there is a lack of transparency about how these preferences are measured and accounted for. This study will test the use of an economic technique known as choice experiments to measure fishers' preferences for suites of management interventions including bag limits, seasonal closures and size limits and attempt to combine these preferences with biological based management strategy evaluations to generate recommendations for policy interventions.
Start	Any
Requirements	

Project title	**Spatial usage of the Australian Marine Parks network**
Supervisors	Dr Matt Navarro, matthew.navarro@uwa.edu.au Dr Tim Langlois tim.langlois@uwa.edu.au Dr. Jacquomo Monk jacquomo.monk@utas.edu.au
Description	In 2019 44 new marine parks were implemented in offshore commonwealth waters around Australia as part of the Australian Marine Parks network. At present little is known about how boat based fishers and non-fishing recreators are using these areas. This project will analyse existing data and collect new data on spatial usage patterns at boat ramps adjacent to 13 of these new marine parks. These usage patterns will form baselines in Parks Australia's social and economic monitoring program and inform the planned 10 year review of the marine parks zoning.
Start	Any
Requirements	

Project title	**Developing Sea Country management protocols through combining traditional ecological knowledge of Indigenous Australians and Western Science.**
Supervisors	Harriet Davies harriet.davies@uwa.edu.au Dr Tim Langlois tim.langlois@uwa.edu.au
Description	Indigenous Australians have a profound connection to nature and a cultural obligation to take care of Country. As a result, Indigenous people have been sustainably managing their marine estates for millennia. There is an increasing interest in documenting and embedding traditional knowledge into marine management and monitoring yet little work has been done in developing methods and protocols to achieve these goals. This project will build upon participatory mapping methods to document knowledge of senior knowledge holders to help inform marine park and fisheries management in Western Australia.
Start	Any
Requirements	

Project title	**Investigating the economic impacts of no-take marine reserve establishment**
Supervisors	Dr Matt Navarro, matthew.navarro@uwa.edu.au Dr Tim Langlois tim.langlois@uwa.edu.au
Description	The impact of no-take marine reserves creation on local economies is the subject of much debate. Fisheries interest groups often claim these management actions have negative economic impacts due to impacts on fishing whilst some scientists have claimed benefits for local economies due to increased tourism. This study will use existing long term data from the ABS and Tourism Research Australia along with beyond BACI experimental designs to determine the impact the establishment no-take marine reserves in Australia have had on local economies.
Start	Any
Requirements	

MARINE MEGAFAUNA

Project title	**Complementary mapping of Shark Bay using footage obtained from underwater video cameras mounted on sea turtles**
Supervisors	Dr Ana Sequeira (ana.sequeira@uwa.edu.au) and Dr Takahiro Shimada (takahiro.shimada@uwa.edu.au)
Description	The mains aims are to 1) reveal habitats in Shark Bay where sea turtles engage in a variety of activities (e.g. feeding, travelling, resting), and 2) relate each activity type with relevant environmental variables (e.g. depth, cover type, presence of structure, temperature). The results will help us identify areas of conservation importance and understand how their activities are related with habitat properties.
Start	February
Requirements	

SEAGRASS RESEARCH (https://www.seagrassresearch.net/)

Project title	**Optimise sporophyte density of *Asparagopsis taxiformis* to enhance seeding onto cultivation string**
Supervisors	Dr John Statton (john.statton@uwa.edu.au) Prof Gary Kendrick (gary.kendrick@uwa.edu.au)
Description	Seaweed is one of the most attractive emerging aquaculture industries Australia-wide. The Red Seaweed, *Asparagopsis taxiformis*, when fed to cattle in small quantities, can mitigate harmful methane emissions from the livestock industry by up to 98%. Asparagopsis could become the 'wheat crop' of Australia's oceans, and is on track to be grown and processed here in Australia. This project will determine the density that optimises attachment, survivability and growth of sporophytes prior to transfer to grow-out trials. This project will be based at the Watermans Bay Marine Research Facility (30 minutes north of UWA crawley campus), successful candidates need to be part-time located at this facility to undertake the research trials.
Start	Feb start
Requirements	Snorkelling, strongly lab-based project, desire to learn about aquaculture techniques and seaweed.

