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MARINE SCIENCE
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RESEARCH *Highlights*

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Whiting put to dredging impact test

Curtin University

Department of Primary Industries and Regional Development

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One of the most popular catches for beach anglers in Cockburn Sound has been included in research exploring the potential impact on fish from dredging.

Researchers at Curtin University studied 60 whiting to determine what happened to their feeding habits and overall condition when varying concentrations of suspended sediment were added to their water. Dr Ben Saunders (who led the tank trials), said the research team used a dozen 400 litre tanks with five whiting in each. At the end of the trial the fish were weighed and measured, their body condition was assessed and cells from their gills were examined under a microscope. A control group had no sediment added to their tanks. Another group had 25 milligrams per litre of very fine limestone sediment added and the highest concentration was 44 milligrams per litre. The whiting were exposed to these conditions for the 10 day experiment.

"At the highest concentrations of sediment there were significant differences, so the fish had a greater inflammatory response," Dr Saunders said.

"Testing on the cells in their gills showed there were more white blood cells and more clusters of white blood cells observed compared to the control group."

He said although the measurements weren't necessarily all statistically significant, there was a trend of increasing effects as the amount of sediment levels increased.

"The concentrations were designed to be similar to the levels of sediment that whiting might experience a couple of hundred metres from a dredging operation. We were trying to find the lowest concentration where the feeding rate of the fish changed and their overall body condition changed".

Dr Saunders said body condition was significantly lower in the 44 milligrams per litre category compared to the control group. The study found a trend of decreasing body condition with the increased sediment load. This research will help inform Westport's dredge management planning.

The project is co-led by Professor Euan Harvey and Dr Stephen Newman.

Squid on camera in sediment project

Curtin University

Department of Primary Industries and Regional Development

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Cameras set up in large tanks are capturing what impact varying levels of fine limestone sediment in the water has on the feeding habits of squid, as part of a project for the WAMSI Westport Marine Science Program.

This tank trial which started recently, is led by Dr Ben Saunders, a Senior Lecturer in the School of Molecular and Life Sciences at Curtin University.

It will be used to inform the WAMSI Westport project in Cockburn Sound.

Dr Saunders said traditionally research had focused on the lethal effects of sediment on marine life during dredging operations.

"What we are interested in is the lowest measurable effects, where the behaviour of the animal starts to change," Dr Saunders said.

"They may start to feed differently and there could be changes to their body condition and overall health."

Three levels of sediment are being used to replicate what is likely to be in the water during a dredging operation. We are testing 25 milligrams per litre, then 44 milligrams per litre, and a control with no added sediment."

The highest level is based upon the turbidity levels where previous research suggests that 5% of fish species begin to be affected.

"We feed the 17 squid in front of the video cameras and we try to get them to come in so we can record any delay between the fish going into the tank and the squid realising it is there and coming in to eat it."

One sign the squid may not be able to see their prey, is fish remaining uneaten at the base of the tank.

Two trials will be conducted, and each trial runs for 10 days.

The squid are fed and monitored three times a day and researchers regularly test water quality and monitor the video footage.

Robot sowing the seeds for healthy seagrass meadows

A robot that plants seagrass seeds directly into the seabed is being trialled in Cockburn Sound as part of a program to speed up the restoration of badly depleted underwater meadows.

Seagrass, the ocean's only flowering plant, is vital as a habitat for wildlife, for stabilising sediment and storing carbon. But pollution, marine heatwaves and development have wiped out vast areas of seagrass meadows.

Emeritus Professor Gary Kendrick, a researcher from The University of Western Australia, who is a seagrass restoration project leader on the Western Australian Marine Science Institution (WAMSI) Westport Marine Science Program said it wasn't enough to let 'nature takes its course' because the process was too slow.

"In Cockburn Sound, south of Perth, we are talking about a system that lost more than 3,000 hectares of seagrass from the mid-1950s to the 1980s," Professor Kendrick said.

"Less than 100 hectares has come back."

"Even when we disperse seagrass seeds where the plants are needed, it can take two or three weeks for them to attach to the sediment and in that time, most are lost," he said.

The specially designed autonomous robot, which is powered by batteries, injects seeds into the seafloor which the research team says improves their chances of taking hold and growing into healthy new plants.

It was developed by Ulysses Ecosystem Engineering, which is based in San Francisco.

Their team travelled to Perth to operate the machinery trial. The robot works by taking collected seeds and depositing them directly into the seabed.

