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Member - National Biodiversity Authority - Invasive Alien Species
Member - State Board for Wildlife - Tamil Nadu State
Member - State Level Steering Committee - Nilgiri Biosphere Reserve
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He has completed his post-graduation and Ph.D.,in Wildlife Biology in A.V.C. College, Mayiladuthurai. He has started his carrier as a Junior Research Fellow and Senior Research Fellow in Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore. He worked as a Senior Research Fellow in A.V.C College (Autonomous) from 2002-2003. He worked as a Senior Research Fellow in WWF-India from 2004 to 2005 and as a Field Officer in Wildlife Trust of India from 2007 to 2010. Since 2011, He is working as an Assistant Professor of Wildlife Biology in the Department of Zoology and Wildlife Biology at Government Arts College, Udhagamandalam, The Nilgiris, Tamil Nadu. Presently, 8 Ph.D and 3 M.Phil students are pursuing their research under his supervision. So far 7 M.Phil and 40 M.Sc students have completed their dissertations under his supervision. He has published 67 research papers in national and international peer reviewed journals and he delivered 27 oral presentations at national and international workshops, seminars, conferences and symposia so far. He is one of the editors in Aftermath of Diclofenac and Vulture Population (2008), An Anthology of Nilgiri Biosphere Reserve (2013) and Aftermath of Diclofenac and Vulture Conservation in Nilgiri Biosphere Reserve-Moyar Valley (2016). He has published two books on Asian elephants. As a Principal Investigator and Co-Principal Investigator he has completed 25 research projects so far.

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SECURING VULTURE POPULATION IN SOUTHERN INDIA Edited by B. Ramakrishnan

SECURING VULTURE POPULATION IN SOUTHERN INDIA

Proceedings of the Workshop Conducted from 8th to 9th January 2018

Edited by

B. Ramakrishnan

Govt. Arts College
Udhagamandalam

R·R·C·F

Indo American Wildlife Society

TNFD

2018

SECURING VULTURE POPULATION IN SOUTHERN INDIA

Edited by

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2018

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Fore word

Vulures play a vital role in the hygience of the Forest Eco-system, as they are the efficient scavengers and dispose of the dead animals of the forest in the best manner to prevent any infection and disease. The doyen of Indian Ornithology, Dr. Salim Ali says, “Vultures are God’s own incinerators, which cannot be replaced by even the most sophisticated ones which humans may invent”! A flock of vultures has the ability to dispose of an Ox in just 30 minutes!

Their sudden decline was noticed in the 1990’s as the population of them plummeted by 90% and a study in Pakistan attributed it to indiscriminate use of the veterinary drug Diclofenac. But this was mainly on the population around villages and towns and the forests. There were no data as to hos many were affected by NSAIDs or how the population dynamics got altered.

This is the focal point of this Workshop held in Udhagamandalam with the theme of “Securing Vulture Population in Southern India” since the last known population in all the Southern States were discussed and also their current status. The aim to conserve this last thriving population is the bottom line of the papers presented.

I am happy to note that papers from Telangana and Andhra Pradesh where few Vultures are seen, have been presented along with some path breaking studies by Toxicologists and Veterinarians on NSAIDs and their impact on Vulture population. Of course, the major population as of now is seen along the Moyar Valley in Tamil Nadu, on which due focus has been given!

It is a unique congregation of Scientists and Enthusiasts working for Vulture Conservation and the findings in their States have been collated for future plans in saving these Critically Endangered Species from extinction.

The Group Discussions have brought out many useful suggestions to implement and I congratulate the Organisers for having conducted a noteworthy Workshop on critically endangered species. I wish they continue with a blueprint for securing this population for posterity and Tamil Nadu Forest Department will be keen to render all support to the revival of these “God’s own Incinerators”.

T.P. RAGHUNATH, I.F.S.,
Principal Chief Conservator of Forests &
Chief Wildlife Warden

TAMIL NADU FOREST DEPARTMENT

S.RAMASUBRAMANIAN, I.F.S.
Conservation of Forests

Preface

Raptors are the apex predators in the avian community due to their magnificent flight and hunting skills enamoured by acute vision and powerful talons. They can fly in the sky on motionless wings effectively using the thermals. Vultures, in particular are exponents of seemingly effortless flying with their fabulous soaring capacity. At the same time they do commendable job in the ecosystem by scavenging dead animals and thereby ridding the forest of dangerous diseases. But for the banning of the harmful drug named “Diclofenac” in India in 2006, for veterinary use, their population adjoining human habitation would have been wiped out, Vultures are closely asociated with the presence of carnivores as camp followers. Sometimes the carnivores tend to kill the cattle in the nearyby villages provoking retaliatory poisoning of the carcass to eliminate them. This unintended act is also a major threat to the Vultures as many such instances of mass death were reported in the Nilgiris Biosphere Reserved earlier.

This two days workshop at Udhagamandalam from 8th-9th, January, 2017 was organised as a sequel to the previous two workshops held in Sathyamangalam and Udhagamandalam during 2008 and 2010 respectively. This time experts from the adjoining states viz, Kerala, Karnataka, Telangana and Andhrapradesh also participated to provide a pan Indian perspective in Vulture conservation. It was a valuable experience and enlightenment for having the privillage of interacting with National and International experts whos have contributed significantly across the globe.

The organisers meticulously brought out the book entiled “Securing vulture populations in Southern India” with a conservation action plan emanated from the group discussions by the renowned experts which include scientists, researchers, veternarians, NGO representatives, conservationists and naturalists in the southern states as well as across the world. This book also embodies 28 research papers under 4 chapters covering the strategic aspects of present status and distribution, conservation issues and mangement implications on vultures in southern India. This is a welcome step and a giant leap from the previous two workshop which would surely translate the action plan into reality.

As dutiful citizens, we have the moral obligation to take all possible measures to bring back the vulture populations to ensure natural disposal mechanism in the forest ecosystem.

I also would like to profusely congratulate the organizing secretary and the editor of this book, Dr. B.Ramakrishnan and his assistant Mr. A.Samson for their earnest effort to bring this book with a treasure of knowledge to the public domain.

S. RAMASUBRAMANIAN, I.F.S.

Message from the Principal's Desk

Dr. M.Easwaramurthy, M.Sc.,M.Phil.,Ph.D

I have great pleasure as the Principal of the Government Arts College, Udhagamandalam, The Nilgiris to give message of the book entitled "Securing vulture population in southern India" edited by our faculty Dr.B.Ramakrishnan, Assistant professor of Wildlife Biology, Department of Zoology & Wildlife Biology for brought out conservation action plan for the conservation of vultures in southern India.

The planet earth is inhabited by diverse array of living organisms such as micro organisms, plant and animals and human beings, which collectively constitute the Biodiversity. Thus, the diverse arrays of biotic components are interdependent and interacting with one another, so as to sustain their own existence and the habitat and environment in which they live. The Nilgiris Biosphere Reserve is one of the world heritage sites and is the first and foremost biosphere reserves in India declared by the UNESCO which has variety of the species including both flora and fauna. The vultures in this biosphere are very important and play vital role in the ecosystem as scavengers. So their presence is highly needed one.

I am very happy that our college has involved to bring out centralized action plan by this book for the long run conservation of endangered and critically endangered vulture species, not only in the Nilgiris, but almost for entire south India.

This book, I am confident, contains presentations of eminent personnel both form national and international and their research articles are have the potential to create a strong awareness and conservation strategies to various stakeholders on vultures.

On behalf of the college and being its Principal, I am proud to be a part of publishing this book. I congratulate the editor and the faculty from our college Dr.B.Ramakrishnan for organizing the workshop and bring out the proceedings as a book. I wish him all success.

(Dr.M.EASWARAMURTHY)

PRINCIPAL

Acknowledgements

I express my sincere thanks and gratitude to Thiru. T. P. Raghunath, I.F.S., the Principal Chief Conservator of Forests & Chief Wildlife Warden of Tamil Nadu for granting permission to conduct this workshop and given foreword for the proceedings. I express my sincere thanks to Thiru. Srinivas R. Reddy, I.F.S., the Chief Conservator of Forests & Filed Director, Mudumalai Tiger Reserve & Mukurthi National Park for providing continuous support to me and delivered the presidential address during the inaugural session of the workshop. My heartfelt thanks to Thiru. S. Ramasubramanian, , I.F.S., the Conservator of Forests, Coimbatore Circle for supporting various ways not only for this workshop, previous two workshops also held in 2008 at Sathyamangalam and Udhagamandalam in 2011 for his advice and uncomplaining assistance during the workshop as well as all logistics provided during field visit to the participants. I am thankful to Thiru. S. Kalanithi, I.F.S., the District Forest Officer, Nilgiri North Forest Division for his unfailing support rendered in many ways for the successful completion of the workshop and field visit. I express my sincere gratitude to all Forest Range Officers in the Nilgiri North and South Forest Divisions especially, Thiru. Selvam (Sigur Range) and Thiru. Muthukrishnan (Nilgiris North Range) and Mr. Siddaraj (Forester, Sigur Range) for providing necessary facilities and logistics to the participants during field visit.

My whole hearted thanks to our Principal (i/c) Thirumathi. V.Mallika for permitting me to conduct this workshop and delivered inaugural address in the workshop. I express my thanks and gratitude to the principal Dr. M. Eswaramoorthy for giving message and supporting our activities to the department. I record my sincere thanks to our Head of the Department Dr.J Ebanasar for his continuous advice and encouragement. I am thankful to all my colleagues in the department for providing necessary helps during the workshop. I thank all our office staff for helping in various ways especially releasing funds in right time and verifying vouchers, auditing bills and finally issuing utilization certificates to respective donors.

This workshop would not be possible without financial support. My sincere and heartfelt thanks to my sponsor of the workshop the Raptor Research & Conservation Foundation, Mumbai, especially I thank Mr. Kiran Srivastava for releasing major amount of funds in right time for the successful completion of the workshop. My sincere gratitude to the co-organizers namely the Tamil Nadu Forest Department and Arulagam for providing partial financial support and providing all logistics to the workshop. I thank all the collaborators namely, CSIR-India, NWEA, OSAI, NCS and IAWS who have helped by providing small grants and supplying required materials to the workshop.

This workshop and the proceedings was successfully completed mainly because of my Ph.D., Research Scholar Thiru.A.Samson's effort, commitment and dedication start from communicating the participants, receiving the papers from the presenters by sending reminders and coordinating with me for wonderful field visit and so on. I record my sincere and whole hearted thanks to him.

My sincere thanks are due to the research scholars of my lab, Mammalogy & Forest Ecology and neighbouring lab Herpetology & Tribal Medicine for untiring assistance provided for successful completion of two days workshop and one day field visit. I am very much thankful to Mr. S.Chandrasekar, Freelancer, Chennai for helping me in various ways and giving valuable comments and suggestions for this proceedings. I express my gratitude to Dr. Jayshankar, Assistant Professor in English for critically gone through this document.

(B. RAMAKRISHNAN)

Organizing Secretary & Editor

BACKGROUND

The vultures play a vital role in the ecosystem as a scavenger by habit. It is noteworthy to mention that the scavengers occupy an imperative and final level in the ecosystem without which the recycling or proper disposal, especially that of dead and decaying materials will be either stopped or delayed, leading to chaos. There are nine species of vultures found in the Indian Subcontinent. Of which, four are found in Southern India, namely Egyptian Vulture (*Neophron percnopterus),* Red-headed Vulture (*Sarcogyps calvus),* White-rumped Vulture (*Gyps bengalensis)* and Long-billed Vulture (*Gyps indicus).* These four species of vultures are spread out in continuous forest tracts of Western Ghats and Eastern Ghats areas of five states namely Tamil Nadu, Karnataka, Kerala, Telangana and Andhra Pradesh in South India. These are considered to be the wild and viable vulture populations in India south of the Vindhyas. Apart from this, stragglers of Cinereous and Himalayan Griffon have also been recorded in south India. Due to jurisdiction limits the information collected or research done by various personnel or authorities are not shared or not brought under one umbrella. However all five states are trying to secure these vulture populations which nests in one state, roosts and forage in another state or they do all or part of these activities in varying proportion in the same contiguous landscape of the Western Ghats and Eastern Ghats areas in southern India. The aim of the workshop was to share the findings and management implications initiated by five state forest departments, researchers and NGOs for securing our country's southern wild and viable vulture population under centralized action plan for the first time in our country.

The rapid collapse in vulture populations in India has led to a breakdown in natural ecosystem services coupled with one of the slowest rates of reproduction. This has necessitated the urgent need to introduce various conservation action plans in the country in order to bring back vulture population. Two days workshop was organized from 8th to 10th January, 2018 and one day field visit on 11th was intended to highlight the current key issues such as present population status, breeding status, usage of diclofenac and other NSAIDs and exigent measures needed to protect vulture populations in the southern India by bringing together scientists, researchers, toxicology experts, conservation organizations and NGOs to share their findings with the five state forest department officials. The purpose was to jointly discuss and bring out a centralized action plan with viable management solutions in each state to secure the country's southern wild and viable vulture populations.

AIM

- Securing vulture population in Southern India

SPECIFIC OBJECTIVES

- ❖ To share population estimations, research findings, nesting status, conservation threats and management implications on vultures of five states in southern India
- ❖ To discuss the issues and solutions and
- ❖ To formulate holistic and centralized action plan for securing wild and viable vulture population in southern India.

SYNOPSIS OF THE WORKSHOP

After the formal inauguration, one full day was dedicated for presentations by various experts, scientists, researchers, NGO representatives and officials of forest departments on population estimation, scientific research studies, awareness programmes and management implications already done or under process in all five southern states. The first session of the second day was given to Arulagam to present blue print for vulture conservation action plan with respect to prevalence of NSAIDs. Due to objection raised by the gathering none of the plan from the Arulagam was considered and the gathering directed the outcome of the workshop should be a Blue Print for Vulture Conservation in Southern India. This was followed by a half of the second day for group discussion by two groups namely 1) Standardizing methodology for vulture population estimation & Research activities and 2) Conservation threats & Management implications to discuss feasible actions that have been already carried out as well as handicapped or required for the successful management of vulture populations in southern India. By pooling various groups' comments and suggestions a holistic and centralized vulture conservation action plan was prepared for the long run conservation of the country's southernmost wild and viable vulture population in southern India. The last session of the second day was given for presentations which were left out on day one. Finally formal valedictory session was conducted with the end of group photo along with vulture model and vote of thanks. The third day was spent for field visit in the Nilgiri North Forest Division to see one of the White-rumped Vulture nesting site (Jagalikadavu Nesting Site).

INAUGURATION

Date: 08/01/2018 Venue: HADP Hall, Udhagamandalam

Time	Programme	Resource Person
09.30am-10.00am	Registration and issuing Name/ Organisation tags	
10.00am-10.05am	Tamizhthaai Vaazhthu and Lighting Kuthuvilakku	
10.05am-10.15am	Welcome Address	Dr.B. Ramakrishnan, Ph.D. Assistant Professor in Wildlife Biology and Organizing Secretary of the workshop, Government Arts College, Udhagamandalam
10.15am-10.25am	Inaugural Address	Thirumathi. V. Mallika, The Principal (i/c), Government Arts College, Udhagamandalam.
10.25am-10.35am	Key Note Address	Thiru.S. Ramasubramanian, I.F.S The Conservator of Forests Coimbatore Circle
10.35am-10.45am	Workshop Abstract Released by Received by RRCF Project Final Report Released by Received by	Thiru.Vijaykumar, I.F.S District Forest Officer Ramnagara Division Thiru.S. Ramasubramanian, I.F.S The Conservator of Forests, Coimbatore Circle. Thiru. Sajan, I.F.S Wildlife Warden, Wyanad Wildlife Sanctuary. Thiru. Kiran Srivastava Raptor Research and Conservation Foundation, Mumbai.
10.45am-11.00am	Honouring Ceremony	Dr. Robert B Grubh, Ph.D (who is the first Ph.D., holder on vulture research in India)
11.00am-11.10am	Presidential Address	Thiru. Srinivas R. Reddy, I.F.S, Chief Conservator of Forests and Field Director, Mudumalai Tiger Reserve and Mukkurthi National Park, Udhagamandalam
11.10am-11.20am	Honouring dignitaries, sponsors, joint organizers and collaborators by presenting Mementos	
		Tea Break
11:20 am onwards	Technical Session started	

INAUGURAL SESSION

From left to right: Dr.B.Ramakrishnan, Mr.Kiran Srivastava (RRCF) Mr.S.Ramasubramanian, IFS., Mr.Srinivas.R.Reddy, IFS., Tmt.V.Mallika., Mr.N.T.Sajan., Mr.S.Kalanithi,IFS., Mr.Vijaykumar, IFS

Mr. Srinivas R.Reddy, IFS., the Chief Conservator of Forests & Field Director, Mudumalai Tiger Reserve lighting Kuthuvilakku

Mr. Srinivas R.Reddy, IFS., releasing RRCF's Vulture Project report and received by Mr.S.Ramasubramanian, IFS., the Conservator of Forests, Coimbatore Circle

Dr.Robert B Grubh, the first Ph.D., holder on Vultures in the country is being honored by his student Dr.N.Sivaganesan

Mr.Chris Bowden (RSPB, UK) honoring forest range officers working in the Vulture habitats

Mr. Selvan, Sigur Forest Range Officer, Mudumalai Tiger Reserve

Mr.Chris Bowden (RSPB, UK) honoring forest range officers working in the Vulture habitats

Mr. Ramesh, NES Forest Range Officer, Mudumalai Tiger Reserve

ORAL PRESENTATIONS

TECHNICAL SESSION – I
STATUS, SURVEY AND POPULATION ESTIMATION OF VULTURES

The current threats and status of Asian vultures -

By **Mr. Chris Bowden,**
Globally Threatened Species Officer & SAVE Programme Manager, UK Address: RSPB,
The Lodge, Sandy, Beds SG19 2DL

Mr. Chris Bowden talked about Global scenario of new threats and the overall scenario for vultures globally. In his plenary talk, he pointed out the emerging trends of vulture threats in Africa and Europe where these are quite different from South Asia. The most widespread threats are unintentional poisoning through poison baits and electrocution and collisions. Elsewhere, illegal killing for belief-based use, or by elephant poachers in Africa are significant. In other areas, food shortage and nesting habitat loss are problems. He explained that diclofenac and other NSAIDs remain the major threat and cause of the most dramatic declines across South Asia and how this is still the case today.

In his talk he has mentioned the important step-the ban of veterinary diclofenac by the Government of India (also quickly followed by Nepal, Pakistan, and Bangladesh) but how illegal use of human formulations means this threat has not gone away. The introduction of meloxicam as an alternative safe drug in veterinary practice has been crucial to reducing diclofenac use by vets. The establishment of vulture captive breeding centers by the Bombay Natural History Society (BNHS) in India, as an emergency measure has been an important safety net and in Nepal where diclofenac use is less, the first releases have already taken place.

He stressed on the Vulture Safe Zone initiatives which is a concept to focus awareness and activities in a 100 km radius around existing vulture colonies, with a team including the coordinator, biologist and community mobilizer and how testing of cattle carcasses for NSAIDs and pharmacy surveys are key actions. Finally he stressed that human diclofenac formulations are still being illegally used by vets (especially in large vials) and other NSAIDs such as nimesulide, ketoprofen, aceclofenac and other untested NSAIDs are available in veterinary usage which is still harmful to vultures. He further added that although multi-dose (large) vials of diclofenac have been banned by the Indian Ministry of Health on July 2015, still some vets and quacks will illegally use the drug.

After his presentation, Mr. Kalanithi, IFS., District Forest Officer, Nilgiri North Forest Division asked some questions. One about criteria for the declaration of vulture safe zone in the Nilgiris, and another question was on the status of usage of diclofenac before 1990s and finally he asked about supplementary feed to vultures. Mr. Chris answered that based on experiment one can think on providing supplementary food to vultures, but that the evidence of food shortage is not clear or scientifically shown. Dr. Baranidharan, Assistant Professor, Forest College & Research Institute, Mettupalayam asked about case studies and success rate of releasing vultures from captive breeding. Mr. Chris explained quoting couple of case studies done by Gujarat Zoo Conservation Breeding Program and Bulgaria. And the end he concluded by addressing some of the key points such as declining but stabilising vulture numbers at very low levels (after 99% declines), that releases of captive birds can only be done once usage of diclofenac and other NSAIDs is reduced close to zero, and demonstrated through testing for other NSAIDs in pharmacies and in dead cattle. This needs engagement of state Governments, local NGOs, Pharmaceutical industries & individuals, and monitoring local medical shops and systematic analysis of dead vultures and livestock throughout India.

Status and conservation of White-rumped vulture in India – An Overview -

By **Robert B Grubh,**
2nd Main Road, Christopher Nagar Extn., Nagercoil,
Tamil Nadu

Dr. Grubh the first Ph.D holder on vulture studies in India stated that the White-rumped Vulture (*Gyps bengalensis*) was the most common species in the Indo-Gangetic plains until about a decade before close of the 20th century. This vulture was also commonly seen at carcasses all over Peninsular India right down to Kanniyakumari District. However, the vulture population in the Southern India, particularly Kanniyakumari district where the author grew up, showed noticeable decline after mid-20th century. Dr Grubh found the reason for declining vulture population from his own district was mainly due to degradation and destruction of natural forest or conversion of the natural forest into commercial plantations has resulted in depletion of large wild herbivores, hence a reduction in the food source for *Gyps* vultures. Traditionally, the farmers raised cattle for milk, organic manure and for manual labour such as pulling carts, drawing irrigation water, and plowing. However, with the introduction of mechanized ploughing, motorized pumps and chemical fertilizers, farmers depended less on cattle for agriculture, resulting in decline of village cattle. The author further quoted that due to introduction of high-yielding dairy cattle, they had access to modern veterinary medical aid, which minimized death of cows through diseases. Further, most of these animals did not get to die of old age because they were sent for slaughter house when they became economically nonviable. Thus, the sustenance of vultures was highly affected, resulting in their population decline. White-rumped vultures became extremely rare in Kanniyakumari district and the surroundings, decades before diclofenac (a new non-steroid anti-inflammatory drug, which was widely used by veterinarians).

Dr. Grubh shared his experience in those days of the vulture population scenario especially in Indo-Gangetic plains, where cows are generally not slaughtered for meat. Even while the vulture population was dwindling in the southern states, vultures flourished here. The numbers increased to such an extent that it was not uncommon to view as many as 3000+ white-rumped vultures at a single site in Delhi during the eighties of the 20th century. Many people used to send their cows or oxen from gaushalas (cow shelters) or even released them in the streets where they eventually died, thus making available a steady supply of food for vultures (pers. obs.). Vultures have a habit of taking advantage of thermals to soar in the sky for their various survival needs. Usually they used to soar in dense spirals between 11 and 12 hours in order to gain height and then drift off to various locations of their choice (Grubh, R.B. 1980). He added that it was the usual time of day when aircraft encountered with vultures, especially during critical aircraft flight phases such as initial climb and final approach. As a result, the white-rumped vulture and even the Indian vulture (*G. indicus*) became major potential problematic birds for civil and military aircraft in India. While commercial airlines suffered huge financial losses due to engine damage and delayed flights, the Indian Air Force lost many fighter planes and, more importantly, valuable fighter pilots at the peak of their career. Considering this bird-strike hazard potential of vultures, recommendations were made (Grubh, RB. 1990) for ecological control of these birds by setting up modern abattoirs and modern carcass processing plants at key locations throughout the country. These recommendations were brought later on to the attention of members of a bird hazard prevention meeting specially convened in Delhi by the Scientific Advisor to the Minister of Defense in the year 1996. This committee unanimously accepted these recommendations for implementation with a sense of urgency. A speculation was floated by some researchers that some unknown virus or another disease factor was possibly the cause of vulture decline (Risebrough, Robert W. 2000). Later, this speculation was replaced by a hypothesis that diclofenac, introduced in India around the same time was the cause of vulture population decline in the neighboring country Pakistan (Oaks et al. 2004). Soon a simulation model was developed by Green, Rhys E. (2004) based on some data and several assumptions that even if only 1% of carcasses were contaminated by diclofenac, the Indian *Gyps* vulture populations would fall drastically. A welcome outcome of this hypothesis, however, was the banning of this harmful drug in India in the year 2006 for veterinary use.

