



Analysis Evaluation of Resource Value Effects Territorial Defense by Broad-Tailed and Rufous Humming Birds

Venkata Kanaka Srivani Maddala^{1*}, Muniyandy Elangovan², Rahul Kumar³, Prasanta Kumar Parida⁴, Ram Bajaj⁵, N Konda Reddy⁶

¹Associate Professor, Department of Chemistry, Vignana's Foundation for Science Technology and Research Deemed to Be University, Vadlamudi, Guntur District, Andhra Pradesh, 522213

²Department of Biosciences, Saveetha School of Engineering, Thandalam & Department of R&D, Bond Marine Consultancy, London, UK

³Department of Zoology, Sheodeni Sao College (Magadh University), Kaler-824127, India

⁴Associate Professor, School of Rural Management, KIIT University, Bhubaneswar, Odisha,

⁵RNB Global University, Bikaner, Rajasthan

⁶associate Professor, Department of Engineering Mathematics, Koneru Lakshmaiah Education Foundation, Gfreenfields, Vaddeswaram, Guntur Dist, Andhra Pradesh

*Corresponding author's: Venkata Kanaka Srivani Maddala

Article History	Abstract
Received: 06 June 2023 Revised: 05 Sept 2023 Accepted: 15 Nov 2023	<i>Hummingbirds of the species Selasphorus platycercus and Selasphorus rufus were studied in Colorado, where they displayed territorial behaviour at feeders containing 10%, 20%, and 30% sucrose solutions. At each of the three energy availability levels, the number of invaders, the number of territory owners, and the level of Defence were recorded. After being forced out of their breeding area by Rufous Hummingbirds, Broad-tailed Hummingbirds only bother to defend locations of inferior quality. Both Wide-tailed and Rufous hummingbirds, while keeping tabs on important locations, resort to more flamboyant modes of behaviour, such as extended pursuits augmented with chip cries and aimless wing flapping. According to certain probes, a chase is ready to start if chip calls and hovering are any indication. However, I learned that when an intruder was present, it was only natural to want to get rid of them. Hovering and chip calls were utilised to increase the intensity of the chase. Broad-tailed Hummingbirds were less likely than Rufous Hummingbirds to make chip sounds or hover without giving pursuit.</i>
CC License CC-BY-NC-SA 4.0	Keywords: Resource Value, Broad-Tailed, Rufous Hummingbirds, Territorial Defense.

1. Introduction

Hummingbirds, those iridescent jewels of the avian world, have long captivated the imagination of nature enthusiasts and scientists alike. Among these enchanting creatures, the Broad-tailed and Rufous hummingbirds stand out as remarkable species that play a vital role in the delicate balance of their ecosystems. However, their significance extends far beyond their sheer beauty and astonishing aerial acrobatics. These tiny dynamos are integral to the complex web of life, making their resource utilization and territorial behaviors subjects of intrigue and scrutiny for researchers and conservationists. In this analysis and evaluation, we embark on a journey into the enchanting realm of these avian wonders, delving deep into the intricacies of how resource availability influences their territorial defense strategies.

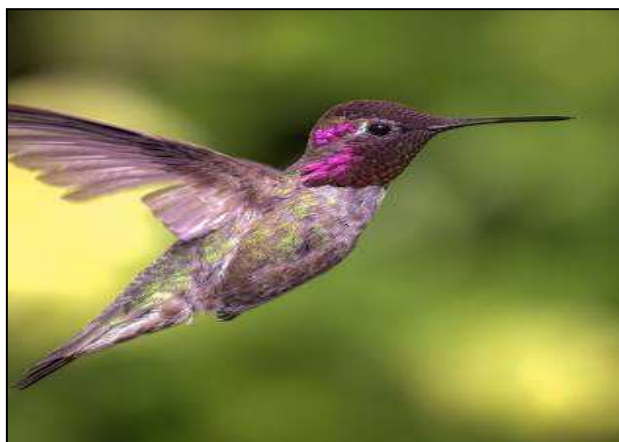


Figure 1: Hummingbird

As we unravel this captivating narrative, we gain insight not only into the lives of these feathered marvels but also into the broader implications of their actions on the ecosystems they inhabit. Join us in exploring the fascinating world where the vibrant plumage of hummingbirds conceals a tapestry of ecological interactions and survival strategies, where every sip of nectar and every inch of territory hold profound implications for the delicate balance of nature.

