Mozambique's cyclone flooding was devastating to animals—we studied how body size affected survival

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Anyone who watches the news will have seen the devastation that tropical cyclones can cause when they reach land, with very strong

winds, high rainfall and flooding. A cyclone like this, Idai, moved over Gorongosa National Park in central Mozambique in March 2019. At that time, it was the deadliest storm in Africa.

Rainfall at Gorongosa averages about 850mm per year. When Idai passed over, more than 200mm of rain fell in less than 24 hours. Over the following week, the depth of flood waters increased from 2 meters to 5.9 meters and the flood zone increased from 24.1km^2 to 117.7km^2. Only by late May did conditions return to normal.

Gorongosa protects 3,674km^2 of savanna ecosystem. Much of the park's wildlife was decimated by the Mozambican Civil War (1977-1992). Since then, scientists have studied the recovery of wildlife populations and changes in the park ecosystem.

When it comes to natural hazards, scientists think that traits such as body size, dispersal ability and habitat preference may be important in determining how vulnerable animals are. But it's seldom possible to test these ideas. The research that was taking place in Gorongosa National Park at the time of Cyclone Idai provided the perfect opportunity to investigate this.

We were part of an international research team which drew on existing data about wildlife in Gorongosa and compared it with data after the cyclone. We found that overall, the effect of Idai was to push animals out of lower-lying, inundated areas and crowd them into higher regions. The shift in distribution, combined with the reduction in flood zone plant productivity, affected what herbivores had available for food. Larger herbivores were better able to move in response to the flooding and to cope with food shortage. Large carnivores had a more easily accessible food supply.

Our results identify general traits that govern animal responses to severe

weather, which may help to inform wildlife conservation in a volatile climate.

This effect of animal size on responses to catastrophic storms is similar to that found for island systems affected by hurricanes in the Bahamas.

Measuring the impact of Idai on animals

We integrated data from multiple research projects for which animal GPS locations were available to capture the responses of animals to the flooding.

The individual movement of 48 GPS-collared animals from seven species was measured. Changes in distribution of animals were measured over three years with 30 camera traps covering an area of 300km^2. Satellite imagery allowed us to assess changes in forage availability, and dung samples provided a picture of dietary changes. The body condition of animals captured for GPS collaring was assessed. We estimated changes in abundance from aerial survey counts covering years 2014, 2016, 2018 and 2020.

Herbivore responses

Among the species monitored at the time of the cyclone were small antelopes such as the oribi (17kg) and bushbuck (49kg), and large animals like buffaloes (550kg) and elephants (4,000kg).

The bushbuck that survived did so by perching on patches of high ground, like the tops of termite mounds within the flood zone. Locations from the GPS collars showed that they camped out on these temporary little islands or moved quickly between them, hopping from one island to the next.

Larger antelopes like nyala, kudu and sable were able to move long distances towards higher ground.

In addition to the sheer volume of water entering the Gorongosa system, the timing of the flood was also a disturbance. Because the cyclone occurred in March, foraging areas normally open to grazing were covered with water and unproductive.

Herbivore diet in the months following the cyclone shifted to taller, more woody plants, which are harder to digest and have less protein. Plant species eaten showed less overlap between herbivores than in normal years, a strategy that likely reduced competition. Compared to larger herbivores, smaller herbivores experienced a larger change in diet, a greater expansion in the number of plant species eaten to cope with the loss of preferred plants, and a larger decrease in diet quality.

Because food following Idai was scarce, and competition among crowded herbivores was stronger, there was a reduction in body condition for smaller species like bushbuck and nyala. For the larger, more wide-ranging kudu, body condition showed little change.

Crowding and food quality and availability had an impact on numbers of herbivores in the park.

Regular aerial surveys have shown consistent growth in herbivore numbers since the end of the civil war. The survey following Idai, however, showed the first population decreases for many species in the last 30 years. The strongest decreases (47%-53%) were for the small antelopes, oribi and bushbuck. Numbers of larger herbivores (wildebeest, buffalo and elephant) also decreased, but not as severely (27%).

Carnivore responses

The effects of Idai on lions and wild dogs were not nearly as strong as for the herbivores. GPS-collared animals moved away from the expanding flood zone. Diets of lions did not change much, but wild dogs began to eat more waterbuck, especially after the cyclone pushed many waterbuck into areas used by wild dogs.

Lion and wild dog populations both increased in numbers following the cyclone. Prey animals consisting of weaker and more food-stressed herbivores became easier to catch and a more abundant food supply for the large carnivores.

Size matters

Among the lessons learned from the disturbance caused by Cyclone Idai are that larger species tend to be more resilient to disturbances through their ability to move longer distances and their greater stores of body resources to survive when forage is unavailable. Smaller species were more strongly affected, but they also have the potential to recover more quickly.

Knowledge of how different wildlife species respond to and recover from climatic disturbances will be increasingly important for the conservation of protected areas like Gorongosa National Park. For instance, knowing the different roles species play in a natural system can help wildlife managers to focus conservation efforts on vulnerable species and habitats according to their likely contributions to system recovery following a disturbance.

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