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**RESEARCH AREAS:**

1. Behavioural ecology of bats
2. Biospeleology
3. Human circadian rhythms
4. Chronopharmacological and chronotherapeutic studies

**HONORS AND AWARDS:**

Fellow of National Academy (FNA)  
Fellow of National Academy of Science (FNASc)  
Fellow of Academy of Science (FASc)  
Tamil Nadu Scientist Award (TANSA).

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**RESEARCH INTERESTS:**

I have been studying various behavioural repertoires of bats for the past 25 years. The main behavioural components I focus on are foraging behaviour, prey detection and capture, breeding behaviour, postnatal growth, age estimation and mother-young relations, and development of prey capture and foraging. The organisms live inside caves and the microclimatic features prevail inside caves are studied. On humans, I am interested in studying the circadian rhythmic patterns in sleep-wakefulness, rectal temperature, heart rate, blood pressure, time estimations, and mealtime intervals.

Majority of studies on bats rely on fieldwork under natural conditions. The study on foraging behaviour of fruit bats is being carried out during entire nights when they visit fruit trees in residential areas (custard apple, guava, sapota etc.) as well as in orchards (grapes, mangoes and guava). The spatial and temporal patterns in their foraging behaviour are analyzed.

- The passive and active modes of detecting and capturing prey (frogs) by the Indian false vampire bat *Megaderam lyra* are being studied in detail under semi-natural conditions.
- The linear increase in the length of forearm and the linear decrease in the total epiphyseal gap in the fourth metacarpal phalangeal joint during the postnatal growth of bats are used to derived age predictive equations.
- The fauna and flora live inside caves are listed out. The locomotor activity of a cave millipede, that has never and ever seen the environmental light, has been recorded. Food chain prevail inside caves is worked out.

- We record the timings of sleep-wakefulness, rectal temperature, etc. of human volunteers who stay inside our Human Isolation Chamber for a period of 2 to 6 weeks. In addition we study the development of sleep-wake pattern from newborn up to the age of 6 months.

### **Chronopharmacological and chronotherapeutic studies:**

Circadian rhythms are known to regulate hundreds of functions in the body, including blood pressure, hormone production, digestive secretion and immune activity, DNA synthesis and cell division. Disruption of these rhythms can have a profound influence on health. Chronopharmacology is the study of coordinating biological rhythms (chronobiology) with medical treatment. Chronotherapy addresses the question on how to use the predictable changes in cellular metabolism along the 24h time scale to improve treatment outcome for a variety of diseases (including cancer). The therapeutic index of more than 30 drugs can be modified by varying the time of drug administration in a variety of diseases. Specifically timed chemotherapy (chronotherapy) can be applied successfully for the treatment like cancer. The cytokinesis of healthy tissues, as well as the pharmacologic and toxicologic effects of drugs characterized by circadian rhythms with predictable times of peak and trough. The objectives undertaken are

- The characteristics of locomotor rhythms ( $\tau$ ,  $\psi$  and  $\alpha$ )
- DNA synthesis and mitotic activity
- Assessment of lipid peroxidation products and glutathione
- Temporal expression pattern of *period 2* gene (the gene supposed to regulate neoplastic growth phase and DNA-damage response) in liver tissue by *in situ* hybridization

Activity-rest circadian cycle of *Mus booduga* will be used as a parameter for the administration of chemotherapy at specific times in order to improve drug tolerability and efficacy. Liver cancer will be induced in the field mouse by administering N-nitrosodiethylamine (NDEA). Oxaliplatin and 5-fluorouracil (anticancer drugs) are selected for the present study. Animals will be divided into the following groups: Normal, NDEA treated, NDEA+drug treated and drug treated. All the experiments will be carried out under LD (12h:12h) and DD (constant darkness) conditions. Drug will be administered at intervals and the levels of 5-fluorouracil and oxaliplatin in plasma will be analyzed. The survival rate of *M. booduga* as a function of dosing time will be assessed. The best drug tolerable time (with least toxicity) will be chosen to administer the drug/s.

### **PUBLICATIONS**

1. G. Marimuthu, R. Subbaraj and M.K. Chandrashekar (1978). Social synchronization of the activity rhythm in a cave dwelling insectivorous bat. *Naturwissenschaften* 65: 600.
2. G. Marimuthu, S. Rajan and M.K. Chandrashekar (1981) Social entrainment of the circadian rhythm in the flight activity of the microchiropteran bat *Hipposideros speoris*. *Behav. Ecol. Sociobiol.* 8: 147-150.
3. G. Marimuthu and P.F.L. Selvanayagam (1981) Apparent allomaternal care in an insectivorous bat *Hipposideros speoris*. *J. Bomb. Nat. Hist. Soc.* 78: 591-592.