Resource Value Effects Territorial Defense

The concept of "resource value" plays a pivotal role in understanding the intricate dynamics of territorial defense among various species, including birds like hummingbirds. Asset esteem alludes to the apparent worth or meaning of a specific asset to an individual or a gathering inside a populace. In the context of territorial defense, resource value encompasses various aspects, such as food, shelter, mating opportunities, and safety, that influence an organism's decision to establish and vigorously protect a specific territory. Here, we delve into how resource value affects territorial defense behaviors in animals, with a particular focus on hummingbirds.

1. **Food Resources:** Food is often the primary resource that drives territorial behavior in hummingbirds. Nectar-rich flowers are highly sought after, and territories are established around these abundant food sources. The resource value of a specific patch of flowers can vary based on factors like nectar quality, quantity, and the competition from other hummingbirds. Hummingbirds will vigorously defend territories with high-quality nectar sources, as these ensure their survival and energy needs.
2. **Mating Opportunities:** For many species, territories are crucial for securing mating opportunities. In the case of hummingbirds, males often establish territories with an abundance of flowers not only to feed themselves but also to attract potential mates. The resource value here extends beyond food to include the prospect of successful reproduction.
3. **Nesting Sites:** Safe and suitable nesting sites are another valuable resource for territorial species like hummingbirds. Females seek out territories with access to well-hidden and secure nesting spots to protect their eggs and young from predators. The resource value, in this case, includes the survival and reproductive success of offspring.
4. **Predator Avoidance:** Territories that offer protection from predators hold high resource value. Hummingbirds are vulnerable to predators like larger birds and insects. Establishing territories in areas with natural cover or in proximity to protective features, such as thorny bushes or dense vegetation, can enhance their safety, making these territories valuable in terms of survival.
5. **Overlapping Resources:** Sometimes, resources may overlap or become contested. When multiple hummingbirds perceive the same resource as valuable, intense territorial disputes can arise. The competition for these shared resources can lead to aggressive interactions and territorial boundary disputes.

Understanding how resource value influences territorial defense in hummingbirds and other animals provides valuable insights into their ecology and behavior. It sheds light on the trade-offs and compromises individuals make to maximize their chances of survival and reproduction within a given environment. Additionally, it underscores the importance of conserving critical resources and habitats to ensure the well-being of these remarkable avian species and the ecosystems they contribute to through their territorial behaviors.

➤ **Broad-Tailed in Territorial Defense**

The Broad-tailed Hummingbird (*Selasphorus platycercus*) is another enchanting species in the world of hummingbirds, renowned for its iridescent emerald plumage and distinct, high-pitched trilling calls. While their captivating beauty often takes center stage, these hummingbirds have their own unique strategies when it comes to territorial defense. Territoriality is a crucial aspect of the Broad-tailed Hummingbird's life. During the breeding season, which typically spans from late spring to summer, males establish and fiercely defend territories that encompass prime foraging areas and nesting sites. Their territorial displays are not only visually striking but also acoustically impressive, with males performing aerial displays accompanied by the distinctive, resonant "chirping" sounds produced by their wing feathers.

Broad-tailed Hummingbirds, like their Rufous counterparts, are known for their aggressive and territorial behaviors. They vigorously chase away intruders, often engaging in high-speed aerial chases and mid-air confrontations with other hummingbird species or even insects that encroach upon their territory. These territorial battles can be especially intense when it comes to access to nectar-rich flowers, which are essential for their energy needs. The defense of these territories is not only about food but also about securing suitable nesting sites. The availability of safe and well-hidden nesting locations is critical for successful reproduction. Female Broad-tailed Hummingbirds select nest sites carefully, often choosing well-concealed spots in trees or shrubs to protect their delicate nests from potential predators.

In studying the territorial defense strategies of Broad-tailed Hummingbirds, we gain valuable insights into the intricate ways in which these remarkable birds adapt to their environments. Their territorial behavior not only ensures their own survival but also contributes to the health and biodiversity of the ecosystems they inhabit by promoting the pollination of flowering plants. This underscores the broader significance of these iridescent jewels in the intricate tapestry of nature.

