



# ZAMBEZE DELTA ECOLOGY

*Holistic Ecological Research Project*



**JANUARY 2019**

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**MONTHLY RESEARCH REPORT**  
**PRELIMINARY COLLAR-DATA ANALYSES**



# ZAMBEZE DELTA LION COLLAR-DATA

This report is a preliminary spatiotemporal analysis of the first 4 months of the Zambeze Delta lion collar-data since their reintroduction into the system. This is not a long period of time in ecology, and, as such, the results presented here are in no way comprehensive. The period over which this data was collected (September to December 2018) is essentially the end of the warm dry season in the Zambeze Delta; and the vegetation, and thus habitats, potentially undergoes a significant transformation during the normal wet season, which may affect the behavioural ecology of both predators and prey, and their relationship to one another. Therefore, at least 2 years worth of continuous tracking data is ideally needed before we can begin to truly understand the ecology of lions in the Zambeze Delta ecosystem.



However, this data is incredibly valuable and interesting due to one key attribute: *it represents the behavioural ecology of a lion seed population into a naïve area, from the moment of reintroduction.* Lions are the apex predator, and as such exert top-down control over the rest of the ecosystem. The reintroduction of the species, including the elements of risk and fear, to an environment historically devoid of lion presents us with a unique opportunity to understand the formation of their spatial organisation and relationships in respect to territorial behaviour, as well as obviously their impact on prey species in terms of both their reactions to the real and perceived risk of predation, as well as their overall population numbers.

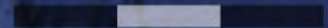
# THE ZAMBEZE DELTA ECOREGION

## CLOCKWISE:

- Coutada 12 (*blue*)
- Coutada 11 (*blue*)
- Coutada 14 (*blue*)
- Marromeu Reserve (*red*)
- Coutada 10 (*blue*)

Mozambique

100 km





# RESEARCH COLLAR-DATA HISTORY

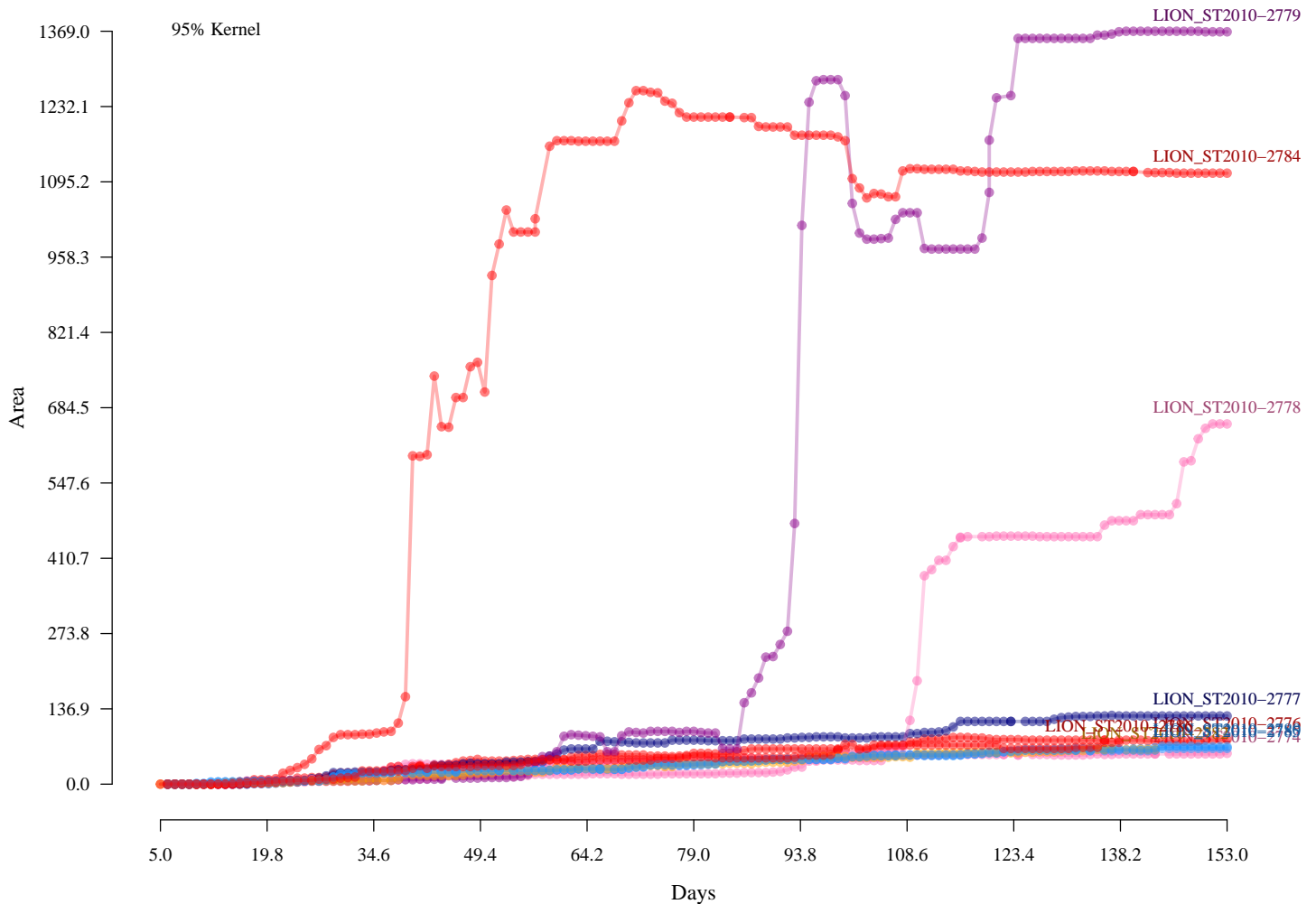
15 of the original reintroduction group of 24 lions were fitted with satellite biotelemetry collars (Savannah Tracking, Nairobi, Kenya). Unfortunately, 4 of these collars failed shortly after deployment, but were replaced in December 2018, during which an additional 5 lions were similarly collared (2 with new SirTrack collars). The spatiotemporal data collected by the collars is hourly point-location fixes. Unfortunately, one of the male lions was killed as the result of a poacher's gin-trap in early September 2018. The total tally of lions currently collared is thus 19 animals of the remaining 23 original introductions. *(Additionally, several local lions have recently been recorded interacting with the new introductions; these lions obviously originate from the surrounding areas, attracted to the Zambeze Delta ecosystem by the prospect of mates).*



