MAY 2024

RESEARCH
Highlights

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Better science **Better decisions**

Ship safety helping Sound's noise research

A safety system that tracks ships and helps prevent collisions is being used as part of a study of noise levels in Cockburn Sound and their potential impact on marine life.

Cristina Tollefsen from Curtin University said researchers were using ship location information from the worldwide Automatic Identification System along with data from recorders on the seabed.

At the start of the project, researchers placed recorders with hydrophones (underwater microphones) at nine locations in and around the Sound.

"AIS gives us details of ships and their location which means we can attribute portions of the recording to certain vessel types," Dr Tollefsen said.

"Because we can combine this information with data from the recorders, we have been able to measure the sound levels of all the different vessel classes from tugboats and the pilot vessel to the massive bulk carrier ships," Dr Tollefsen said.

"Port activities require more than one vessel typically, so we wanted to capture a set of activities including the pilot boats meeting larger ships as they arrive and the tug boats assisting ships as they come into port.

"It's less common in research to measure the combined noises but that is much more realistic."

Dr Tollefsen, who is working on the project for the WAMSI Westport Marine Science Program, said there was growing awareness of the impact of noise on animals.

"Because light doesn't penetrate very well underwater, a lot of animals use sound to communicate," Dr Tollefsen said.

"The most well-known animals to do this are whales and dolphins but invertebrates and fish also use sound.

"If it's too noisy from human activities, you can imagine that it's harder for the animals to find a mate or find food.

"That's why we're doing this work is to understand the sounds in Cockburn Sound and whether there are ways to estimate a potential increase in noise or mitigate any increase if shipping traffic were to increase."

Dr Tollefsen said a port in Vancouver, Canada had implemented a strategy to slow vessels on approach as a way of protecting the endangered population of orcas in the area.

She said by slowing the vessels, similar to a maritime equivalent of a traffic school zone, they had made the waters less noisy with the aim of reducing the impact of human-caused noise on the marine mammals.

The messy, muddy work retrieving recorders from the seafloor

They are moments of excitement mixed with relief when researchers pull up their mud and weed covered hydrophones and recorders which have spent months on the seafloor quietly capturing the sounds of weather, marine life and boats.

The equipment used for the 'Noise' theme project in the WAMSI Westport Marine Science Program, was put out three times over a year in Cockburn Sound and left underwater for four months.

The research team carefully noted the coordinates of the devices when they lowered them underwater and connected them by rope to weights to stop them drifting.

The underwater recorders contain enough batteries to sustain them through the months of data collection and are built to withstand the pressures of saltwater, sediment and sometimes rough weather conditions.

Because of the boating and fishing activity in Cockburn Sound the team decided not to attach the devices to floats which would increase the possibility of ropes becoming snagged in propellers.

When it comes time to retrieve the devices, the team takes its boat to the drop sites using the GPS coordinates and uses a hook to grab the line. It can feel like looking for a needle in a haystack.

When they are found, the recorders are usually covered in mud and some are tangled in seagrass but once they are cleaned the precious data is retrieved.

What's downloaded are the sounds of the Sound. There are wind and bubbles, jet skis, boats, large ships but also fish, dolphins, crabs and many noisy shrimp.

Penguin ‘poop study’ to help unlock colony’s diet

Researchers from The University of Western Australia and Murdoch University are analysing DNA from the excrement of little penguins in Cockburn Sound to find out what, other than fish, they are eating and whether it is affecting their breeding.

Penguin researcher Dr Belinda Cannell, from UWA, said analysing the animals’ diet in greater detail would provide an insight into their breeding and how it related to the availability of their primary diet, which is fish.

Little penguins in Cockburn Sound (their northern most range in Western Australia) primarily eat anchovies, pilchards, scaly mackerel and sandy sprat.

Penguins are known to also feed on crustaceans, cephalopods and even jellyfish.

“If it’s a poor year and there are not a lot of fish around, the little penguins may be feeding more on other things such as jellyfish,” Dr Cannell said.

“It may be that the chicks don’t fatten up as quickly.”

She said diet made up one element of the project, which is part of the WAMSI Westport Marine Science Program.