Project title	**Optimising sporophyte growth for commercialisation of the methane mitigating seaweed, *Asparagopsis taxiformis***
Supervisors	Dr John Statton (john.statton@uwa.edu.au) Prof Gary Kendrick (gary.kendrick@uwa.edu.au)
Description	Seaweed is one of the most attractive emerging aquaculture industries Australia-wide. The Red Seaweed, *Asparagopsis taxiformis*, when fed to cattle in small quantities, can mitigate harmful methane emissions from the livestock industry by up to 98%. Asparagopsis could become the 'wheat crop' of Australia's oceans, and is on track to be grown and processed here in Australia. This project will focus on optimising cultivation techniques to produce high quality seed stock for Western Australian conditions. This project is aquaculture focussed and will use dose:response testing of environmental variables (light, nutrients) to optimise this life stage. This project will be based at the Watermans Bay Marine Research Facility (30 minutes north of UWA crawley campus), successful candidates need to be part-time located at this facility to undertake the research trials.
Start	Feb start
Requirements	Snorkelling, strongly lab-based project, desire to learn about aquaculture techniques and seaweed.

Project title	**Enhance gametophyte fecundity of *Asparagopsis taxiformis* for aquaculture**
Supervisors	Dr John Statton (john.statton@uwa.edu.au) Prof Gary Kendrick (gary.kendrick@uwa.edu.au)
Description	Seaweed is one of the most attractive emerging aquaculture industries Australia-wide. The Red Seaweed, *Asparagopsis taxiformis*, when fed to cattle in small quantities, can mitigate harmful methane emissions from the livestock industry by up to 98%. Asparagopsis could become the 'wheat crop' of Australia's oceans, and is on track to be grown and processed here in Australia. This project aims to enhance fecundity of gametophytes by testing dose:response relationships of environmental conditions (nutrients x light x temperature). Enhanced fecundity of gametophytes is a necessary pathway to developing the commercialisation potential of this seaweed species. This project will be based at the Watermans Bay Marine Research Facility (30 minutes north of UWA crawley campus), successful candidates need to be part-time located at this facility to undertake the research trials.
Start	July start
Requirements	Snorkelling, strongly lab-based project, desire to learn about aquaculture techniques and seaweed.

Project title	**Saving seagrass from climate change**
Supervisors	Prof Gary Kendrick (gary.kendrick@uwa.edu.au) Dr Elizabeth Sinclair (elizabeth.sinclair@uwa.edu.au)

Description	This project will address fitness in Posidonia seagrass meadows and how it can be improved through inter-population genetic connectivity. This research will target range edge seagrass meadows, with a focus on the World Heritage site Shark Bay. There are several opportunities to develop projects around genomic diversity and genetic regulation of flowering and testing outcrossing in range edge populations.
Start	February
Requirements	Snorkelling, driving (2WD essential, 4WD desirable)

WERNBERG LAB (https://wernberglab.org/)

Project title	**Tracking coral growth in the temperate WA**
Supervisors	Dr. Thomas Wernberg-thomas.wernberg@uwa.edu.au, Dr. Karen Filbee-Dexter-karen.dexter@uwa.edu.au, Defne Sahin-aysedefne.sahin@research.uwa.edu.au
Description	Temperature is a significant driver controlling many biological processes, such as skeletal growth in scleractinian corals. This process can be altered by extreme climatic events (i.e. marine heatwaves, cold spells), which are happening ever more frequent and lasting longer. This project will use the density banding in coral skeletons to assess changes in growth under current conditions and recent disturbances. As this will involve coral collection, diving skills would be helpful to have (but not essential). This project will improve our understanding of how these corals might be expanding their ranges poleward in the temperate reefs as a consequence of anthropogenic climate change.
Start	Feb or July start, Feb preferred
Requirements	Diving, driving (2WD/4WD)