In addition to the 19 active lion collars, since December 2017, we have also deployed 49 collars on other large mammal species, including elephant, buffalo, eland, sable, zebra, hartebeest, reedbuck and warthog, of which 30 are currently still active. We plan in time to analyse the interaction between the lions and these species and thus further understand the predator-prey dynamics in relation to the conservation of the Zambeze Delta ecosystem.



# MINIMUM DATA FOR SPATIAL ANALYSES

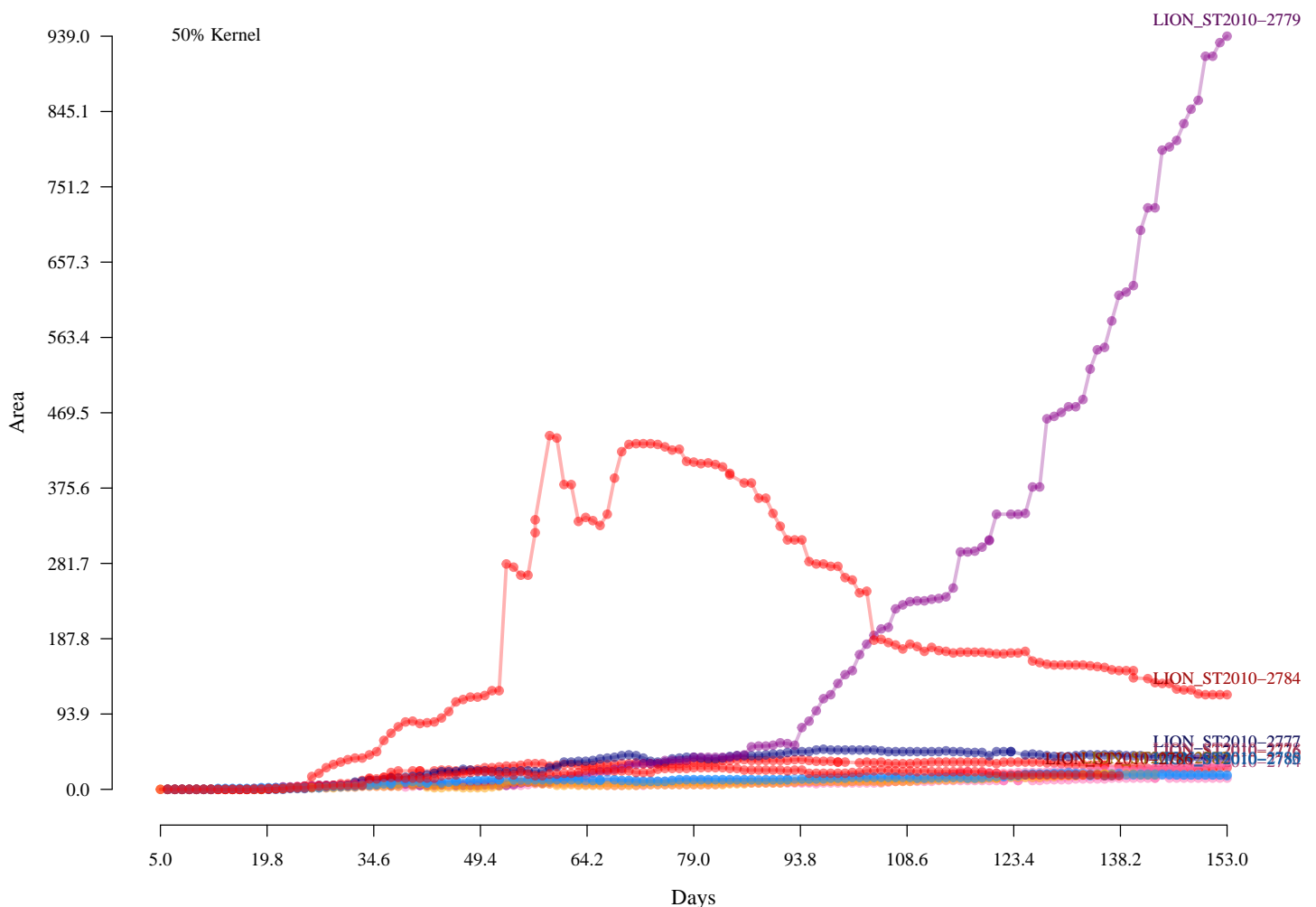


*The 95% (range) cumulative utilisation distribution of the lions, starting with 5 days worth of spatial data, and increasing this by one day at time over a period of 5 months. For all the collared lions living in social units, there is a slight but steady increase in range size from the moment of release from the bomas until about 120 days later, from which point onwards there is a negligible change in area. The solitary lions however display vagrant behaviour with much greater utilisation distributions as they are not defending a specific patch, but wandering far and wide.*