Status of vultures in Kerala-

By **Sashikumar, C,**
Malabar Natural History Society, 9 Subhash Nagar,
Kannur 670002, Kerala

Mr. Sashikumar in his introductory talk described about ornithological literatures regarding Kerala since the beginning of 20th century. He told that four species of vultures occurred in Kerala namely Red-headed Vulture *Sarcogyps calvus,* Indian (Long-billed) Vulture *Gyps indicus,* White-rumped (Oriental White-backed) Vulture *Gyps bengalensis* and Egyptian Vulture *Neophron percnopterus.* Sightings of all species of vultures became increasingly rare from late 1960s onwards and they became virtually extinct in most parts of the state by late 1970s. He has pointed out that the causes of vulture decline in Kerala due to change in habitat, livestock management, socio-cultural attitudes, use of pesticides and direct poisoning, increase in human population density and awareness of social hygiene and changes in food habits and social taboos. He has stated that vulture monitoring was begun in the year of 2003 at least visited once in a month in Wayanaad Wildlife Sanctuary (WLS). The vultures were counted while travelling within the sanctuary through forest roads for a distance of about 30 km. soaring vultures were observed from vantage points mostly the *vayals* (open grassy marshes) in the PA. An average of 15 White-rumped and 2 to 4 Red-headed vultures were seen. At the end of his presentation he talked about synchronized survey which was conducted in the sanctuary in December 2013 and counted **35** White-rumped, **5** Red-headed and **2** Indian vultures. At the carcasses, congregation of vultures numbering more than 50 had been seen on some occasions.

Mr. Sashikumar said that the White-rumped vultures had a good rate of breeding success, at an average of 65% in Wayanad WLS. His team conducted NSAIDs prevalence surveys in drug stores of Wayanad district in 2008, 2011 and 2013 and found that there were about 13 brands of NSAIDs offered for sale. He has stated that the diclofenac in large pack (30 ml) was available in in at least one drug store in the year 2013. Other drugs which are harmful to vultures e.g. aceclofenac, ketoprofen, nimesulide etc. were also available. Hence it is inferred that the threat of NSAIDs harmful to vulture population still persists. The summary of his presentation showed that the small population of two species of vultures has been more or less stable for the last 15 years and all-time low number of nests was recorded. Management practices, especially the *vayal* management should be continued in the sanctuary. The prevalence of diclofenac and other NSAIDs should be strictly monitored and availability of NSAIDs should be totally eliminated in Kerala, especially in Wayanad and the neighboring districts by the Drug Controller. At the end he concluded that monitoring of carcasses should be continued till a substantial data is generated for proper assessment and a joint action plan has to be designed with Bandipur National Park, Rajiv Gandhi National Park (Nagarhole) of Karnataka and Mudumalai Tiger Reserve of Tamil Nadu so as to make effective conservation strategy.

Mr. Sashikumar informed that Teak and Rose wood are the preferred trees for nest construction and that coordination with neighboring states is not up to the mark and that there are human disturbances if nests are located very close to human habitations. Then Mr. N. Mohanraj, Honorary Wildlife Warden, Mudumalai Tiger Reserve asked about the impact of the forest cover on vulture population between Wayanad and Bandipur and the impact on *Lantana* cover proliferation on vulture population. Mr Sashikumar replied yes there is an impact of *Lantana* cover, but it required a detailed study to comment on it. Dr. Christopher from Mahathma Gandhi University, Kottayam supplemented that forest fire play vital role on forest dynamics, but still it requires long term study to bring out conclusion.

Population estimation of vultures in Moyar Valley: Sweep surveys -

By **Mr. Chandrasekaran, S.,**
Freelancer, Chennai

Mr. Chandrasekaran presented his sweep survey findings. He mentioned that his sweep surveys were carried out by adopting standard protocols as suggested by Gary M. Fellers and Kathleen L. Freel by modifying a bit to suit area of his study, that is, Moyar Valley. Ideally this survey brings to light that experts who have extensive experience in species identification and the capacity to walk in remote forest areas can to a large extent assess the population since they occupy known niches in this vast terrain and a complete survey includes all habitats and terrain fully covered within the survey period so that vulture niches and numbers may be identified with fair accuracy. He stated that some of the biologists believe that individuals routinely move from one population to another and without this dispersal, the populations may not be self-sustaining over a period

of time. He added that this method has many advantages over other techniques, because there is no bias in selecting sites and no need to extrapolate the data. At the same time, he opined that this method also has some disadvantages such as time required, man power and cost. In a large park or wilderness, it may be a deterrent unless suitable modifications are adopted. He finally concluded that there is a stable population for the last three years as the figures indicate. Giving allowance to observer bias and repetitions (that was restricted to only few camps), the population may well be around 150+ for all the four species. The Egyptian vulture is pretty rare to find in this landscape as per the results of the surveys. After his presentation, Dr. Baranidharan, Assistant Professor, Forest College & Research Institute, Mettupalayam asked that how the complete count avoided duplication. Mr Chandrasekaran replied that all sightings would have time, numbers, species name along with direction. The teams operate in a synchronized pattern, that is, operate at different camps placed equidistant in the landscape at the same time and day. When results are plotted in a map of the area, one can see the movement of birds versus time and day and can easily find overlapping territories or adjacent camps in order to avoid duplication. Fortunately, only 2 camps out of 12 indicated the possibility of overlapping.

Population estimation of vultures in Moyar Valley, Tamil Nadu: Road transect survey -

By **Dr. Venkitachalam, R. ATREE,**
Bangalore

Dr. Venkitachalam has mentioned that although nine species of vultures are recorded in Indian sub-continent, six vulture species were found in the Moyar Valley of Tamil Nadu namely, Oriental White-rumped (OWRV), Long Billed Vulture (LBV), Red-Headed Vulture (RHV), Egyptian Vulture (EV), Himalayan Griffon and Cinereous Vulture. He stressed that the Oriental White-rumped and Indian Vultures have an active nesting population in the landscape. Record of few RHV juvenile vultures in the landscape indicates that RHV also breeds in the landscape. He also quoted sightings of two migratory vultures namely Himalayan Griffon and Cinereous Vulture in the landscape as well as in the adjoining states of Kerala and Karnataka. Dr.Venkitachalam had applied road transect count driven by a four wheeler on tarred road, sand and metal roads. He says that the flock size of the OWRV was significantly higher and the LBV was very low and there was no difference in RHV. Dr. Venkitachalam also stated that there is no seasonal variation noticed in Red-headed Vulture and Long Billed Vulture across the season. However he found that there was a seasonal variation in population and encounter rate in OWRV. He stressed on the need of government and non-governmental organizations involvement to save last surviving small population of vultures through research, advocacy and awareness. He opined that the recent mortality of vultures in the landscape is another challenge for conservationists. Finally he concluded on the need of long term ecology studies such as (nest monitoring, NSAID survey & transect survey) advocacy and conservation awareness for announcing this landscape as a permanent safe zone for vultures. After the presentation the forum suggested that they should come up with a uniform methodology especially for population estimation. Some of them were suggested that combine methodology might be a good option for entire landscape. Finally the forum suggested to undertake synchronized population estimation within the landscape to get accurate number of vultures.

Conservation strategies for securing Critically Endangered White-Rumped (*Gyps bengalensis)* and Long Billed (*Gyps indicus)* vulture species in the Tamil Nadu part of the Nilgiri Biosphere Reserve-

Dr. B. Ramakrishnan,
Assistant Professor in Wildlife Biology & Organizing Secretary of the "Securing Vulture Population in Southern India" workshop, Udhagamandalam

Dr. B. Ramakrishnan and his team made a study on vulture population in Mudumalai and Sathyamangalam Tiger Reserve and Nilgiri North Forest Division for two years from 2015 to 2016. Population estimation was done by nest site count method, breeding ecology (was studied by direct field observation) diclofenac and other threats assessed by questionnaire survey. Ramakrishnan said that his team has identified a total of seven nesting and one roosting locations used by two vulture species, of which belonged to four White-rumped and three Long-billed vultures. A total of nine villages

are there in and around the nesting and roosting colonies. A total of 52 White-rumped vulture nests were recorded in 38 nesting trees. Jagalikadu nesting colony had recorded 28 nests in 21 trees. Two tree species namely *Terminalia arjuna* (37 trees with 51 nests) and *Spondias mangifera* (one tree with one nest) were used for nest construction. Among the 52 White-rumped vulture nests, 40 nests were observed as active nests evidenced by frequent usage of a nesting pair. Out of 40 incubations, 24 hatchlings came out with the 58% of the breeding success in all four nesting colonies altogether. On the other hand, 100% (n=2) fledge out was recorded from 2 incubations of a Long-billed vulture. He has concluded the need for long-term monitoring of vultures in order to find out the reasons behind for breeding success and failures of White-rumped vultures in the landscape and study on food availability, population viability, etc.

Dr. B. Ramakrishnan and his team presented their drug store survey. The result revealed that a total of ten diclofenac composition painkillers are being currently prescribed by the doctors for human use. An alarming message is that 30 ml vials are still available in the drug stores. He stated that they have recorded a total of forty-two White-rumped vulture deaths between 2013 and 2016. Of which thirty-four individuals were adult and eight were immature. The post-mortem was conducted only for eight of them other 32 individuals were seen with skeletal and feather remains unable to conduct post-mortem. The autopsy laboratory result revealed that the tissues of the vultures were contaminated by ***Organo phosphorus and urea*** which is a poison used as an insecticide in agriculture practice and one died due to its neck lock between the vertebral bones of the domestic buffalo carcass while feeding. He concluded that retaliatory killing is effectively influencing on vulture population than Diclofenac.

After his presentation Dr. N. Sivaganesan, Freelancer from Mayiladuthurai asked why vulture sightings were more in thorn forests?. In reply Dr. Ramakrishnan responded that due to open area and easy visibility in thorn forests, the vultures were able to sight carcasses apart from this it would be easier for them land easily and takeoff than other dense forest types. Presence of perennial water source is also another important for the use of thorn forest (Moyar Valley). Then Mr. Rajkumar from Wildlife Conservation Foundation, Mysore supplemented that he also sighted is more number of vultures in thorn forests than in other forests in Bandipur Tiger Reserve, which is an adjoining landscape. Mr. S. Paulraj, IFS (Retd.) Chennai, clarified and supplemented the persistence of deliberate poisoning of carcasses even during his tenure as a wildlife warden in the Mudumalai Wildlife Sanctuary during 1995-2000. Mr. K. Kalidasan, President of OSAI Environmental Organization, Coimbatore question on the reason for declining vulture population in Siriyur nesting colony. Mr. Bharathidasan from Arulagam asked about correlation between mortality of vultures and striped hyenas the striped hyena is also one of the most important species seen in the landscape which has drastically reduced?. Dr. Ramakrishnan replied that 2 cases of hyena deaths were recorded in 1990 and 2000. Mr Bharathidasan asked about what are the alternatives to work against poisoning. Dr. Vijayaragavan, Forest Assistant veterinary Surgeon supplemented his experience by evidencing poisoning incidents through his 3 to 4 post mortem examinations. Finally he concluded that poisoning was the most threatening culprit followed by Diclofenac and other NSAIDs, pilgrims, honey collectors and fire, etc. for vultures in and around the Nilgiris Landscape.

Status of vultures in Bandipur Tiger Reserve, Karnataka-

By **Mr. Rajkumar, D.,**
Wildlife Conservation Foundation (WCF), Mysore

Mr. Rajkumar, WCF, Mysore presented vulture status in Bandipur Tiger Reserve (BTR). He applied search method from 2003 to 2016. He has compared his data which were collected earlier in 2002-2003, when 17 sites were surveyed for one year in four phases in BNP and *Gyps* vulture species in 12 sites. He presented compilation of all sightings, including breeding sites. He had recorded around 125 birds in 2003. On the contrary, he has sighted just 7 birds in 2007, followed by 60 birds in 2008 and 479 birds in 2010. In 2012 he had sighted 169 birds, in 2013 a total of 311 birds were seen by him. At last he has sighted 251 birds in 2016. He has recorded one breeding site of Long billed vulture at cliff in Byladakuppe in Moyar range then it was disturbed by labours who worked on the construction of road and fire watch tower. Rampura bordering Waynaad Wildlife Sanctuary had 3 breeding trees and Banoor had 2 breeding trees that are still habited by vultures. Kabini River and Nugu River back waters are the major feeding sites to vultures where elephants congregate during peak summer. Cattle and livestock death along border villages make another good but vulnerable feeding sites to vultures. He quoted that Diclofenac and other NSAIDs were easily available in Gundlupet town, Chamarajanagar district, H.D. Kote with veterinary attendees in villages surrounding BTR. He conducted many awareness programmes in schools, colleges and surrounding villages of BTR and circulated save vulture pamphlets in local language. Apart from this a bike rally was conducted by him with the help of Arulagam

in Gundlupet which was also supported by the Karnataka Forest Department.

After his presentation, Dr. Sivaganesan supplemented that he found elephant carcasses only by looking the vultures' soaring in the sky during 1985-1990s, when elephant poaching was at peak. Mr. Sashikumar from MNHS, Kerala said that the overall numbers presented by Mr. Rajkumar was seemed to be a very high numbers especially, white rumped vultures and he asked why the reason for Red headed vultures were seen just one or two in BTR at the end he asked why there is a lacking of publications on vultures in Karnataka, though the state has declared first vulture sanctuary in the country. Mr Rajkumar replied that the high number of vultures sighted mainly during elephant migration periods. He also stressed that may be a synchronized vulture population count by three states might give more accurate picture rather than what we are doing in their respective states. Mr. Chris Bowden added that ecology of Red headed vulture might not be the same then as for White rumped vulture. Mr. Rajkumar responded that keeping cameras near to carcasses of tiger kill or elephant deaths would give more realistic pictures of various vulture species. At last Dr. Robert B. Grub, the first vulture Ph.D holder in the country asked when there was any competition between vultures and tigers since tigers might hide their prey remains which might not be accessible to vultures. Mr Rajkumar responded that there is a competition between vultures and tigers, but he has not recorded any event. To another question Mr Rajkumar answered that the tiger drag the prey remains. But in during summer it would be more open in Kabini back water. Hence it is easily accessible for the vultures to identify the carcasses.

Population, breeding ecology and conservation threats of Long Billed Vultures (*Gyps indicus*) in the Ramadevarabetta Vulture Sanctuary (RVS) in Ramanagaram Hills, Karnataka.-

By **Mrs. Padma Ashok,** Save Tiger First, Bangalore

Mrs. Padma presented on the status of Long-billed vultures in the Ramanagara hills. She described that the Ramanagara hill as the world's oldest granite outcrops and is also known as South India's earliest rock climbing hub. She told that apart from its geological importance, Ramanagara is the home for the country's first vulture sanctuary called the *Ramadevarabetta Vulture Sanctuary*. The hills at Ramanagara are one of the few locations in the land of South India where Long-billed Vulture (LBV) constructs nest was today. She said that with an effort to conserve the tiny population in the Ramanagara, a study was conducted in 2005 by a team of bird watchers led by Dr. S. Subramanya,

Ornithologist. Based on the findings of this small study about 346.14 hectares was declared as Ramadevarabetta Vulture Sanctuary on 31st January 2012 by the Government of Karnataka. As a recent update there were about 15-20 Long-billed Vultures in 2010-11. The study initiated by Save Tiger First commissioned by Karnataka Forest Department was a continuation to the study conducted in 2005. Aim of the study was to assess palatable habitats to Long-billed Vulture (*Gyps indicus*), to estimate their present population and monitor them. She told that there were about 4-5 LBVs which currently roosted on the cliffs of Ramadevarabetta hill. Occasionally there were 7 LBVs seen. She pointed out the movement of local people and tourists as pilgrims as well as rock climbing are mainly attraction of the Ramadevarabetta hill. Awareness creation was given to the school children and diclofenac survey was conducted in drug stores. She concluded that there is a disappearance of LBVs from other bettas (hills) which are surrounded nearby mainly due to human disturbances. After her presentation the forum asked many questions such as breeding status, sex ratio, nest status and validation of the methodology and so on. She answered that presently she had observed just 2 male and 1 female and there was about 14 individuals when it was declared as a sanctuary. The methodology is not validated because she did not publish her findings so far. Finally the forum suggested instead of just doing observation some standard methodology can be followed in future for the betterment of this vulture population.

Status of vultures in Telangana and Andhra Pradesh-

Shaik Hussain,
Laboratory for the Conservation of Endangered Species, CCMB, Attapur, Hydrebad-500 048.

Mr. Shaik Hussain from Hydrebad presented on vultures in Telangana and Andhra Pradesh. He told that three vulture species were found in Telangana and Andhra Pradesh namely, Oriental white-rumped, Indian long-billed and Egyptian Vultures. His team surveyed vultures across Telangana and Andhra Pradesh, from September to October 2017. Road transect method was applied mostly on state highways and on roads running through protected areas. Breeding colony of Indian long-billed vulture was situated on the southern face of 80-90 meter high elevated rock cliff (108 meter total height of the cliff), named **"**Palarapu cliff", in the Bejjur Reserved Forest near Nandigaon village at the confluence of Peddavaagu stream and Pranahita river. Two *Gyps* species have been reported by his team in three locations from Andhra Pradesh *i.e*. Indian long-billed Vulture (Srihari kota, n=2 and Domalapenta- Srisailam Tiger Reserve, n=1) and Oriental white-rumped Vulture (Mamandur-Thirupathi, n=1). He added that in the initial stage of the project named "Conservation of Indian long-billed Vulture" by Telangana Forest Department at Palarapu cliff, there were only 9 individuals, now this population has grown up to 26 individuals in 2015, 30 individuals in 2016 and 32 individuals in 2017. He mentioned that Egyptian Vultures were recorded from Kesrera gutta-Municipal yard (n=6), Rajendra Nagar (n=3), Ameenpur Lake (n=4) and Bejjur Reserved Forest (n=1). He concluded his presentation by quoting major threats on the vulture populations in Telangana and Andhra Pradesh are diclofenac, food scarcity both natural and artificial, competition for food from other scavengers, cyclones especially in coastal areas, habitat destruction especially in nesting sites, human movement, malaria and other diseases. After his presentation, the forum asked about the possibility of captive breeding of Long-billed vultures, what kind of malaria was recorded, invitro or insemination programme and any gastro intestinal parasitic study was found in the population. Mr. Hussain responded that they observed plasmodium which caused malarial infestation. Due to difficulty in dropping sample collection there would be less chance to carryout gastro intestinal parasitic study in birds. He finally he opined that the need for long term scientific study for invitro or insemination programmes in birds especially critically endangered vultures like Long-billed vultures should be done as their numbers are very low.

TECHNICAL SESSION - II
CONSERVATION THREATS

Diffuse pollutants other than NSAIDS – Any potential concern for vultures in India-

Dr.S. Muralidharan,
Principle Senior Scientist, SACON, Coimbatore

Dr. Muralidharan from SACON presented on diffuse pollutants other than NSAIDs role on death of vultures in India. He mentioned that though the diclofenac was a major culprit for decline in vulture populations across the south Asian countries there were also incidents of others contributing to the decline of vulture population. But incidentally or unfortunately he was unable to have adequate samples to his laboratory to identify what chemical was responsible for it. But through recently published papers, they have compiled information of around 50 vulture samples altogether from Tamil Nadu, Gujarat and Assam between 2013 and 2015. This was not even 1/100th of actual mortality. He also added that the sample from Mudumali Tiger Reserve also had residues of diclofenac, but it was not adequate enough to be called as toxic but otherwise it was exposed. He stressed the role of diclofenac cannot be ruled out. At the same time circumstantial evidence also suggests on other contaminants also could cause more problems. He added that so far about 90 individual samples came to his lab between 1999 and 2015. Between 2015 and 2017 alone they had received around 68 bird samples along with liver, kidney, muscle, gut content, undigested food materials, blood samples and couple of eggs also. They tested these samples for organochlorine pesticide, polychlorinated biphenyls, polycyclic aromatic hydrocarbons and heavy metals like Pb, cadmium, Cu, Cr and so on. At the end he stated that Organochlorine, DDT and banned Endosulfan also found in the autopsy of vulture tissues. After his presentation the forum asked many interesting questions like, what is the lethal level of diclofenac contamination would kill vultures, Symptoms of diclofenac caused deaths and which part of the livestock carcass is more susceptible part if the vultures feed. He replied by quoting Newton's paper for lethal level of diclofenac in the carcass and symptoms of diclofenac caused deaths. Finally he concluded that muscle eating vultures might consume more diclofenac or other NSAIDs and thus resulted in high probability of mortalities because liver and kidney of livestock could have excreted or metabolized the effects of NSAIDs than muscle.

Impact of Diclofenac, other NSAIDS and indirect poisoning on vultures -

By **Dr. N. S. Manoharan,**
Forest Veterinary officer, Coimbatore Circle, Coimbatore

Dr. Manoharan stressed on the impact and symptoms of all NSAIDs on veterinary aspects and shared his experience on deliberate poisoning reasoned behind for deaths of various carnivores such as tiger, leopard, hyaena, wild dog, wild pig and including vultures in the Nilgiris and surrounding areas. He compared between vulture and tiger populations co-existence in the way back 1980s when it was drop down and recovered back since 2005 in the Nilgiris.

Vultures and NSAID'S -

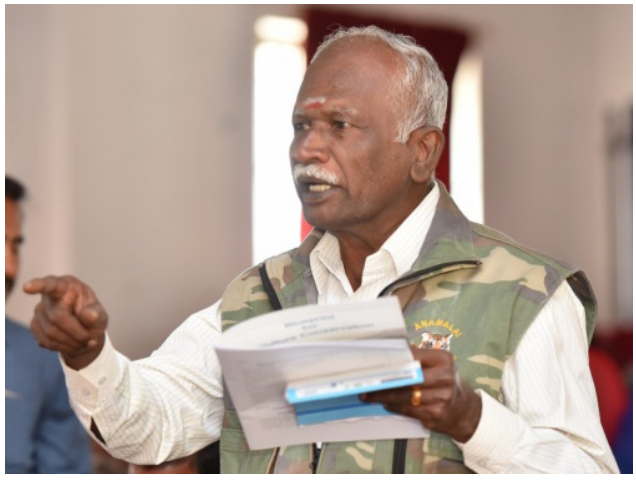
By **Dr. Percy E. Avari,**
Assistant Professor, Department of Poultry Science,
Bombay Veterinary College

Dr. Avari explained in detail on the effect of NSAIDs like diclofenac and others on the physiology of vultures. He dealt in detail on the symptoms shown in vultures by these NSAIDs physically, physiologically and veterinary perspectives. He also elaborately discussed the inadequacies in handling NSAIDs like Diclofenac, Accelofenac, Nimesulide etc. and the least affecting drugs like Aspirin, Melaxicam, Paracetamol etc. He emphasized the need to test new NSAIDs on the toxicity level so that the remnant vulture population is not affected. He insisted that Veterinary practitioners should educate farmers about the role of these toxic NSAIDs so that misuse is restricted. After his presentation long discussion took place on the symptoms of NSAIDs and his experience in vulture post mortem analysis and whether only diclofenac is the cause of decline, in which many of the veterinary doctors participated enthusiastically.

Use of Diclofenac and other NSAIDs in rural veterinary practice -

By **Dr. *Shanmugasundaram, S.***
Forest Veterinary Officer (Retd.)