Project title	**Export of blue carbon from kelp forests to deep marine sinks**
Supervisors	Dr. Thomas Wernberg-thomas.wernberg@uwa.edu.au, Dr. Karen Filbee-Dexter-karen.dexter@uwa.edu.au,
Description	One approach to combat climate change is to increase carbon storages and sinks. Recent research suggests that large seaweed forests may sequester substantial amounts of carbon in the deep sea. Key unknowns remain about the fate of this carbon once it leaves the shallow reefs; especially how much is transported across the shelf and reaches deep marine sediments. This project will use an underwater camera system to track kelp detritus moving from shallow reefs (<20 m) to deeper areas (20 - 100 m) off Western Australia. Laboratory flume trials will be used to measure deposition and resuspension thresholds of different types of kelp detritus, which are essential to predict movement along the seafloor. This research should help assess the carbon storage potential of kelp forests. The project will involve work in the field and the lab. A background in field ecology and/or oceanography would be helpful but not essential.
Start	Feb or July start, Feb preferred
Requirements	Diving, driving (2WD/4WD)

Project title	**Developing a novel restoration tool for threatened kelp forests**
Supervisors	Dr. Thomas Wernberg-thomas.wernberg@uwa.edu.au, Dr. Karen Filbee-Dexter-karen.dexter@uwa.edu.au,
Description	Human-driven impacts on our oceans are intensifying and there is urgent need for novel solutions to combat habitat loss and promote resilience in marine ecosystems. In warmer margins of their range kelp forests are being replaced by algal turfs. This project will help develop and test a novel restoration tool 'green gravel' and evaluate its ability to restore kelp forests in Australia. Green gravel involves seeding kelp spores onto pebbles, where they grow into small sporophytes that can be scattered across an impacted area. This tool could be effective at overcoming reinforcing feedbacks (propagule and recruitment limitation) that prevent recovery of kelp forests after shifts to turf. This is a collaborative project between UWA and the NSW Department of Primary Industries. This project can be field based or laboratory based. There are also opportunities for this project to include social-ecological research and science communication, such as engaging with communities to evaluate and test this restoration tool.
Start	Feb or July start, Feb preferred
Requirements	Diving, driving (2WD/4WD)

Project title	**Thresholds for kelp forest loss and turf expansion**
Supervisors	Dr. Thomas Wernberg-thomas.wernberg@uwa.edu.au,
Description	Pervasive habitat deterioration and destruction presents one of the biggest threats to species and global ecological function. There has been an accelerating loss kelp forests globally, and an associated rise and persistence of degraded seascapes of sediment-laden algal 'turfs'. This project will conduct field and aquarium experiments on kelp and turf dynamics across different environments to identify thresholds for collapse and mechanisms for recovery. Advances here will improve how we understand the stability of these marine habitats, and the reversibility of sudden changes in the context of ongoing climate change. This is a collaborative project between UWA and the NSW Department of Primary Industries. This project can be field based (SCUBA) and/or laboratory based (Aquarium experiments).
Start	Feb or July start, Feb preferred
Requirements	Diving, driving (2WD/4WD)

Project title	**Using strong genotypes to boost resistance or restore threatened kelp forests**
Supervisors	Dr. Thomas Wernberg-thomas.wernberg@uwa.edu.au,