For spatiotemporal analyses, especially as they pertain to territoriality, a useful first step is to assess the temporally cumulative utilisation distribution, where a plateau indicates relative stability in terms of overall dynamic size – and thus a sufficient quantity of relocation data for which to analyse ranging behaviours. This basically tells us whether the animals have been collared for long enough so that there is enough data to represent their normal ecology; as



too few data could either over or under represent actual space use, and is thus potentially pointless. With regarding to territoriality, there are basically 2 levels at which these are considered; the 95% range, and the 50% core utilisation distributions. The 95% range (excluding 5% of the outermost locational data as outliers) is the overall area used by the lions, and which is defended to some extent. The 50% core area is the space in which the lions spend the majority of their time, which usually includes key resources such as water sources and productive hunting grounds, and is the area actively defended from any and all competitors.

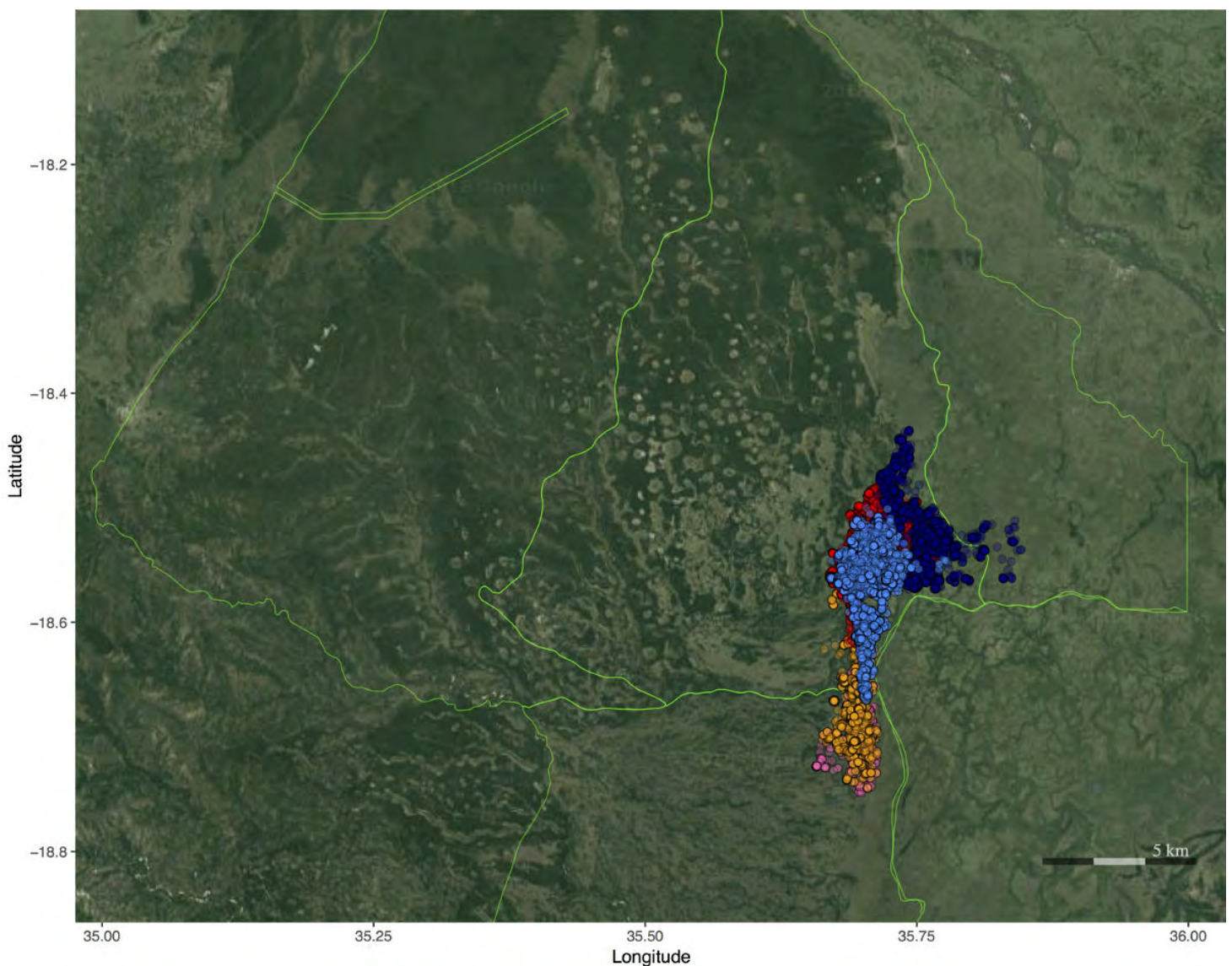


*The 50% (core) cumulative utilisation distribution of the lions. For all the collared lions living in social units, there is a slight but steady increase in core area size from the moment of release from the bomas until about 100 days later, at which point there is a slight decrease in area as the territories stabilise. Solitary Lion2784 joined the Mkuze group after a period of vagrancy, from which point his core range area decreased in size. Conversely Lion2779 took longer to leave the reintroduction site, but has yet to either settle or return.*