This has been shown to have a greater germination rate than traditional methods of restoration, which see the seeds scattered at the surface. Professor Kendrick said the trial had come a long way.

"I have worked with the Ulysses engineers now for one year and in that time we have got a full robotic system working."

"Next year we are hoping we can demonstrate you can plant a hectare in a day."

"We are seeing a slow recovery at Kwinana Shelf and what we are really trying to do is speed it up and build resilience in a whole community," Professor Kendrick said.

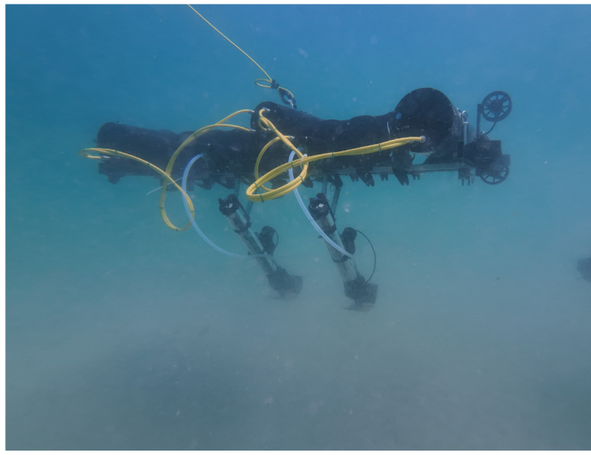
Researchers from UWA will return to the trial sites to assess for restoration success over the next year.

Will O'Brien, one of the co-founders of Ulysses added "It is crucial that we develop automated solutions for seagrass restoration."

"Existing methods are too expensive and slow to achieve the results that are needed," Mr O'Brien said.

"This trial is the first step in restoring WA's seagrass coverage to historic levels and we are off to a very promising start."

The trial will be supported by a $230,000 investment by Westport.



CT Scanner helps reveal what endangered sea lions hear

In a world first study, researchers working on the WAMSI Westport Marine Science Program have built a 3D digital model based on CT imaging that mimics sound reception to reveal the hearing sensitivity of Australian sea lions.

There is a growing recognition globally of the impact human-caused noise can have on marine mammals such as seals, sea lions, dolphins and whales. But Dr Chong Wei, who worked on the study with his Curtin University colleague Professor Christine Erbe, said there were major challenges and ethical problems testing the hearing of live animals.

"For this study we relied on modelling along with CT imaging of the head of a male sea lion that had died a few hours earlier in Cockburn Sound, probably from a boat strike," Dr Wei said.

He said the research method had been used on baleen whales but not the endangered Australian sea lion.

"We mimic how the sea lion hears sound from different directions and are able to investigate how the animal's ears respond to the different sound frequencies."

"Then we can calculate the acoustic energy transformation from, for example, the outside of the head into the middle and inner ear."

"We use this energy transformation to predict what they can hear and how well they can hear at different frequencies," Dr Wei said.

Units of frequency are called hertz and humans with normal hearing can hear sounds between 20 Hz and 20,000 Hz.

Dr Wei said the study found Australian sea lions had similar hearing sensitivity to Californian sea lions, which have a bigger population and have been studied more intensely.

"It appears they can hear frequencies ranging from about 100 Hz to 40,000Hz underwater and about 350 Hz to 20,000Hz in air," Dr Wei said.

"Ship noise typically ranges from 20 to 1000 Hz and pile driving from 50 to 5000 Hz."

Australian sea lions are one of the world's most endangered pinnipeds and the population has plummeted by 60% in four decades.

"Since the industrialisation of the oceans, steadily increasing marine noise has become a worldwide issue," Dr Wei said.

'Volume and spatial extent of marine noise pollution have become one of the significant threats to marine animals." "Previous studies on seals have shown they display strong avoidance behaviours and stop feeding in response to seismic surveys."

"Responses such as swimming away and stopping feeding were documented during trials with grey seals. They changed from making foraging dives and moving away from the source and some seals hauled out on land, possibly to avoid the noise."

Dr Chong Wei

Dr Wei said the results would be relevant to establishing management plans around noise mitigation measures with developments.

"The audiograms from this study provide important information that can also be used to predict the effects of anthropogenic (human caused) underwater noise and to assess the extent to which biologically relevant sounds are masked by this noise."

"This study provides valuable data for marine fauna conservation and management."