Description	Research on marine habitat loss has mainly focused on negative impacts and declining performance of foundation species, and the effectiveness of passive strategies for recovery (e.g. marine reserves). Instead, an innovative approach targets individuals and areas that perform well under stress ('bright spots') to discover mechanisms, traits and active interventions that promote persistence. This project will use cutting edge genetic analyses to identify strong genotypes in natural 'bright spots' where surviving kelps have resisted or adapted to degraded conditions. This will provide a foundation to develop innovative proactive restoration and conservation solutions to breed resistance or promote recovery of degraded systems. This is a collaborative project between UWA and the NSW Department of Primary Industries.
Start	Feb or July start, Feb preferred
Requirements	Diving, driving (2WD/4WD)

BEHAVIOURAL ECOLOGY

Project title	**Camouflage patterns in pelagic predators**
Supervisors	Jennifer Kelley: (jennifer.kelley@uwa.edu.au) Jan Hemmi: (jan.hemmi@uwa.edu.au)
Description	Sharks and other pelagic predators rely on camouflaging colouration to avoid being detected by their prey. One of the commonest types of camouflage pattern is countershading, where the upper body surface is darker than the underside. This form of patterning is thought to counteract the effect of overhead lighting and a 3D body shape. This project will use virtual animation platforms such as Unity™ and Blender™ to explore the relationship between predator body shapes, virtual lighting conditions, and optimal camouflage patterns. The modelling outcomes will be compared to the known camouflage patterns and habitats of oceanic predators using a phylogenetic framework.
Start	Feb or July start
Requirements	A strong interest in 3D modelling and animation. Strong analytical skills using platforms such R, Matlab.

Project title	**Decision-making and predator evasion in wild damselfish shoals**
Supervisors	Jennifer Kelley: jennifer.kelley@uwa.edu.au Jan Hemmi: jan.hemmi@uwa.edu.au
Description	One of the main advantages of group living is a reduction in the risk of predation due to effects such as risk dilution and predator confusion. As a result, animals in smaller groups tend to display stronger antipredator responses than those in larger groups. However, defensive strategies also depend on other factors, such as nearest-neighbour distance and the distance to shelter. This project will investigate how shoals of wild damselfish respond to a looming visual threat (computer-simulated object approach) depending on the social organisation (e.g. distance and orientation of nearest-neighbour) and the size of the shoal.
Start	July (note that this project requires animal ethics approval)
Requirements	Snorkelling. Strong analytical skills (e.g. Matlab, R).

Project title	**Gamete-level chemical signalling in the sea**
Supervisors	Prof. Jon Evans (Jonathan.evans@uwa.edu.au) Dr. Jason Kennington (Jason.kennington@uwa.edu.au) Collaborators: A/Prof. Xavier Conlan; Dr Craig Sherman; Mr Jake Penny (Deakin University, Vic.); Dr Rowan Lymbery (UWA).
Description	This project will seek to understand how female mussels (*Mytilus galloprovincialis*) differentially attract sperm from different males via the chemical signals emitted from their eggs. The project will build on preliminary data collected in collaboration with colleagues at Deakin University that explores how different chemical fractions of the female's egg water influence the way that sperm swim towards eggs (sperm chemotaxis). The student will gain practical experience in mussel spawning, computer-assisted sperm analyses, experimental design and a chemistry component that will be commensurate with the experience and interests of the student. The chemistry component will be well supported by our Deakin colleagues.
Start	Feb or July start: The start date for this project is negotiable, as mussels commence spawning in late May and typically finish in late September. A student might therefore commence in either semester, although it is recommended that students who choose semester 2 commence practical work earlier than the scheduled start.
Requirements	Snorkelling, diving, driving (2WD/4WD): No special requirements.

