Report on The Heat Proofing of Colony Sites:

The Central Coast/Singleton Experience

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Introduction

Mortality occurs in Heat Stress Events when the temperature is over 40C and the relative humidity is under 30%. It is the dryness of the air that kills, as animals reduce their temperature by evaporative cooling. With hot dry air their evaporative cooling works too well and they lose too much water. Above 37C the amount of water lost to the dry air increases exponentially (Laburn and Mitchell 1975) which results in uncontrolled heating and rapid dehydration by the time the temperature passes 40C. Juvenile flying-foxes are particularly at risk as they have a large surface to volume ratio and so lose water faster than adult animals. The faster the water loss, the faster the animal proceeds towards death unless there is a source of water available (Mitchell et al. 2009) or unless the rate of evaporative water loss can be slowed (Baker 1989).

A Heat Stress Event can be a major catastrophe for a vulnerable species, such as the Grey-headed Flying-fox, as they can suffer a very high death rate and tens of thousands of animals can be involved. In heat stress events, flying-fox bodies and animals that are barely alive can be piled waist high within sites and scattered throughout the surrounding residential areas. There is little evidence to support a hands-off approach to this problem. While human presence in sites that are unused to humans can cause a disturbance (though this effect seems to be muted during a heat stress event) the damage that this disturbance might cause is minor compared to the huge death rate that follows non-intervention. At most urban sites, humans are regularly seen in and around the site and so flying-foxes are unaffected by the presence of humans unless the humans are specifically trying to disturb the camp and even then the flying-foxes can be slow to move.

On January 4th 2014 temperatures ranged from 42.9C and 44.6C in South Queensland and it has been estimated that 45,000 animals died and 1000 orphans were collected. The incidence of extremely hot and dry days is increasing and these sorts of figures are becoming common as Heat Stress Events which during the years prior to 1990 were extremely rare have now become at least annual occurrences in many areas throughout NSW. Traditionally the response to Heat Stress Events has been to mobilise carers to hand spray the affected flying-foxes with water (Stanvic et al 2013) however it would be far more effective if strategies could be put into place to “Heat Proof” colony sites, so that by their structure or by the equipment or resources available at the site, fewer flying-foxes were affected by the extreme heat.

Along with the increase in Heat Stress Events has been a change in the ecology of flying-foxes. Colonies are now more prone to splintering, so more sites have come into use and hence they are closer together. There are also more urban sites which are frequently located in remnant patches of vegetation which are weed infested and not well structured. Heat Stress Events are likely to be more evident at these urban sites and large numbers of

dead flying-foxes more of a health hazard however in general these sites are easily accessible and easy to monitor and could be used to trial various methods of Heat Proofing.

Colony Site Characteristics and Heat Stress Events

Throughout this report I have quoted the "official" BOM reports on temperatures at the nearest recording location. However these temperatures are often not the same as those experienced at the colony site. There are four main reasons for this: the particular weather conditions on the day, the orientation of the site, the nearness of creeks and water courses and the vegetation at the site.

Of these the vegetation can be altered so that it plays its part in heat proofing the colony. It is well known that sites that have the most layered vegetation do the best in hot weather. "Flying-foxes need the understorey to escape the intense heat" (Stanvic et al 2013 p5) however a thick ground cover and an intact canopy are also important to promote humidity and shading and thick plantings (wind breaks) on the side reached by drying winds from the north or west can give shelter.

Typically the worst Heat Stress Events occur at urban sites that have poor structure to their vegetation. In this context the Singleton colony at Burdekin Park, which in recent times has suffered multiple Heat Stress Events each year, is an extreme example with virtually no ground cover, no understorey and no intact canopy. While Singleton is extreme there are various other sites where the vegetation offers no protection to heatwave conditions. The colony site at Avoca North has had rampant weed growth over the last 5 years to the extent that there is no canopy in most of the site. The flying-foxes are hanging on tall dead melaleuca trees and vine overgrowth has collapsed all the understorey layers. Luckily at the back of the site there is still some rainforest surviving which acts as a refuge however it is also weed infested and when the colony is large flying-foxes roost in trees in nearby backyards.

So part of "heat proofing" colony sites must involve long term strategies aimed at improving the structure of the vegetation at colony sites. Grants (and vaccinations) for bush regenerators working under colony sites could be one of these strategies.

Water and Heat Stress Events

The Central Coast

There is no recorded Heat Stress Event on the Central Coast until New Year's Day 2006 (43.8C) when the Wingello Creek colony was affected. Wildlife Animal Rescue and Care Society Inc (The ARC) rehabilitators used hand sprayers to water the bats that were found comatose on or near the ground and removed more than 200 for further intensive treatment. Most of the treated dehydrated bats recovered and eventually re-released. The death rate was under 300 within the colony.

There were two heat events at the Avoca North site in 2013: One on the 8th (42.3C) and the next was on the 18th of January (44.8C).
(http://www.bom.gov.au/climate/current/statements/scs43e.pdf).

I counted the camp the night of the 7th found that there were about 20,000 flying-foxes in residence. I walked through the middle of the site on the 8th and virtually every animal was hanging lower than my shoulders and most were clumped to get relief from the locally 45+C temperatures by clutching each other (37C) or the cooler tree trunk. They were too mazed with the heat to respond to my presence. They certainly didn't seem stressed by me being there; they were dying. The maths appalled me. If half the colony were breeding females then we were looking at a possible 10,000 dead and dying baby flying-foxes and an unknown number of adults. If only 5% came down alive this would result in 500 animals for rehabilitation. Which is a massive undertaking and similar to the numbers rescued when the Casino colony came down in November 2014.