Dr. Shanmugasundaram told that he never used diclofenac as anti inflammatory drug in his veterinary practice (At presently he is practicing in rural areas near to vulture habitats). At the same time he also stated that the Government of Tamil Nadu provides adequate vulture safe drug named Melaxicum as an alternative to diclofenac. But continuous vigil is required especially in the vulture surrounding areas in order curtail diclofenac usage as well as impact on other NSAIDs to rural veterinary doctors may be through Government or organizing separate workshops for rural veterinary doctors would be much better for the long run conservation of vultures in future.



Post mortem analysis of White-rumped vulture in Mudumalai Tiger Reserve -

Dr. Vijayaraghavan, E.
Forest Assistant Veterinary Surgeon,
Mudumalai Tiger Reserve.

Dr Vijayaragavan in his introductory speech emphasized on the importance of postmortem examination for all wild animals. Dr. Vijayaragavan shared one of his experiences of vulture postmortem which happened during 2015 year. On that occasion about four White rumped vultures were brought to his dispensary. Among the four individuals, two of them were already dead and two in dying condition. He provided saline water and peak of sublimate. After one hour both died. He found vomiting was the major symptom that he observed from the two vultures before they died. When he conducted the post mortem, he found meat material in the crop. He also found other organs normal and saw ammonia and urea in the intestine. At last he found calcareous

symptoms and blood in mouth and anus. Thereby he had suspected that the cause of death of the four vultures was due to poisoning. After the post mortem blood samples and required internal organs were sent to two laboratories namely SACON and Regional Forensic Science Laboratory, Coimbatore for further lab analysis. After 5 days the field staff found another the vulture dead near a buffalo carcass which has got trapped its neck between vertebral bones of the buffalo when it was feeding. Dr. Vijayaragavan told he has received astonished message was that there were two totally different lab analysis reports from two institutions. The SACON has submitted the four vulture death was caused due to diclofenac effect and another Regional Forensic Science Laboratory, Coimbatore report stated that it was due to poisoning by ***Organophosphorus and urea.*** After his presentation the forum asked that how come two different results which were totally deviated for same samples. The forum also asked that the poisoning is an accurate and diclofenac effect is chronic, so how come two institutions could provide two different results. This presentation really opened an eye on lab results and its reliability. At the end, the forum suggested to send the samples to at least three labs considering the importance of critically endangered species like vultures in future.

The prevalence survey on Non Steroidal Anti-Inflammatory Drugs (NSAIDs) in The Nilgiris, Tamil Nadu-
By **Mr. Manigandan,**
S. Biologist, Arulagam, Udhagamandalam

Mr Manigandan a researcher working with Arulagam made a survey from 107 medical shops in 18 locations on prevalence of NSAIDs in and around the Nilgiris. He told that out of 107 medical shops, 19 medical shops sold medicines for veterinary purpose. He found that all medical shops were very much aware on the ban of diclofenac. He added that 30 ml diclofenac vials were very much available in all medical shops for human purpose. During his survey he also found that other NSAIDs such as ketoprofen, acelofenac, flunixin and nimesulide were available and the shop keepers were not aware of harmful nature of them on vultures. Recent ban on ketoprofen was known by just eight medical shop keepers. He stressed on the need of awareness creation programmes to medical shop keepers especially who sells veterinary medicines.

TECHNICAL SESSION - III
AWARENESS PROGRAMMES

Maligned Hero-Birds: Importance of conservation awareness programmes on vulture conservation -

Daniel, B.A,
Scientist, Zoo Outreach Organization, Coimbatore

Dr Daniel from Zoo Outreach Organization delivered a speech on the importance of awareness programmes for vulture conservation. During 1999 on behalf of Zoo Outreach Organization Dr. Daniel, Mr. Marimuthu and his team conducted a study on status and management of vultures in Indian zoological gardens. Subsequently utilizing the data collected from Indian zoological gardens, developed user friendly educational materials for target groups. In 2012 all vulture education materials were revised and utilized by a range of wildlife and environmental educationists across India and South Asian countries. He told that this kind of awareness programmes created measurable impact on vulture conservation. The awareness programmes contain principle, approach, contents, practical education tools, feedback from the participants and discussed future management recommendations in selected places in India and south Asian countries.

Vulture conservation activities done By Arulagam from 2012 to 2017-

By **Bharathidasan, S., Arulagam,**
Coimbatore

Mr. Bharathidasan from Arulagam presented on efforts made by his team on vulture conservation covering four districts in Tamil Nadu state. Mr. Bharathidasan told that he and his team organized various programmes such as street theatre, puppet show, rally, human chain, exhibition, survey, sports event, carnivals, advocacy meetings to change the policy for sensitizing various stakeholders in and around vulture surrounding areas during 2013. In his presentation he stated that such programmes resulted in the withdrawal of ketoprofen, increased frequent raids by drug control officers, resolution passed in gramasabha, withdrawal of stay order against pharmaceutical companies on diclofenac by the Honorable Madras High Court. Finally he concluded that although various naturalists and scientists all over the world did their best efforts by taking timely interventions for recovering vulture populations, the Arulagam also did its level best for the state of Tamil Nadu.

People's perception on vulture conservation in Tamil Nadu part of the Nilgiri Biosphere Reserve, Southern India -

By **Samson, A, Ph.D**
Research Scholar, Government Arts College,
Udhagamandalam

Mr. Samson, A from the Government Arts College Udhagamandalam stressed on people's attitudes that play vital role for survival of vultures as it has multiple linkages and provides both positive and negative impacts on them. He interviewed totally three hundred and ninety one livestock holders from twenty six hamlets. Of which most of them were tribals (Irrular) and illiterate. A total of 8531 livestock were recorded by his door to door survey. Of which cattle were dominant (n=3621). He found that the livestock holders were making money mainly from dung (Rs.35,12,000/ annum). He also stated that a total of 8191 livestock were lost by 391 people during the past five years. Of which, most of them (n=5631) were lost due to various diseases and considerable (n=2548) number of livestock were lost due to wild carnivore's depredation. Mr. Samson quoted that the need of some long term mechanism to make sure food security to vultures as most of the (n=217) livestock owners just thrown away their livestock carcasses into forest areas and considerable (n=174) number of people buried their dead livestock carcasses. Sizeable number (n=137) of people known about diclofenac and its effects on vultures, at the same time most of them (n=254) were not aware of diclofenac and its related issues on vultures. His interview stated that the vulture population is declining (n=313), feral dog's population is increasing and compensation paid by the forest department for livestock loss due to wild carnivore's depredation is inadequate (n=388) and long procedures to be followed by the livestock keepers. At the end of his talk, he stressed on the need of adequate and timely compensation/ exgratia to the livestock holders in order to curtail deliberate poisoning of carcasses as retaliatory killing which is highly need of the hour to secure vulture population in the Nilgiris.

TECHNICAL SESSION - IV
MANAGEMENT IMPLICATIONS

Legal Battle to remove the stay on the ban of Multi Dose Vials (MDV) of Diclofenac -

By **Mr. Bharathidasan, S. Arulagam**

Mr. Bharathidasan talked about the legal battle faced by him for the ban of multi dose vials of diclofenac in the market. In his introductory speech he spoke about the Union government's decision to ban on multi-dose vials of diclofenac for veterinary use sparked hopes for the survival of the critically-endangered vulture species in India. He added that large multi-dose vials of 30 ml diclofenac labeled instruction mentioning '*Not for veterinary use*' is still available in the market, facilitating illegal use of the drug in veterinary practice, which may cause further decline in vulture populations. He mentioned that a big boost to vulture conservation was the recent notification passed by the Union Ministry of Health and Welfare on a total ban on multi-dose vials of diclofenac on July 17, 2015. The notification said that the diclofenac formulation for human use will henceforth be available only in single dose vials of 3ml. This ban was challenged by a pharmaceutical companies and stay was issued on 29th December, 2017 by the Madras High Court. It took 2 years to get a judgment from the Madras High Court. At the end, in October, 2017 the Madras High Court reinstated against pharmaceutical companies which has given hope of vulture conservation in southern India. The book released by Tamilnadu Forest Department in February 2016, authored by S.Chandrasekaran, Dr.N.Kalaivanan & Dr.B.Ramakrishnan formed the scientific base for the High Court to deliver this verdict.

GROUP DISCUSSION
GROUP-I
THEME: STANDARDIZING METHODOLOGY FOR VULTURE POPULATION ESTIMATION & RESEARCH ACTIVITIES

Name of the facilitator: **Dr. Robert B Grubh**

Name and Designation of the group members

Sl. No.	Name	Organization
1	Kiran Srivastava	RRCF, Mumbai
2	Rajkumar D	WCF, Mysore
3	Ravikanth M	Telangana Forest Department
4	Padma Ashok	Save Tiger First
5	Shaik Hussain	Conservationist & Wildlife Researcher
6	Dr. R Venkitachalam	ATREE, Bangalore
7	Vishnudas C K	Hume Centre for Ecology, Kerala
8	Mrs. Shailaja Grubh & Dr. Robert Grubh	Environmental Edu-Organization & Director, IRNE, Nagercoil
9	K Ranjith	Forestry Research Fellow
10	Dr. E Vijayaraghavan	Forest Assistant Veterinary Surgeon Tamil Nadu
11	Dr. Prayag H S	Sr. Ph.D. Researcher, KVAFSU-WII
12	Dr. Sujay C S	Wildlife Vet, Bannerghatta Zoo
13	Shashikumar B.	KVCT, Ramanagara
14	Dr. K Baranidharan	FCRI, Mettupalayam
15	Dr. S Paulraj	Trustee, CSPT, Chennai
16	R. Marimuthu	Zoo Outreach Organisation
17	A. Samson	Research Scholar, Govt. Arts College, Ooty
18	S .Saravanan	WWF, Nilgiris Western Ghats Landscape
19	D. S. Srinivas	Wildlife Conservation Foundation (WCF)
20	Dr. N S Manoharan	AA/FVO, Coimbatore

GROUP- II
THEME: CONSERVATION THREATS & MANAGEMENT IMPLICATIONS

Name of the group facilitator: **Mr. C.Shashikumar**
Name and Designation of the group members

S.No	Name	Designation
1	Mr. C.Shashikumar	MNHS, Kerala
2	Dr. Sivaganesan	Executive Director, Wildlife Environment Trust
3	Mr.Chris Bowden	RSPB and SAVE Programme Manager. Co-Chair IUCN Vulture Specialist Group
4	Mr.K.Kalidasan	President, OSAI, Coimbatore
5	Mr.S.Bharathidasan	Secretary, ARULAGAM, Coimbatore
6	Mr.S.Chandrasekar	Freelancer, Coimbatore
7	Mr.M.Rangasamy	Environment Science, Teacher , Riverside Public School
8	Mr.Jalaludin	NCS, Coimbatore
9	Dr.B.A.Daniel	Zoo Outreach Organization, Coimbatore
10	Dr.S.Shanmugasundaram	Forest Veterinary Officer (Rtd)
11	Mr.Sivasubramani	Senior Biologist, Tamil Nadu Forest Department
12	Mr.N.Mohanraj	Honorary Wildlife Warden, Mudumalai Tiger Reserve
13	Dr.P.Rajasekaran	Blue plant Trust, The Nilgiris
14	Dr.Percy Avari	Assistant Professor, Department of Poultry Science, Bombay Veterinary College.
15	Dr.Balamurugan	Assistant professor, Government Arts College, Udhagamandalam
16	Dr.Ronaldross	Assistant Professor , Department of Zoology Government Arts College, Ariyalur
17	Dr.Milton Prabu	Assistant Professor , Department of Zoology Annamalai University
18	Dr.Vijayaragavan	Forest Assistant Veterinary Surgeon, Mudumalai Tiger Reserve, Theppakadu, The Nilgiris
19	Mr.Samuel	WWF- India, Nilgiris Western Ghats Landscape
20	Dr.Sukumaran	Additional Director, Animal Husbandry
21	Mr.S.Manigandan	Biologist, ARULAGAM, Coimbatore

Group discussion by the experts to bring out feasible scientific management implications

Group - I

Group - II

CONSERVATION ACTION PLAN BROUGHT OUT FROM GROUP DISCUSSIONS FOR SECURING VULTURE POPULATION IN SOUTHERN INDIA

1. The workshop has formed "Vulture Conservation Working Group - South India" (VCWG-SI)" which is committed to protect the vultures in south India, and to advocate suitable conservation measures to protect their habitats in south India. VCWG-SI sincerely expresses its appreciation to

a. The Forest Department, Government of Tamil Nadu for its contribution for coordinating this workshop in Tamil Nadu, first of its kind .

b. The Secretary to Government & the Director, Animal Husbandry Department, Tamil Nadu for withdrawal of vulture harmful drug 'ketoprofen' from the Government dispensary.

c. Drug Control General of India for banning Multi Dose Vials (MDV) of diclofenac and records its gratitude to the Honorable High Court of Madras for upholding the ban of MDV of diclofenac.

d. Central Drugs Standard Control Organization and State Drug Control Department of Tamil Nadu for their support and also for conducting periodic raids in the pharmacies.

e. The Forest Departments of Kerala and Karnataka for faster compensation process to livestock holders for livestock kills by large carnivores and reducing the pressure of retaliatory poisoning.

The Workshop appealed and RESOLVES to

(2) The Secretary to Government & the Director, Animal Husbandry Department of Tamil Nadu, Kerala, Karnataka, Andhra Pradesh & Telangana

a. Not to procure Non-Steroidal Anti Inflammatory Drugs (NSAIDs) and other similar veterinary drugs that are harmful to the vultures such as Aceclofenac, Nimesulide and Ketoprofen for the Government dispensary and initiate necessary action for the immediate withdrawal of all harmful NSAIDs from all Government dispensaries. Instead to promote traditional remedies and medicines or known safe drugs such as meloxicam.

b. State Governments in South India to issue the appropriate Government order for testing of NSAIDs in dead cattle and vulture carcasses and sending the tissue samples to at least three, but not limiting to fully equipped laboratories such as Indian Veterinary Research Institute (IVRI), Sálim Ali Center for Ornithology (SACON), Advinus or Veterinary colleges in the respective States.

(3) This workshop highlighted poisoning of carcasses poses a grave threat to the vulture populations and appeals to the State Principal Secretary to Ministry of Environment & Forests, Principal Chief Conservator of Forests, Chief Wildlife Warden of respective State Forest Departments to initiate policy level decisions to immediately ease the compensation process in order to curtail the poisoning of cattle carcasses. Because of the understandably high profile concern for avoiding poisoning of large cats, and the measures already in place to tackle this issue, there is some very positive synergy here between these measures and those needed for vultures. Reinforcing these synergies as part of the vulture conservation action plan is urgently needed.

(4) Expresses its concern over the forest fires in and around vultures nesting colonies and appeals to the

State Forest Departments to take necessary fire protection measures to prevent such fires destroying vulture nests and its habitat especially during local temple festivals.

(5) Appeals State Governments in South India to appoint and train Vulture Watchers from the indigenous ethnic communities and initiate people's participatory approach for vulture conservation by also involving the conservation organisations and institutions, policy makers, NGO's and other interested individuals for promotion of 'Vulture Safe Zones' in South India.

(6) Highlights the need for a 'Vulture Conservation Action Plan' in their management plans of all forest divisions. Similarly, all 'Tiger Reserves' should also incorporate 'Vulture Conservation Action Plan' within their 'Tiger Conservation Plan', and that this may be readily available in regional languages as well.

(7) Requests that 'Vulture Research Centers' to be established and operated in all vulture ranging states by the Forest Department where a core team consisting of, but not limiting to, a veterinary doctor, wildlife biologists, research assistants and supporting field staff to monitor, document (and carry out necropsy, tissue analyses at accredited laboratories) on all the available carcasses of wild fauna including livestock and vultures as far as possible as well as liaisoning with forest department and livestock holders in order to curtail deliberate poisoning in livestock as retaliatory killing.

(8) Expresses its concern for biotic and abiotic disturbances to vulture nesting sites and in particular, the conduct of festivals in eco-sensitive zones of Siriyur, Jagalikadavu and Karuvannarayar Temple of Moyar region (of Nilgiri Biosphere Reserve) that are pose threats to vulture nesting sites and, appeals (a) to the Forest Department, Govt. of Tamil Nadu to initiate steps to control and implement suitable measures to reduce the impacts of pilgrims and/or tourists by coordinating with the District Administration and the Hindu Religious Endowment Board, Government of Tamil Nadu (b) to regulate tourism in the vultures nesting sites based on recommendations made in the Vulture Conservation Action Plan.

(9) Appeals to the Principal Secretary to the Ministry of Environment & Forests, PCCF, Chief Wildlife Warden of Forest Department of respective States to (a) amend and/or frame the rules not to bury or burn wild animal carcasses (if there is no evidence of poisoning and contamination) and to leave them for vultures and other wild scavengers as food (b) that if any wildlife carcass is found near human settlements, suitable arrangements made to shift the carcass to the forest areas and away from human habitation.

(10) Appeals to the respective State Forest Departments to (a) assess the impacts of windmills and power lines on the vultures and other related avifauna and take corrective measures (b) the Electricity Board to remove all overhead transmission lines or re-align power lines to avoid collision and electrocution of vultures (c) wherever possible, replace and install underground cables and wires and, (d) carry our Sensitivity mapping with respect to wind farms and transmission lines to the potential impact on vultures.

(11) Appeals to the District Administration, Forest Department and Public. Works Department of respective State Governments to provide adequate water and monitor the quality of water in the forest areas by joining hands with appropriate research institutions and Non-Governmental Organizations.

(12) Appeals to the District Administration, Animal Husbandry Department and Forest Department of respective States to take appropriate steps for the disposal of poultry waste which is likely to spread unknown pathogens and contaminants across the vulture landscape.

(13) The 'Blueprint for Vulture Conservation' be re-titled as draft of "Vulture Conservation Action Plan" and the same for each State be finalized as soon as possible.

(14) A uniform and coordinated methodology be adopted for surveys, studies on breeding biology and ecology of vultures for all landscapes.

(15) The workshop has selected the following state coordinators with respect to their states and one Coordinator for south India to take forward conservation initiatives for securing vulture populations in southern India

1. Dr B Ramakrishnan for Tamil Nadu
2. Mr. Rajkumar D for Karnataka
3. Mr. C Sashikumar for Kerala
4. Mr. M Ravikanth for Telangana
5. Mr. Shaik Hussain for Andhra Pradesh with
6. Mr. Bharathidasan S. of Arulagam as Overarching coordinator who is designated for closer co-operation and liaising with and between the State Forest Departments, Animal Husbandry departments, Drug Control authorities, conservation organisations and NGOs, etc.

(16) VCWG-SI appeals to the 'Chief Wildlife Warden', Government of Tamil Nadu for taking necessary steps for safe release the rescued Cinereous Vulture from Kanyakumari and attaching GPS – PTT tags for monitoring its migratory route.

(17) The VCWG-SI suggests the following step wise methodology for estimating vulture populations in all vulture ranges in south India

a) Secondary data collection

To get basic information about the presence and absence of vulture nesting, roosting, bathing and foraging sites in the focused study areas from local people, forest field staff, local NGOs, wildlife photographers, media personnel and old records (journals, personal communications) through Questionnaire Method.

b) Preliminary Survey

To get vulture's occurrence, distribution and confirmation of nesting, roosting and bathing sites in the focused study area

1. Road survey
2. Foot survey

c) Standard Methodology for population estimation

To estimate accurate population status of vultures in the focused study area

1. Nest site count
2. Roost site count
3. Carcass count

The following persons were identified to provide protocol for research activities to be taken up in their respective states

1. Dr. Prayag – Sexing of Birds in India & Post-mortem Studies, Collection, Preserving, Clinical Science and sending back the respective institutes, India
2. Dr. Bharanidharan (Forest College) – Ethology of Vultures, Tamil Nadu
3. Mr. Ravikanth – Breeding Biology – LBV, Telangana
4. Mr. A. Samson – Population Dynamics, Breeding Biology and Conservation Threats of Vultures in TN
5. Dr. Venkitachalam – Dispersal Patterns of Vultures, Breeding Biology & Diclofenac prevalence, Tamil Nadu
6. Mr. Vishnu Das – Population Genetics of Gyps vultures & Breeding Biology, Kerala
7. Miss. Padma – Study of Habitat & Diclofenac Prevalence at Ramanagara, Karnataka
8. Dr. N. S. Manoharan, Post-mortem Studies, Collection, Preserving, Clinical Science and sending back the reports to respective institutes, Tamil Nadu
9. Dr. Sujay, Bannerghatta Zoo, Post-mortem Studies, Collection, Preserving, Clinical Science and sending back the reports to respective institutes, Karnataka
10. Dr. Arun Satyaprakash - Post-mortem Studies, Collection, Preserving, Clinical Science and sending back the respective institutes, Andhra Pradesh
11. Dr. Praveen - Post-mortem Studies, Collection, Preserving, Clinical Science and sending back the respective institutes, Telangana
12. Mr. Sheik Hussain – Long-term Monitoring of Vultures – Status, Distribution, Abundance (Nesting, Roosting & Carcass Counts), Diclofenac Prevalence, Telangana & Andhra Pradesh
13. Mr. Sandeep Goud – Conservation Breeding Program, (ex-situ) Nehru Zoological Park, Hyderabad
14. Mr. Rajkumar D (WCF) – Monitoring of Vultures, Karnataka & Southern Flyways – Telemetry Studies (to be started)
15. Synchronized vulture survey, as a first phase in Tamilnadu, Kerala & Karnataka, lead by the respective state coordinators.

FIELD VISIT

On 10th early morning by 06.00 am interested persons were taken to one of the important vulture nesting colonies named as Jagalikadavu which is located in the Nilgiri North Forest Division. vultures. The group sighted two vultures resembling Griffon but later diagnosed as Immature Indian vultures. Working breakfast was provided in the field.

