Crafty Australian crayfish cheat

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Nestled just off the east coast of Australia, picturesque North Stradbroke Island is a haven for local wildlife. Yet some of the inhabitants of the island's creeks and swamps are far from peaceful. Slender crayfish are aggressive territorial creatures, explains ecologist Robbie Wilson of the University of Queensland, Australia. When two crayfish catch sight of one another, they size each other up in a ritualistic display, which can quickly escalate from careful tapping of their opponent's chelae (enlarged front claws) to a full-blown fight.

Studying these fascinating animals, Wilson discovered that crayfish decide whether to flee or fight based on the size of their adversary's chelae, and that victorious females always have larger and stronger claws. But to his dismay, he found that some males with weaker claws cheat; they defeat stronger foes despite having a weaker - albeit larger - claw. 'Theory does not predict such dishonesty,' Wilson says. Deceptive signals of weapon strength should not exist, as opponents would quickly stop taking notice of an unreliable cue. Wilson wondered how the crafty males get away with it and publishes his results on Friday 27th February 2009 in The *Journal of Experimental Biology*.

Teaming up with Candice Bywater, Wilson first took a closer look at the relationship between claw size and strength in female crayfish, to compare them to the males. 'We knew that male signalling is unreliable, so we expected to see more variability in weapon strength in males than in females,' Wilson explains. To measure crayfish claw strength, Frank Seebacher of the University of Sydney, Australia, helped Wilson design a custom-made apparatus consisting of two thin parallel beams with

external force transducers. Luckily, it wasn't too tricky to entice the animals to clamp down on the contraption. Crayfish are 'very enthusiastic about biting,' says Wilson. 'We just had to direct their claws to the device and they'd bite.' The team found that, for a given claw size, males had huge variation in claw strength compared with females. This makes it hard for males to size each other up using claw size alone, which allows males to cheat when it comes to advertising their strength.

To understand just how serious the cheating was, muscle physiologist Rob James from Coventry University, UK, measured how much force crayfish muscles produce. He found that the muscles of female crayfish are actually more powerful than those of males. 'So males are not only cheating by creating large chelae with little muscle inside, but the muscle they do put in there is actually weaker,' Wilson concludes.

But these findings still didn't explain how males get away with cheating. Wilson wondered if there might be a disadvantage to growing large claws - if growing intimidating weapons is costly, this would ensure that males' unwieldy claws are actually a reliable signal of their prowess. To test whether large claws might be a handicap when it comes to escaping danger, Wilson and Bywater measured how quickly crayfish sped off when startled. Sure enough, while females' swimming performance was unaffected, 'the large claws of the cheating males reduced their swimming speed,' Wilson says. This suggests a potentially serious fitness cost to growing large claws; males encumbered by big claws may end up as a predator's lunch.

According to Wilson, the importance of dishonesty in weapon signalling is underappreciated, and may play a larger role than previously suspected. The next step, he says, is to 'find out how frequently cheating occurs in nature.'

More information: Wilson, R. S., James, R. S., Bywater, C. and

Seebacher, F. (2009). Costs and benefits of increased weapon size differ between sexes of the slender crayfish, Cherax dispar. *J. Exp. Biol.* 212, 853-858. http://jeb/biologists.org.

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