4. G. Marimuthu and M.K. Chandrashekar (1983) Continuous light inside a cave abolishes the social synchronization of the circadian rhythm in a bat. *Behav. Ecol. Sociobiol.* 12: 321-323.
5. G. Marimuthu and M.K. Chandrashekar (1983) Social cues of a hipposiderid bat inside a cave fail to entrain the circadian rhythm of an emballonurid bat. *Naturwissen.* 70: 620.
6. G. Marimuthu (1984) Seasonal changes in the precision of the circadian clocks of a tropical bat under natural photoperiod. *Oecologia* 61: 352-358.
7. P.F.L. Selvanayagam and G. Marimuthu (1984) Spatial organization of roosting in the insectivorous tropical bat *Hipposideros speoris*. *Behav. Process.* 9: 113-121.
8. G. Marimuthu and M.K. Chandrashekar (1985) Communication and synchronization of circadian rhythms in insectivorous bats. *Proc. Indian Acad. Sci. (Anim. Sci.)* 94: 655-665.
9. G. Marimuthu: Batty behaviour - Quiz. *Science Age*, pp.47-49 (June 1985).
10. J. Habersetzer and G. Marimuthu (1986) Ontogeny of sounds in the echolocating bat *Hipposideros speoris*. *J. Comp. Physiol. A* 158: 247-257.
11. A. Link, G. Marimuthu and G. Neuweiler (1986) Movement as a specific stimulus for prey catching behaviour in rhinolophid and hipposiderid bats. *J. Comp. Physiol. A* 159: 403-413.
12. G. Marimuthu: Bats: Sonic sailors. *Science Today*, pp.70-72 (December 1986).
13. G. Marimuthu and G. Neuweiler (1987) The use of acoustical cues for prey detection by the Indian false vampire bat *Megaderma lyra*. *J. Comp. Physiol. A* 160: 509-515.
14. M.K. Chandrashekar and G. Marimuthu (1987) Sighting of a colony of the Indian false vampire bat *Megaderma lyra*. *Bat Res. News* 28: 26.
15. G. Marimuthu: 'Vauval' - an article in Tamil in the book 'Uyirial Ulagam' published by Ariviyal Mandram, Dr. Zakir Husain College, Ilayangudi - 623 702 (1987).
16. G. Marimuthu: 'Iravinil attam pakalinil thookam' - an article in Tamil published in daily newspaper 'Dinamalar' (12.11.1987).
17. G. Marimuthu (1988) Mother young relations of an insectivorous bat *Hipposideros speoris*. *Curr. Sci.* 57: 983-987.
18. G. Neuweiler, A. Link, G. Marimuthu and R. Rubsamen (1988) Detection of prey in echo cluttering environments. In: *Animal Sonar - Processes and Performance* (Eds. P.E. Nachtigal and P.W.B. Moore) NATO, ASI series. Plenum Press; New York, London, Series A: Life Sciences 156: 613-617.
19. G. Marimuthu: The sacred flying fox of India. *Bats* (1988) 6: 10-11.
20. R. Rubsamen, G. Neuweiler and G. Marimuthu (1989) Ontogenesis of tonotopy in inferior colliculus of a hipposiderid bat reveals postnatal shift in frequency-place code. *J. Comp. Physiol. A* 165: 755-769.