➤ **Rufous Hummingbirds in Territorial Defense**

Rufous Hummingbirds are known for their stunning appearance and fierce territorial defense during the breeding season. They employ aerial displays, aggressive chases, vocalizations, and occasional physical aggression to protect their territories, which are rich in nectar sources. These behaviors are essential for securing food and ensuring reproductive success. Additionally, their territorial presence aids in the pollination of flowering plants, making them crucial to their ecosystems. Studying these strategies sheds light on their remarkable adaptations and emphasizes the importance of conserving these charismatic birds and their habitats.

Broad-tailed and Rufous hummingbirds are captivating species integral to their ecosystems. This analysis explores how resource availability influences their territorial defense strategies. Their vibrant plumage conceals a tapestry of ecological interactions. Join us in exploring this fascinating world where every sip of nectar and inch of territory holds profound implications for the delicate balance of nature.

2. Literature Review

Armstrong, D. P. (1992) In the controlled experimental trials that are the focus of this work, the usage of sugar-water feeders as a strategy to improve the accessibility of energy for honeyeaters is investigated. The motivation behind this study is to explore the impact that supplemental taking care of has on the energy necessities of honeyeaters as well as their way of behaving. This work makes important additions to our current knowledge of the use of artificial food sources in avian scientific research via the findings that it has uncovered.

Brown, J. L. (1964) This study investigates the evolutionary patterns and processes underlying the development of variety within bird territorial systems. This study explores the ecological and evolutionary determinants that contribute to the emergence and establishment of territorial behaviour in avian species. This study elucidates the underlying factors that lead to the diverse range of territorial systems seen among bird populations.

Calder, W. A. (1993) and Calder, W. A., et al. (1992) This request is for comprehensive descriptions of Broad-tailed Hummingbirds (*Selasphorus platycercus*) and Rufous Hummingbirds (*Selasphorus rufus*) in North America. The provided species reports provide significant insights into the ecology of hummingbirds by offering essential information pertaining to their habitat, behaviour, and population dynamics. This thorough knowledge contributes to a more profound comprehension of the subject matter.

Calder, W. A., et al. (1983) This article presents the findings of an extensive study that was conducted over a period of 10 years and looked at the phenomena of site loyalty, longevity, and population dynamics in Broad-tailed Hummingbirds. This research sheds important light on the long-term stability and durability of hummingbird populations within their distinct habitats, providing findings that are both interesting and useful.

Camfield, A. F. (2003) This study examines the influence of food supply quality on the visiting and display rates of female Broad-tailed Hummingbirds by male individuals. This research elucidates the impact of the nutritional composition of food sources on the behaviour of hummingbirds and their interactions during courting displays.

Carpenter, F. L., et al. (1983) The phenomena of migrating hummingbirds gaining weight and experiencing changes in the size of their territories is the subject of this research. The current research studies the fluid properties of hummingbird territories as well as their capacity to adapt in response to changing environmental conditions.

Dearborn, D. C. (1998) This study focuses on the phenomenon of interspecific territoriality in Rufous-tailed Hummingbirds. The research focuses on the ramifications of this behaviour for invasion size and resource value. Our knowledge of how different species of hummingbirds interact with one another across territory has been expanded as a result of this research.

3. Materials And Methods

I studied hummingbirds in Colorado's Gunnison National Forest. The county is named after the forest. Each time I made an observation, I counted the number of incursions and noted their species and gender. If a territorial holder was present, I calculated how quickly (in a flash) each pursuit would last and took note of whether or not the defending hummingbird uttered chip calls, floated, or chased after the intruder. Since Rufous Hummingbirds move through the area, stopping for just a week or two at a time, it's very improbable that every single encounter at a feeder was of the same bird. Several of the analyses' dependent variables have out-of-the-ordinary distributions.

Nonnormal count data were modelled using a negative binomial distribution, which included the counts of intrusions, chases, chip calls, and hovers. I used Generalized Estimating Equations to account for the lack of independence between my observations taken at the same locations because I frequently returned to the same locations to carry out my research.