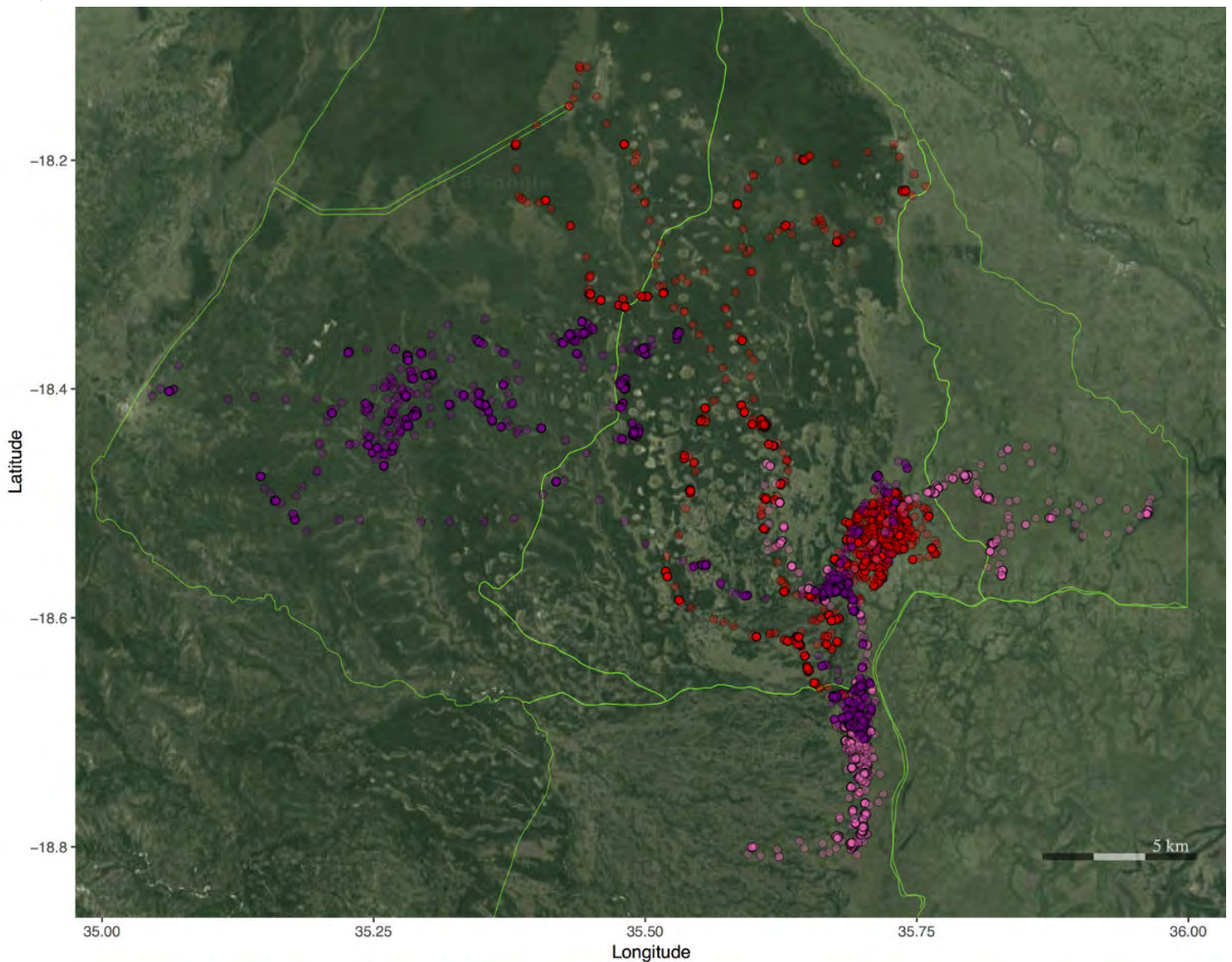


# COLLAR-DATA POINT TRACKING MAP

The key result of this report is the distinct differences in ranging behaviour between solitary lions and those in a cohesive social unit (*as predicted in the original motivation for the lion reintroduction*). Lions that belong to a group (*female pride / male coalition*) are territorial, with defined boundaries between their core ranges and those of their neighbours, which are actively defended. Solitary lions are generally less able to defend their patch from the more common groups, and are subsequently more vagrant in their ranging behaviour (solitary fare less well as lion density increases).