Solving the food web 'puzzle' in Cockburn Sound

For a body of water so close to a capital city, Cockburn Sound's food web has been like an unsolved jigsaw puzzle until now, according to a leading Perth researcher. The comprehensive food web or trophic pathways project was carried out as part of the WAMSI Westport Marine Science Program and saw researchers examine more than 2,000 fish and invertebrates from 18 species to look at gut contents and 55 species for stable isotopes.

Project co-leader Professor Glenn Hyndes, from Edith Cowan University, said the research team set about tracking sources of food from plants up to larger fish and crustaceans.

"We wanted to trace the pathway of material through the food web as high as you could go and understand the sources of food," Professor Hyndes said.

"While Cockburn Sound is on our doorstep there was very little information on its food web."

"If we lose a link in the food web it can have a significant impact on the ecosystem so it's important to understand all aspects of it."

He said the study, co-led by Murdoch University showed that most of the species studied had a general diet but some, such as flathead and octopus, had more specialised diets. The collaborators on this project are The Department of Primary Industries and Regional Development and The Unversity of Newcastle.

"What surprised me was that a lot of species feeding from the water column gained the organic matter from the sediment, so organic matter from the sediment is going into water and being consumed."

"Detritus on the seafloor therefore is vital because it is driving a lot of the food web structure."

How to study a food web:

The researchers did gut content analysis on 2,117 fish and invertebrates as well as stable isotope analysis to create a map of what the animals were eating and the food web.

"Gut content analysis effectively tells us about the animal's last meal," Professor Hyndes said.
The examination of stable isotopes gives us a broader understanding of its diet."

"If we know what the stable isotopes are for certain plants then we can determine the level the consumers are in the food web and what base source is ultimately driving the food web."

The combination of the two research approaches was considered a strong way of establishing the food web structure.

"Gut content analysis in this project demonstrated that each species studied consumed a significantly different suite of prey and thus had a unique diet influenced by their mouth and body morphology."

Many of the samples came from researchers working on other projects within the broader program, particularly those involving invertebrates and fish.

What is eating what?

Filter-feeding invertebrates gain their nutrients from re-suspended detritus from the sea floor, whereas the filter-feeding bait fish: blue sprat and sandy sprat fed primarily on zooplankton particularly planktonic crustaceans.

Longspine dragonet and skipjack trevally consumed mainly bivalve and gastropod molluscs and crustaceans, while species such as western butterfish, snapper and western trumpeter whiting had a broader diet and consumed a range of taxa including molluscs, polychaetes, crustaceans and echinoderms.

Typically, larger predators consumed larger and more mobile prey. Regional and seasonal differences in diet were also detected for most species.

Professor Glenn Hyndes

New reports published

Several dozen reports from the WAMSI Westport Marine Science Program have now been published online. The major research program, focused on Cockburn Sound, is designed to ensure the environmental impact assessment for any future container port is informed by rigorous, independent science.

Reports have now been published on topics including ecosystem modelling, dredging and climate change impacts on seagrass, water quality, marine invasive species, hearing in little penguins and Australian sea lions, coastal processes and the area's iconic marine species such as Indo-Pacific bottlenose dolphins. More reports will soon be published under the Cockburn Sound program page on the WAMSI website (wamsi.org.au/programs).

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ACKNOWLEDGEMENT AND ARTICLE CONTRIBUTION

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Effects of total suspended solids on key fish species.
Project leaders: Professor Euan Harvey (CU) and Dr Stephen Newman (DPIRD)

SQUID ON CAMERA IN SEDIMENT PROJECT (Page 2)
Effects of total suspended solids on key fish species.
Project leaders: Professor Euan Harvey (CU) and Dr Stephen Newman (DPIRD)

ROBOT SOWING THE SEEDS FOR HEALTHY SEAGRASS MEADOWS (Page 3 & 4)
Seagrass restoration program.
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CT SCANNER HELPS REVEAL WHAT ENDANGERED SEA LIONS HEAR (Page 5 & 6)
Hearing sensitivity of Australian sea lions, little penguins, and fish.
Project Leader: Professor Christine Erbe (CU)

SOLVING THE FOOD WEB 'PUZZLE' IN COCKBURN SOUND (Page 7)
Trophic pathways and food web structure of Cockburn Sound and Owen Anchorage.
Project leader: Professor Glenn Hyndes (ECU) and Dr James Tweedley (MU)

NEW REPORTS PUBLISHED (Page 8)
WAMSI Westport Marine Science Program (WWMSP).
Project leader: Dr Alan Kendrick (WAMSI)

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