Another methodology being used to determine diet composition is the analysis of stable isotopes of carbon, nitrogen and sulphur from the down of little penguin chicks and feathers from adults.

“Stable isotopes of carbon reflect primary production sources and is more enriched in inshore, seagrass dominated areas, compared to offshore food webs,” Dr Cannell said.

“The stable isotope of nitrogen increases up the food chain and can also increase between size classes of the same prey species.”

“Stable isotopes of sulphur can be useful to distinguish between offshore and inshore components in food webs and can also indicate if producers are using sulphur from seawater, which is more enriched, or from sediments which are less enriched.

“This gives us a better idea of the whole diet of these birds.”

Dr Cannell said stable isotopes assisted with establishing diet composition.

“I presume little penguins are eating jellyfish, but we haven’t had stable isotopes for jellyfish until now.”

The Western Australian Museum provided samples to help with the research.

Eco-design and pre-seeding among options to encourage healthy port marine life

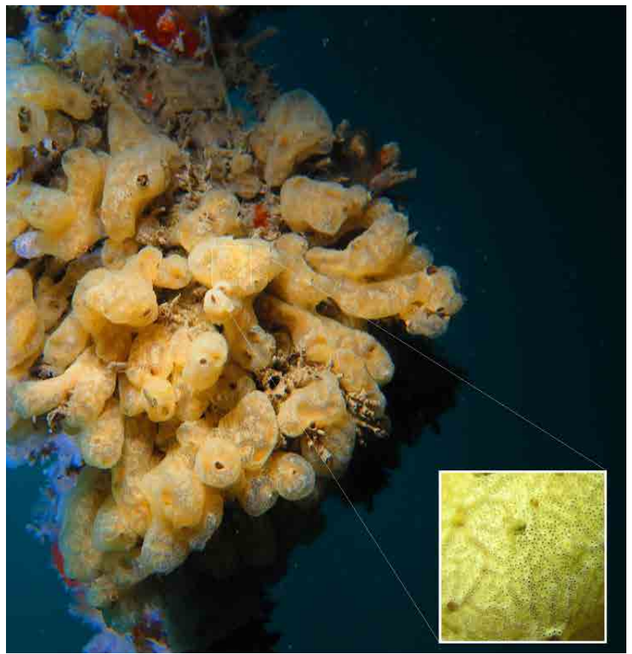
Pre-seeding new port structures to encourage the colonisation of native species is one of the mitigation measures against invasive marine plants and animals, outlined in a new report prepared for the WAMSI Westport Marine Science Program.

The literature review by Curtin University School of Molecular and Life Sciences Adjunct Professor Fred Wells lists many of the invasive marine species that have been recorded in waters around Perth and mitigation measures that could be used during any port construction.

Pre-seeding works by attaching local, fast-growing species to a new structure. The common mussel is one option identified in the report.

Professor Wells said invasive marine species were a worldwide problem and shipping was the most common way they spread to coastal areas. Ninety-eight percent of trade in and out of Australia is on vessels.

“Invasive marine species are concentrated on artificial surfaces and eco-engineering is a new field that attempts to encourage biodiversity and prevent potential marine pests taking hold,” Professor Wells said.



“The risk of introducing new species is greatest during construction but experience during the construction boom in the Pilbara demonstrated the issue is manageable.”

Professor Wells said eco-design was a new and evolving field that could help improve the biodiversity of the marine community that develops underwater, while minimising the risk of invasive species.

“Current design procedures tend to create uniform habitats, such as seawalls with smooth vertical faces. The lack of habitat diversity reduces the biodiversity of the marine community that develops on the structure.”

“Increasing the habitat diversity of new immersed structures and pre-seeding them with native species appear to be the most promising ways for mitigating against species that can cause ecological harm and prove expensive.”

Professor Wells said the biggest threats from invasive species to marine ecosystems were introducing disease, displacing native species, changing the ecology of native communities, clogging pipes and damaging other critical infrastructure.

The report, which was done to understand potential risks, is a literature review of invasive marine species from Cottesloe to Cockburn Sound, including waters around Fremantle and the Swan River.