21. T.R. Radhamani, G. Marimuthu and M.K. Chandrashekar (1990) Relationship between infant size and carrying of infants by hipposiderid mother bats. *Curr. Sci.* 59: 602-603.
22. D. Audet, D. Krull, G. Marimuthu, S. Sumithran and J. Balasingh (1991) Foraging behaviour of the Indian false vampire bat, *Megaderma lyra* (Chiroptera: Megadermatidae). *Biotropica* 23: 63-67.
23. G. Marimuthu (1991) Marginal changes in the frequency during the development of vocalizations in the Indian false vampire bat *Megaderma lyra*. *J. Acoust. Soc. India* 19: 15-21.
24. M.K. Chandrashekar, L. Geetha, G. Marimuthu, R. Subbaraj, P. Kumarasamy and M.S. Ramkumar (1991) The menstrual cycle in a human female under social and temporal isolation is not coupled to the circadian rhythm in sleep-wakefulness. *Curr. Sci.* 60: 703-705.
25. M.K. Chandrashekar, G. Marimuthu, R. Subbaraj, P. Kumarasamy, M.S. Ramkumar and K. Sripathi (1991) Direct correlation between the circadian sleep-wakefulness rhythm and time estimation in humans under social and temporal isolation. *J. Biosci.* 16: 97-101.
26. G. Marimuthu and M.K. Chandrashekar (1991) A rare sighting of a python ingesting a flying fox *Pteropus giganteus* from a natural colony. *Bat Res. News* 31: 49-50.
27. M.K. Chandrashekar and G. Marimuthu: Beyond the myths - In the world of bats. *Frontline* (August 14, 1992).
28. S. Suthakar Isaac and G. Marimuthu (1993) Early outflying and late homeflying in the Indian pygmy bat under natural conditions. *Oecologia* 96: 426-430.
29. S. Suthakar Isaac and G. Marimuthu (1993) Infant's calls attract mother Indian pygmy bat. *Bat Res. News* 34: 57.
30. S. Suthakar Isaac, G. Marimuthu and M.K. Chandrashekar (1994) Fecundity in the Indian pygmy bat *Pipistrellus mimus*. *J. Zool.* 234: 665-668.
31. G. Jones, K. Sripathi, D.A. Waters and G. Marimuthu (1994) Individual variation in the echolocation calls of three sympatric Indian hipposiderid bats and an experimental attempt to jam bat echolocation. *Folia Zoologica* 43: 347-362.
32. M.K. Chandrashekar and G. Marimuthu (1994) A huge colony of the dog bat, *Rousettus leschenaulti*, in South India. *Bat Res. News* 35(4): 82.
33. G. Marimuthu, J. Habersetzer and D. Leippert (1995) Active acoustic gleaning of water surface by the Indian false vampire bat. *Ethology* 99: 61-74.
34. S. Suthakar Isaac and G. Marimuthu (1996) Postnatal growth and age estimation of the Indian pygmy bat *Pipistrellus mimus*. *J. Mammal.* 77: 199-204.
35. G. Marimuthu (1996) Foraging behaviour in bats. In: *Readings in Behaviour* (Ed. R. Ramamurthi), Wiley Eastern Ltd., Hyderabad, Pp.103-125.
36. G. Marimuthu: Diversity of bats. *Resonance* pp.103-110 (March 1996).
37. G. Marimuthu: Echolocation - The strange ways of bats. *Resonance* pp.40-48 (May 1996).

38. M.K. Chandrashekar, G. Marimuthu and L. Geetha (1997) Correlations between sleep and wake in internally synchronized and desynchronized circadian rhythms in human under prolonged isolation. *J. Biol. Rhythms* 12(1): 26-33.
39. S. Suthakar Isaac and G. Marimuthu (1997) Development of wing morphology in the Indian pygmy bat *Pipistrellus mimus*. *J. Biosci.* 22: 193-202.
40. G. Marimuthu (1997) Stationary prey insures life and moving prey ensures death during the hunting flight of gleaning bats. *Curr. Sci.* 72: 928-931.
41. G. Marimuthu, K.E. Rajan, A. John Koilraj, S. Suthakar Isaac and J. Balasingh (1998) Observations on the foraging behaviour of a tent roosting megachiropteran bat *Cynopterus sphinx*. *Biotropica* 30(2): 321-324.
42. A. John Koilraj, and G. Marimuthu (1998) Algal flora in the cave soils. *Curr. Sci.* 75: 1111-1113.
43. G. Marimuthu: Flightless young and meticulous mother bats. *Resonance* pp.62-69 (June 1998).
44. J.O. Whitaker, Jr., S. Suthakar Isaac, G. Marimuthu and T.H. Kunz (1999) Seasonal variation in the diet of the Indian pygmy bat, *Pipistrellus mimus* in Southern India. *J. Mammal.* 80: 60-70.
45. N. Gopukumar Nair, V. Elangovan, K. Sripathi, G. Marimuthu and R. Subbaraj (1999) Foraging behaviour of Indian short-nosed fruit bat *Cynopterus sphinx*. *Int. J. Mammal. Biol. (Z. Saeugetierkunde)* 64: 187-191.
46. K.E. Rajan and G. Marimuthu (1999) Postnatal growth and age estimation in the Indian false vampire bat *Megaderma lyra*. *J. Zool. Lond.* 248: 529-534.
47. V. Elangovan, G. Marimuthu and T.H. Kunz (1999) Temporal patterns of individual and group foraging behaviour in the short-nosed fruit bat *Cynopterus sphinx*, in South India. *J. Trop. Ecol.* 15: 681-687.
48. A. John Koilraj and G. Marimuthu (1999) A comparison of eye and body surface between surface and cave-dwelling millipedes. *Curr. Sci.* 77: 339-340.
49. A. John Koilraj, G. Marimuthu and V. K. Sharma (1999) Circadian rhythm in the locomotor activity of a surface-dwelling millipede *Syngalobolus* sp. *Biol. Rhy. Res.* 30: 529-533.
50. A. John Koilraj, G. Marimuthu, K. Natarajan, S. Saravanan, P. Maran and Minna J. Hsu (1999) Fungal diversity inside caves of Southern India. *Curr. Sci.* 77: 1081-1084.
51. A. John Koilraj, N.K. Udaya Prakash, G. Marimuthu and K. Natarajan (1999) Occurrence of thermophilic fungi in the soil of caves at South India. *Vasundhara The Earth* 1: 6-8.
52. K.E. Rajan and G. Marimuthu (1999) Localization of prey by the Indian false vampire bat *Megaderma lyra*. *Mammalia* 63: 149-158.
53. V. Elangovan, G. Marimuthu and T.H. Kunz (2000) Nectar feeding behaviour in the short-nosed fruit bat *Cynopterus sphinx*. *Acta Chiropterologica* 2: 1-5.