Project title	**Egg competition in a broadcast spawning marine invertebrate**
Supervisors	Prof. Jon Evans (Jonathan.evans@uwa.edu.au) Dr. Jason Kennington (Jason.kennington@uwa.edu.au) Ms Jessica Hadlow (Jessica.hadlow@uwa.edu.au)
Description	When we think about sexual selection, and particularly competition among gametes from different individuals for fertilization opportunities, we rarely if ever think about 'egg competition'. Yet both theory and empirical data strongly support the idea that egg competition should be a pervasive evolutionary force in the sea, where gametes from both sexes are often limiting and eggs may need to compete to ensure that they are fertilized. This project is designed to fill a critical gap in our knowledge of sexual selection in marine invertebrates, many of which exhibit the ancestral mating strategy of broadcast spawning (releasing both sperm and eggs for external fertilization). The results from this study, performed on the mussel *Mytilus galloprovincialis* will therefore also have far-reaching implications for sexual selection in more 'familiar' mating systems, where most studies of gamete ('sperm') competition have focused.
Start	Feb or July start: The start date for this project is negotiable, as mussels commence spawning in late May and typically finish in late September. A student might therefore commence in either semester, although it is recommended that students who choose semester 2 commence practical work earlier than the scheduled start.
Requirements	Snorkelling, diving, driving (2WD/4WD): No special requirements.

POPULATION GENETICS

Project title	**Assessing stock structure in nearshore and estuarine finfish.**
Supervisors	Dr Jason Kennington (jason.kennington@uwa.edu.au) and Dr Rodney Diffy (DPIRD).
Description	The catch of nearshore and estuarine finfish from commercial and recreational fisheries in Western Australia is composed of many different species from distinct populations and sub-populations. Management of these stocks, and the definition of what constitutes a stock, is based on information related to movement, biology and existing fisheries management practices. Traditionally, a number of different techniques have been used to identify stocks, from tagging studies to determine movement and mixing, to various genetic methods. Whilst effective, these methods can prove costly and time consuming, and can lack fine scale resolution. Often these investigations have focussed on species of high value or high abundance caught within a single, or small number of fisheries. Species that are caught by many fisheries, but that don't dominate the catch of any, have been forgotten, despite the overall catch of these species being significant. To address this shortfall, we are interested in understanding stock structure of three finfish species: sea mullet (*Mugil cephalus*), yelloweye mullet (*Aldrichetta forsteri*) and tailor (*Pomatomus saltatrix)* using modern, cost effective techniques (SNPs), that offer fine scale resolution to understand stock structure. The outcome of this work will be of direct relevance to fisheries management within Western Australia.
Start	February
Requirements	

INTERTIDAL ECOLOGY

Project title	**Geographical variation in the ecology and morphology of gastropod molluscs:**
Supervisors	Dr Jane Prince (jane.prince@uwa.edu.au), Matilda Murley (matilda.murley@research .uwa.edu.au)
Description	Some species of molluscs have an extensive distribution down along the western coast of Western Australia spanning from the Kimberley to the Capes crossing recognised biogeographic regions. Each species could be the topic of a research project. These projects aim to investigate the morphological and ecological characteristics of these species at various points along the coast, looking for natural transitions. Tissue samples will be collected for DNA analysis either in these projects or at a later stage.
Start	Feb start
Requirements	Driving (2WD essential, 4WD desirable), multivariate statistics and the use of other specialist software. This project will require one extended trip to the Kimberley and Pilbara in June 2021 and numerous trips closer to home in spring/summer 2021/2022

Project title	**The effect of sampling method on the interpretation of field surveys: implications for citizen science.**
Supervisors	Dr Jane Prince (jane.prince@uwa.edu.au), Matilda Murley (matilda.murley@research .uwa.edu.au)
Description	Quadrat sampling to determine the assemblage structure of intertidal invertebrates is a time consuming process that requires considerable expertise. This makes it unsuitable for citizen science projects where participants may be unskilled or have limited time. This project will firstly re-examine data collected over four years by indigenous rangers in the Kimberley to see how different methods of scoring the invertebrates in the quadrats affects the outcome and interpretation of the analysis. The second phase will involve field trials of different methods to gauge efficiency
Start	Feb start
Requirements	Driving (2WD essential, 4WD desirable), multivariate statistics and the use of other specialist software. Must be comfortable with computers and willing to "play" with data. This project will require one extended trip to the Kimberley and Pilbara in June 2021 and at least one trip closer to home in spring/summer 2021/2022