LIST OF ORAL AND POSTER PRESENTATIONS DELIVERED IN THE WORKSHOP

S.No	TECHNICAL SESSION – I STARTS	Status, survey and population estimation of vultures
1	Mr. Chris Bowden, Globally Threatened Species Officer & SAVE Programme Manager, UK Plenary Talk	The Current Threats and Status of Vultures in Asia
2	Toby Heath Galligan Senior Conservation Scientist, RSPB Centre for Conservation Science, The Lodge,Sandy, Bedfordshire.	The Good, The Bad And The Unknown: NSAIDs Available in Vulture-Range Countries
3	Dr. Robert B Grubh Scientist (Retd.), BNHS Nagercoil, Tamil Nadu	Status and conservation of White-rumped vulture in India – an overview.
4	Mr. C.Shashikumar and K. Vishnu Das Malabar Natural History Society, Kerala.	Status of Vultures in Kerala
5	Mr.S. Chandrasekar, Freelancer, Chennai	Population estimation of Vultures in Moyar Valley: Sweep surveys
6	Dr.R.Venkitachalam ,Ph.D ATREE,Bangalore	Population estimation of Vultures in Moyar Valley: Road side count
7	Mr. Rajkumar, Wildlife Conservation Trust, Mysore	Status of Vultures in Bandipur Tiger Reserve, Karnataka.
8	Mrs. Padma, Save Tiger First Foundation, Bangalore	Population, Breeding Ecology And Conservation Threats Of Long Billed Vultures (Gyps Indicus) In The Ramadevarabetta Vulture Sanctuary (RVS) In Ramanagaram Hills, Karnataka.
9	Mr. Sheik Hussain Free Lancer Andhra Pradesh	Status of Vultures in Andhra Pradesh and Telangana
10	Dr.B.Ramakrishnan,Ph.D Assistant Professor in Wildlife Biology Department of Zoology & Wildlife Biology, Govt. Arts College Udhagamandalam.	Conservation Strategies for Securing Critically Endangered White-Rumped (Gyps bengalensis) and Long Billed (Gyps indicus) vulture species in the Tamil Nadu part of the Nilgiri Biosphere Reserve
	LUNCH BREAK	
	TECHNICAL SESSION – II STARTS	Conservation Threats
11	Dr. S. Muralidharan, Principal Senior Scientist, SACON Coimbatore Plenary Talk	Diffuse Pollutants other than NSAIDS – Any Potential Concern for Vultures in India
12	Dr. N.S. Manoharan, M.V.Sc Forest Veterinary Surgeon Coimbatore	Impact of Diclofenac, other NSAIDS and Indirect Poisoning on Vultures

13	Percy E Avari Assistant Professor, Department of Poultry Science, Bombay Veterinary College.	Vultures and NSAID's
14	Dr.S. Shanmugasundaram, B.V.Sc Forest veterinary Officer (Retd)	Current usage of Diclofenac and other NASID in rural veterinary practice
15	Dr. N. Kalaivanan, B.V.Sc Assistant Veterinary Surgeon, Theni	Secondary phorate poisoning of large carnivores in India
16	Dr. Vijayaragavan, BVSc Forest Assistant Veterinary Surgeon, MTR	Post mortem analysis of White-rumped Vulture in Mudumalai Tiger Reserve - A case study
17	Mr.S. Manigandan, Biologist, ARULAGAM	NASIDs prevalence survey in the Nilgiris
18	TEA BREAK	
	Dr.B.A.Daniel, Scientist, Zoo Outreach Organization, Coimbatore Plenary Talk	Maligned Hero-Birds: Importance of Conservation awareness Programmes on Vulture Conservation
19	Mr. Arunagirinathan, Coordinator, ARULAGAM	A Synopsis of Vulture Safe Zone Activities Undertaken By Arulagam 2012-17
20	Mr. A. Samson Ph.D. Research Scholar Department of Zoology & Wildlife Biology, Govt. Arts College Udhagamandalam.	People's perception on vulture conservation in Tamil Nadu Part of the Nilgiri Biosphere Reserve, Southern India.
21	TECHNICAL SESSION – IV: MANAGEMENT IMPLICATIONS	
	Mr. S. Bharathidhasan, Secretary, ARULAGAM	Legal Battle to Remove The Stay on the Ban of Multi Dose Vials of Diclofenac
22	WWF- India	Screening of Vulture clippings

	POSTER PRESENTATIONS	
23	Mr. A. Samson Ph.D. Research Scholar	Do anthropogenic activites affect White-Rumped Vulture Nesting Colony: A Cause Studies For Siriyur Nesting Colony, Nilgiri North Forest Division, The Nilgiris, Tamil Nadu
24	Mr. A. Samson Ph.D. Research Scholar	Impact Of Awareness On Conservation Amongthe School Students In The Sigur Plateau, The Nilgiris
25	Ravikanth Manchiryala Telangana	Conservation of Indian Long-Billed Vulture (Gyps Indicus) At Palarapu Cliff, Telangana, India
26	Lekeshmanaswamy,M Kongunadu Arts Science college, Coimbatore	Population Status of The Endangered Vulture (*Gyps Bengalensis*), Nilgiri District, Tamilnadu, India
27	Lekeshmanaswamy,M Kongunadu Arts Science college, Coimbatore	Impact Of Meloxicam Drug An Alternative For The Diclofenac Toxicity On The White Backed Vulture (*Gyps Bengalensis*), Nilgiri District, Tamilnadu, India

28	Mahaly Moorthi AVC, College Mayiladuthurai	State Of Vulture Population and Its Need For Awareness Among Public About The Role Of Vultures In The Ecosystem
	DAY – 2, 09/01/2018	
	GROUPS FORMATION	
1	Group Discussion	Group-1. Standardizing methodology for vulture population estimation & Research activities Group-2. Conservation threats & Management implications
	LUNCH BREAK	
2	Summarize group discussions and resolution preparation	Presented by the respective group facilitator
3	Vote of Thanks	Dr. B. Ramakrishnan Organizing Secretary

TECHNICAL SESSION - I

STATUS, SURVEY AND POPULATION ESTIMATION OF VULTURES

THE CURRENT THREATS AND STATUS OF ASIAN VULTURES

Chris Bowden

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ABSTRACT

Nine of the world's 23 vulture species occur in Asia and indeed all nine occur in India, but five of these are on IUCN's Red List, four of them in the highest threat category: Critically Endangered. There have been very few more dramatic, fast and wide scale species declines of any birds or other taxa than those of South Asian *Gyps* vulture populations since the 1990s. The formerly most abundant of these species across the region, the white-rumped vulture *Gyps bengalensis*, declined by 99.9% over less than 20 years. The main cause, at least for the *Gyps* vultures, was shown to have been the veterinary drug diclofenac which was being widely used to treat cattle, and which proved to be lethal to vultures feeding on cattle carcasses that had been treated shortly before death. Three priority actions were identified in 2004 as urgently required in order to prevent the total extinction of at least three endemic species: Removal (through effective banning) of the veterinary drug diclofenac, the identification of safe alternatives, and the establishment of captive populations for later reintroduction back to the wild. But several challenges have meant that instigating a sufficiently quick and coordinated approach was not something that would happen automatically.

The fact that detecting the drug in dead vultures requires very sophisticated and sensitive testing; the vultures live long enough after ingestion; that they die well dispersed away from the toxic carcass – all mean that only through rigorous scientific analysis could the correct conclusions regarding the main cause of decline be made. International boundaries and restrictions regarding the transport and export of samples further added to the challenge. Speedy rigorous scientific publication in peer-reviewed journals was a key step, and the engagement of in-country scientists and institutions was essential. Ongoing rigorous scientific inputs was also important, and then the communications of these (including collection and analysis and writing up of monitoring work both for vultures and the drugs concerned) led to Government attention and key legislative changes (i.e ban of veterinary diclofenac in 2006).

In February 2011, seven years after the diagnosis of the main diclofenac problem (although other veterinary drugs (NSAIDs) had meanwhile emerged as also being toxic to vultures), a consortium of 14 partners (now 19) from across the region signed up to work together under the banner 'Saving Asia's' Vultures from Extinction' (SAVE), and these meet and report annually. Partners are mainly NGOS but also include key government institutions. A detailed action plan ('Blueprint') was developed in 2014 outlining the main activities required to save the most threatened species up to 2015, and this is reviewed annually.

This plan has since been adopted by a multi-lateral governmental committee (Regional Steering Committee of the four South Asian countries India, Bangladesh, Nepal and Pakistan) which was created soon after the formation of SAVE and provides a further forum for agreed priority actions to be taken up at higher levels. Most recently, a Multi-species Action Plan for all vulture species has been coordinated by the Raptors MoU of the Convention of Conservation of Migratory Species (CMS), which has again adopted ***the SAVE Blueprint*** as a central resource, but due to the wider remit of all vulture species in Asia, Africa and Europe, it also encompasses a somewhat wider set of actions. The combined effect of these three initiatives is a significant degree of coordination regarding the key steps required in Asia. However, a number of challenges remain, and the priority areas of safety-testing of veterinary drugs for vultures, regulation of veterinary NSAIDs, the release of birds back to the wild, and the development of Vulture Safe Zones are all crucial, and the releases and vulture safe zones offer high profile opportunities to engage and attract support more widely, and to publically test the safety of the environment for releases and the potential recovery of the species in the wild.

Key Words: Asia, Vulture, Threats

Overview of South Asian vulture declines

Nine of the world's 23 vulture species occur in Asia and indeed all nine occur in India, but five of these are on IUCN's Red List, four of them in the highest threat category: Critically Endangered (Table 1). There have been very few more dramatic, fast and wide scale species declines of any birds or other taxa than those of South Asian Gyps vulture populations since the 1990s. The formerly most abundant of these species across the region, the white-rumped vulture *Gyps bengalensis*, declined by 99.9% over less than 20 years (Prakash *et el.,* 2012). The main cause of these declines, at least for the Gyps vultures, has been clearly shown to have been the veterinary drug diclofenac (Oaks *et al.*, 2004, Green *et al.*, 2007, Prakash *et al.,* 2012) which was being widely used as a painkiller and anti-inflammatory to treat cattle, and which proved to be lethal to vultures feeding on cattle carcasses that had been treated shortly before death. Three priority actions were identified in 2004 as urgently required in order to prevent the total extinction of at least three endemic species (ASARPW 2004, MoEF 2006, Pain *et al.,* 2008): Removal (through effective banning) of the veterinary drug diclofenac was the key step required, the identification of safe alternatives, and the establishment of captive populations for later reintroduction back to the wild

were also prioritised. But several challenges have meant that instigating a sufficiently quick and coordinated approach was not something that would happen automatically.

The fact that detecting diclofenac in dead vultures requires very sophisticated and sensitive testing techniques; that the vultures live long enough after ingestion that they die well dispersed away from the toxic carcass – mean that only through rigorous scientific analysis could the correct conclusions regarding the main cause of decline be made. International boundaries and restrictions regarding the transport and export of samples further added to the challenge. Speedy rigorous scientific publication in peer-reviewed journals was a key step, and the engagement of in-country scientists and institutions was essential. The initial breakthrough was made in Pakistan (Oaks *et al.*, 2004), but almost immediately demonstrated to be true for India and Nepal (Shultz *et al.*, 2004, Prakash *et al.,* 2012) and this work was then extended to demonstrate just how devastating the effects have been across the subcontinent. Ongoing rigorous scientific inputs have also been important, with key involvement of the Indian Veterinary Research Institute (IVRI) and then the communications of these (including collection and analysis and writing up of monitoring work both for vultures and the drugs concerned) which attracted Government attention and key legislative changes (ie bans of veterinary diclofenac in 2006 and full gazettement in 2008).

Table 1. The current IUCN Red list status of the Asian vulture species:

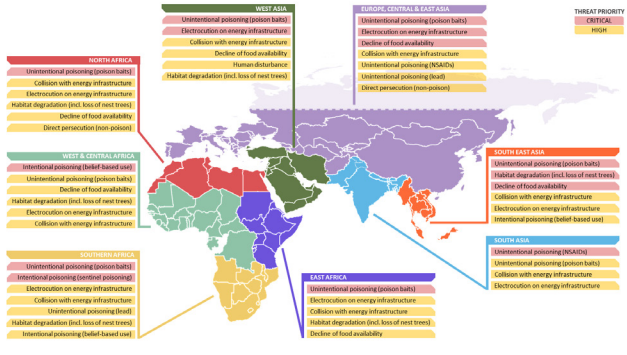
English name	Scientific name	IUCN Redlist status
White rumped Vulture	*Gyps bengalensis*	Critically Endangered
Indian Vulture	*Gyps indicus*	Critically Endangered
Slender-billed Vulture	*Gyps tenuirostris*	Critically Endangered
Red-headed Vulture	*Sarcogyps calvus*	Critically Endangered
Egyptian Vulture	*Neophron percnopterus*	Endangered
Himalayan Griffon	*Gyps himalayensis*	Near threatened
Cinereous Vulture	*Aegypius monachus*	Near threatened
Bearded Vulture	*Gypaetus barbatus*	Near threatened
Eurasian Griffon Vulture	*Gyps fulvus*	Least concern

Coordinating a conservation response for South Asia

In February 2011, seven years after the diagnosis of the main diclofenac problem (although other veterinary drugs (Non-Steroidal Anti-Inflammatory Drugs - NSAIDs) had meanwhile emerged as also being toxic to vultures), a consortium of 14 partners (now 19) from across the region signed up to work together under the banner 'Saving Asia's' Vultures from Extinction' (SAVE), and these meet and report annually (for full description see Bowden 2017). Partners are mainly NGOS but also include key government institutions such as IVRI. A detailed regional action plan ('Blueprint') was developed by this partnership in 2014, outlining the main activities required to save the most threatened species up to 2015, and this is reviewed annually. This plan has since been adopted by a multi-lateral governmental committee (Regional Steering Committee of the four South Asian countries India, Bangladesh, Nepal and Pakistan) which was created soon after the formation of SAVE and provides a further forum for agreed priority actions to be taken up at higher levels. Most recently, a Multi-species Action Plan for all vulture species has been coordinated by the Raptors MoU of the Convention of Conservation of Migratory Species (CMS), which has adopted and endorsed the SAVE Blueprint as a central resource, but due to the wider remit of all vulture species in Asia, Africa and Europe, it also encompasses a somewhat wider set of actions (Botha *et al.,* 2017). The combined effect of these three initiatives is a significant degree of coordination regarding the key steps required in Asia. However, a number of challenges remain, and the priority areas of safety-testing of veterinary drugs for vultures, regulation of veterinary NSAIDs, the release of birds back to the wild, and the development of Vulture Safe Zones are all crucial, and the releases and vulture safe zones offer high profile opportunities to engage and attract support more widely, and to publically test the safety of the environment for releases and the potential recovery of the species in the wild.

It is clear from the CMS Vultures Multi-species Action Plan (MsAP) and from SAVE priorities (Table 2) that the threats faced by vultures in SE Asia are quite different from South Asia where the NSAIDs remain the predominant threat. This is summarised in the threats map from the MsAP (Figure 1)

Figure 1. Map of current predominant threats to vultures for each region including South Asia (from Botha *et al.* 2017)



With vulture population levels now at drastically reduced levels following the effects of diclofenac (99.9% have already gone for white-rumped vulture, Prakash *et al.,* 2007), other localised threats may play an important role and demand conservation attention. But it is important that these threats and mortality must not distract from addressing the mainly invisible and ongoing threat of NSAIDs. For example in Gujarat there have been important efforts to prevent the kite-flying mortality, especially associated with the annual kite-flying festivals. Probably the most important of the secondary threats to vultures in India are poison-baits (retaliatory killing of tigers, leopards, dogs, elephants, cows which can all unintentionally kill vultures) and this is a major threat to vultures in other regions especially Africa (Figure 1). It needs targeted awareness efforts, and ensuring that government compensation schemes are operating efficiently can be an important way to reduce this threat. This threat was apparently earlier more prominent in South India but coordination with efforts being made to prevent eg tiger poisoning can also benefit vultures in addressing this threat. A further significant localised threat is electricity infrastructure and both electrocution and collision. Wires in locations close to feeding or breeding sites (there can be ways to avoid cattle carcass dumps being sited where this makes cables a high risk), can help significantly reduce this risk. The siting of wind-energy turbines needs to take vulture flyways into account and there is an urgent need for sensitivity mapping of the whole country (especially as this is a growing pressure) to prevent the power company proposing hazardous locations. Pylon design is another important factor for species such as Egyptian vulture which often perch on such and electrocution risks can be avoided with appropriate designs adopted. The final relevant threat can be the destruction of nesting trees, which again requires awareness work at a local level. Food shortage is not regarded as a current threat in India, although changing carcass disposal practices may make this a problem in future. With vulture populations generally reduced by over 95% and even 99.9% for white-rumped vultures, it is unlikely that food availability has also reduced by this extent so far. It is however a topic that needs careful monitoring for the future, as it is a problem in other regions outside South Asia.

All vulture populations are under pressure in India, and for several species the declines have been so drastic that it seems unlikely they can ever fully recover. Developing a coordinated network and through initiating 'Vulture Safe Zone' initiatives appears to be a good way forward at a local level, and it is hoped that the outputs of the Ooty workshop can help in this respect for South India.

Table 2. The current conservation priorities for South Asian vultures - from 7th Annual SAVE Report from November 2017 – (SAVE 2018)

- Veterinary licenses to be withdrawn for two drugs – ketoprofen and aceclofenac - based on the good existing evidence that they are unsafe for vultures.
- An effective system of regulation of veterinary drugs, based upon safety-testing on vultures is continued for all current painkillers (NSAIDs) and for all potential new ones entering veterinary practice.
- Evaluate safety to vultures of nimesulide as a priority.
- Identify additional vulture safe NSAIDs (alternatives for vets).
- Defend and communicate the 2015 multi-dose ban of human diclofenac formulations to relevant authorities & stakeholders (India).
- Major efforts urgently needed within South Asia to address the immediate and increasing gap in funding for vulture conservation which now jeopardises the programme. [2018 proposal to work with BNHS to investigate CSR funding options for SAVE priority vulture conservation in India and elsewhere in Asia]
- Promotion of network and approach of 'Vulture Safe Zones' across South Asia with expansion to include trans-boundary cooperative efforts.
- Maintain and support the existing vulture conservation breeding programmes throughout South Asia.
- Create a safe environment for further soft releases of captive vultures at identified sites (100km radius) in Nepal and first soft releases in India in 2018, requiring satellite monitoring of the released birds.
- Improved availability of well-formulated meloxicam products thereby facilitating their popularity with veterinary practitioners.
- Use the Convention of Migratory Species' Vulture Multi-species Action Plan as a tool to promote SAVE priority actions and engage with governments. Inform CMS about significant changes (e.g. changes to threats) in the SAVE region.
- Closely support National Vulture Recovery Committees and the Regional Steering Committee in order to facilitate the urgent implementation of the 2012 Delhi Regional Agreement and SAVE priorities

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THE GOOD, THE BAD AND THE UNKNOWN: NSAIDS AVAILABLE IN VULTURE-RANGE COUNTRIES

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ABSTRACT

Gyps vultures are highly intolerant to the non-steroidal anti-inflammatory drug (NSAID) diclofenac. Common and widespread use of diclofenac to treat domesticated ungulates, the carcasses of which constitute the primary food for vultures, caused catastrophic declines in vulture populations throughout South Asia. Veterinary diclofenac is now banned and vulture populations are no longer declining as fast as they were before the ban. Vulture populations may even be starting to recover, but the total number of vultures that persist is small and they are therefore vulnerable to additional threats. The most disturbing additional threats are other veterinary NSAIDs that are as toxic or nearly as toxic to vultures as diclofenac and freely available in South Asia. SAVE (Saving Asia's Vultures from Extinction) are aware of 14 NSAIDs sold for veterinary use in South Asia. We use drug safety testing on vultures and post mortem examinations of wild vultures to determine which of these NSAIDs are toxic to vultures and which are non-toxic to vultures. Both methods of research are challenging, but ongoing. We currently know that only one NSAID – meloxicam – is not toxic to vultures; and that five other NSAIDs – aceclofenac, carprofen, flunixin, ketoprofen and nimesulide – are toxic to vultures. Further, eight NSAIDs are of an unknown toxicity to vultures. We are desperate to know the toxicity of all NSAIDs, to find more vulture-safe ones and to bring about bans on other vulture-toxic NSAIDs. It is essential that all conservationists working in South Asia know which NSAIDs threaten vulture populations so that they can contribute to building environments safer for vultures. To this end, we have produced NSAID Alert summaries for each vulture-toxic NSAID covering the evidence for toxicity and its effectiveness in comparison to meloxicam that can be used to educate and engage communities, professionals and decision makers.

Key Words: NSAID, Vulture-Range, Countries

Introduction

Non-steroidal anti-inflammatory drugs (NSAIDs) are effective at pain relief and many also reduce inflammation and/or high fevers. In South Asian countries, NSAIDs are commonly used in domesticated ungulates that are ill or injured. Further, NSAIDs are used in large doses in dying animals to give them a painless death. This is particularly common in India where cows and sometimes buffaloes are considered sacred. As a result, the carcasses of these cattle, traditionally left for scavengers to dispose of, regularly contain high concentrations of NSAIDs that were not metabolised before the animal's death. It is an unlucky coincidence that the primary scavengers in South Asia – that is, the *Gyps* vultures – are highly intolerant to NSAIDs in general and one in particular, called diclofenac. During the 1990s and 2000s, diclofenac was the NSAID of choice among South Asian veterinarians and farmers. Millions of doses were administered to cattle, contaminating the carcasses of many and poisoning hundreds of thousands *Gyps* vultures (see Pain *et al.,* 2008).

Gyps vulture populations crashed, like no avian population had done before. The number of white-rumped vultures *Gyps bengalensis* (aka Oriental white-backed vulture) in India dropped by 99.9% in 15 years (Prakash *et al.,* 2007). Catastrophic population declines also occurred in the other two *Gyps* species resident to South Asia – the long-billed vulture *Gyps indicus* (aka Indian vulture) and the slender-billed vulture *Gyps tenuirostris* – (Prakash *et al.*, 2007) and the other two vulture species resident to South Asia – the red-headed vulture *Sarcogyps calvus* and the Egyptian vultures *Neophron percnopterus* (Cuthbert *et al.,* 2006). In addition, population declines occurred in the Himalayan griffon *Gyps himalayensis* (aka Himalayan vulture; Acharya, 2010), probably occurred in the steppe eagles *Aquila nepalensis* and possibly other species scavenging birds of prey (see Sharma *et al.,* 2014). While we only know that *Gyps* vultures are high intolerant to diclofenac through safety testing experiments (Oaks *et al.*, 2004; Swan *et al.,* 2006a), the other species showed declines of similar timing and magnitude to those of the *Gyps* vultures (Cuthbert *et al.*, 2006) or, in the case of the steppe eagle, showed diclofenac residue and signs of poisoning in wild individuals at post-mortem examinations (Sharma *et al.,* 2014) therefore, there is little doubt that diclofenac caused death and decline in these species and possibly other scavenging birds of prey. Given that South Asia was home to either all or the largest proportion of the global populations of these birds, these declines resulted in the up-listing of the three *Gyps* vultures and red-headed vulture to critically endangered, the Egyptian vulture to endangered and the Himalayan griffon to near threatened (IUCN 2017).

The mass killing of vultures in South Asia was not intentional. No one knew diclofenac was toxic to *Gyps* vultures until the populations had already crashed. In 2003, conservationists uncovered the toxicity of diclofenac to *Gyps* vultures through a safety testing experiment and the impact diclofenac had had on the Pakistan populations through the examination of many dead individuals (Oaks *et al.*, 2004). In 2004, conservationists showed that diclofenac contaminated cattle carcasses across India (Taggart *et al.,* 2007), had killed many *Gyps* vultures (Shultz *et al.*, 2004) and was the main or sole cause of population declines in the country (Green *et al.,* 2004, 2007). Also in that year, conservationists discovered through safety testing that

another NSAID available in South Asia, called meloxicam, was non-toxic to *Gyps* vultures (Swan *et al.,* 2006b; Swarup *et al.*, 2007). Thus, at the end of 2006, the evidence was clear, the case for stopping the use of veterinary diclofenac was strong and a vulture-safe alternative to diclofenac existed. Conservationists presented these findings to South Asia's governments and, in 2006, India, Pakistan and Nepal banned veterinary diclofenac to save their vultures. Starting in 2012, surveys of vultures in India, Pakistan and Nepal have shown encouraging trends – all populations are no longer declining as fast as they had been before the ban on veterinary diclofenac; and some populations have stabilised and others have even begun to recover (Chaudhry *et al.,* 2012; Prakash *et al.*, 2012, 2017).

In 2012, the fight to save *Gyps* vultures in South Asia was seen as a success story, and in many ways it was, because in 10 years: a mysterious vulture-killer was uncovered; a suitable solution was found; governments took fast and strong action to conserve vultures; and declines in vultures at least slowed. However, the fight was not over; in fact, conservationists had won just three battles of a larger war. Further, the total number of vultures in South Asia remains dangerously low. In India, the best estimates of current population sizes were approximately 6,000 white-rumped vultures, 26,500 long-billed vultures and 2,500 slender-billed vultures (Prakash *et al.,* 2017). Outside India, approximately 4,000 white-rumped vultures survive in South and South-East Asia, but the number of long-billed vultures and slender-billed vultures is only a couple of hundred. Population sizes for the red-headed vulture and Egyptian vulture are also dangerously low (see Galligan *et al.,* 2014). Therefore, South Asia's vultures were vulnerable to additional threats.

