Home ranges of predators and small sources of marine biomass.

Sergio Cobarrubia-Russo*

Department of Laboratory of Ecosystems and Global Change, Venezuelan Institute for Scientific Research, Caracas, Venezuela

Abstract

The meaning of the ecological term home range defines an important ecological aspect of mobile animals and has "evolved" in an attempt to project the most comprehensive definition. In a study of home ranges and ranges of two species of coastal dolphins and fishermen on the western coast of Aragua, Venezuela, South Caribbean, it was observed that these three species coincided in a specific area, so that a spatial analysis determined a small and important source of biomass that provides prey throughout the year for dolphins, fishermen and local people. This note aims to highlight the ease of defining these areas and their conservation importance as sources of protein for humans and other predators.

Keywords: Bottlenose dolphins, Atlantic spotted dolphins, Fishermen, Feeding area, Fishing area, Venezuela, South Caribbean.

Accepted on 03 September, 2021

Introduction

Home range evolution

It is interesting how an ecological term evolves with research, in the case of the home range it began with a purely spatial meaning in which the animal was restricted to the area it used most during the day [1,2]. Later, the concept was subject to additions and modifications, for example it was the area where vital activities such as feeding, mating and breeding took place which will later be understood to be extrinsic factors that shape the home range, such as the quality and richness of prey, the risk of predation and anthropogenic activity [3,4]. Now, this occurs when there is some nomadic character in the individual, therefore, the term is subject to the inclusion of the time factor, this led to think that it is most of the time (95%) is the home range and half of this (50%) the core area as the space where the individual is most concentrated [5-8].

Apart from the spatial and temporal dimensions, a more subjective factor, inherent to the individual's cognition, is being included, which is knowledge about space: feeding area(s), refuge area(s), area(s), route(s) safe from predation [9-12]. This is where intrinsic factors such as physiological constraints, reproductive status, heterospecific behaviours, individual body size and sex play a role, so the home range may be "an animal's cognitive map of its environment that it chooses to keep up to date" [13,14]. Ultimately, this "cognitive map" must be managed by the majority of the group in social species. And in cetaceans suggested that whaling probably destroyed this knowledge in certain populations because today, despite the moratorium, whale populations have not recovered as mathematically predicted, most likely due to the loss of the "cognitive map" held by adult individuals who were the individuals of greatest size and value to whalers [15].

Dolphins and Fishermen on the Western Coast of Aragua

In an ecological characterization of the Bottle Nose Dolphin (BND) in the western coast of Aragua, Venezuela, Caribbean South, it was perceived that this species fed mostly during the mornings in a certain extension of the coast, as well as the Atlantic Spotted Dolphin (ASD, a sympatric species) and in the large fishing area of the fishing villages (FIS), this area was included [16]. From this daily observation came the idea of overlapping the ranges of these three top predator species in order to determine the overlapping area [17]. Although it was observed that both dolphin species eventually hunted from the same schools, ASD tended to be sighted more distant from the coast. It should be noted that commercial fishing in this area supports the state of Aragua and surrounding states.

Overlapping of Feed Areas

Once the Minimum Convex Polygons (MPC) and the Fixed Kernel (FK) were determined with the Animal Movement function of ArcView 3.3, the feeding and fishing ranges of the three species were overlapped in MPC and the same with the FK and then the area of overlap was calculated at 45% and 25% for the definition of the core area. It could be confirmed that it is necessary to have at least 20 sightings as that the area accumulation curve for each new sighting starts its asymptote in the area covered by each new perimeter point [18,19,20]. This overlapping area was 63.31 km2 (FK 95%) and 24.75 km2 (FK 25%), which equated to 26.86% of the study area [5].

Then a finer analysis of this feeding area was the Correlation plot of standardized residuals of sightings by dolphin species and by isobath were performed, although there were eventual sightings where both species feed on the same school, a significant separation was demonstrated where BND fed

between 50 and 100 m depth and ASD fed between 100 m and 200 m [5].

Biomass Source Area

Thus, the overlapping of feeding and fishing areas indicated an important area of presence of annual prey of biological and commercial interest. These types of feeding areas, besides being important for fisheries, when offering additional shelters and low anthropic impact, allow the long residence of groups of reproductive cetaceans, which maintain the species and the presence of a top predator vital for the food chain to monitor the populations of smaller predators. In fact, by resuming studies in the same area we have detected the residence of individuals exceeding 15 years of residence. Since 2019 we have initiated a photo-identification study in the area, this time targeting both species with the aim of investigating social sympatry and we came across the fact that ASP had practically disappeared from the study area, reducing its sighting rate to almost zero. We are now investigating the cause, but we also came across the presence of whale shark pups moving along the coast. Also, in conversations with fishermen, they have told us that in the area where BND feeds the bottom are rocky, this information needs to be corroborated, but if true, it could be acting as a refuge for the recruitment of fish species of biological and commercial interest. Although it would be ideal to sound the bottom, this information is very important because it would be a factor, apart from a slight upwelling and a contribution of nutrients from the rivers, which could be contributing to the presence of prey.

Also, I think it is necessary to add other kinds of predatory animals, for example birds (in feeding behavior) because they would determine a "maximum limit" of the prey source in view of the fact that the mobility of birds is superior to that of fishermen and dolphins. And on the other hand, in view of the ease of sighting whale sharks, it would be possible to estimate at least the extent of coastline with primary productivity [21-23].