The rates of chipping and hovering, both with and without chasing, were modelled using a binomial distribution and generalized Estimating Equations (GEE). The GEE analysis yields both a result and an error value. Subsequently, the generalized Estimating Equations (GEE) methodology enabled the facilitation of indirect comparisons among the three treatments. The Bonferroni correction was used to account for multiple comparisons in the post hoc analysis, with a significance level (alpha) of 0.02. All following tests were performed at a significance level of 0.05. The data is given in the form of mean standard error. The studies were conducted using SAS 8.2 for Windows' Proc Genmod.

3. Results and Discussion

The male Broad-tailed Hummingbirds in the valley lost their mating grounds to the Rufous Hummingbirds when they arrived. Both sexes of Rufous Hummingbirds were seen protecting feeders filled with 30%, 20%, and even 10% sucrose solutions.

The male Broad-tailed Hummingbirds exhibited a behaviour of defending feeders containing 10% sucrose solutions exclusively following the entrance of the Rufous Hummingbirds, although they had previously defended feeders containing sucrose solutions of 10%, 20%, and 30% before to the introduction of the Rufous Hummingbirds. The Rufous Hummingbird was the most common species seen throughout the 55 observation sessions, with territorial individuals present 52 times. No territorial behaviour was seen during any of the three observation periods when 10% sucrose solutions were used in the feeders.

Table 1: Percentage of territory defense against resource quality. Rufous Hummingbirds guarded the majority of the feeders. Black and grey bars represent the territories of male and female Rufous Hummingbirds, while white bars represent those of male Broad-tailed Hummingbirds.

	6-19	7-19	3-19
10	0.31	0.39	0.15
	6-19	9-19	4-19

20	0.3	0.47	0.2
	2-17	8-17	7-17
30	0.10	0.45	0.4

As sugar concentrations grew, the quantity of invaders also surged noticeably. The frequency of chases likewise increased as sugar content increased since intruders were often pursued.

The duration of the average pursuit was found to be the longest when feeders were filled with solutions with a sucrose concentration of 30%, while it was seen to be the shortest when feeders had solutions with a sucrose concentration of 10%. Irrespective of the species involved, the prevailing reaction shown by territorial proprietors towards intruders was that of pursuit. The frequency of chip calls and hovering behaviour shown by territory holders was found to be higher at feeders with sucrose solutions of 20% and 30% compared to feeders with sucrose solutions of 10%.

Table 2: Average intrusions, chases, and chase duration per observation session at feeders with 10%, 20%, and 30% sucrose solutions.

Variable	Sucrose Concentration (%)	Mean $\pm$ SE	N	Range
Number of intruders	10	3.8 $\pm$ 1.4	19	0-22
	20	15.1 $\pm$ 2.4	19	3-37
	30	27.5 $\pm$ 4.3	17	7-79
Number of chases	10	2.6 $\pm$ 0.9	19	0-12
	20	11.6 $\pm$ 2.6	19	2-43
	30	21.1 $\pm$ 3.0	17	4-53
Average Chases Lenth (s)	10	1.9 $\pm$ 0.4	19	0-4.7
	20	3.4 $\pm$ 0.3	19	2.0-5.4
	30	4.2 $\pm$ 0.2	17	2.8-6.2

In 119 of 754 observations, hummingbirds just made chip sounds or hovered, not pursued intruders. Chip calls and hovering were the preferred responses of Rufous Hummingbirds to intruders. Chip calls and hovering without moving became more common as sugar concentration increased.

All through the preliminary, Wide followed Hummingbirds protected feeders with every one of the three tried groupings of sucrose: 5%, 10%, and 20%. However, when Rufous Hummingbirds arrived, the first group largely avoided the second and third concentrations. In their study, Dunford and Dunford documented an instance whereby a male Broad-tailed Hummingbird exhibited territorial Defense against a male Rufous Hummingbird. However, it is noteworthy that migratory Rufous Hummingbirds often displace resident Broad-tailed Hummingbirds from their respective areas.

Table 3: Chip calls for resource quality. Chip calls and hovering increased chases at high-concentration feeders. Chip calls and white bar lingering chases. Chases without chip calls or loitering are grey bars. Hovering without pursuit and chip calls are black bars.

