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INSIDE JEB

Dragonfly males overshoot to herd intruders from their territory

A male eastern pondhawk dragonfly (*Erythemis simplicicollis*). Photo credit: Amanda Lohmann.

Bumbling gnat snacks are no match for a hungry dragonfly in hot pursuit, but other adversaries might be more of a challenge. Amanda Lohmann from the University of North Carolina at Chapel Hill, USA, explains that male dragonflies are extremely territorial, fending off intruding males that encroach on their patch. 'Males fiercely defend their territories', says Lohmann, who was intrigued how defending males shoo away invaders. 'We were curious to see if a dragonfly would use the same strategy to chase another dragonfly as it uses to chase a gnat', says Lohmann, who teamed up with Ty Hedrick, also at the University of North Carolina, to film the insects' manoeuvres.

'The hardest thing was to actually track the dragonflies in the videos', says Lohmann, who constructed a bespoke stereo camera by attaching two GoPros at either end of a 65 cm long aluminium rod mounted on a tripod to film the encounters. Yet, despite triggering both cameras simultaneously with a remote control, the movies were often out of sync by as many as 5 frames until Lohmann matched them manually. And when she scrutinised the movies back in the lab, many had to be rejected. 'Both dragonflies have to be marked in both videos in every frame of the chase', says Lohmann, adding that many of the eastern pondhawk dragonflies (*Erythemis simplicicollis*) were barely visible during the breakneck encounters, forcing her to click manually on the positon of each insect during a 100–300 frame pursuit; 'which was a lot of clicking', she chuckles. After filming over 20 pursuits, Lohmann reconstructed the entire 3D flight paths of both combatants in nine duels, before Aaron Corcoran calculated the bearing angle between the defensive insect and the interloper and the optimal interception angle as the territory owner pursued the intruder from his patch.

Having analysed the high-speed chases, the team realised that the defending males were using the same strategy that they used when pursing a shambling gnat, turning quickly toward the optimal direction to intercept the intruder as soon as the invader swerved in a new direction. However, when Lohmann and Corcoran analysed the dragonflies' pursuits to find out how close their manoeuvres were to the ideal strategy – which would allow them to intercept the intruder most rapidly – something wasn't quite right. 'The calculation includes a number, called the gain, which basically determines how aggressively a pursuer will turn to correct errors in its direction', says Lohmann. However, the gains that Lohmann and Corcoran calculated suggested that the defending dragonflies appeared to be twisting and turning far too enthusiastically, overshooting the intruder's trajectory as they tried to hurry it from their territory. 'We were sceptical about this,' says, Lohmann, adding, 'it seemed odd that they would pursue a target so inefficiently'. But when the team looked back at the defending dragonflies' trajectories, they noticed that the insects seemed to be zig-zagging to and fro across the path of the male that they were seeing off. 'We realized that this crossing-over behaviour might come from the overshooting turning of the gain we had calculated' says Lohmann.

So it seems that male dragon flies have adapted the strategy that they use to pursue and intercept dinner for fending off intruders, but why do they defend their territories so sloppily? 'We hypothesize that… the goal isn't actually to intercept the intruder' says Lohmann. They suspect that defensive dragonfly males may be trying to intimidate trespassers by showing off their superior agility while herding intruders from their territory. And Lohmann is impressed by the insects' versatility. 'Rather than having to invent an entirely new mode of interception behaviour, dragonflies simply crank up the absolute value of the gain on the behaviour they use to catch prey', she says.

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