SEA AROUND US – INDIAN OCEAN NODE (http://www.seaaroundus.org/)

Project title	**Using satellite-data from the Global Fishing Watch to infer likely catches by foreign fleets inside EEZs and on the High Seas in the India Ocean**
Supervisors	Dirk Zeller dirk.zeller@uwa.edu.au Gabe Vianna gabriel.vianna@uwa.edu.au Jessica Meeuwig jessica.meeuwig@uwa.edu.au
Description	Recent technological advances in remote monitoring technology are increasingly being used to assist broad-scale marine conservation and fisheries management objectives. These technologies are particularly useful for fisheries monitoring in low-income regions and on the High Seas, where the lack of resources for adequate monitoring and surveillance and the vast extents of ocean make it difficult to keep track of fishing activity. To address this issue, the Global Fishing Watch initiative has developed a fisheries monitoring tool that enable the estimate of fishing effort by registered commercial fishing vessels anywhere in the world. The proposed project will adopt a novel approach to expand the use of this tool by combining the *Sea Around Us* fisheries catch reconstructed data with the Global Fishing Watch fishing effort dataset to generate estimates of foreign fishing catches within EEZs of low-income countries and on the High Seas in the Indian Ocean region. Thus, despite potentially high uncertainty, this project will generate urgently needed estimates on foreign and distant-water fisheries, which are hard to monitor, to enable national and regional decision-makers to better manage fisheries. This research does not involve field-based data collection, as we emphasize the utility of pre-existing databases and data sets. Students are expected to have R programming skills, exercise use of their critical thinking skills, be self-driven and have curiosity about fisheries data science. Good and collegial communication, networking and collaborative skills are also required, as this

	project form part of the *Sea Around Us'* international collaboration with the Global Fishing Watch initiative.
Start	Feb or July start
Requirements	Good basic skills with Excel (including Pivot Table) Good R-programing skills Good literature searching skills Willingness to read extensively Ability to digest a wide diversity of reading material

Project title	**Reconstructing the marine fisheries catches for the Mascarene Islands Marine Ecoregion entities (Reunion Island and Mauritius)**
Supervisors	Dirk Zeller dirk.zeller@uwa.edu.au Gabe Vianna gabriel.vianna@uwa.edu.au Jessica Meeuwig jessica.meeuwig@uwa.edu.au
Description	The science and policy of Tanzania's marine fisheries are currently impacted by foreign industrial fisheries, much of it illegal. However, most of this country's marine food security, coastal livelihoods and local economic benefits are derived from small-scale, coastal fisheries. These fisheries, however, are heavily under-valued and under-represented in fisheries science and policy at the national and regional level, as they are often dominated by marginalized small-scale fisheries that do not feature adequately or accurately in national data used for decision making. The issue is exacerbated in modern-day Tanzania by the former split into two separate countries decades ago (mainland Tanganyika and the Zanzibar Islands) which continues to lead to marine fisheries data and management issues for Tanzania. As part of the international *Sea Around Us - Indian Ocean* research initiative (www.seaaroundus-io.org), the student will engage in a country-level fisheries data science project to improve and update the globally available data on marine fisheries catches and fishing effort of Tanzania's fisheries within their national waters. This research does not involve field-based data collection, as we emphasize the utility of pre-existing databases and data sets for enhancement through data gap assessments and large-scale meta-analyses. This is strongly augmented through collaborations with in-country experts. An open and keen mind, diplomatic demeanour (sensitivities due the colonial past remain), critical thinking skills, self-drive and a curiosity about fisheries data science is crucial. While not crucial, if you also have some R programming skills …. all the better.
Start	Feb or July start
Requirements	Good basic skills with Excel (including Pivot Table) Good literature searching skills Willingness to read extensively Ability to digest a wide diversity of reading material