	18-63	45-63	3-18
10	18	70	3
	148-202	54-202	27-283
20	72	23	10
	262-374	112-374	89-287
30	68	30	35

Powers, Conley, and Sandlin hypothesized that subordinate hummingbird species avoid expensive hostile encounters by shifting their foraging choices from high- to low-quality food patches when faced with a dominating species. My research shows that when Rufous Hummingbirds visited feeders with higher concentrations of sucrose (i.e., 20% and 30%), Broad-tailed Hummingbirds switched their defensive behaviour to the feeders with lower concentrations of sucrose (10%). It's possible that when more birds moved into the region, the feeders' greater quality required more energy to protect. Or, as Dearborn put it, there is a "cost of engagement" in hostile exchanges. As the interaction's cost rises, so do the potential dangers of continuing it. After mating, male Broad-tailed Hummingbirds may escape

the costs of hostile engagement with dominant Rufous Hummingbirds by switching to feeders with higher concentrations of 10% sucrose.

When they ate from feeders that had a lot of sucrose, Rufous and Broad-tailed hummingbirds were both more aggressive. The duration of chases was shown to be longer and more intensified when chip calls were used and when birds hovered more often at high-quality feeders compared to low-quality feeders. The duration of chases would have shown an increase in direct proportion to the rise in sucrose content, regardless of whether the invaders displayed more persistence at high-quality feeding locations or the territory holders exhibited heightened aggression in defending the higher-quality sites. In any event, our findings substantiate the notion that a resource characterized by superior quality exhibits an elevated degree of defensive capabilities. In a similar vein, Camfield looked at how Broad-tailed Hummingbird males displayed. He found that males displayed more frequently at high-quality locations than at low-quality locations because more females visited the former. Hummingbirds entered territories more as they improved. Anna's, Dark-chinned, and Blue-throated Hummingbirds behaved similarly. My research found a favorable association between territory quality and chases, chip calls, and hovers. Intruders and territorial defenders gain from higher-quality locations owing to greater energy, which is rational. Kodric-Brown and Brown hypothesized that territorial hummingbirds would pursue an intruder who failed to withdraw, as shown by the lack of flight, chip calls, and neck gorget flashing. In fact, nearby domain proprietors aggressively pursued the interloper. Instead of being used alone, chip calls were often used with pursuits. According to Ewald and Bransfield, Black-chinned and Anna's hummingbirds' "chips," or vocalizations, are mostly used in defensive situations rather than as a prelude to aggression. research showed that Rufous Hummingbirds responded to intruders by making chip sounds rather than pursuing them. Given the preponderance of Rufous Hummingbirds over Broad-tailed Hummingbirds, chip calls may be an effective way of communication that requires less energy than chase. Ewald and Bransfield found that Anna's Hummingbirds employed chip cries to protect their territory from subordinate Black-chinned Hummingbirds rather than fighting.

4. Conclusion

The complex and intriguing dynamics within these avian ecosystems are shown by our investigation and assessment of the resource value impacts on territorial Defence by Broad-tailed and Rufous Hummingbirds. With their exquisite plumage and territorial behaviors, these little but magnificent birds provide a glimpse into the fragile balance of nature. Hummingbirds have a great sensitivity to their environs via their resource-driven territoriality. The tenacious Defence of safe nesting locations and nectar-rich flowers highlights how crucial these resources are for their survival and procreation. In addition to ensuring the hummingbirds' personal survival, these territorial behaviors provide a considerable contribution to the ecological health of the habitats they live in, notably via their participation in pollination. We come to understand the connection of species and their surroundings more fully as we dig into the realm of these colorful gems. Our research emphasizes how important resource availability is in influencing these birds' behaviors and adaptations. This research also highlights the significance of conservation initiatives that try to maintain hummingbird populations and the environments on which they rely. By preserving the resources that hummingbirds depend on, we not only conserve these endearing animals but also help to maintain the ecological balance and variety of our planet. Ultimately, the investigation into the territorial Defence strategies of Broad-tailed and Rufous Hummingbirds in relation to resource value serves as a pertinent indication that even the most little and delicate species may have a substantial influence on the broader ecological dynamics of the planet.

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