*Groups of lions are better able to defend a resource-rich patch, and they consequently have smaller and more stable home-ranges.*



*Solitary lions have a greater tendency to be vagrant, as they are generally less able to defend a patch, and tend to avoid interaction with larger groups.*

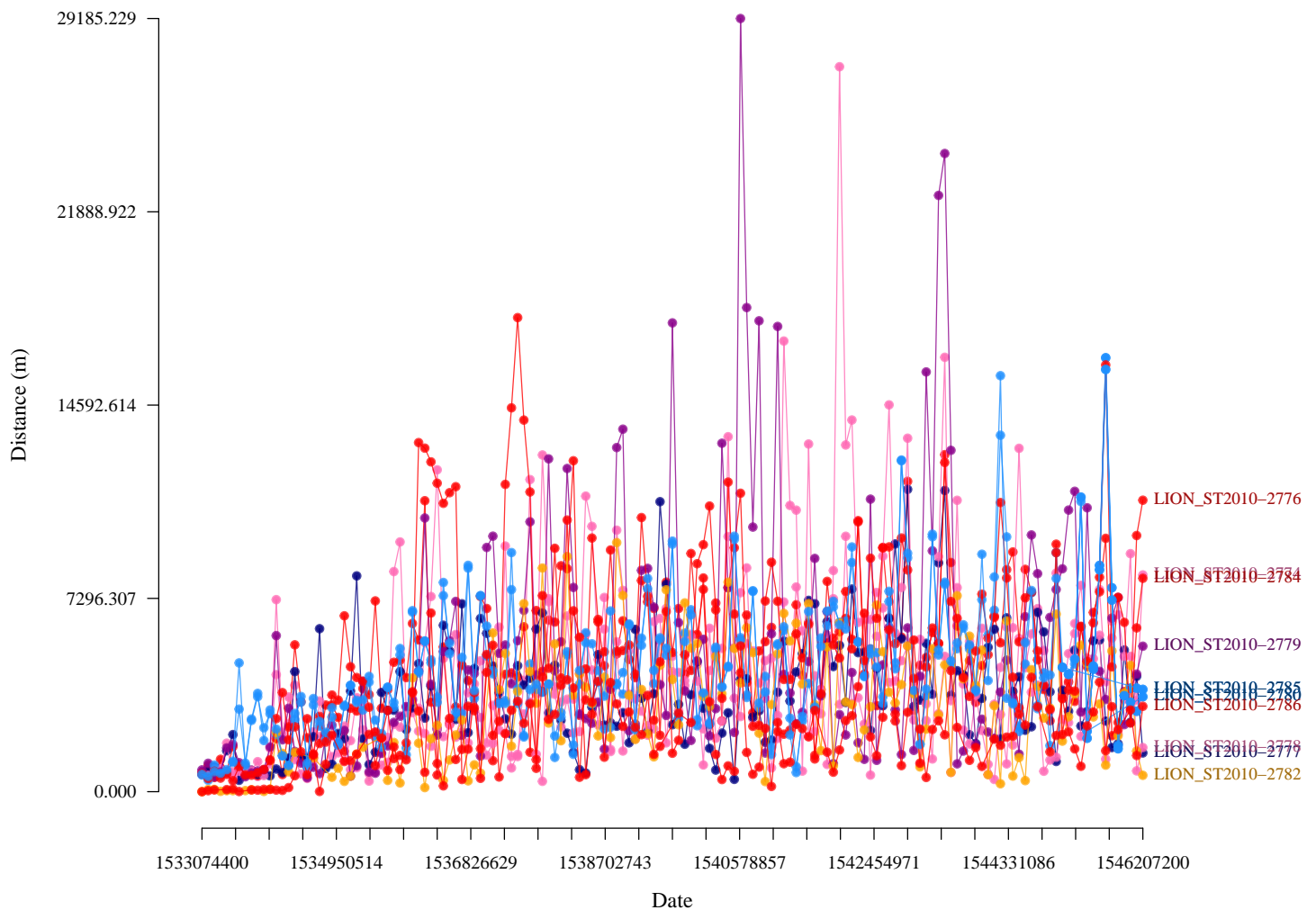
From a conservation management perspective, solitary animals are obviously a lot more difficult to both protect and predict, and depending on human density and risk, management action should be focussed on these individuals, with a plan for intervention if necessary. The Zambeze Delta Holistic Ecological Research Project, through the support of the Cabela Family Foundation, is fortunate to be in a position where we have continual access to a helicopter for the monitoring of lion as and when necessary – which is a huge advantage in an environment as vast as the Zambeze Delta, and in which many areas are seasonally inaccessible from the ground, and some permanently. *The use of this helicopter for both monitoring and intervention purposes has been a key component in the success of the lion reintroduction project to date.*





# LION STEP-LENGTH AND MOVEMENT

The distance moved by lions on an hourly, daily, and monthly basis, contains a wealth of information that can indicate a range of behaviours such as feeding (*small hourly movement*), interaction with neighbours (*spike in daily distance moved – usually in a straight line*), and formation of a territory (*stable monthly movement behaviour*).