Conclusion

Finally, the global depression of fisheries makes it necessary to safeguard these small prey source areas as they support many species. This may be happening in Venezuela in view of the trawling ban in 2009, so that massive by catch or incidental fishing is almost non-existent in Venezuelan fisheries. However, it is necessary to analyze the fishing history in the aforementioned study area to determine whether an increase in the volume of sardine and anchovy fishing could be a factor in the displacement of ASD, which was previously very abundant and has now practically disappeared. Therefore, further studies together with the fisheries will be necessary as these small sources of marine biomass are worth protecting because they provide protein for humans and animals and are easier to manage due to their small size.

References

1. Darwin C. On the origin of species (3rd Edn). London: Murray. 1861.
2. Seton ET. Life-histories of Northern animals: an account of the mammals of Manitoba. New York, NY: Charles Scribner's Sons. 1909.
3. Burt WH. Territoriality and home range concepts as applied to mammals. J Mamm. 1943; 24: 346-52.
4. Nekolny SR, Denny M, Biedenbach G, et al. Effects of study area size on home range estimates of common bottlenose dolphins *Tursiops truncatus*. Curr Zool. 2017; 63: 693–701.
5. Powell RA. Animal home ranges and territories and home range estimators. In Pearl MC, Boitani L and Fuller TK (edn), Research techniques in animal ecology: Controversies and Consequences. Columbia University Press. 2000; pp: 65-110.
6. Dixon KR, Chapman JA. Harmonic mean measure of animal activity areas. Ecology. 1980; 61: 1040-44.
7. Samuel MD, Pierce DJ, Garton EO, et al. Identifying areas of concentrated use within the home range. J Anim Ecol. 1985; 54: 711-19.
8. White GC, Garrott RA. Home range estimation. In White GC and Garrott RA (edn), Analysis of Wildlife Radio-Tracking Data. San Diego, CA: Academic Press. 1990; pp. 145-82.
9. Peters R. Communication, cognitive mapping, and strategy in wolves and hominids. In Hall RL and Sharp HS (edn), Wolf and Man: Evolution in Parallel. San Diego, CA: Academic Press. 1978; pp. 95-108.
10. Börger L, Franconi N, Ferretti N, et al. An integrated approach to identify spatio-temporal and individual-level determinants of animal home range size. Am Nat. 2006; 168: 471-85.
11. Kie J, Matthiopoulos J, Fieberg J, et al. The home-range concept: are traditional estimators still relevant with modern telemetry technology?. Philos Trans R Soc B. 2010; 365: 2221-31.
12. Spencer WD. Home ranges and the value of spatial information. J Mamm. 2012; 93: 929-47.
13. Wearmouth VJ, Sims DW. Sexual segregation in marine fish, reptiles, birds and mammals: behaviour patterns, mechanisms and conservation implications. Adv Mar Biol. 2008; 54: 107-70.
14. Powell RA, Mitchell MS. What is a home range? J Mamm. 2012; 93: 948-58.
15. Whitehead H, Rendell L, Richard W, et al. Culture and conservation of non-humans with reference to whales and dolphins: review and new directions. Biol Conserv. 2004; 120: 431-41.
16. Russo CS. Ecology and behaviour of the bottlenose dolphin *Tursiops truncatus* on the coast of Aragua State (MSc thesis). Simón Bolívar University, Caracas, Venezuela. 2010.
17. Russo CSE, Esnal BGR, Lizarraga MAE, et al. Individual home ranges of *Tursiops truncatus* and their overlap with

ranges of Stenella frontalis and fishermen in Aragua, Venezuela, South Caribbean. J Mar Biol Ass UK. 2020; 1-10.

18. Gubbins K. Use of home ranges by resident bottlenose dolphins (*Tursiops truncatus*) in a South Carolina estuary. J Mamm. 2002; 83: 178-87.
19. Mares MA, Willig MR, Bitar NA, et al. Home range size in eastern chipmunks, *Tamias striatus*, as a function of number of captures: statistical biases of inadequate sampling. J Mamm. 1980; 61: 661-9.
20. Schoener TW. An empirically based estimate of home range. Theor Pop Biol. 1981; 20: 281-325.
21. García IEC, Ortiz M, Jara RE, Magaña CAL, et al. The functional trophic role of whale shark (*Rhincodon typus*) in the northern Mexican Caribbean: network analysis and ecosystem development. Hidrobiología. 2016.
22. Russo CS, Barreto G, Torres QE, et al. Occurrence, abundance, range, and residence patterns of *Tursiops truncatus* on the coast of Aragua, Venezuela. Mamm Res. 2018; 64: 289-97.
23. Reeves RR, Stewart BS, Clapham PJ, et al. Atlantic spotted dolphin. In Stewart RR, Clapham BS and Powell J (edn), Guide to Marine Mammals of the World. New York, NY: Alfred A. Knopf. 2008; pp: 370-73.

*Correspondence to

Sergio Cobarrubia-Russo

Department of Laboratory of Ecosystems and Global Change,

Venezuelan Institute for Scientific Research

Caracas

Venezuela

E-mail: sergio.cobarrubia@gmail.com