Veterinary diclofenac was a big money-spinner for many pharmaceutical companies and only it, not diclofenac for human use, had been banned; so, following the ban, South Asian pharmaceutical companies increased their production and distribution of diclofenac in multi-dose vials (30 ml), which were supposedly for use in people, but appropriately-sized for use in cattle (see Cuthbert *et al.*, 2011). Misuse of this source of diclofenac resulted in the continued deaths and declines of *Gyps* vultures in India (Cuthbert *et al.*, 2016; Prakash *et al.*, 2017). Conservationists brought this circumvention of the ban to the attention of authorities and, in 2015, the government of India restricted the manufacture of all diclofenac to single dose vials (3 ml). The vial size restriction would not affect human healthcare, but make dosing cattle more complicated and costly. Ultimately, NSAID-users are predicted to switch preference to easier to use and cheaper to buy alternatives, which would collapsing the market for diclofenac and thereby end much of its production in India. Two pharmaceutical companies legally challenged this new regulation in a lengthy court case, but the multi-dose vial of diclofenac ban, as it was dubbed, was upheld in 2017. Another two battles won, but still not the end of the war because the diclofenac problem is only part of a bigger problem for vulture conservation in South Asia.

Diclofenac is certainly the most vulture-toxic NSAID that we know. However, diclofenac is not the only vulture-toxic NSAID that we know. In fact, we know of five more NSAIDs – namely, aceclofenac, carprofen, flunixin, ketoprofen and nimesulide – used in veterinary use in South Asia that kill *Gyps* vultures. We also know of only one vulture-safe NSAID – that is, meloxicam. In addition, there are at least eight other NSAIDs available for veterinary use in South Asia – namely, aspirin, dipyrone (Analgin), ibuprofen, phenylbutazone, piroxicam, mefenamic acid, naproxen and tolfenamic acid – that are of an unknown toxicity to vultures. The latter group should be consider potentially vulture-toxic given that most NSAIDs tested on vultures to date are found to be actually vulture-toxic. Thus, 13 out of 14 NSAIDs available for veterinary use in South Asia are actually or potentially vulture-toxic – this is the bigger problem for vulture conservation in South Asia. Perhaps worse than the large and increasing number of vulture-toxic NSAIDs, is the fact that none of these drugs are banned nationally in any of the South Asian countries.

The market share of diclofenac throughout South Asia is shrinking, but the market for NSAIDs is not. Meloxicam is attaining much of the market in the wake of diclofenac, but other actually and potentially vulture-toxic NSIADs are vying for part or all of that market share. In northern India, pharmacists most often sell meloxicam for use in cattle, but the number of shops selling actually and potentially vulture-toxic NSAIDs (not including diclofenac) combined is the same as those selling meloxicam. There exists a real threat that one or more of these actually and/or potentially vulture-toxic NSAIDs become the prominent painkillers in South Asia and the region's vultures will become extinct.

In this paper, I will review the good (vulture-safe), the bad (actually vulture-toxic) and the untested (potentially vulture-toxic) NSAIDs available in South Asia. I will present the evidence for toxicity or non-toxicity to vultures attained from the outcome of therapeutic treatment of vultures, NSAID safety testing on vultures and post-mortem examinations of vultures found dead in the field. I will end by calling conservationists, veterinarians, researchers and decision makers to action.

The Good

Meloxicam is the only vulture-safe NSAID known. The evidence for the non-toxicity of meloxicam to vultures comes from therapeutic treatment of vultures (Cuthbert *et al.,* 2007), safety testing on vultures (Swan *et al.,* 2006b, Swarup *et al.,* 2007) and post-mortem examinations of vultures found dead in the field (Cuthbert *et al.,* 2016). Meloxicam is also a safe and effective painkiller for domesticated animals and safer and more effective than vulture-toxic NSAIDs.

A survey of the therapeutic use of meloxicam among veterinarians caring for captive birds found the drug did not kill or cause ill effects in *Gyps* vultures (Cuthbert *et al.,* 2007). The survey included 39 cases of meloxicam use in six species of *Gyps* vulture.

The maximum level of exposure reflects the greatest likely exposure to the drug encountered by that species in the wild. For a given drug and given vulture species, the maximum level of exposure is calculated from the mean body weight of the species, the mean weight of a large meal for that species and highest tissue-specific residue concentration of the drug in cattle treated with a typical dose. Two experiments

showed that oral doses of meloxicam above the maximum level of exposure did not kill or cause hyperuricemia or any other ill effects in 45 out of 45 individual *Gyps* vultures from three species (Swan *et al.*, 2006b, Swarup *et al.*, 2007). Oral doses of meloxicam below the maximum level of exposure did not kill or cause hyperuricemia or any other ill effects in 15 out of 15 individual *Gyps* vultures from three species. These experiments also showed that tissues from cattle and buffalo dosed with meloxicam and fed to *Gyps* vultures, with some doses above and some dose below the maximum level of exposure, did not kill or cause hyperuricemia or any other ill effects in 33 individual *Gyps* vultures.

A survey of NSAIDs residues in dead wild vultures, found 2 out of 48 had meloxicam residue (Cuthbert *et al.,* 2016). One of the 2 presented with visceral gout (i.e., evidence of renal failure); however, that individual tested positive for nimesulide as well. In the same survey, nimesulide residue alone was associated with visceral gout in 4 dead vultures, demonstrating that it is a vulture-toxic NSAID and thereby responsible for killing the individual testing positive for both meloxicam and nimesulide.

In addition, therapeutic use of meloxicam is not associated with death or illness in a diversity of other predatory and scavenging bird species (Cuthbert *et al.,* 2007). This sample included 700 individuals from 54 species. Further, oral doses of meloxicam above the maximum level of exposure did not kill or cause hyperuricemia or any other ill effects in 5 Egyptian vultures*,* 5 cattle egrets *Bubulcus ibis*, 5 crows *Corvus spp.* and 5 common myna *Acridotheres tristis*, which also scavenge from cattle carcasses (Swarup *et al.*, 2007).

A review of the published literature assessing meloxicam found it was an effective treatment for pain, inflammation, stress and dysfunction in a variety of veterinary and husbandry situations and in a variety of domesticated animals (T. H. Galligan unpublished data). Additionally, meloxicam was shown to increase immune response, pregnancy rate and productivity in cows, as well as productivity in calves. Overall, 79% of studies reported a positive effect of meloxicam treatment. In comparison to such studies assessing flunixin and ketoprofen, more studies of meloxicam showed a positive effect and less studies showed a negative, mixed or no effect of meloxicam (see SAVE 2016b, c). No good comparison could be made between meloxicam and aceclofenac/diclofenac or nimesulide because only one study for each of these NSAIDs examined an effect (See SAVE 2016a, d).

In summary, 132 cases exist where individual *Gyps* vultures have been exposed to meloxicam. None of these cases have resulted in death or illness. In addition, 720 cases of meloxicam exposure in other bird species have not resulted in death or illness either. Importantly, 79% of studies examining an effect of meloxicam in livestock found a positive one. Further, more studies found a positive effect and less studies found a negative, mixed or no effect of meloxicam than the known vulture-toxic NSAIDs. Meloxicam is not only vulture-safe, but livestock-safe and -effective.

The Bad

Aceclofenac, carprofen, diclofenac, flunixin, ketoprofen and nimesulide are all vulture-toxic NSAIDs. The evidence for the toxicity of these NSAIDs to vultures comes from therapeutic treatment of vultures, safety testing on vultures and post-mortem examinations of vultures found dead in the field. As veterinary painkillers for domesticated animals, these NSAIDs are not as safe and effective as meloxicam or their safety and effectiveness has essentially not be assessed.

Diclofenac is highly toxic to *Gyps* vultures. Two studies that safety tested diclofenac in *Gyps* vultures found: oral doses just below the maximum level of exposure (i.e., 65-82% of the maximum level of exposure) killed 15 out of 15 individuals tested; oral doses further below the maximum level of exposure (i.e., 8-49%) killed 2 out of 4 individuals tested; and oral doses far below the maximum level of exposure (i.e., >1-3%) killed 1 out of 6 individuals tested (Oaks *et al.*, 2004, Swan *et al.,* 2006a). Post-mortem examination found kidney damage and visceral gout in all individuals that died. Blood sampling of some individuals before death found elevated uric acid concentrations.

Two studies that surveyed the cause of death in wild *Gyps* vultures, found all individuals (i.e., 39 individuals) that tested positive for diclofenac also presented visceral gout; and all individuals (i.e., 17 individuals) that tested negative for diclofenac presented visceral gout (Oaks *et al.*, 2004, Shultz *et al.,* 2004). Therefore, wild *Gyps* vultures were exposed to lethal levels of diclofenac.

Aceclofenac is a pro-drug for diclofenac (Sharma *et al.,* 2012). An experiment examining the behaviour of aceclofenac following its administration in cattle showed that nearly the entire drug was quickly converted to diclofenac (Galligan *et al.*, 2016). Therefore, a carcass of a cow given aceclofenac shortly before death would contain diclofenac at a similar concentration to a carcass of a cow given diclofenac shortly before death. Safety testing aceclofenac in *Gyps* vultures is unnecessary because it is known that diclofenac kills *Gyps* vultures.

A review of the published literature assessing aceclofenac/diclofenac found a single study. That study showed a positive effect, but the fact that it is the only study of its kind makes it difficult to compare to the effectiveness of other NSAIDs.

Ketoprofen is often given in large doses to dying cattle, which is revealed in surveys of NSAID concentrations in cattle carcasses. As a result, the maximum level of exposure calculated using the recommended dose for ketoprofen (i.e., 1.54 mg/kg vulture body weight) is substantially less than that calculated using the actual dose of ketoprofen needed to explain the maximum concentrations of the drug found in cattle carcasses (i.e., 5 mg/kg vulture body weight; see Taggart *et al.*, 2009). A study that safety tested ketoprofen in *Gyps* vultures found oral doses below the maximum level of exposure based on the recommended dose killed 1 out of 2 individuals tested; and oral doses above the maximum level of exposure based on the recommended dose killed 7 out of 11 individuals tested (Naidoo *et al.,* 2010). However, had that study used the maximum level of exposure based on the

actual dose being given, then oral doses of ketoprofen below this maximum level of exposure killed 8 out of 13 individuals. All deaths caused by ketoprofen caused elevated blood uric acid, kidney damage and visceral gout.

A review of the published literature assessing ketoprofen found 63% of studies reported a positive effect and the remainder reported either a mixed, negative or absent effect. In comparison to meloxicam, fewer studies reported a positive effect of ketoprofen and more studies reported a non-positive effect.

Carprofen is not easily absorbed by cattle. An experiment examining the behaviour of carprofen following its administration in cattle showed high concentrations at the injection site in some individuals. Safety testing carprofen in *Gyps* vultures found that the average concentration in cattle tissue at the injection site caused elevated blood uric acid, kidney damage and death in 1 out of 2 individuals tested (Naidoo *et al.,* 2018).

Flunixin caused visceral gout and death in 2 out of 4 *Gyps* vultures uncovered in survey of the therapeutic use of the drug among veterinarians caring for captive birds (Cuthbert *et al.*, 2007). The same study found flunixin caused visceral gout and death in 6 out of 20 other bird species, including scavenging birds of prey. A survey of dead vultures found 5 out of 5 *Gyps* vulture carcasses had visceral gout and flunixin residue, but no residues of other NSAIDs or toxins (Zorrilla *et al.*, 2015, I. Zorrilla unpublished data).

A review of the published literature assessing ketoprofen found less than half (i.e., 44%) of studies reported a positive effect and the remainder reported either a mixed, negative or absent effect. In comparison to meloxicam, fewer studies reported a positive effect of flunixin and more studies reported a non-positive effect.

Nimesulide residue has been found in association with visceral gout in 4 out of 5 *Gyps* vultures (Cuthbert *et al.,* 2016). A review of the published literature assessing nimesulide found a single study. That study showed a negative effect.

In summary, the number of cases where individual *Gyps* vultures have died from exposure to diclofenac/ aceclofenac, ketoprofen, carprofen, flunixin and nimesulide are 57, 8, 1, 7 and 4, respectively. Safety testing experiments provides direct evidence for the toxicity of diclofenac, and thereby aceclofenac, ketoprofen and carprofen to *Gyps* vultures. Post-mortem examinations of dead vultures found in the field and those therapeutically treated with NSAIDs provide indirect evidence for the toxicity of diclofenac, and thereby aceclofenac, flunixin and nimesulide. None of these actual vulture-toxic NSAIDs can be said to be more safe or effective at treating aliments in domesticated ungulates than meloxicam. In fact, some (diclofenac and nimesulide) are possibly unsafe and/or ineffective given the lack of studies demonstrating the opposite.

The Unknown

Aspirin, dipyrone (Analgin), ibuprofen, phenylbutazone, piroxicam, mefenamic acid, naproxen and tolfenamic acid are all NSAIDs of unknown toxicity to vultures. It is not possible to predict whether these NSAIDs are toxic by simply comparing their structure or classification to that of actually toxic NSAIDs. Further, it would not be possible to convince decision makers that any of these NSAIDs should be banned based on structure or classification. Cases of vulture deaths following therapeutic treatment provide clues about the toxicity of certain NSAIDs to vultures. However, safety testing on *Gyps* vultures is the necessary direct evidence that is needed to determine whether a certain NSAID is toxic or non-toxic to vultures. In vitro studies showing cell death following administration of NSAIDs is not a substitute for safety testing in vultures because what happens at the cellular level does not always translate to what happens at the organism level. Conservationist need to know with high certainty that a given NSAID is vulture-toxic and, more importantly, vulture-safe, which can only come from safety testing experiments. Finding dead wild vultures with visceral gout and certain NSAID residues provide indirect evidence of toxicity, but also direct evidence that wild populations are being killed by that NSAID. Reviews of veterinary reports, NSAID safety testing and searches and examinations for dead vultures must be undertaken promptly to know the toxicity of all NSAIDs available in South Asia.

Actions

The war on vulture-toxic NSAIDs continues and there are still many battles to fight. Some of the battles are unforeseeable, but permanently ending the veterinary use of the 5 actual vulture-toxic NSAIDs and temporarily stopping the veterinary use of the 8 potential vulture-toxic NSAIDs until they are safety tested are two apparent battles that can be fought now. Below are my suggestions how conservationists, veterinarians, researchers and decision makers can help.

Conservationists need to understand the bigger problem of vulture-toxic NSAIDs (see SAVE 2016a, b, c, d). They need to share the bigger problem widely among communities. They should talk to farmers, veterinarians (both registered and unregistered), forest officials, livestock officials, drug control officials, politicians and other conservationists. Conservationists should aim to engage these groups with ethical, emotional, spiritual, economical and legal arguments for conserving *Gyps* vultures of which there are many. In their conversations, they should promote the use of only pure meloxicam as a vulture-safe veterinary NSAID. They should not promote the use of meloxicam products that contain paracetamol, as safety testing on this combination of drugs or paracetamol alone has not been undertaken and therefore these could be vulture-toxic. Conservationist can ask farmers and veterinarians to pledge to not use vulture-toxic NSAIDs; ask government officials to spread messages down and up their chain of command, among departments and the agricultural and pharmaceutical industries (prepare letters, papers or presentations for them to argue the case); and ask decision makers for local control on actually and potentially vulture-toxic NSAIDs. Conservationist should not be distracted by all the possible causes of vulture mortalities (e.g. poison baits, collision with power, kite-string injuries) and by unsubstantiated causes of decline (e.g. lack of food, lack of nesting sites, climate change), but rather focus on the bigger problem as vulture-toxic NSAIDs are the only cause of

decline in *Gyps* vultures that has been substantiated. Further, conservationists need to approach vulture conservation on a united front. They can visit the SAVE (Saving Asia's Vultures from Extinction) website (www.save-vulture.org) for further information, guidance and support, including NSAID Alert summaries for each actual vulture-toxic NSAID covering the evidence for toxicity and its effectiveness as a veterinary drug in comparison to meloxicam.

Veterinarians can make an enormous contribution to vulture conservation by using only pure meloxicam in domesticated ungulates. Again, meloxicam and paracetamol combined products should not be used. If every veterinarian in South Asia only used pure meloxicam from this day forth then the markets for all the actual and potential vulture-toxic NSAIDs would crash and *Gyps* vulture populations would begin to recover. Of course, not all veterinarians are going to read this paper nor converse with a vulture conservationist; therefore, veterinarians must spread the word among their own (see SAVE 2016a, b, c, d). Veterinarians can even influence non-registered veterinarians by setting an example and changing the NSAID market. Veterinarians working with captive and wild birds that have used NSAIDs on vultures or other birds of prey could provide clues to the toxicity of NSAIDs of present unknown toxicity.

Researchers can enhance our knowledge of the toxicity of certain NSAIDs to vultures. Ten NSAIDs currently available in South Asia have yet to be safety tested. Some safety testing is underway by SAVE partners, but there is no reason why other researchers cannot contribute to this work. We are happy to share our rigorous experimental protocols for safety testing that minimise the welfare concerns and risk of death for the domesticated ungulates and vultures involved. There is also a need to know the tolerance of other scavenging birds (e.g., Egyptian vulture, black kite *Milvus migrans*, crows *corvus spp.*) to certain NSAIDs, including those that have been already tested on *Gyps* vultures, like diclofenac/aceclofenac. It is important to note that safety testing is relatively expensive; and permission is often needed to attain wild birds, particularly protected species, as well as to conduct experiments on domesticated and wild animals. Researchers can also search for dead vultures and other scavenging birds opportunistically or systematically, conduct post-mortem examinations and analyse tissues for NSAIDs to expand our understanding of which ones are killing birds. Finally, researchers may come up with novel ways to contribute to the evidence-base conservationists require; however, researchers should remain focussed on the bigger problem of vulture-toxic NSAIDs. Along these lines, there is plenty of scope to study human and market behaviour involved in producing, selling, buying and using NSAIDs.

Decision makers at the national level have the power to solve the bigger problem in vulture conservation once and for all. The four most important actions these decision makers could take are: the permanent banning of aceclofenac in veterinary formulations and vials larger than 3 ml (see SAVE 2016a); the permanent banning of all other actually vulture-toxic NSAIDs in veterinary formulations and vials larger than 3 ml that are known now and in the future (see SAVE 2016b, c, d); the temporarily banning of all potentially vulture-toxic NSAIDs in veterinary formulations and vials larger than 3 ml that are known now and in the future until each is shown to be either vulture-safe or vulture-toxic through rigorous safety testing experiments; and the ordering of mandatory safety testing on pharmaceutical companies for all untested NSAIDs that are known now and in the future. These actions should be implicated simultaneously and without exception. The decision makers that bring about these actions would create a vulture safe zone throughout their entire country within one year. Admittingly, these are big actions – much bigger than banning veterinary and multi-dose vials of diclofenac – but necessary to solve the bigger problem. The alternative courses of action – besides doing nothing at all, of course – is: to not ban vulture-toxic NSAIDs if these have small market shares; to ban actually vulture-toxic NSAIDs one at a time; to wait for safety testing experiments to show NSAIDs are toxic before executing control measures; and to rely on conservationists to plan, fund and implement safety testing experiments. Alas, this is the course of action most South Asian decision makers are taking at present, which is too inefficient, ineffective and downright dangerous. In 2006, decision makers in India, Pakistan and Nepal (Bangladesh followed suit in 2010) were commended by the international community for taking strong action to stop the catastrophic population declines in their countries *Gyps* vultures; now, in 2018, South Asian decision makers need to take stronger action to allow these birds to recover.

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STATUS AND CONSERVATION OF WHITE-RUMPED VULTURE IN INDIA: AN OVERVIEW

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Of the five species of *Gyps* vultures occurring in India, the Indian White-backed or White-rumped Vulture (*Gyps bengalensis*) was the most common species in the Indo-Gangetic plains until about a decade before close of the 20th century. It thrived on carcasses of large wild herbivores from open forests, and of large domestic livestock from the countryside. This vulture was also commonly seen at carcasses all over Peninsular India right down to Kanniyakumari District. However, the vulture population in the southern peninsula, particularly Kanniyakumari district where the author grew up, showed noticeable decline after mid-20th century. This decline was evidently caused by dwindling of its food supply in the forests, and the countryside.

Degradation and destruction of natural forest or conversion of the natural forest into commercial plantations, in and around Kanniyakumari district, has resulted in depletion of large wild herbivores, hence a reduction in the food source for *Gyps* vultures. As for domestic livestock carcasses, these decreased because of change in the life lifestyle of farmers. Traditionally, the farmers raised cattle for milk, for organic manure, and for manual labour such as pulling carts, drawing irrigation water, and plowing. Carcasses of cattle which died of old age or disease, were flayed by hide collectors, and then left in the open for vultures to clean up the soft parts.

However, with the introduction of mechanised ploughing, motorised pumps and chemical fertilizers, farmers depended less and less on cattle for agriculture, resulting in decline of village cattle. As for those who kept high-yielding dairy cattle, they had access to modern veterinary medical aid, which minimized death of cows through diseases. Further, most of these animals did not get to die of old age because they were sent for slaughter when they became economically nonviable. Thus, the sustenance of vultures was highly affected, resulting in their population decline.

Gyps vultures need regular supply of meat from large mammal carcasses in order to maintain a viable population in any area. Individual vultures scanning the ground from the sky, daily, for carcasses depend upon each other for finding food (Grubh, 1980). When one vulture zeroes in on a carcass, others notice it; and all gather around the meal soon. If their number plummets too low, they cannot undertake such communal search for effective foraging.

White-rumped vultures became extremely rare in Kanniyakumari district and the surroundings, decades before diclofenac (a new non-steroid anti-inflammatory drug, which is widely used by veterinarians), was introduced in India. Since the rest of the southern peninsula, too, share similar socio-economic situation, these areas, too, were presumably governed by the very same factors that influenced vulture decline in Kanniyakumari district (pers. obs.).

As for the Indo-Gangetic plains, where cows are generally not slaughtered for meat, the scenario was rather different. Even while the vulture population was dwindling in the southern states, vultures flourished here. The numbers increased to such an extent that it was not uncommon to view as many as 3000 white-rumped vultures at a single site in Delhi during the eighties of the 20th century (pers. obs.).

This phenomenal proliferation was caused by the superabundance of food originating from dairies, gaushalas (cow shelters) and primitive slaughter houses. Many people sent their spent cows or oxen to gaushalas (cow shelters) or even released them in the streets where they eventually died, thus making available a steady supply of food for vultures (pers. obs.). Vultures often camped near dairies, gaushalas and primitive slaughter houses where there was assured food supply. They roosted on trees at night, and fed during the day.

Vultures have a habit of taking advantage of thermals to soar in the sky for their various survival needs. Usually they used to soar in dense spirals between 11 and 12 hours in order to gain height and then drift off to various locations of their choice (Grubh, R.B. 1980). This is the usual time of day when aircraft would encounter vultures, especially during critical aircraft flight phases such as initial climb and final approach. As a result, the white-rumped vulture and even the Indian vulture (*G. indicus*) became major potential problem birds for civil and military aircraft in India. While commercial airlines suffered huge financial losses due to engine damage and delayed flights, the Indian Air Force lost many fighter planes and, more importantly, valuable fighter pilots at the peak of their career.

Considering this bird-strike hazard potential of vultures, recommendations were made (Grubh, RB. 1990) for ecological control of these birds by setting up modern abattoirs and modern carcass processing plants at key locations throughout the country. These would drastically minimize the availability of edible waste that could sustain a population of vultures in and around airport cities. These recommendations were also, brought, later on, to the attention of members of a bird hazard prevention meeting specially convened in Delhi by the then Scientific Advisor to the Minister of Defence, in the year 1996. This committee unanimously accepted these recommendations for implementation with a sense of urgency.

About a year after this meeting, there were widespread reports of the drastic decline of vulture population around towns and cities in major parts of India. Initially it appeared

to be the result of prompt and effective implementation of the above recommendations, and that the unhealthy proliferation of vultures has been effectively contained through ecological control methods. However, that was not to be the case. While there has been gradual improvement in the quality of slaughter houses in India, modern carcass processing plants were yet to be seen, and the supply of livestock carcass from villages and dairy farms too had not diminished perceptibly. In fact large numbers of putrefying carcasses were seen at several carcass dumping sites, unattended by vultures.