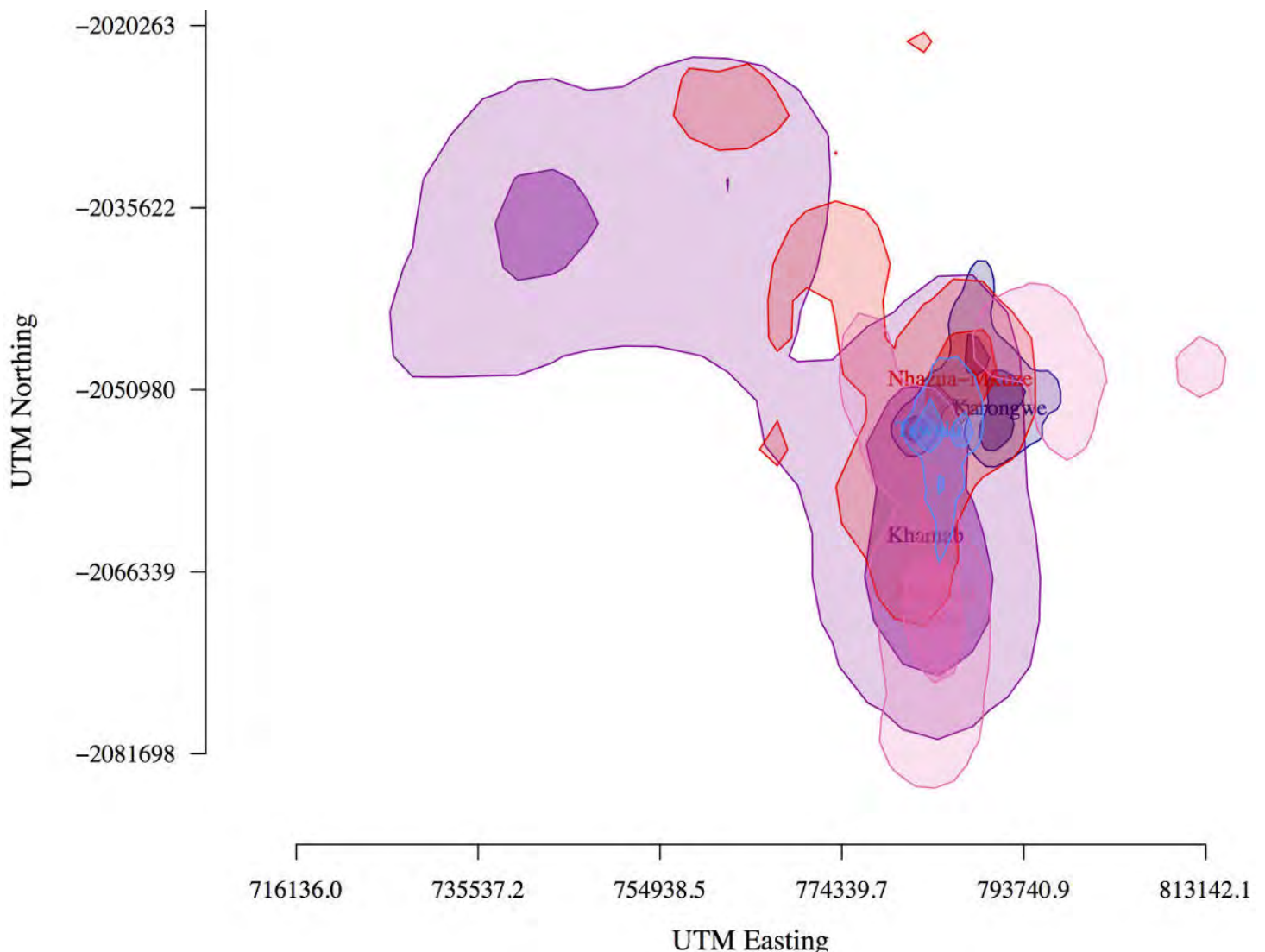


*The daily distances moved by lions. Whilst with all the data overlapping this graph is difficult to make sense of in and of itself, it does indicate a sense of rhythm and regularity in the variation of movement over time that is shared by all of the lions. Lion behaviour changes daily: periods of apparent inactivity are routinely interspersed with spikes in motion. The stationary behaviour could, for example, indicate time spent in a resource-rich patch, whilst the movement behaviour indicates moving to a different resource patch when the prey learn that the predators are in the area.*