A comprehensive survey more than a decade ago recorded 60 introduced marine species living in WA waters. Three were on the national marine pest list. Four additional marine pests were subsequently recorded in WA.

“Fortunately, most introduced marine species are apparently innocuous, causing no known adverse effects and we know only a small portion become pests,” Professor Wells said.

Even for a veterinarian who regularly anaesthetises antelopes, giraffes and hippopotamuses, the Australian sea lions off Perth were a new challenge for Werribee Open Range Zoo's Dr Brett Gardner.

The Victorian based wildlife vet, supporting a specialist wildlife veterinarian from the Department of Biodiversity Conservation and Attractions in Perth, helped fit satellite tracking devices to the endangered mammals after using a novel anaesthetic regime designed to reduce the risk of drowning and aid a quicker recovery.

The regime, or a variation of it, has been used previously to sedate animals including seals and hippos, but this was the first time it was used on Australian sea lions.

Dr Gardner said the team working on the WAMSI Westport Marine Science Program satellite tagging operation included boat and beach crews as well as swimmers.

"For sea lions, the water is their safe space when they are stressed but when they have just been anaesthetised it is dangerous for them to be there," Dr Gardner said.

Traditional methods induce a heavy sedation or even full anaesthesia, which can be risky for the animals. The sea lions' anatomy including their breath-holding ability, more compressible ribcage and vulnerable trachea add to challenges around anaesthesia.

"We used a combination of drugs that induce a light sedation, and we had members of the team on the beach and on boats ready to administer medication that reverses their effects in the case of an emergency such as a potential drowning."

"This lighter sedation is predominantly used to free marine mammals that become caught in fishing line and discarded rope where a heavy sedation would be too dangerous."

Dr Gardner said the way the sea lions are selected for darting is important.

"We try to target animals that are less likely to react by fleeing into the water, so sleeping sea lions are preferable to ones that are awake."

"When we dart animals that are sleeping rather than ones that are alert, they tend to respond like it's one of their mates that's bitten them and then they settle down and the anaesthetic takes effect."

The islands in the Perth metropolitan region are used exclusively by male sea lions but this too poses unique challenges.

"The problem with the Australian sea lion bulls is that they were all on the water's edge, literally, less than 25 metres away and some are less than five metres from the water."

"Also, because of their sheer size and their fat deposits you've got far fewer suitable areas for a dart to be placed."

A paper on the anaesthetic regime's use in Australian sea lions is being written and Drs Gardner and Vitali, said there were no adverse effects observed and the satellite tags were successfully attached to the animals.

In the field

More than 150 researchers have worked on the dozens of projects that make up the WAMSI Westport Marine Science Program.

Their work covers research over nine themes: ecosystem modelling and integration, benthic habitats and communities, water and sediment quality, fisheries and aquatic resources, hydrodynamic modelling, social values, noise, apex predators and iconic species and coastal processes.

The program has involved a huge amount of fieldwork along with laboratory time and the big process of writing and reviewing reports.

Sea lions have been tagged, tiny larvae counted, equipment installed on the seabed to monitor sediment movement and record sound and so much more.

Most of the researchers are from WAMSI's partner organisations and we wanted to share their photographs, from the field and laboratories, to show the diversity of their groundbreaking work.

