INSIDE JEB

Thirst protects cottonmouths from infection

A cottonmouth (*Agkistrodon conanti*) on Snake Key, FL, USA. Photo credit: Mark Sandfoss.

2022 has been an extraordinarily dry year for some regions of the planet. Rivers are running low, reservoirs are shrinking and animals are going thirsty. However, drought is a routine part of life for the cottonmouth (*Agkistrodon conanti*) population of Snake Key, off the Florida coast, USA. 'The islands of the Cedar Keys are recently formed relic sand dunes and recent patterns of sea level rise in the northern Gulf of Mexico suggest the islands have been isolated from the mainland for 3500–4500 years', says Mark Sandfoss from the University of Florida, USA. With access only to rainfall, the snakes often go thirsty. However, Sandfoss and Harvey Lillywhite, also from the University of Florida, had a hunch that the snakes may gain some benefit from their dehydrated lifestyle. 'Recent studies have found that as reptiles become dehydrated, the ability of their immune system to protect them from disease improves', says Sandfoss. Could the same hold true for the castaway cottonmouths?

Sandfoss headed over to Snake Key in search of the marooned vipers. 'They conceal themselves under vegetation but often gave themselves away by attempting a quick strike at a passing boot. This is both helpful and unsettling', chuckles Sandfoss. He picked up each animal with a snake hook before securing it in a bucket and collecting a tiny blood sample, 'which requires incredible trust in the person holding the venomous snake while I draw blood from the tail', Sandfoss admits. With the blood sample in hand, he transported the snakes back to the lab where he offered them a drink to find out how dehydrated they were, weighing them to monitor their mass gain as they took on water to quench their thirst. In addition, François Brischoux (La Rochelle Université, France) checked the animals' corticosterone levels – a hormone which usually rises when animals are thirsty – to find out how stressed they were.

Sure enough, the Snake Key cottonmouths were more dehydrated (with a blood plasma concentration of 344.1 mosmol kg^{-1}) and keener to drink than well-hydrated cottonmouths (309.1 mosmol kg^{-1} blood plasma concentration) from a nearby marshy wildlife reserve at Paynes Prairie, FL, USA. In addition, the thirsty Snake Key cottonmouths were more stressed than the Paynes Prairie snakes. Yet, when the team tested how well primed the snakes' blood was to fight an infection, the island snakes were no better prepared than their mainland cousins. But would the snakes' immunity alter as their thirst levels changed?

This time, Sandfoss transported 17 snakes back to the lab (eight from Snake Key and nine from the mainland) providing the animals with an unlimited water supply to ensure that they were well hydrated before testing how their immune system attacked a fake infection. Then, he removed the reptiles' water bowls until they had lost one-fifth of their body mass – they were thirsty, but not dangerously so – before rechecking the strength of their immune system. Finally, he returned their water bowls and allowed the animals to slake their thirst before retesting their immunity 48 h later.

Both the thirsty Snake Key and mainland snakes produced powerful immune responses after losing 20% of their mass in water. Dehydration made the snakes more resistant to infection, although the strength of the snakes' immune response returned rapidly to normal after a long drink. Even though the Snake Key snakes routinely experience thirst, they are no more immune to infection when deprived of water than their mainland cousins. And it is becoming increasingly essential that we understand how reptiles react when their waterholes dry up as climate patterns continue shifting and animals face greater environmental uncertainty.

10.1242/jeb.244896

Sandfoss, M. R., Brischoux, F. and Lillywhite, H. B. (2022). Intraspecific investigation of dehydration-enhanced innate immune performance and endocrine stress response to sublethal dehydration in a semi-aquatic species of pit viper. *J. Exp. Biol.* **225**, jeb243894. doi:10.1242/jeb.243894.

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