Three out of four turtle populations risk cadmium contamination

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Lead researcher & PhD candidate Gulsah Dogruer, Australian Rivers Institute. Credit: Griffith University

Three out of four Queensland green turtle populations risk harmful effects from cadmium found a Griffith University-led study using a new tool to determine chemical exposure limits for marine animals.

In collaboration with Utrecht University (Netherlands), Goethe University Frankfurt (Germany) and the University of Queensland, the researchers developed a virtual turtle model to simulate cadmium uptake and its effects over a turtles' lifetime. The model was used to reveal at what concentration cadmium in their primary food source, seagrass, is potentially toxic.

"Marine animals are exposed to an array of toxic chemicals entering the oceans," said lead researcher and Ph.D. candidate Gulsah Dogruer from the Australian Rivers Institute.

"Yet policy makers are basically in the dark about the limits these animals can endure before health effects threaten their survival.

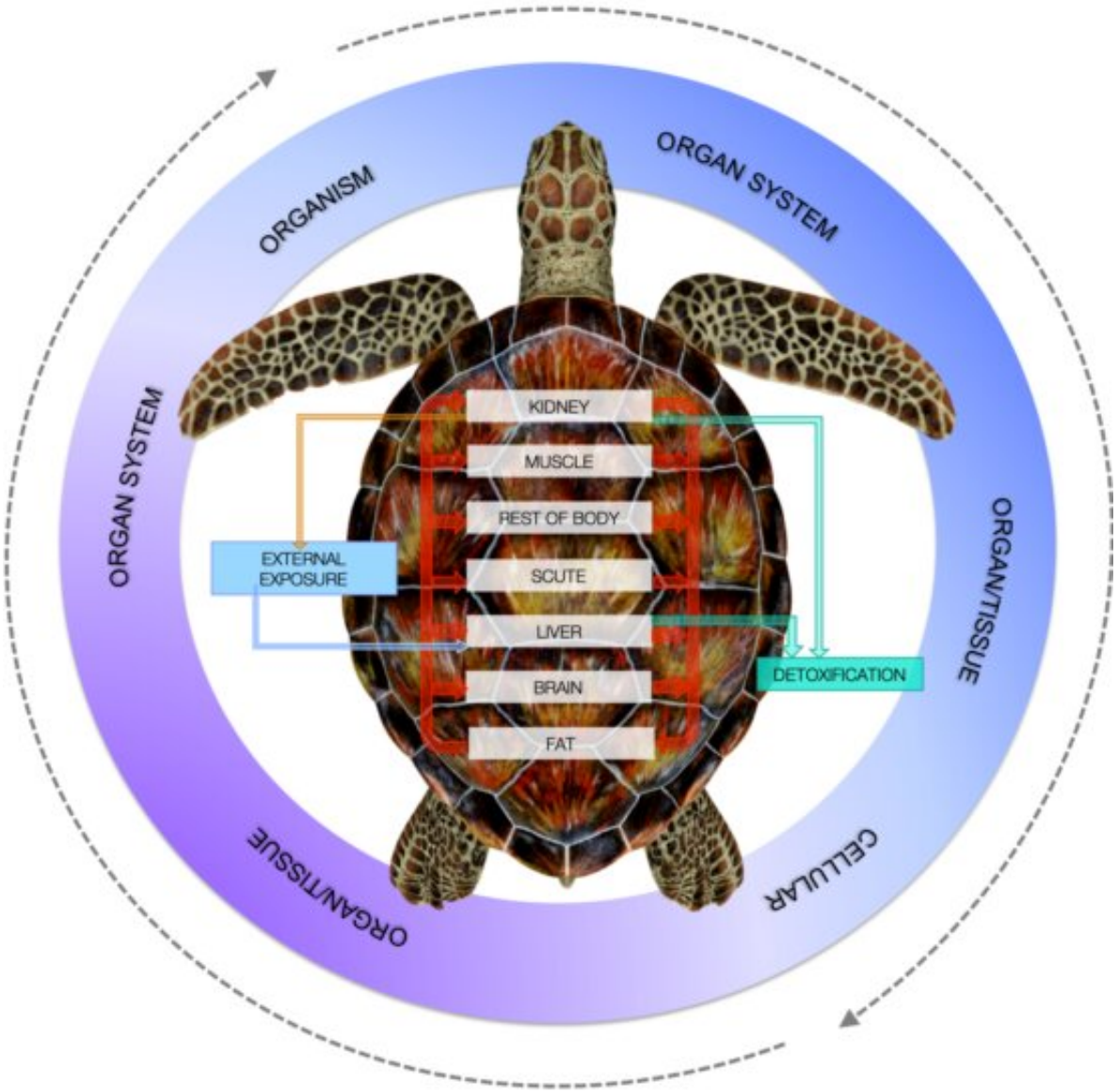
"We developed a framework that sheds some light on this issue for policy makers. By defining the chemical exposure limit for a particular marine animal before there is harmful effects, we can help policy makers identify potentially toxic areas."

When applied to cadmium in green sea turtles, the researchers revealed a concerning 72% of the Great Barrier Reef's green turtle populations were at risk from cadmium contamination.

"Our results show that a green turtle population foraging on seagrass with

more than 0.1 milligram of cadmium for every kilogram of seagrass, is exposed to potential health risks," said co-author and supervisor Dr. Jason van de Merwe, a marine ecologist and eco-toxicologist at the Australian Rivers Institute.

"As seagrass is green turtles' primary source of food, this is a real concern, but knowing this threshold level of cadmium is crucial to identify potential exposure sites."



The virtual turtle model consisting of seven body compartments connected by the circulating blood flow (red arrow). The liver and kidney represent the elimination and detoxification routes (green arrow). The blue arrow represents the exposure route. Credit: Griffith University

To discover the cadmium threshold in green turtles, the researchers used

a generic three-step framework that can be adapted to other marine species and other chemicals.

The framework involved firstly developing a green turtle and cadmium-specific model to predict how much cadmium the turtles are likely to accumulate over their lifetime under various environmental conditions.

"The model we developed used the physiology of the turtles and the chemical properties of cadmium to simulate its absorption, metabolism, excretion, and distribution in the turtles' liver, kidney, muscle, fat, brain, scute, and 'rest of the body'," Ms Dogruer said.

"The second step was to link these contaminant concentrations in the turtles to toxic effects seen in laboratory-based studies and in free-ranging turtles.

The researchers ran the model in reverse, using the cadmium concentration that is toxic in turtles' body, to determine the amount of cadmium in seagrass above which turtles are likely to have a toxic response (0.1 milligram of cadmium for every kilogram of seagrass).

The researchers lastly compared their results to real-world cadmium exposure conditions for green turtle populations globally.

"Three out of the four globally distinct green turtle populations assessed in Australia, Japan and Brazil are exposed to cadmium levels above the threshold seagrass limits we reported," Dr. van de Merwe said.

"Our framework for determining chemical exposure limits will help managers of conservation sites better understand and minimize the risk to marine animals and hopefully begin to turn the tide for green turtle populations worldwide," Ms Dogruer said.

Provided by Griffith University