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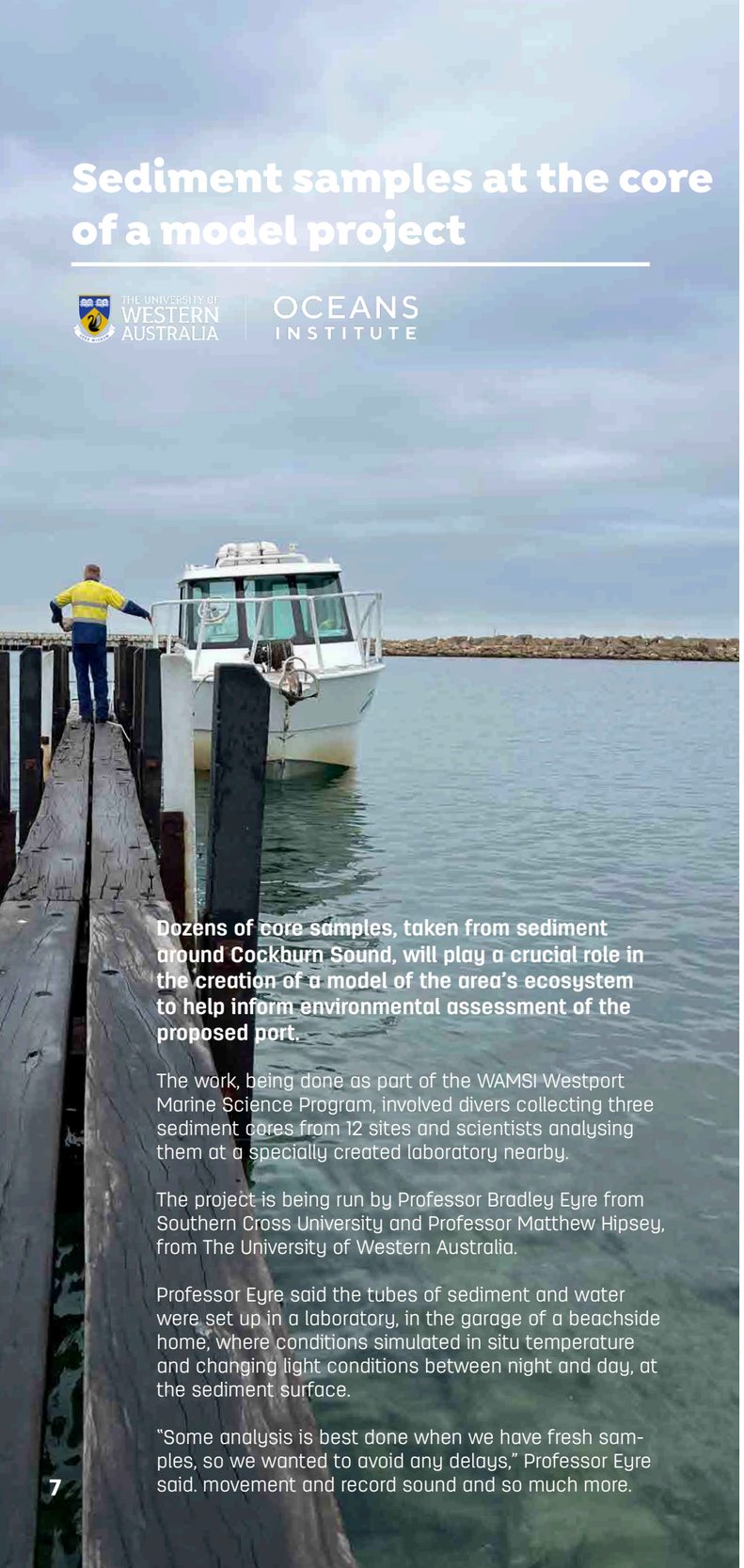
Sediment samples at the core of a model project



Dozens of core samples, taken from sediment around Cockburn Sound, will play a crucial role in the creation of a model of the area's ecosystem to help inform environmental assessment of the proposed port.

The work, being done as part of the WAMSI Westport Marine Science Program, involved divers collecting three sediment cores from 12 sites and scientists analysing them at a specially created laboratory nearby.

The project is being run by Professor Bradley Eyre from Southern Cross University and Professor Matthew Hipsey, from The University of Western Australia.

Professor Eyre said the tubes of sediment and water were set up in a laboratory, in the garage of a beachside home, where conditions simulated in situ temperature and changing light conditions between night and day, at the sediment surface.

"Some analysis is best done when we have fresh samples, so we wanted to avoid any delays," Professor Eyre said. movement and record sound and so much more.

"Other samples will be sent back to the Southern Cross University campus near Byron Bay, which has the only instrumentation in Australia for some of the analyses."

The 12 locations in the Sound, represent different types of shallow and deep sediments including muds, seagrass meadows, and sandy areas.