A speculation was floated by some researchers that some unknown virus or another disease factor was possibly the cause of vulture decline (Risebrough, Robert W. 2000). Later, this speculation was replaced by a hypothesis that diclofenac, introduced in India around the same time was the cause of vulture population decline in the neighboring country Pakistan, (Oaks *et al.* 2004). Soon a simulation model was developed by Green, Rhys E. (2004) based on some data and several assumptions that even if only 1% of carcasses were contaminated by diclofenac, the Indian *Gyps* vulture populations would fall drastically. A welcome outcome of this hypothesis, however, was the banning of this harmful drug in India, in the year 2006, for veterinary use.

As for the population recovery of vultures in India, it is happening slowly. As some current studies indicate, there are some populations (*Gyps* spp. including *G. bengalensis*) surviving in isolated pockets. It is understood that the dedicated scientific team working through the Department of Zoology and Wildlife Biology of the Government Arts College in Udhagamandalam, Tamil Nadu, is taking laudable efforts to study these populations for their long-term conservation in southern India. The BNHS is taking positive efforts to increase the population of wild vultures, by captive breeding and releasing them into the wild.

Vulture conservationists may bear in mind the fact that restoring the ecologically unhealthy superabundance of vultures around towns and cities, which seriously impacted aviation in the recent past, is not restoring ecological balance. What is important is to restore a healthy number of vultures in the forest and the countryside where they have an important role to play as the best natural scavenger available for cleaning up large animal carcasses. Happy co-existence of vultures and man in India is possible, and must be restored.

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STATUS OF VULTURES IN KERALA

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ABSTRACT

According to historical records, four species of vultures were present in Kerala in the beginning of 20th century, viz. Red-headed Vulture *Sarcogyps calvus*, Indian Vulture (Long-billed) *Gyps indicus*, White-rumped (Oriental White-backed) Vulture *Gyps bengalensis* and Egyptian Vulture *Neophron percnopterus*. The population of these vultures began to decline, due to various reasons, from the late 1960s onwards and became virtually extinct in most parts of the state by the late 1970s except for a small resident population of White-rumped and Red-headed Vultures in Wayanad Wildlife Sanctuary (344 km 2), bordering the forested areas of Tamil Nadu and Karnataka. An ornithological survey covering all the bird habitats of the state conducted from 2009 to 2011 confirmed this fact as no vultures were sighted anywhere else in Kerala. There were two records of Cinereous Vulture *Aegypius monachus* (1988 and 1994) and another of Himalayan Griffon *Gyps himalayensis* (2016) in the state. The vulture population in Wayanad Wildlife Sanctuary has been monitored periodically since 2003. During every visit to the sanctuary, about 10 to 20 Oriental White-backed Vultures and 2 to 4 Red-headed Vultures were seen, soaring mostly. A synchronized survey conducted in the sanctuary in December 2013 counted 35 White-rumped, 5 Red-headed and 2 Indian Vultures. At carcasses of wild ungulates, congregation of vultures numbering more than 50 had been seen on occasions. White-rumped Vultures have been found to breed in three colonies situated in three different forest ranges of the sanctuary. The breeding colonies have been monitored regularly since 2003. Up to 12 nests were located in each breeding season. The average breeding success was found to be 65%. The breeding population seemed to be stable except for the all-time low nesting in the 2016- 2017 season with only 4 nests out of which only one was successful. NSAID prevalence surveys were conducted in the drug stores of Wayanad district in 2008, 2011 and 2013. It was found that diclofenac was still available in 2013 in at least one store. Other drugs harmful to vultures e.g. Ketoprofen, Nimesulide etc. also were available in the market. Wayanad Wildlife Sanctuary being contiguous with Bandipur National Park, Rajiv Gandhi National Park (Nagarhole) of Karnataka and Mudumalai Tiger Reserve of Tamil Nadu, a joint action plan will have to be designed so as to make any effective conservation strategy.

Key Words : Vulture, Kerala, NSAID

Introduction

Ornithological literature regarding Kerala since the beginning of 20th century shows that four species of vultures occurred here (Ferguson 1903-04, Baker & Inglis, 1930; Neelakantan, 1959; Ali, 1969, Robertson & Jackson, 1992).

1. Egyptian Vulture *Neophron percnopterus*
2. Red-headed Vulture *Sacrogyps calvus*
3. White-rumped (Oriental White-backed) Vulture *Gyps bengalensis*
4. Indian (Long-billed Vulture) *Gyps indicus*

From the literature, it could be seen that White-rumped Vulture was common till the 1960s, while the other three species were present in small numbers, but were never abundant (Table 1). But, sightings of all species of vultures became increasingly rare from late 1960s onwards and they became virtually extinct in most parts of the state by late 1970s.

Table 1. (Adapted from Sashikumar, 2011)

Species	Ferguson 1903-04	Baker&Inglis 1930	Neelakantan 1959	Ali 1969	Neelakantan 1986	Robertson& Jackson 1992 (Periyar Tiger Reserve)	Sashikumar *et al.* 2011a, 2011b, 2015
S. calvus	Single specimen from south Travancore	As in Ferguson 1903-04	Common in low numbers	? Resident, seen most commonly, not abundant	Rare	Occasional individuals	Seen only in Wayanad WLS
G. indicus	Rare	Rare	Not mentioned	? Resident, not common or abundant	Rare	Seen regularly up to 1954, not seen since.	Not seen
G. bengalensis	Common, breeding	Common	Common, breeding	Resident, common but not abundant	Rare	Increasingly rare since the 1960s.	Seen only in Wayanad WLS
N.percnopterus	Common in drier parts	Common in drier parts	Rare	Resident, not common	Rare	Single record in 1954	Not seen

An ornithological survey covering all the bird habitats of the state conducted from 2009 to 2011 confirmed this fact as no vultures were sighted anywhere else in Kerala except in Wayanad Wildlife Sanctuary (Sashikumar *et al.*, 2011 b, 2015). There were two records of Cinerous Vulture *Aegypius monachus* (Sreekumar 1991, Sashikumar *et al*, 2011a), which probably were stragglers. A juvenile Himalayan Vulture *Gyps himalayensis* was recovered in exhausted condition in January 2013 at Akamala, Thrissur district (Praveen *et al.*, 2014), and another one was caught on the camera trap put up by the forest department at an elephant carcass in Wayanad Wildlife Sanctuary in 2016 (Vinayan P A, pers.comm.).

Sashikumar (2001) has attributed the reason of the decline of vultures in Kerala to the combined effects of:

1. Changes in habitat
2. Changes in livestock management and socio-cultural attitudes
3. Use of pesticides and direct poisoning
4. Increase in human population density and awareness of social hygiene
5. Changes in food habits and social taboos.

Occurrence of vultures has been reported only from the Wayanad Wildlife Sanctuary of Kerala in recent years. Since 2003, I have been monitoring the vulture population, especially the breeding, at this sanctuary.

Wayanad Wildlife Sanctuary

Located in the Wayanad district of Kerala at the eastern part of the Wayanad plateau along the Kerala - Karnataka – Tamilnadu border, this sanctuary has an area of 344 sq.km (Fig.1). The sanctuary is in two separate segments: Tholpetty Range at north is contiguous with Nagarhole Wildlife Sanctuary (Karnataka); Kurichyat, Bathery and Muthanga ranges of the southern segment are contiguous with Bandipur Tiger Reserve (Karnataka) and Mudumalai Tiger Reserve (Tamil Nadu) (Fig.1). The forest type is moist-deciduous and about 1/3 of the area is plantations of teak, rosewood, eucalyptus etc. The sanctuary supports most of the herbivores and carnivores found in the south Indian jungles and more than 200 species of birds have been reported. Temperature varies from 12 to 32° C and the average annual rainfall is 2000mm.

The Sanctuary has a good population of herbivores like Elephant, Spotted Deer, Sambar etc. The wild ungulates are preyed up on by Tiger, Leopard and Wild Dogs, the major carnivores. There are more than 30 tribal settlements within the Sanctuary (many of these are now being relocated outside the sanctuary) where a sizeable population of livestock is reared. While grazing in the forest, some of these are occasionally predated by the carnivores. During the summer months, elephant herds from the drier areas of the neighboring protected areas migrate to Wayanad Wildlife Sanctuary; the stress during migration and dehydration results in deaths of several elephants every summer from February to May. The carcasses of wild ungulates and elephants form the major source of food for vultures in this area.

Monitoring

The sanctuary was visited at least once a month. The number and species of vultures seen and their activity were recorded at each visit to the sanctuary. The vultures were counted while travelling within the sanctuary through forest roads for a distance of about 30 km. Soaring vultures were observed from vantage points also, mostly the *vayal* (open grassy marshes) in the forest. Information on the carcasses and the vultures present were noted.

Nesting activities were observed each season from September to May, from the nest building stage till the juvenile vultures flew out of the nest. The nest trees were marked for identification once the incubation started and monitored till the end of the season. The nesting colonies were visited at least once a month through the breeding cycle. The study spanned 14 years from 2003 to 2017.

The monitoring was done from 2003 to 2008 under the Vulture Monitoring Programme of the Bombay Natural History Society. During 2010 this was conducted as part of the Malabar Ornithological Survey initiated by the Kerala Forests and Wildlife Department and also under the Western Ghats Vulture Survey project sponsored by BNHS-CEPF. In 2013- 2014, the study was conducted as part of the RASTA-ATREE-CEPF project on vulture conservation in Wayanad district. Data for 2014-2017 was gathered from annual vulture monitoring programme of Hume Centre for Ecology and Wildlife Biology, Wayanad..

Vulture population

During every visit to the sanctuary, an average of 15 White-rumped Vultures and 2 to 4 Red-headed Vultures were seen, soaring mostly. Indian Vultures were seen very rarely only. A synchronized survey conducted in the sanctuary in December 2013 counted 35 White-rumped, 5 Red-headed and 2 Indian Vultures. At the carcasses, congregation of vultures numbering more than 50 had been seen on occasions. It is assumed that vultures from the adjacent areas also congregate at the available carcasses in the sanctuary.

The vultures here are extremely alert and fly away at the slightest disturbance, indicating that this is a genuine forest population, not much in contact with humans. Apart from one or two sightings reported near a slaughterhouse at Panamaram, about 20 km from the sanctuary (Ajayan pers. comm.), no vultures have been seen outside the forested area in Wayanad.

Breeding of White-rumped Vultures

Three small colonies of White-rumped Vultures have been located in three different ranges of the sanctuary, viz. Kurichyat, Bathery and Tholpetty. The colony at Kurichyat used to have a maximum of 11 nests, Bathery up to 6 and Tholpetty up to 3. The nests were placed on tall trees in the vicinity of *vayal* or forest roads and always had a source of water nearby. At Kurichyat, the undergrowth of the nesting area used to be cleared under the management of *vayal* (Jayaprasad, 2002; Sunilkumar, 2012). This practice seems to have been discontinued after 2009 and probably after that, the nests have been shifted closer to the forest road, where the undergrowth is being cleared on both sides for fire prevention.

The breeding cycle began in September-October with nest building, egg was laid in late October or early November, chick hatched in late November or early December and the young flew out of the nest in May. In the breeding season of 2013 – 2014, the chick at a nest in Tholpetty range left the nest only in June.

Our observation showed that White-rumped Vultures in the Wayanad had a good rate of breeding success (a nest from which a fledgling flew out was considered as a successful nest) at an average of 65 % (Fig.2); compared to the breeding colonies of north India, this was very high (Vibhu Prakash pers. comm.). No mortality in adult vultures had been reported in or around the breeding colonies. Two dead juvenile vultures were found – one in the nest itself – at the breeding colony at Kutrichyat in April 2009. Post-mortem was conducted on one of the carcasses by, but the cause of death could not be ascertained (Arun Zacharia pers. comm.). No data is available on the mortality of the fledglings once they left the nest and there is no exact information on the annual recruitment into this population.

Red-headed Vultures, seen regularly in the sanctuary albeit in small numbers, were not found to breed here. Juvenile birds of this species also are sighted often indicating that this species may also be breeding here or in the neighbouring areas.

Prevalence of NSAID

Surveys were conducted in the drug stores of Wayanad district in 2008, 2011 and 2013 using standard methodology (Cuthbert *et al.* 2011). The pharmacies were visited and asked for veterinary non-steroidal anti-inflammatory drugs (NSAID) to treat cattle. In all, 13 brands of NSAIDs were offered for sale. It was found that diclofenac in large packaging (30 ml) was still available in 2013 in at least one drug store. Other drugs harmful to vultures e.g. aceclofenac, ketoprofen, nimesulide etc. also were available in the market. This shows that the threat of NSAIDs to the vulture population of the area still persists.

Conclusion

Our study shows that the small population of the two species of vultures has been more or less stable for the last 15 years. The all-time low number of nests in the 2016 – 2017 season is a cause of concern, though.

Recommendations

1. Regular monitoring and documentation of the vulture population, breeding colonies should be carried out by the forest department or the NGOs working in this field.
2. Management practices, especially the *vayal* management should be continued in the sanctuary.
3. The prevalence of diclofenac and other NSAIDs should be strictly monitored and their availability should be totally eliminated in Kerala, especially in Wayanad and the neighboring districts by the Drug Controller. Offenders should be punished.
4. Monitoring of carcasses should be continued till a substantial data is generated for proper assessment.
5. Wayanad Wildlife Sanctuary being contiguous with Bandipur National Park, Rajiv Gandhi National Park (Nagarhole) of Karnataka and Mudumalai Tiger Reserve of Tamil Nadu, a joint action plan will have to be designed so as to make any effective conservation strategy.

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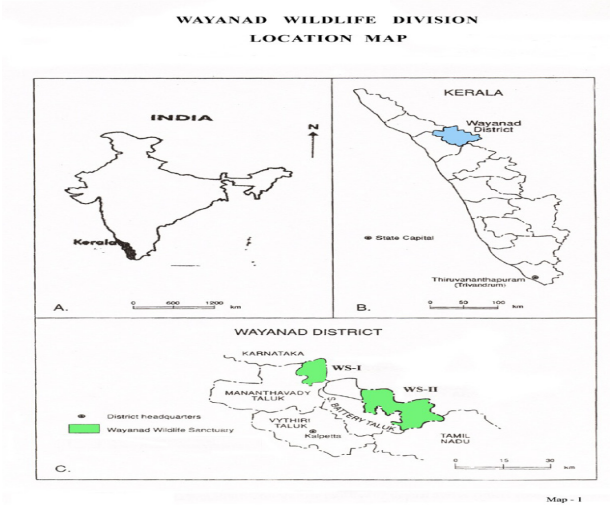

Fig. 1 Wayanad wildlife sanctuary

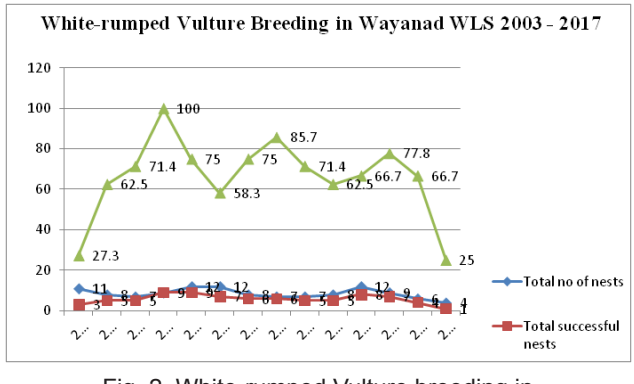

Fig. 2. White-rumped Vulture breeding in Wayanad WLS - 2003 – 20017

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POPULATION ESTIMATION OF VULTURES IN MOYAR VALLEY: SWEEP SURVEYS

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ABSTRACT

Vultures in Moyar valley has not been studied in detail until recently no specific or authentic data on their size or population threats like Brigand Veerappan and other factors limited entry into jungles in the past decades also till the catastrophic decline during 90's, vultures were not in red list even the diclofenac and NSAID effect was mostly restricted to population around habitation no status on wild population and very little study done even the observations of ERC Davidar was related to tiger and elephants and a passing remark on vultures (that too Sigur plateau). This prompted an exercise to judge at least a range of population in wild Moyar valley since it is the last refuge in southern India launched with the help of Amateur birders of Tamilnadu & Kerala timely help of Forest Dept. (Coimbatore Circle) started in 2015 and continued till date sweep surveys with synchronized observations over two days sweep surveys are the best method to judge the probable population when no previous records are available and studies are almost nil effectively glaring double counts minimized methodology of time and direction reduces serious double counts at two places of the same zone facilitation of the range of vultures in the zone, i.e. approximate numbers or reliable estimate breeding statistics also support this the comparative figures suggest a stable population around 150+ in this biotope and some lateral migration during monsoon

Key Words: Vultures, Moyar Valley, Survey

Introduction

It is seen that both the Gazetteer of Nilgiris and erstwhile British Ornithologists like Jerdon, Whistler, etc. observed that vultures are very common in Nilgiris, especially Moyar Valley with Scavenger(Egyptian) vultures being the commonest among Badaga villages (Primrose, Jerdon). However, it is a fact that very few studies have been done on vultures in wild. The observation of ERC Davidar relates to 1990s when cattle killed by tigers were poisoned by villagers of Segur plateau. It does not give any idea of the vulture population at that time but a relative statement based on abundance at that time. All the population crash and decline discussed are with reference to the population that was existing around towns, cities and villages in huge numbers till early 1990s (Dr.Robert B Grubh, personal communication). We do not have reliable statistics or figures on the numbers that thrived in this valley before 2005. Added to these factors, the operation of the brigand Veerappan in these habitats was a great deterrent to many researchers and surveys as safety was at stake and the villagers were also caught in the nexus, thus making the area unsuitable for research of any kind.

In this back drop, the idea of a rapid or sweep survey assumes a great importance since the entire valley could be thoroughly scanned by expert birders at the same time excluding serious double counts (synchronised survey). Also such an exercise will reveal the presence of other raptors along with roosting sites, nesting sites and communal congregations. Also it will give a fair number of vultures that could be using this valley. With a view to get a fair number of raptors and also their preferences in this biotope with reference to ground realities, this survey was organised in 2015; 2016; & 2017-- the first two years with the help of Tamilnadu Forest Dept (Coimbatore Division) and the last with the Dept and Sanctuary Nature Foundation.

Methodology

The success of the survey hinges on having well qualified personnel for conducting the field work. It is essential that the field crew have sufficient experience and training so that the resulting data are complete and reliable. Ideally biologists should be hired who have extensive experience conducting formal surveys, including field work in remote areas. When a sufficient number of qualified biologists are not available, compromises must be made. It is important that field personnel know that where they are, how to get back to where they started, and what to do in poor weather conditions or when things go wrong. Even well recorded scientific observation is of little use when the crew are not sure of where they were. This is also important for basic safety, especially when surveys are conducted in remote areas. It does not matter whether this experience is gained as part of general recreation (eg. Backpacking) or while conducting actual research.

The area to be surveyed must be defined at the start of a season so that an appropriate system of selecting sites within that area can be implemented.

Species habitat or range

This type of survey focuses on a particular species, typically one that is formally listed or believed to be rare. A single species survey would include all habitat for that species within either the entire geographic range or an area of interest such as a National forest or state park. Focusing surveys on particular species limits the habitat types that need to be surveyed. Unless one is familiar with the habitat preferences of a particular species, there is a tendency to focus on other areas. It is also important, however, to search areas that are believed to be marginal or unsuitable for the species of interest.

A complete survey includes all habitats within the survey area eg. the entire length of the terrain. Areas that are clearly unsuitable for the species are not included. Surveys focusing on a particular species may also be complete within the appropriate habitat for that species. Complete surveys conducted in a naturally defined area,

such as a valley or river valley, provide the best information. Some biologists believe that individuals routinely move from one population to another. Without this dispersal, the populations may not be self-sustaining over a period of time. If surveys are conducted in anticipation of significant change in Management practices, complete surveys are to be conducted, not sample surveys. Surveys based on sampling regime are not sufficient when there are potentially serious impacts on population of rare or declining species.

Advantages: A complete survey has advantages over other techniques, because there is no bias in selecting sites and no need to extrapolate the data.

Disadvantages: Primary disadvantage is time and cost. In a large Park or wilderness, it may be a deterrent.

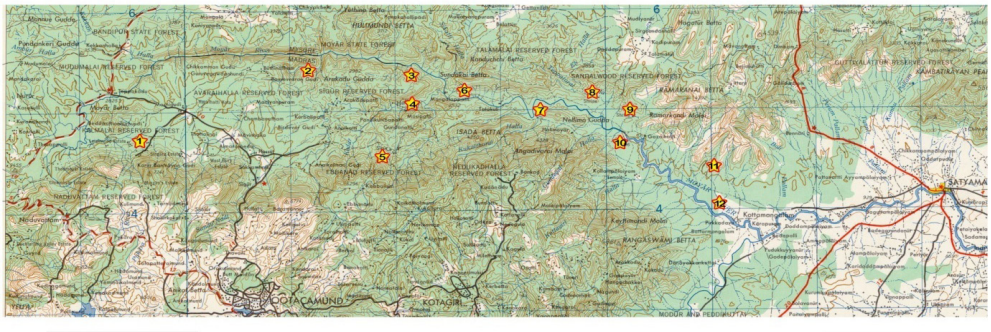
Each team aided with an expert birder was asked to take a slow trek from early morning (depending upon visibility factor) for a minimum period of two hours in a particular path or transects laid for other surveys. The prime time of noon should not be missed, since vultures soar only when hot thermals climb. Similarly, another two hours trek in the evening in another transect was done. The last transect could be the repeat of first one or a new one, to cover the area to satisfaction.

During other times, any interesting observation or details could be noted to give a fair idea on bird behaviour and habitat utilization etc.

Study Area

The study area extended from Boothanathham village near Moyar Power Station in Sigur Reserve and upto Bhavanisagar dam in Sathyamangalam division all along the course of river Moyar. In view of the sightings at Singara range and Sigur range, areas around Singara and Siriyur were also included (These form the sink habitat of Moyar valley). (Please refer to the map given below).

In addition to the observations, the bird watchers were also instructed to note the direction and time of the flight of raptors encountered with numbers. This was done in order to eliminate double counts between adjacent camps as plotting of these in a map will reveal the lateral movement of birds. Similarly roosting sites, nesting sites are to be clearly marked in the data sheets.