I organised a commercial water carter to spray water onto the front of the colony. Very few animals were in this part of the site but this was all the hoses could reach. The ARC also sent numerous rescuers armed with water sprayers and super soakers. The response to the spraying by the water carter was immediate and impressive as the juvenile and adult flying-foxes immediately climbed back up into the canopy. It was interesting that prior to the spraying most of the dependent juveniles were hanging by themselves however one mother and baby fell to the ground in the flurry caused by the female's attempt to push the baby away. I picked both up and while the mother felt to be a reasonable temperature the baby was extremely hot. The smaller animal's inability to lose heat in extreme temperatures is probably the reason why the babies are left by themselves and not clutched by their mothers, and why most of the dead during heat stress events are juveniles. The day ended with less than 100 dead juveniles in the site and 75 live juveniles taken in care.

On the 18th January 2013 the site acted as a heat sink and temperatures in excess of 47C were measured near the colony. I was unable to get a commercial water carter. However the Avoca North RFS had been scrambled to deal with potential bush fires but had not been called out and they volunteered to help. They came and sprayed water from the fire-fighting hose onto the unused front of the site. Once again, almost as soon as the water hit the vegetation, the bats revived and climbed up the trees. There were fewer than 100 dead found in the site and the ARC took in a total of 72 for further treatment and eventual release. Other sites throughout the state had tens of thousands of dead during these 2 heatwaves.

Burdekin Park at Singleton

At the local rehabilitation group's request and in conjunction with the local Council, carers from The ARC organised the response to the three Heat Events at the Singleton colony: 20/12/2017 (43.0C), 7/01/2018 (44.1C) and 22/01/2018 (42.2C). Singleton Council ran the ground-based sprinklers from 37C onwards on days of extreme heat and the rehabilitators used hoses (and soaker hoses) attached to taps in the site, and back-pack sprayers to keep the ground wet. The ARC carers sprayed as high as they could up the trees. (One carer tied a hose to a tall pole and was able to spay water high up a tree. Interestingly, no bats fell from that tree.) There was about half a body bag of dead animals retrieved at each event while total of almost 100 live animals were removed for further treatment and re-release. In comparison, the previous year (2016/2017) Singleton had two heat stress events and

without effective intervention thousands of animals died. Council workers took dead bats to the tip in trailer loads and helped by rehabilitators were clearing the dead from the surrounding streets for days after the event. (Burdekin Park had sprinklers then however Council officers were told that the sprinklers would only acerbate the problem and so they were not used.)

Three Heat Events at Singleton colony site in the summer of 2017/18 were considerably reduced in intensity by having large amounts of water on the floor of the colony. In particular it seemed that the use of the installed ground-based sprinklers reduced the severity of the Heat Events, reduced the number of animals that died (to a hundred or so) and reduced the number of people potentially in contact with downed flying-foxes as well as the number of carers required to monitor and act at the site.

The effectiveness of aerial sprinklers, ground sprinklers and ground watering on the microclimate of the site and the responses of flying-foxes to these interventions should be investigated to determine the most effective technique to be used in Heat Proofing sites. However multiple examples show that the presence of water in a site has a protective effect on flying-foxes during a Heat Stress Event no matter how the water is applied. So another action by Council that would reduce the mortality of flying-foxes at sites during Heat Stress Events would be the installation of water taps throughout the site with keys that are easily available to rehabilitators. Having easy access to water would result in it being easier for carers to lower the death toll during a Heat Stress Event and reduce the possibility of people coming into contact with flying-foxes.

There is an increasing incidence of heat stress events throughout NSW and rehabilitation organisations have limited capacity for the work these events generate, particularly if more than one colony site goes down in any particular area. Overall there is a limited capacity to manage multiple heat stress events even on a State-wide basis. However it seems likely that the installation of sprinklers, particularly if placed high in the canopy could go some way to heat proofing flying-fox colony sites and if these could be automated so that they turned on whenever the temperature exceeded 37C this could make a huge difference to the levels of mortality in flying-fox colonies as well as reducing the need for large numbers of carers to be present. It would enable more sites to be monitored, reduce flying-fox mortality and so reduce the overall cost to Council in managing days of extreme heat.

References

Baker, M. A. 1989. Effects of dehydration and rehydration on thermoregulation sweating in goats.*J. Physiol.* **417**. 421-435.

Laburn H. P. & Mitchell D., 1975. Evaporative Cooling as a Thermoregulatory Mechanism in the Fruit Bat, Rousettus aegyptiacus. *Physiol. Zool.* **48 (2).** 195-202.

Mitchell, D., Fuller, A., & Maloney S.K. 2009. Homeothermy and primate bipedalism: is water shortage or solar radiation the main threat to baboon *(Papio hamadryas)* homeothermy? J. Human Evol., **56**. 439-446.

Stanvic S., McDonald V. & Collins L. 2013. Managing Heat Stress in Flying-fox colonies. https://www.fourthcrossingwildlife.com/HeatStress-StanvicMcDonaldCollins.pdf