54. K. Emmanuvel Rajan and G. Marimuthu (2000) Genetic diversity within and among local populations of the microchiropteran bat *Hipposideros speoris* as based on a RAPD analysis. *Int. J. Mammal. Biol. (Z. Saeugetierk.)* 65: 301-307.
55. D. Leippert, W. Goymann, H. Hofer, G. Marimuthu and J. Balasingh (2000) Roost-mate communication in adult Indian false vampire bats (*Megaderma lyra*): an indication of individuality in temporal and spectral auditory components. *Animal Cognition* 3: 99-106.
56. A. John Koilraj, V.K. Sharma, G. Marimuthu and M.K. Chandrashekar (2000) Presence of circadian rhythms in the locomotor activity of a cave-dwelling millipede *Glyphiulus cavernicolous* Sulu (Cambalidae, Spirostreptidae). *Chronobiol. Int.* 17: 757-765.
57. A. John Koilraj, G. Agoramoorthy and G. Marimuthu (2001) Copulatory behaviour of Indian flying fox *Pteropus giganteus*. *Curr. Sci.* 80: 15-16.
58. V. Elangovan and G. Marimuthu (2001) Effect of moonlight on the foraging behaviour of a megachiropteran bat *Cynopterus sphinx*. *J. Zool. London.* 253: 347-350.
59. V. Elangovan, G. Marimuthu and T.H. Kunz (2001) Temporal patterns of resource use by the short-nosed fruit bat *Cynopterus sphinx* (Megachiroptera: Pteropodidae). *J. Mammal.* 82: 161-165.
60. V. Elangovan and G. Marimuthu (2001) Comparative analysis of food, energy and nitrogen intake of a megachiropteran bat, *Cynopterus sphinx*. *Proc. Nat. Acad. Sci., India (B)* 71: 115-120.
61. N. Singaravelan and G. Marimuthu (2002) Moonlight inhibits and lunar eclipse enhances the foraging activity of fruit bats in an orchard. *Current Science* 82: 1020-1022.
62. G. Marimuthu, K. Emmanuvel Rajan, K. Sripathi, S. Parsons and G. Jones (2002) Effects of different surfaces on the perception of prey-generated noise by the Indian false vampire bat *Megaderma lyra*. *Acta Chiropter.* 4: 25-32.
63. N. Singaravelan and G. Marimuthu. Batty about bats, in: 'Young World' of THE HINDU 03 August 2002. (National Newspaper)
64. V. Elangovan, H. Raghuram, E. Yuvana Satya Priya (2002) Postnatal growth, age estimation and development of foraging behaviour in the fulvous fruit bat *Rousettus leschenaulti*. *J. Biosci.* 27: 695-702.
65. S. Molur, G. Marimuthu, C. Srinivasalu, S. Mistry, A.M. Hutson, P.J.J. Bates, S. Walker, K. Padma Priya and A.R. Binu Priya (Eds.) (2002) Status of South Asian Chiroptera: Conservation Assessment and Management Plan (C.A.M.P.) Workshop Report, 2002. Zoo Outreach Organization, CBSG South Asia and WILD, Coimbatore, India, pp 141.
66. N. Singaravelan and G. Marimuthu (2003) Mist net captures of the rarest bat *Latidens salimalii*. *Current Science* 84: 24-26.
67. N. Singaravelan and G. Marimuthu (2003) Discovery of a cave as the day roost of a rarest bat *Latidens alimalii*. *Current Science* 84: 1253-1256.