1. Singara
2. Jagulikadavu
3. Asuwaramattam
4. Aadikombai
5. Sriyur
6. Mangalapatti

7. Thengumarahada
8. Moolapatti
9. Karuvanaroyar Kovil
10. GT Patti / Nandhipuram
11. Varakatu kombai
12. Bhavanisagar

Results

Timing	Number of birds			
	2015	2016	2017	Grand Total
06.01 AM - 9.00 AM	````39	```63	```22	```124
09.01 AM - 12.00 PM	````74	``117	```57	```248
12.01 PM - 3.00 PM	````18	```18	```26	`````62
3.01 PM - 6.00 PM	````20	```30	```15	`````65
Grand Total	```151	``228	``120	```499

Discussion

- The results indicate a stable tendency in the last three years and the variation is low
- The weather in the first two years was sunny, hot and without strong winds
- The weather in 2017 was cloudy, rainy and humid with low light as monsoon had set in, albeit faintly, with winds.
- There was a perceptible shift in sighting of vultures in 2017, as more numbers were seen from Moyar valley of Satyamangalam, compared to the earlier two years, though the shift may be not in great numbers.
- In 2017, the breeding had almost concluded and juveniles were flying out on their own, which could have influenced a slight drop in numbers, compared to previous years.
- Giving allowance to observer bias and repetitions (that was restricted to only few camps), the population may well be around 150

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POPULATION ESTIMATION OF VULTURES IN MOYAR VALLEY, TAMIL NADU: ROAD TRANSECT SURVEY

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ABSTRACT

Nine species of vultures are recorded in Indian sub-continent. The vulture species threatened across India and in most parts of the world. The major reason for vulture decline in India was use of the veterinary drug for cattle. However, diclofenac is not only vulture-toxic Non-steroidal Anti-inflammatory Drug (NSAID) other NSAIDs such as ketoprofan, aceclofenac, carprofen, phenlbutazone, nimesulide and flunixin drugs also toxic to vultures. There are six vulture species are recorded in the Moyar Valley of Tamil Nadu. They are Oriental White-rumped Vulture *Gyps bengalensis* (OWRV), Indian Vulture (Long-billed) *Gyps indicus* (LBV), Red-headed (King) Vulture *Sarcogyps calvus* (RHV), Egyptian Vulture *Neophron percnopterus* (EV), Himalayan Griffon *Gyps himalayensis* and Cinereous Vultures *Aegypius monachus*. The OWRV, LBV and RHV listed as critically endangered, EV listed as endangered, Himalayan Griffon and Cinereous Vultures listed as Threatened category by the IUCN. The OWRV, LBV, EV and RHV are resident in the landscape. The OWRV and LBV active nesting population were observed in the landscape. However the EV and LBV have been breeding in the adjoining landscape of Karnataka. Record of few RHV juvenile vultures in the landscape indicates that till RHV breeding in the Nilgiri Biosphere Reserve. Recently two migratory vultures namely Himalayan Griffon and Cinereous Vulture were recorded in two different occasions in the landscape as well as in the adjoining states of Kerala and Karnataka. The systematic vulture study was conducted for the first time in the Nilgiri North Forest Division (NNFD) and Sathyamangalam Tiger Reserve (STR) of Moyar Valley to determine the population of vulture and also to get rough estimation of vultures. The vultures were counted on road transect; tarred road sand metal roads were selected for the survey. The road transect were driven between 8:00 to 17:00 local time at 20-30 kmph in the protected areas. These transects were surveyed twice in a month from January to December in 2012 and 2013. The routes followed in 2013 were the same as the previous survey. Vulture nest searches were carried out from October to June. Vulture species counted using a pair of instruments such as binocular (40X10) and telescope (20X). Vulture photographs were taken with Nikon D 5200 digital camera for further identification. The survey result shows that the flock size of the OWRC significantly higher in NNFD when compared to STR of Moyar Valley. The flock size of the LBV was very low and found insignificant between NNFD and STR. There was no difference in the overall RHV sighting between NNFD and STR. There is a significant variation in the total number of vulture sighted between NNFD and STR that the OWRV population and encounter rate was highest during post monsoon season when compared to monsoon and summer season. No seasonal variation noticed in RHV and LBV across the season in NNFD. In STR the mean population of OWRV was significantly highest during summer followed by monsoon and post monsoon. The mean population and encounter rate of LBV showed highest numbers during monsoon season when compared to other seasons in STR. On the other hand the RHV showed uniform distribution and no seasonal variation was observed in STR. However there is a seasonal variation in population and encounter rate per kilometer in both NNFD and STR for the OWRV. The median group size and mean crowding were highest for OWRV, mean crowding was very low for LBV and RHV did not show any variations. The active nesting of OWRV was observed on the trees along the riparian habitat in NNFD and Mudumalai Tiger Reserve. On the contrary LBV breeding on the rocky cliffs in both NNFD and STR. The government and non-governmental organizations are involved for to save last surviving small population of vultures through research, advocacy and awareness. The current mortality of vultures in the landscape is another challenge for conservationists. A long term ecology studies such as (nest monitoring, NSAID survey & transect survey) advocacy and conservation awareness only hopes for announcing the landscape as a permanent safe zone for vultures.

Key Words: Conservation, Flock Size, Moyar Valley, Sesonal Variation, Population

Disclaimer

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Status and population of vultures in Moyar Valley, southern India

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Abstract: Four species of vultures were surveyed using road transects in two parts of the Moyar Valley, three of these are Critically Endangered by IUCN criteria and one is Endangered. The vulture study was done for the first time in Nilgiri North Forest Division and Sathyamangalam Tiger Reserve of Moyar Valley to determine the flock size in the three species of vultures and also to get a rough estimation of vultures. The results show higher flock size and higher densities in Nilgiri North Forest Division than in Sathyamangalam Tiger Reserve and the most numerous of these was the White-rumped Vulture. There is also evidence of seasonal movements in Nilgiri North Forest Division. These data represent the first systematic survey results from the area and demonstrate the significance of the Moyar Valley for all four Endangered vulture species, probably the main stronghold remaining in southern India. They are White-rumped Vulture *Gyps bengalensis*, Indian Vulture *Gyps indicus*, Red-headed Vulture *Sarcogyps calvus* and Egyptian Vulture *Neophron percnopterus*. The study recommends that immediate long-term conservation efforts should be taken to save the Critically Endangered vultures in the Moyar Valley.

Keyword: Conservation, Flock size, Moyar Valley, population, seasonal variation, vultures.

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Author Details: Dr. R. Venkitachalam is a Research Associate at Ashoka Trust for Research in Ecology and the Environment (ATREE), Bangalore. He completed his Ph.D on Status and Ecology of Threatened vulture species in Moyar Valley, Tamilnadu. He so far completed research projects on Hornbills in the Eastern Ghats, one on Ecosystem monitoring (Component Ornithology) in Keoladeo National Park, involved captive management programme on vultures conservation in India and two projects on in situ Conservation of vultures in Tamil Nadu. At present he is studying dynamics of ecosystem services in Western Ghats of Tamil Nadu. Dr. S. Senthilnathan is working as Assistant Professor in the Department of Zoology, Chikkanna Government Arts College, Tirupur. He has more than twenty years research experience and done a commendable work on environmental studies. He is an awarded of UGC Research Associateship and CSIR Scientist Pool Officership in his credit. He has also worked with several research institutions like CAS in Marine Biology, Annamalai University, Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore and CEE, Ahmadabad. He completed the World Bank projects under PWD, Tamil Nadu and published several papers in the national and international in the field of environmental science in reputed journals.

Author Contribution: RV conceived and designed the experiments, performed the experiments and analyzed the data.
RV and SS wrote the paper.

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INTRODUCTION

White-rumped Vulture and Indian Vulture were the most abundant large raptors present in almost all bio-geographical zones of the Indian subcontinent and absent in the Trans-Himalaya and the Andaman & Nicobar Islands (Ali & Ripley 1983). Vulture species are threatened across India (Prakash 2012) and in most parts of the world (Ogada et al. 2012). The major reason for vulture declines in the Indian subcontinent was the use of veterinary diclofenac for cattle (Green et al. 2004; Oaks et al. 2004). Population declines of vultures indicate dysfunctional ecosystems because the population dynamics of top order predators often reflect the ecosystems they inhabit (Newton 1979). The drug diclofenac was banned in India for veterinary purposes from 2006. This threat persists despite the ban and ongoing efforts of various organizations to save vultures that have recently resulted in a further step by the Ministry of Health, Government of India which posted the gazette notification on 17 July 2015, restricting larger multi-dose vials for humans to single unit 3ml packs only, to curb the illegal veterinary use of the human drug in cattle. Similarly, The Director of Veterinary and Animal Husbandry banned another vulture killer drug, ketoprofen in three districts of Tamil Nadu in September 2015 such as Coimbatore, Nilgiri and Erode. These districts fall within the Vulture Safe Zone (VSZ) in Tamil Nadu. VSZ is centered on a surviving wild vulture colony. Based on range size of White-rumped Vultures determined using satellite telemetry, a VSZ includes an area with a radius of at least 100km in every direction (i.e., a circular area with a 100km radius). This equals a total area of over 30,000km^2 (IBCN, 2014). VSZs are a means of focusing effort on priority actions to remove diclofenac and other vulture NSAIDs (Non-Steroidal Anti-Inflammatory Drug) for a network of areas where vultures survive. Saving Asia's Vultures from Extinction (SAVE) refers to these VZSs as provisional and when the threats of diclofenac and other vulture toxic NSAIDs have been removed will declare a provisional VSZ as a true VSZ (SAVE 2014a). The VSZ concept was pioneered in Nepal, and introduced in other parts of the country. Without steps such as this, vultures remain under serious threat (SAVE).

So far no systematic studies are available on vultures in southern India, especially in Tamil Nadu. Few opportunistic observations and short notes were available on vultures in Tamil Nadu. Badshah (1968) reported that the White-rumped Vulture was common in Tamil Nadu except near seacoasts (BirdLife International, 2001) and Gokula et al. (1996) reported that the White-rumped Vulture and the Indian vulture are resident in the Mudumalai Wildlife Sanctuary. The Indian vultures were previously recorded breeding on cliffs in the Nilgiri and Palani hills of Tamil Nadu (Sathyamurthi 1970). Hence, the study was undertaken to estimate the population and distribution pattern of the vulture species in detail in Nilgiri North Forest Division (NNFD) and Sathyamangalam Tiger Reserve (STR) of Moyar Valley.

MATERIALS AND METHODS

Study Area

The Moyar Valley located between 11.701289^{0}N & 76.587062^{0}E and 11.472443^{0}N & 77.147608^{0}E encompasses the Nilgiri plateau in the southeast, Thalamalai plateau in the northeast, and Mudumalai Tiger Reserve in the west (Fig. 1). The approximate length of the valley is 50km falling within the Tamil Nadu and Karnataka states. Mudumalai Tiger Reserve and Sathyamangalam Tiger Reserve of Tamil Nadu and Bandipur Tiger Reserve of Karnataka within the Moyar Valley are protected areas. The altitude of the valley ranges from 290m to 1950m. Extremes of climate are experienced with temperatures varying between 17–37.5 ^{0}C. During the northeast monsoon season, the extreme eastern part of the Valley receives heavy rainfall and during the southwest monsoon the western parts of the Valley receives heavy rainfall.

There is a 260m deep gorge in the valley called Moyar Gorge, which is located in the eastern end of Nilgiri district, which separates the Segur plateau and the Mysore plateau in the northwest. The study area sprawling over 600km^2 covers part of Masinagudi Range of Mudumalai Tiger Reserve, Segur Range, Singara Range, Nilgiri Eastern Slope Range of Nilgiri North Forest Division and Bhavanisagar Range of Sathyamangalam Tiger Reserve in the northeast. The different types of vegetation and the healthy prey and predator base support the four vulture species in the valley.

Line transect method

In Moyar Valley, vultures were counted on road transects; tarred roads and metal roads are maintained by the Tamil Nadu Forest Department to easily access the villages in the protected areas of STR and NNFD (Fig. 1). These roads were selected for vulture survey. The transects were driven between 08:00 and 17:00 local time at 20–30 kmph in the protected areas. These transects were conducted twice each month from

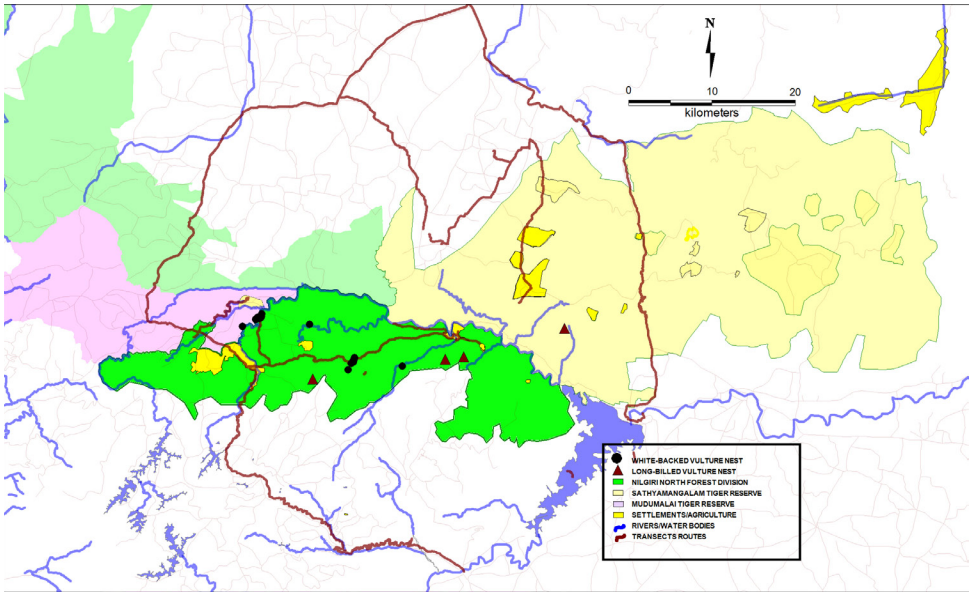

Figure 1. Study Area showing vulture survey transect routes and vulture nest distribution in Moyar Valley

January to December in 2012 and 2013. The routes followed in 2013 were the same as in the previous surveys. The total length of transects of the present study covers a distance of 1277km in STR and 1308km in NNFD of Moyar Valley. Vulture nest searches were carried out during the months of October to June. We walked on elephant footpaths, alongside streams and river to search for vulture nests. Vulture species were counted from vantage points using a telescope (29X) and with a binocular (40X10) and nesting trees were marked by using GPS (global positioning system) (Images 1–4).

Statistical Analysis

Basic statistics such as, arithmetic mean, standard deviation and standard error were calculated for all the replicative variables and are given as X ± SD or X ± SE. Statistical analyses were performed by using Windows based statistical packages—Microsoft Excel, MINITAB (Ryan et al. 1992), and SPSS (Statistical Package for Social Science: Nie et al. 1975). The significance of the Pearson correlation co-efficient was tested using t test. The non-parametric test used was chi-square test for testing the association between variables. For hypothesis testing $P<0.05$ and $P<0.01$ were considered and these levels of significance are indicated as appropriate. Statistical inferences were made following Sokal & Rohlf (1995) and Zar (2003). Although chi-square results are given in many tables and graphs, where the data were used in percentages, the analyses were done only on frequencies.

Image 1. Indian Vulture *Gyps indicus*

Image 2. Egptiyan Vulture *Neophron percnopterus*.

Image 3. Red-headed Vulture *Sarcogyps calvus*

Image 4. White-rumped Vulture *Gyps bengalensis*

RESULTS

Flock size of three vulture species was significantly higher in NNFD when compared to STR of Moyar Valley (Table 3). White-rumped Vultures showed a significant difference in the flock size in NNFD and STR. This was demonstrated statistically with a significant difference in the flock size between the study sites for White-rumped Vulture (c^2=3.68; df =1; $p < 0.05$). Though there is variation in mean encounter rate of White-rumped Vulture, it was not statistically significant (c^2= 0.86; df =1; $p > 0.05$).

The flock size of the Indian Vulture was very low and found insignificant between the NNFD and STR (Table 3). There was no difference in the overall number of Red-headed Vultures sighted between NNFD and STR. In the present observation, there is a significant variation in the total number of vultures sighted between NNFD and STR, hence an attempt was made to study the seasonal variations of vulture abundance in Moyar Valley.

Seasonal variation in the flock size and encounter rate of vultures in Nilgiri North Forest Division

Seasonal variations in the number of vultures sighted and encounter rate of three species of vultures varied in NNFD. The White-rumped Vulture population (Fig. 2) and encounter rate (0.92±0.17) was highest during post-monsoon period compared to other seasons (Table 1). Indian Vulture sightings were relatively higher during monsoon period when compared to post monsoon and summer (Fig. 2; Table 1). No seasonal variations were noticed in Red-headed Vulture numbers across different seasons in the NNFD.

Seasonal variation in the flock size and encounter rate of vultures in Sathyamangalam Tiger Reserve

The mean population of White-rumped Vultures was significantly highest during summer season (April, May, June and July) followed by monsoon (August,

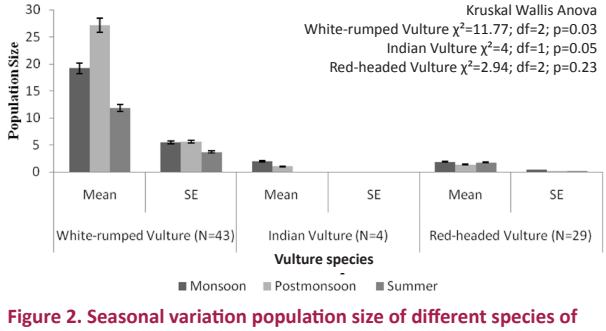

Figure 2. Seasonal variation population size of different species of vultures in Nilgiri North Forest Division

Table 1. Seasonal variations in the encounter rate of different species ofvultures in Nilgiri North Forest Division (NNFD)

Parameters	Seasons	White-rumped Vulture (n=43)		Indian Vulture (n=4)		Red-headed Vulture (n=29)	
		Mean	SE	Mean	SE	Mean	SE
Encounter rate (/km)	Monsoon (August, September, October, November)	1.14	0.310	0.44	-	0.48	0.101
	Post-Monsoon (December, January, February, March)	0.92	0.179	0.33	0.00	0.46	0.069
	Summer (April, May, June, July)	0.50	0.130	-	-	0.37	0.061
	Kruskal-Wallis Anova	c^2=5.79; df=2;p=0.055		c^2=4; df=2;p=0.046		c^2=0.91; df=2;p=0.636	

- No value

Table 2. Seasonal variations in the encounter rate of different species of vultures in Sathyamangalam Tiger Reserve (STR).

Parameters	Seasons	White-rumped Vulture (n=24)		IndianVulture (n=15)		Red-headedVulture (n=11)	
		Mean	SE	Mean	SE	Mean	SE
Encounter rate (/km)	Monsoon (August, September, October, November)	0.79	0.253	0.41	0.140	0.43	0.066
	Post-Monsoon December, January, February, March)	0.41	0.120	0.36	0.084	0.21	0.017
	Summer (April, May, June, July)	0.60	0.233	0.41	0.124	0.33	0.087
	Kruskal-Wallis Anova	c^2=0.23; df=2;p=0.89		c^2=0.77; df=2;p=0.68		c=4.88; df=2;p=0.087	

Table 3. Flock size and encounter rate of Vulture comparison between the Nilgiri North Forest Division and Sathyamangalam Tiger Reserve

Parameters	Study area	White- rumped Vulture (n=67)		Indian Vulture (n=19)		Red-headed Vulture (n=40)	
		Mean	SE	Mean	SE	Mean	SE
Flock size	NND	18.51	2.863	1.25	0.250	1.66	0.143
	STR	12.79	3.980	2.87	0.515	1.36	0.152
	Kruskal-Wallis Anova	c^2=3.68; df=1;p=0.055		-		c^2=0.755; df=1;p=0.39	
Mean Encounter rate	NND	0.81	0.120	0.36	0.028	0.43	0.043
	STR	0.64	0.137	0.40	0.080	0.32	0.042
	Kruskal-Wallis Anova	c^2=0.86; df=1;p=0.35		-		c^2=0.75; df=1;p=0.36	

- No value

Table 4. Mean and Median crowding of Vultures in Moyar Valley.

Species	Min	Max	Mean crowding	95% Confidence Interval	Median
White-rumped Vulture (n=67)	1	79	38.27	29.9 to 47.8	31
Indian Vulture (n=19)	1	08	3.88	2.65 to5.77	3
Red-headed Vulture (n=40)	1	04	1.89	1.63 to 2.33	2

September, October and November) and post monsoon seasons (December, January, February and March) (Table 3). The mean population (Fig. 3) and the encounter rate of Indian vultures were found to be highest during monsoon season when compared to the other seasons (Table 2); however the encounter rate of Red-headed

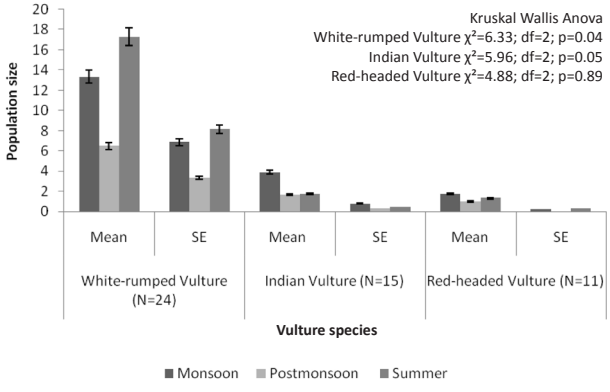

Figure 3. Seasonal variation population size of different species of vultures in Sathyamangalam Tiger Reserve

Vulture showed uniform distribution and no seasonal variation was observed (Table 2). It is clear that the mean encounter rate of all the three vulture species did not show any variation between seasons (Table 2). Nevertheless there is a clear seasonal variation in the White-rumped Vulture population and encounter rate per kilometer in both NNFD and STR (Tables 1,2; Figs. 2,3).

The mean crowding and median group size of the present study were highest for White-rumped Vulture with 38.27 and 31 respectively. The mean crowding ranges from 30 to 48 individuals in a single White-rumped Vulture group. In the Indian vulture the mean crowding was low (3.88) and it ranged from 2.65–5.77. Statistical mean crowding for the Red-headed Vulture was 1.89 and did not show any variation (Table 4). The mean and median crowding results concluded that mean crowding varied greatly and the mean group size of White-rumped Vulture was highly varied in skewed (aggregated) distribution group size in both NNFD and STR.

Breeding populations recorded

Thirty-six pairs of White-rumped Vulture active nesting population were observed on the trees along the riparian habitat in NNFD and Mudumalai Tiger Reserve (Fig. 1) and four pairs of Indian vultures were breeding on the rocky cliffs in both NNFD and STR of Moyar Valley (Venkitachalam et al. 2015).

DISCUSSION

This is the first systematic survey of three species of vultures, viz., White-rumped Vulture, Indian Vulture and Red-headed Vulture in the NNFD and STR of Moyar Valley of Tamil Nadu. Significantly larger vulture flocks were recorded in NNFD than in the STR. The flock size of Indian vulture and Red-headed Vulture was very low and statistically non-significant between the study sites. The present study results however reveal that there is a significant variation in the total numbers of vultures sighted between NNFD and STR, and we also attempted to examine any seasonal variation of vulture numbers in Moyar Valley.

The mean populations of the three species of vultures varied according to the seasons in the both study areas NNFD and STR of Moyar Valley although these variations were only significant for White-rumped Vulture. Population size of White-rumped Vulture was found to be highest during post monsoon season compared to summer and monsoon seasons in NNFD. In STR White-rumped Vulture was found to be highest during summer when compared to other seasons. In monsoon, the time available for forage is limited and thermal production is very uncertain because of the relatively low temperature and in summer, the high availability of day light hours, and the almost continuous formation of thermal lifts helps disperse the breeding and non-breeding vultures to forage. The vultures start breeding from post monsoon and summer onwards, and variations on the counts could simply reflect less movement by incubating vultures. Nest surveys provide a measure of the size of the breeding population, hence yield an important measure of the local status of these long-lived, slow breeding vultures (Margalida et al. 2011). White-rumped Vultures were not observed nesting in STR although they were frequently recorded soaring, roosting and feeding in STR. The Red-headed Vultures are solitary species occurring during the present study period and these were recorded with similar frequency throughout the year. Juveniles of Red-headed Vultures were recorded during the study period, indicating that the Red-headed Vulture may be breeding in or around the study area of Moyar Valley. Statistical mean and median highest aggregated populations of vultures were White-rumped Vulture followed by Indian Vulture and Red-headed Vulture. However, the prey, predator base in the thorny savanna forest helps vultures to easily locate animal carcasses and the lesser intrusion of the vulture killer drugs has led to the presence of vultures in the landscape. The mammalian predators scat analysis revealed that though the diet of the three predators consisted of 15 to 21 prey species, wild ungulates formed a major portion of their diet (88.4–96.7 %) in the Mudumalai Tiger Reserve (Ramesh et al. 2012), which is adjacent to the Nilgiri North Forest Division. We strongly recommend that immediate in situ monitoring efforts such as revisiting annual nest monitoring, synchronized and well coordinated seasonal and carcass surveys should be conducted in the Nilgiri North Forest Division, Sathyamangalam and Mudumalai tiger reserves to understand the species-wise populations of the highly threatened vultures.