# TERRITORY AND RANGE FORMATION

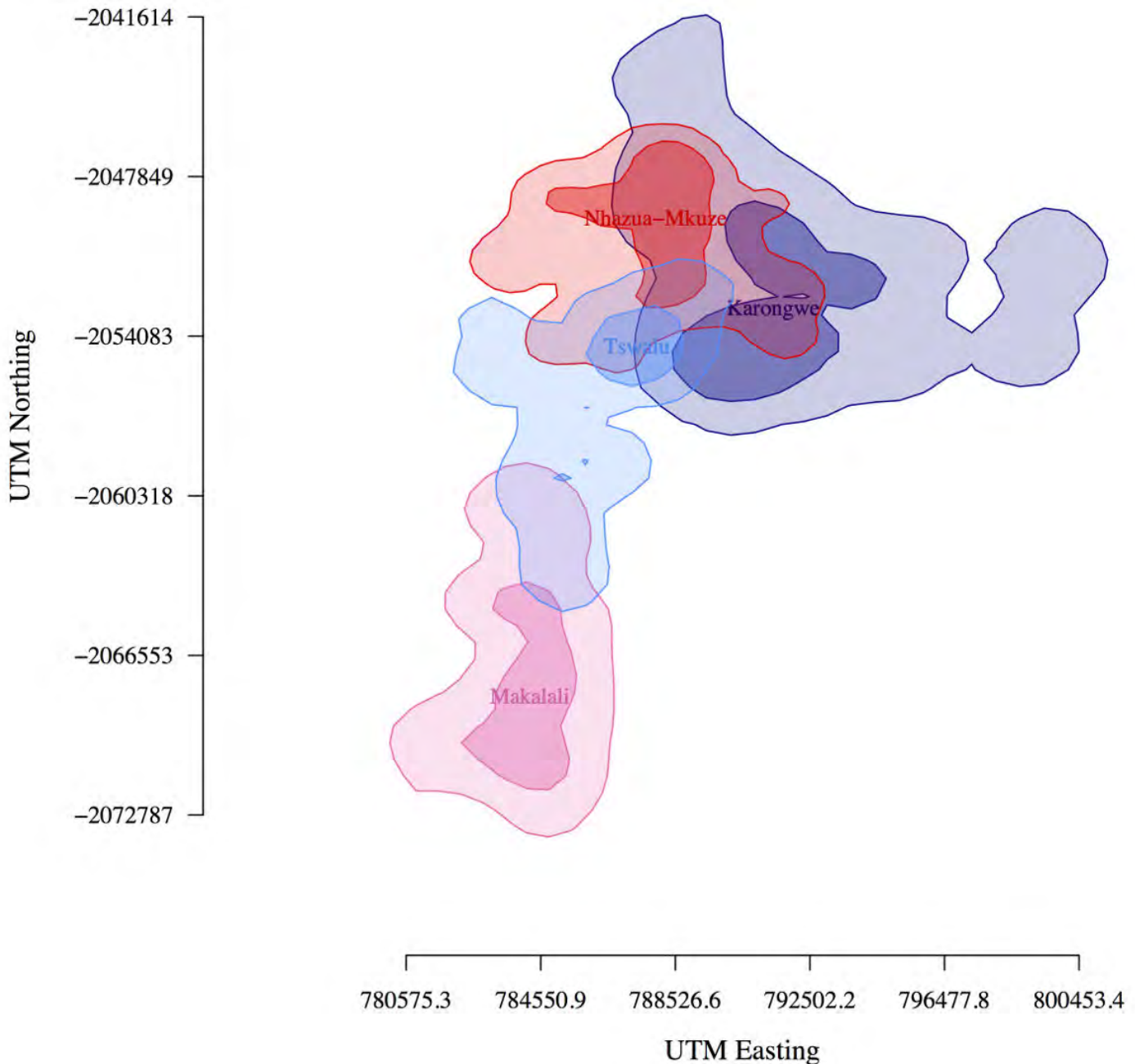
For context; small groups of lions were sourced from various locations in South Africa for reintroduction into the Zambeze Delta, and were essentially forced to integrate with other social units whilst in the bomas. Since their release into a new environment, there was a period of readjustment whilst the lions acclimated; but they are now showing clear signs of settling down and establishing distinct territories. Even the solitary male (Lion-ST2010-2784), whose brother was caught and killed in a poacher's gin-trap, and after a long period of roaming, has settled down on the floodplain and has successfully formed a social relationship with a younger male and 2 females.



*The overall home-range and core utilisation distributions for the distinct lion social units. The paler area represents the 95% utilisation distribution; the nucleus represents the 50% core area.*