68. N. Gopukumar, P.T. Nathan, P.S. Doss, A. Prakash, K. Emmanuel, J. Balasingh, G. Marimuthu and T.H. Kunz (2003) Early ontogeny of foraging behaviour in the short-nosed fruit bat *Cynopterus sphinx* (Megachiroptera): preliminary results. *Mammalia* 67: 139-145.
69. V. Elangovan, E. Y. S. Priya, H. Raghuram and G. Marimuthu (2003) Postnatal development in the Indian short-nosed fruit bat *Cynopterus sphinx*: growth rate and age estimation. *Acta chiropter.* 5: 107-116.
70. H. Raghuram and G. Marimuthu (2003) Onset of gleaning and prey capture in the Indian false vampire bat *Megaderma lyra*. Proceedings of the 28th Conference of the Ethological Society of India. Pp. 93-96.
71. N. Singaravelan and G. Marimuthu (2004) Nectar feeding and pollen carrying from *Ceiba pentandra* by pteropodid bats. *J. Mammal.* (in press).
72. V. Elangovan, H. Raghuram, E. Yuvana Satya Priya and G. Marimuthu (2004) Wing morphology and flight performance in *Rousettus leschenaulti*. *J. Mammal.* (in press).
73. N. Singaravelan and G. Marimuthu (2004). Nectar feeding and pollen carrying from *Ceiba pentandra* by pteropodid bats. *J. Mammal.* 85: 1-7.
74. V. Elangovan, H. Raghuram, E. Yuvana Satya Priya and G. Marimuthu (2004). Wing morphology and flight performance in *Rouseettus leschaenaulti*. *J. Mammal.* 85: 806-812.
75. J. M. Ratcliffe, H. Raghuram, G. Marimuthu, J.H. Fullard and M.B. Fenton (2005). Hunting in unfamiliar space: echolocation in the Indian false vampire bat, *Megaderma lyra* when gleaning prey. *Behav. Ecol. Sociobiol.* 58: 157-164.
76. P. Thiruchenthil Nathan, H. Raghuram, V. Elangovan, T. Karuppururai and G. Marimuthu (2005). Bat pollination of kapok tree *Ceiba pentandra*. *Curr. Sci.* 88: 1679-1681.
77. V. Elangovan, E. Yuvana Satya Priya and G. Marimuthu (2006). Olfactory discrimination ability of the short-nosed fruit bat *Cynopterus sphinx*. *Acta Chiropterol.* 8: 247-253.
78. Bandana Aul and G. Marimuthu (2006). Sighting of an albino bat in a colony of cave-dwelling micropchiropteran, *Hipposideros diadema nicobarensis* at the Nicobar Islands. *Curr. Sci.* 90: 912-914.
79. K. Emmanuel Raj and G. Marimuthu (2006). A preliminary examination of genetic diversity in the Indian false vampire bat *Megaderma lyra*. *Animal biodiversity and conservation* 29: 109-115.
80. H. Raghuram and G. Marimuthu (2007). Development of prey capture in the Indian false vampire bat *Megaderma lyra*. *Ethology* 113: 1-7.
81. V. Elangovan, E. Y. S. Priya, H. Raghuram and G. Marimuthu (2007). Wing morphology and flight development in the short-nosed fruit bat *Cynopterus sphinx*. *Zoology* 110: 189-196.
82. H. Raghuram and G. Marimuthu (2007) Maternal feeding of offspring with vertebrate prey in captive Indian false vampire bat *Megaderma lyra*. *Acta Chiropterol.* 9: 437-443.
83. N. Singaravelan and G. Marimuthu (2007) Nectar feeding strategies of pteropodid bats on *Parkia bigladulosa*: the influence of angular variations in nectar rings. *Proc. Indian Nat. Sci. Acad.* 73: 127-135.

84. N. Singaravelan and G. Marimuthu (2008) In Situ Feeding Tactics of Short-nosed Fruit Bat (*Cynopterus sphinx*) on Mango Fruits – Evidence for Extractive Folraging in a Flying Mammal. *J. Ethol.* 26: 1-7.