"In the laboratory, we were measuring the flux of oxygen and nutrients in and out of sediment including nutrients such as ammonia and phosphate," Professor Eyre said

"Some of the tubes contained sediment with seagrass growing in it.We are also measuring a critical process in the sediments called denitrification.

"Denitrification is a natural process by which ecosystems such as Cockburn Sound can remove nitrogen."

"It is a really important cleansing process but if the carbon load gets too high the process can be reduced."

The researchers said data from the sediment testing would underpin new water quality modelling of the Cockburn Sound ecosystem.

"The data complements other key experimental data being collected as part of the WAMSI Westport Marine Science Program on the chemical and biological conditions, allowing the development of Cockburn Sound Integrated Ecosystem Model platform to help manage the system," Professor Hipsey said.

"What we are measuring will reflect what is happening currently in the Sound and when used alongside the modelling we will be able to predict what will happen under future scenarios."

WAMSI Westport Marine Science Program Reports Live

Cockburn Sound research teams have started delivering project reports for their work on the WAMSI Westport Marine Science Program.

These are now published on the Cockburn Sound webpage under 'Research Themes and Reports' at:

www.wamsi.org.au/research/programs/wamsi-westport-marine-science-program

Lozano-Montes, H., Loneragan, N., Fourie, S., Wise B. (2024). Using conceptual, qualitative and quantitative ecosystem models to characterise the trophic structure, ecosystem attributes and functioning of Cockburn Sound.

Said, N., Webster, C., Dunham, N., Strydom, S., McMahon, K., (2024). Current state of knowledge for dredging and climate change impacts on seagrass ecosystems to inform environmental impact assessment and management. A case study: Cockburn Sound and Owen Anchorage.

Harvey, E., Schramm, K., Saunders, B., Wakefield, C., Wenger, A., Ackermann, F., Newman, S. (2024). The effects of total suspended sediment associated with dredging on fishes: a review and management strategies.

Wells, F. (2024). Marine Invasive Species Literature Review.

Hughes, M., Kobryn, H., Henningsen, S., Burton, M., Rogers, A., Pauli, N., Clifton, J., Kim, M. (2024). Spatial mapping of non-fishing recreational activities and associated values in Cockburn Sound, Western Australia.

ACKNOWLEDGEMENT AND ARTICLE CONTRIBUTION

SHIP SAFETY HELPING SOUND'S NOISE RESEARCH (Page 1)
Baseline soundscape, sound sources and transmission.
Project leader: Professor Christine Erbe (CU).

THE MESSY, MUDDY WORK RETRIEVING RECORDERS FROM THE SEAFLOOR (Page 2)
Baseline soundscape, sound sources and transmission.
Project leader: Professor Christine Erbe (CU).

PENGUIN 'POOP' TO HELP UNLOCK COLONY'S DIET (Page 3)
Determining the diet, causes of mortality, foraging habitat and home range of Little Penguins using Cockburn Sound.
Project leader: Dr Belinda Cannell (UWA).

ECO-DESIGN AND PRE-SEEDING AMONG OPTIONS TO ENCOURAGE HEALTHY PORT MARINE LIFE (Page 4)
Marine invasive species literature review.
Project Leader: Adjunct Professor Fred Wells (CU).

HIPPO SEDATION ADAPTED FOR PERTH SEA LION TAGGING (Page 5)
Australian sea lions.
Project leaders: Dr Chandra Salgado Kent (ECU) and Dr Kelly Waples (DBCA).

IN THE FIELD (Page 6)
WAMSI Westport Marine Science Program (WWMSP).
Program leader: Dr Alan Kendrick (WAMSI).

SEDIMENT SAMPLES AT THE CORE OF A MODEL PROJECT (Page 7)
Cockburn Sound benthic nutrient flux dynamics.
Project leader: Professor Matt Hipsey (UWA).

WAMSI WESTPORT MARINE SCIENCE PROGRAM REPORTS LIVE (Page 8)
WAMSI Westport Marine Science Program (WWMSP).
Program leader: Dr Alan Kendrick (WAMSI).

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Front cover image: Rachel Austin

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WAMSI is funded by