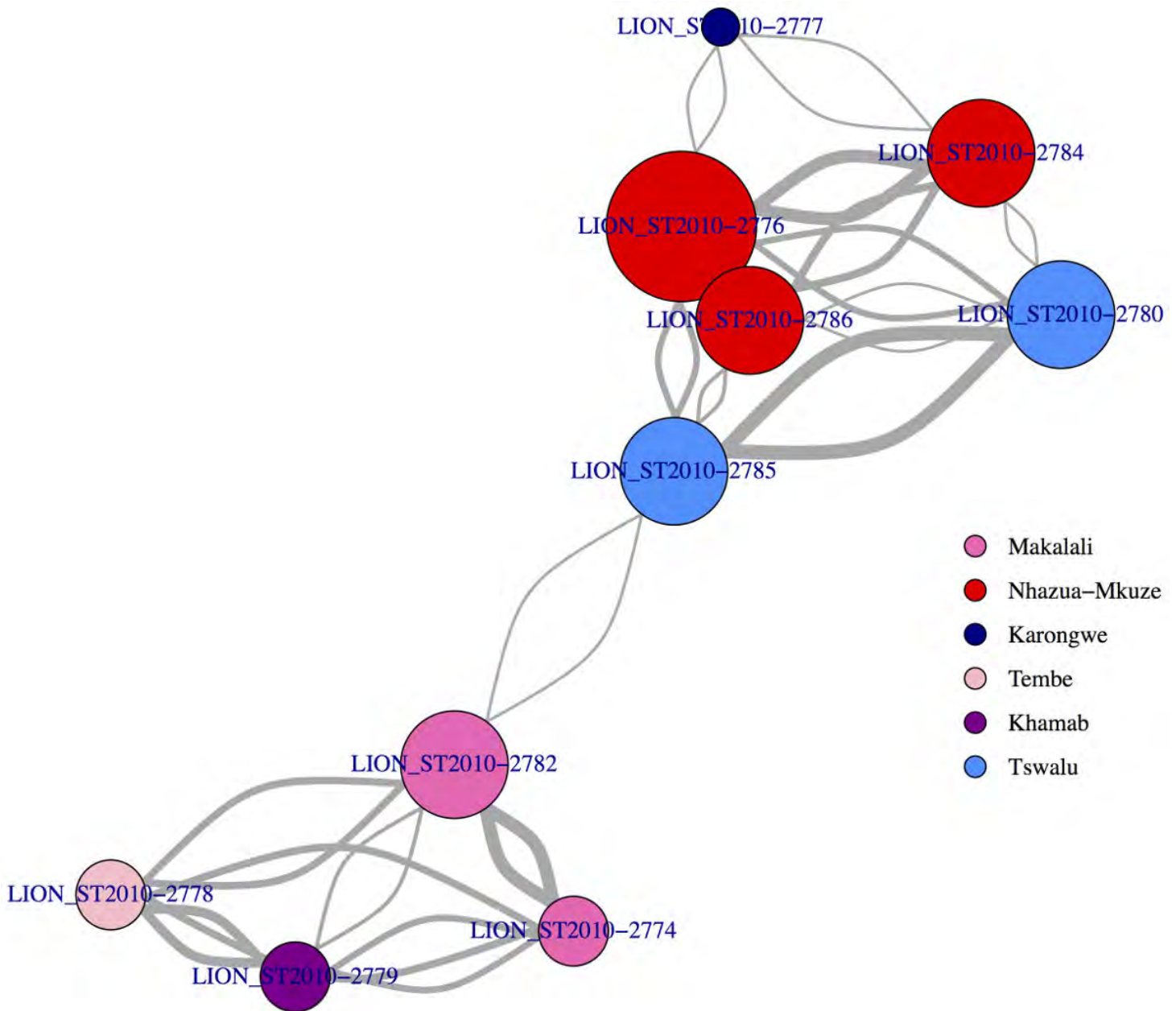
# DECEMBER 2018



*This amoeboid graph represents the data for the month of December 2018, as the most advanced stage of the lion process of settling into the Zambeze Delta. To clarify, this graph explores the territorial behaviour of the lions, and as such the ranges of the solitary lions, having no actively defended patch, have been excluded. What is interesting to note is that while there is extensive overlap of the overall range kernels, there is no overlap of the core area kernels – though they touch each other in 3 out of the 4 distinct groups. This is clear evidence of territorial behaviour where there are clearly defined boundaries (though these shift in space with time) that are actively defended.*



# LION SOCIAL NETWORK ANALYSIS



*This social network analysis represents each of the collared lions during the period of September to December 2018, inclusive. The size of the individual represents the number of other animals it is in contact with, whilst the thickness of the contacts between individuals represents their relative frequency. As an exploratory exercise that will be built on in future as more data accumulates, individual lions were considered to have made contact if they were located within 100 m of one another.*

Ecological social network analyses is an emergent field that is improving our overall understanding of population structures as well as inter- and intra-group behaviour, including: transfer of information; personality and status;



and cooperation. This allows ecologists to address the more complex challenges regarding the structures and function of biological societies. With regard to reintroductions, the cohesion of social units is considered one of the determinants of success, whereas a lack of group unity generally leads to increased post-release dispersal and mortality rates, which we have observed. This however is by no means a comprehensive social network analysis, but rather a static representation of the interaction between individuals and groups in terms of the level of contact and relative popularity of each individual in the overall social scene. This will be an on-going work which will develop over time, and which should provide an interesting backdrop to the other spatiotemporal analyses, especially with reproduction and recruitment into the population as it matures, and increasing levels of interaction and competition between individuals and groups.





# SUMMARY OF THE REINTRODUCTION PROCESS FROM THE PERSPECTIVE OF THE LIONS

There is no doubt that the reintroduction of lions back into the Zambeze Delta ecosystem has been a roaring success. Despite the fact that we lost one individual to a poacher's gin-trap, the fact that the rest of the lions are thriving in an area from which local lions were historically eradicated is sheer testament to the decades of dedicated boots-on-the-ground anti-poaching and mature conservation management plans.

One of the critical results to have come out of the monitoring program to date, though we have barely really begun, is that larger and more mature cohesive social units are much more stable in the post-release phase of reintroduction than are individuals or smaller groups that are at relatively greater risk of mortality. Larger groups hold much better defined territories, in which they are defending a resource patch; fewer groups of less individuals have less ability and incentive to defend an area, and are thus more at risk of becoming vagrant, and potentially wandering far from where they are protected. We can safely assert with scientific support that future attempts by other conservationists wanting to follow our lead with lion translocations carefully consider lions based on these criteria so as to avoid risk to the lions or people.

Also, any attempt to translocate wildlife should only be attempted with the support of dedicated partners – for that we are most grateful, and we certainly would not have achieved anything near to the success we have experienced without direct support from the Cabela Family Foundation for funding the lion translocation and research from start to finish, including the helicopter aerial support without which active monitoring of the lions would be nearly impossible. We are also grateful to the Mozambican Government Administração Nacional das Áreas de Conservação for allowing us to bring these animals into the country and for facilitating the administrative processes and granting of permits to conduct the research. Thanks also to Alexandra Jahr for funding 2 new lion collars – the data of which were not used in this report as they were deployed in December 2018 (onto 2 females in the Makalali Pride), but will be extremely valuable going forward. Finally, Savannah Tracking were very good about replacing faulty collars with new devices that are working beautifully.

DR Byron du Preez  
IVAN CARTER WILDLIFE CONSERVATION ALLIANCE

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**THIS COALITION OF LIONS IS THE 3 MALES FROM THE TSWALU GROUP; the data from their collars has been used extensively in this report. This is a dominant coalition in the Zambeze Delta ecosystem, which defend a large floodplain territory in the Coutada 11 area.**

**This photo represents the lions ranging, while their collars record data that we analyse simultaneously with the other tagged animals – it is effectively an alternative version of the collardata map; a snapshot of lion behavioural ecology on the Zambeze Delta floodplain, SIMULTANEOUSLY AFFECTING + BEING AFFECTED BY THE WHOLE ECOSYSTEM**

DR. BYRON DU BREEZ

**#24LIONS**