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CONSERVATION STRATEGIES FOR SECURING CRITICALLY ENDANGERED WHITE-RUMPED (GYPS BENGALENSIS) AND LONG BILLED (GYPS INDICUS) VULTURE SPECIES IN THE TAMIL NADU PART OF THE NILGIRI BIOSPHERE RESERVE.

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ABSTRACT

Here we present the results of a study about the conservation strategies for securing critically endangered White-rumped (*Gyps bengalensis)* and Long billed (*Gyps indicus)* vulture species in the Tamil Nadu part of the Nilgiri Biosphere Reserve from 2015to 2016 (Two years).Nest site count was made for population estimation, breeding ecology was carried out by direct field observation, diclofenac and other threats were assessed by questionnaire survey and management recommendations were suggested from the findings of the project. This present study has identified a total of seven nesting and one roosting location used by two vulture species. Of which four of them were belonging to the White-rumped vulture and three of them were a Long-billed vulture. A total of nine villages is recorded in and around the nesting and roosting colonies of two vulture species. The mean kilometer distance between villages and White-rumped vulture nesting habitat was 2±0.44 and the Long-billed vultures' nesting habitat was 2.41±0.17. Thorn forest was effectively used by vultures (NNFD (n=1586; 16.18±2.53), STR (n=327; 8.38±1.26) and MTR (n=75; 4.41±2.27).

Among four White-rumped vulture nesting colonies, the Jagalikadavu nesting colony has recorded a maximum number of individuals (68; 79±3.19). Long-billed vulture population was high in Nilgiri Eastern Slopes nesting colony (4.06±0.30). A total of 52 White-rumped vulture nests were recorded in 38 nesting trees. Jagalikadu nesting colony has recorded 28 nests in 21 trees. Two tree species namely *Terminalia arjuna* (37 trees with 51 nests) and *Spondias mangifera* (one tree with one nest) were used for nest construction. A total of eight plant species materials were used by White-rumped vultures for nest construction. Of which *Chloroxylon swietenia* twigs were maximum used with the Mean±SE (30±3.06). Most of the nests were located towards the North East direction (n=21). This was mainly because of to get maximum sunlight in order to obtain thermal energy to fly.

Among the 52 White-rumped vulture nests, 40 nests were observed as active nests evidenced by frequent usage of a nesting pair. Out of 40 incubations, 24 hatchlings came out with the 58% of the breeding success of White-rumped vulture in all four nesting colonies altogether. On the other hand, 100% (n=2) fledge out was recorded from 2 incubations of a Long-billed vulture. This was an important outcome of the project to emphasize that the need for long-term monitoring of vultures in order to find out the reasons behind for 58% of the breeding success of White-rumped vultures.

Totally thirteen veterinary personnel were interviewed during this project period. Of which four of them were Veterinary Assistants (Quacks) and other were Veterinary Assistant Surgeons (Doctors). All of them were very well aware on the ban of the use of diclofenac in veterinary practice and its effects on vulture population as well. It was quite interesting to note that all of them use Melaxicum as a painkiller for veterinary practice. Another healthy trend is the Tamil Nadu Government is providing the Melaxicum to Government veterinary dispensaries. Our drug store survey result revealed that a total of ten diclofenac composition painkillers are being currently prescribed by the doctors for human use. An alarming message is that 30 ml vials are still available in the drug stores.

During our study, we have recorded a total of forty-two White-rumped vulture deaths between 2013 and 2016. Of which thirty-four individuals were adult and eight were immature. A post-mortem was conducted only for eight individuals. Other 32 individuals were seen with skeletal and feather remains unable to conduct a post-mortem. The autopsy laboratory result revealed that the tissues of the vultures were contaminated by ***Organo phosphorus and urea*** which is a poison used as an insecticide in agriculture practice and one was died due to its neck lock between the vertebral bones of the domestic buffalo carcass while it was feeding. One immature was fell down and eaten by wild boars. This present study has recorded none of the death was caused due to Diclofenac. Therefore this study strongly suggests that retaliatory killing is effectively influencing on vulture population than Diclofenac. This year plenty of livestock carcasses were available to vultures due to monsoon failure. Still, the breeding success was just 58%. Therefore this present study concluded that long-term monitoring to be initiated in order to implement and take forward many management recommendations which are prescribed from this project for the long run conservation of wild viable the country's southernmost vulture population.

Key words : Conservation strategies, White-rumped vulture, Long billed vulture, Tamil Nadu, Nilgiri Biosphere Reserve

Introduction

Scavengers play an important and critical role in the food chain without which the recycling or proper disposal, especially that of dead and decaying materials will be either stopped or delayed. The vultures are excellent scavengers on dead bodies and their status is critically tagged with the present situations (Mandel *et al.,* 2008). There are 22 species of vultures in the world which belong to two taxonomically distinct groups (Amadon, 1977; Sibely and Ahlquist, 1990). New World vultures are under the order Falconiformes of family Cathartidae and Old World vultures are Accipitridae family. Due to lot of variations in geographical and environmental gradient nine species are reported to be present in India namely White-rumped Vulture (*Gyps bengalensis*), Slender-billed Vulture (*Gyps tenuirostris*), Long-billed Vulture (*Gyps indicus*), Egyptian Vulture (*Neophron percnopterus*), Red-headed Vulture (*Sarcogyps calvus*), Indian Griffon (*Gyps fulvus*), Himalayan Griffon (*Gyps himalayensis*), Cinereous Vulture (*Aegypius monachus*) and Bearded Vulture or Lammergeier (*Gypaetus barbatus*) (Ali and Ripley, 1983). *Gyps* are a group of obligate scavengers that typically breed colonially or semi-colonially. *Gyps* vultures specialize in feeding the soft tissues that make up the bulk of animal carcasses and therefore comprise the majority of vultures numerically. Vultures are known to inhabit tall trees in forests, smaller trees in open areas, rocky cliffs, old monuments and countryside (Thompson *et al.*, 1990; Liberatori & Penteriani, 2001; Donazar *et al.*, 2002; Monadjem & Garcelon, 2005; Carrete *et al.*, 2006; Thakur & Narang, 2012; Harris, 2013; Ramakrishnan *et al.*, 2014).

Vulture population have declined in many parts of their former ranges owing to food shortages and loss of habitat (Pain *et al.*, 2003). However, since the early 1990s there has been a catastrophic decline in three *Gyps* species in the Indian subcontinent namely, White-rumped (*G.bengalensis*), Long-billed (*G.indicus*) and Slender-billed Vultures (*G. tenuirostris*) (Prakash 1999, Virani *et al.*, 2001, Prakash *et al.*, 2003).In response to these population crashes, all of these three were reclassified as 'Critically Endangered', placing them among the species most threatened with global extinction (BirdLife International 2001). Oaks *et al.* (2004) found that the Diclofenac, a widely used painkiller and anti-inflammatory drug administered to livestock and humans caused mortality in vultures in Pakistan. A postmortem examination of dead or dying birds from India and Nepal also showed the high incidences of Diclofenac residues and visceral gout (Shultz *et al.*, 2004). The results of these studies suggested that Diclofenac contamination was the major cause of vulture population crash across vulture range countries in Asia. However, other causes such as habitat destruction, food shortage, human persecution, poisoning and pesticide use have also caused a gradual decline in vulture population (BirdLife International 2001).

In southern India there are seven species of vultures recorded namely, White-rumped (*G. bengalensis*), Long-billed (*G. indicus*), Red-headed (*Sarcogyps calvus*), Egyptian (*Neophron percnopterus*), Himalayan Griffon (*G.himalayensis*), Eurasian Griffon (*Gyps fulvus*) and Cinereous vultures (*Aegypius monachus*) (Sashikumar, 2001; Davidar & Davidar, 2002; Thejaswi, 2004; Subramanya & Naveen, 2006; Davidar, 2007; Umapathy *et al.*, 2009; Ramakrishnan *et al.*, 2010, 2012 & 2014 ; Praveen *et al.*, 2014; Samson *et al.*, 2014a,b ; Venkitachalam & Senthilnathan, 2015; Venkitachalam & Senthilnathan, 2016; Samson *et al.*, 2015; Samson & Ramakrishnan, 2016a,b; Samson *et al.*, 2016a,b,c) were recorded.

The Tamil Nadu part of the Nilgiri Biosphere Reserve (5540 sq. km) reported 6 species of vultures. Of which 4 of them holds sizeable numbers except for Eurasian Griffon. They are mainly dependent on wild carcasses (90%) as their diet (Ramakrishnan *et al.*, 2010). This project's study area is part of the Nilgiris & Eastern Ghats Landscape which is considered to have the single largest Asian elephant population in the world. It also probably holds the largest tiger population in the country and their wild prey ensures continuous food availability to vultures. Among the lesser carnivores wild dog packs quickly consume their prey leaving behind skeleton remains. Leopards always prefer small or medium sized prey and usually hide the remains on the tree branches inaccessible to vultures. The tiger generally prefers large size prey and tend to consume their prey over a number of days which is accessible to vultures. The previous study by Davidar & Davidar (2002) reported that the given study area had a good number of vultures but had been lost mainly due to retaliatory killing of carnivores through poisoning of carcasses. This area is now harboring sizeable numbers of vulture populations and is considered to be the India's southernmost wild viable breeding population. Since captive breeding programmes have been undertaken in the northern Indian States, the conservation of this wild breeding vulture population is need of the hour. Due to lack of sustained studies there has been no science-based management in place to conserve this vulture population. Considering this lacunae this study was attempted in the Tamil Nadu part of the Nilgiri Biosphere Reserve to bring out feasible conservation perspectives of White-rumped and Long-billed Vultures between 2015 and 2016.

Study Area

The Nilgiri Biosphere Reserve (NBR) is the first and foremost biosphere reserves established in the year 1986 in India. The reserve is situated in the Western Ghats, in the Nilgiri Hills range of South India and is considered as an International Biosphere Reserve. It was declared under the Man and Biosphere Programme (MAB) of UNESCO and is also under consideration by the UNESCO World Heritage Committee for selection as one of the World Heritage Sites. The reserve encompasses 5,520 km² surrounded by Karnataka (1527.4 km²), Kerala (1455.4 km²), and Tamil Nadu (2537.6 km²) states. The Biosphere lies between 11o 36' to 12o 00' N Latitude and 76o 00' to 77o 15' E Longitude. Central location: 11°30'00 N, 76°37'30 E. The NBR has protected areas namely, Mudumalai Tiger Reserve (321.1 km²), Sathyamangalam Tiger Reserve (745.9km²) Wayanad Wildlife Sanctuary(344km²), Bandipur Tiger Reserve (874km²), Nagarhole Tiger Reserve (643 km²), Nugu Wildlife Sanctuary, Mukurthi National Park (78 km²) and Silent Valley National Park (89.52km²). This reserve also includes Nilgiris North Division (448.3 km²) and Nilgiris District, South Division (198.8 km²) and Coimbatore Division (696.2 km²) in

Tamil Nadu (Map1). The reserve extends from the tropical moist forests of the windward western slopes of the Ghats to the tropical dry forests on the leeward east slopes. Rainfall ranges from 500 mm to 7000 mm per year. The reserve encompasses three eco-regions, the South Western Ghats moist deciduous forests, South Western Ghats montane rain forests, and South Deccan Plateau dry deciduous forests. The Nilgiri Biosphere Reserve is very rich in plant diversity. About 3,300 species of flowering plants of which 1232 are endemic to the Nilgiri Biosphere Reserve. The fauna of the Nilgiri Biosphere Reserve includes over 100 species of mammals, 350 species of birds, 80 species of reptiles and amphibians, 300 species of butterflies and innumerable invertebrates. Of the vertebrate species recorded, 39 species of fish, 31 amphibians and 60 species of reptiles are endemic to the Western Ghats also occur in the Nilgiri Biosphere Reserve. NBR is one of the critical catchment areas of peninsular India. Many of the major tributaries of the river Cauvery like the Bhavani, Moyar, Kabini and Chaliyar, Punampuzha, etc., have their source and catchment areas within the reserve boundary. The forests of NBR are spread over a vast area and cover various ecotypes. The overall classification of the different forest types are as follows: Evergreen,Semi-Evergreen, Moist Deciduous, Southern Montane Wet Temperate, Dry Deciduous, Dry Scrub Woodland, Grasslands and Evergreen Forest. The present study was attempted in Mudumalai Tiger Reserve, Nilgiri North Forest Division and Sathyamangalam Tiger Reserve in the Tami Nadu part of the Nilgri Biosphere Reserve.

Materials & Methods

Population Estimation

Nest and Roost Site Count

At the initial stage of the project a questionnaire was circulated among the local people and various forest field staff in order to locate roosting and nesting colonies of White-rumped and Long-billed Vultures. Once roosting and nesting locations were confirmed we monitored the colonies with vulture counts twice in a month. The rivers and nullahs (streams) were also surveyed since White-rumped Vultures preferred to roost and nest in tall trees nearby. The population size of vulture species was estimated in the roosting sites and nesting colonies in the morning (0630 to 0930 hrs.) and late evening (1730 to 1930 hrs.) by foot surveys as described by Baral (2005). We assumed fidelity of nesting colonies, fixed time of roosting and geographic closure, no movement into (immigration) or out of (emigration) colonies to estimate population size and the vulture mortality rate. The nesting and roosting colonies were thoroughly searched for dead vultures to estimate mortality rate.

Breeding Ecology of Two Vulture Species

To study the nesting and breeding ecology of two vulture species namely, White-rumped Vulture and Long-billed Vulture, on average each nesting colony was visited 4 times in a month during breeding season (September to May) to check the status and number of vultures present in each colony. All observations were with binoculars (Nikon 52×10) from an appropriate distance (100-300m) in nesting colonies. Focal animal sampling method was used to monitor the status and behavior of breeding population of the two vulture species in nesting colonies (Postupalsky, 1974; Acharya *et al.*, 2009; Awan *et al.*, 2017). During the visits, five to ten minutes were spent to observe the breeding status of each nest in the colonies. All observations were made from 0700 hrs to 1200 hrs. Nests were identified by the presence of the fresh nesting material and whitewash (excreta) below the nest or by the presence of the incubating vulture in the nest. All the nests were identified and nesting trees were tagged and monitoring for future work (Postupalsky, 1974). Nest exposure on the nesting trees as well as rocks was determined by compass. Nest location on trees were determined by visual estimation viz., top of the crown and limb (offshoot growing directly out of a tree trunk). Confirmation of active (occupied) and abandoned (unoccupied) nests was based on the criteria laid down by Postupalsky (1974). An active breeding pair was defined as one that laid an egg, and non-breeding pair was one that occupied the nest at least for three weeks but did not lay an egg. Breeding success was calculated based on the number of fledglings divided by the number of breeding pairs. On each visit a nest was considered occupied by a pair when two adult vultures were observed at the nest, one standing and one incubating or one incubating adult was present or one adult with chick or a young chick alone was present in the nest. Information on mortality, especially of adult mortality was recorded at nesting colonies (Baral *et al.,* 2005; Steenhof & Newton, 2007). A colony was considered as active, if it was occupied by at least one active egg (Xirouchakis and Mylonas, 2005).

People's perception on vulture conservation and assessment of diclofenac usages and others threats

People's attitude towards the vulture conservation was assessed through a questionnaire survey. The questionnaire detailed (i) general background of the respondents (ii) livestock holding pattern and, (iii) local knowledge and perception of vulture conservation. Most questions were close-ended, although some open-ended contingency questions were included. The variables such as livestock population, medication of livestock, the extent of use of Diclofenac, methods of carcasses disposal, compensation/ ex gratia details and wild animals' depredation on livestock, etc (Subadi, 2005; Baral & Gautam, 2007) were collected in the villages that were located in the vicinity of vulture habitats. Diclofenac prevalence survey and its usages were determined again by questionnaire surveys with veterinary doctors and quacks including drugs stores adjoining vulture habitats to document various veterinary practices for treating livestock in villages fringing vulture habitats. Other threats were quantified by direct field observation during the field trips.

RESULT

Based on the questionnaire and foot surveys White-rumped and Long-billed Vultures nesting and roosting locations were identified, confirmed in MTR, NNFD, and STR. A total of 7 nesting and 1 roosting location were recorded in the NNFD of which 4 of them belonged to the White-rumped Vulture and 3 of them to Long-billed Vulture. White-rumped Vultures preferred to construct their nests on trees along the

riparian forest whereas the Long-billed Vultures construct their nests on cliffs of the slopes and gorges. A total of 8 villages were recorded in and around the nesting and roosting colonies of two vulture species altogether. Of which Siriyur tribal settlement is located nearest to White-rumped Vulture nesting colony (0.29km). On the other hand, the Ebbanad revenue village is located nearest to Long-billed Vulture nesting colony (2.24km). The mean distances of villages located from White-rumped Vulture nesting habitat was 2±0.44 and the Long-billed Vulture nesting habitat was 2.41±0.17. (Table 1 & Map 5).

A total of 1963 individuals were recorded in 126 sightings comprising of 4 vulture species. White-rumped Vultures was recorded in higher numbers (n=1814 (23.87 ± 3.23)) followed by a Long-billed Vulture (n=83 (2.86±0.33)), Red-headed Vulture (n=60 (3.35±0.38)) and Egyptian Vulture. (n=6 (2.00±0.58)) in the Nilgiri North Forest Division followed by A total of 120 individuals of vultures were recorded in MTR with 41 sightings comprising 4 vulture species. Of which, White-rumped Vulture was recorded in highest numbers (n=98) followed by a Red-headed Vulture (n=14), Egyptian Vulture (n=6) and Long-billed Vulture (n=2) in Mudumalai Tiger Reserve and in STR, a total of 436 individuals were recorded in 69 repeated sightings. White-rumped Vulture was recorded in highest numbers (n=728; 9.97±1.29) followed by a Long-billed Vulture (n=68; 1.86±0.13) Red-headed Vulture (n=40; 1.85±0.23) and Egyptian Vulture (n=4; 1.5±0.5).

The occurrence of vultures with respect to different vegetation types in NNFD shows that more sightings were recorded in Thorn Forest (n=1586; 16.18±2.53) and sizable numbers were also sighted in Mixed Deciduous forest (Foothill forest) (n=377 13.46±3.97) followed by in MTR showed that more sightings were recorded in Thorn Forest (n=75 4.41±2.27) followed by Dry Deciduous Forest (n=21 1.5±0.20), Moist Deciduous Forest (n=12 3±1.08) and Riparian Forest (n=12 2±0.82) and in STR showed that more sightings were recorded in Scrub and Thorn Forest (n=327; 8.38±1.26) followed by Scrub and Mixed Deciduous Forest (n=75; 5±1.79), Dry Mixed Deciduous Forest (n=16; 2.66±0.33), Deciduous Forest (n=11; 1.57±0.20) and Moist Deciduous Forest (n=7; 3.5±0.5).

The population status of White-rumped Vultures at 4 nesting colonies the Jagalikadavu nesting colony recorded a maximum number of individuals (68.79±3.19) as well as adults (47.95±2.71) and immatures (20.79±0.74) followed by Anaikatty Nesting Colony (47.88±1.64), Ebbanad (30.7±0.63) and Siriyur nesting colonies (3.12±0.58) (Table 8). Long-billed Vulture population was high in Nilgiri Eastern Slopes nesting colony with the maximum number of population (4.06±0.30) as well as adults (3.12±0.20) and immature (1.15±0.10) followed by Moyar valley roosting colony (1.93±0.19) and Ebbanad nesting colony (1.88±0.11) (Table 8).

A total of 38 nesting trees comprising 52 nests of White-rumped vulture was recorded in 4 nesting colonies in the study area. A number of nests (n=28), as well as nesting trees (n=21), were recorded in the Jagalikadavu nesting colony followed by Anaikatty nesting Colony (13 nests in 9 nesting trees), Ebbanad nesting colony (8 nests in 6 nesting trees) and Siriyur nesting Colony (3 nests in 2 nesting trees). There were only 2 tree species preferred by the White-rumped Vultures to construct their nests in all four nesting colonies altogether. Of which *Terminalia arjuna* (37 trees with 51 nests) was highly preferred tree species. One nest in one tree *Spondias mangifera* which recorded

The results of the nest position revealed that about 60% of the nests (n=31) were placed on the top (crown) of the nesting trees. On the other hand, 40% of the (n=21) nests were located at the limb of the nesting trees. Most of the nests were located towards the North East direction (n=21) followed by South West (n=14), South East (n=13) and North West (n=4)

Among the 52 nests, 40 nests were observed as active nests evidenced by frequent activities of a nesting pair. The Jagalikadavu nesting colony had recorded the maximum number of active nests (n=23) as well as abandoned nests (n=5) followed by Anaikatty nesting colony (9 active nests and 4 abandoned nests), Ebbanad nesting colony (6 active nests and 2 abandoned nests) and Siriyur nesting colony (2 active nests and 1 abandoned nest)The breeding success was calculated from a total number of fledglings divided by a total number of nests seen in incubation for each nesting colony. Overall 58% of breeding success was recorded in all four White-rumped Vulture nesting colonies altogether. Among the 4 nesting colonies, Siriyur nesting colony found 100% of breeding success, followed by Ebbanad nesting Colony (67%) and Jagalikadavu nesting Colony (61%). Least breeding success was observed in Anaikatty nesting colony (33%) 2 nesting colonies of Long-billed Vultures were recorded on rocky slopes in the study area. Totally 4 nests were recorded. 3 were active nests concluded by frequent activities of the nesting pairs. Nilgiri Eastern Slopes nesting colony recorded the maximum number of active nests (n=2) as well as an abandoned nest (n=1). The Ebbanad Valley has recorded just 1 active nest. 67% breeding success was recorded in two Long-billed Vulture nesting colonies altogether. Among the two nesting colonies, Nilgiri Eastern Slopes nesting colony observed 100% of breeding success

A total of 13 veterinary personnel were interviewed of which 9 Veterinary Assistants Surgeons (doctors) and 4 were Veterinary Assistants (quacks). All were aware of the ban on the use of Diclofenac in veterinary practice and its effects on vulture population as well. They were using Melaxicam as a painkiller for veterinary practice. It is interesting to note the Tamil Nadu Government provided meloxicam to Government Veterinary hospitals for livestock practices. The veterinary persons also opined that an average of 31 cases was attended by them per month of which most of the cases were attributed to sickness (n=20) and carnivore attacks (n=11). The drug store survey results revealed that a total of 10 Diclofenac composition painkillers were currently prescribed by the doctors. As per Government's Gazette Notification dated 17th July 2015 (attached) doctors can prescribe only 3 ml and 1 ml vials for human uses. It's interesting to note that 30 ml vials are still available in the drug stores. A total of 42 White-rumped Vultures died between 2013 and 2016. 34 individuals were adults and 8 were juveniles. Post-mortem could only be conducted on 8 individuals and the results revealed that

their tissues were contaminated by ***Organophosphorus and urea.*** The former is a poison used as an insecticide in agriculture practice. 1 vulture died while feeding when its neck got stuck between the vertebral bones of a domestic buffalo carcass. Skeletal and feather remains from 32 individuals was insufficient for mortem analysis (Table 21). 1 immature fell from its nest and was eaten by wild boars.

DISCUSSION

Among the vulture species, the decline of *Gyps* vulture population was alarming in the Indian subcontinent with high mortality rate and breeding failure (Prakash, 2001). It is likely to lead to their extinction if the problems are not urgently addressed (Birdlife international, 2001). Hence, this population study was taken up in the Tamil Nadu part of the Nilgiri Biosphere Reserve (NBR) in order to protect the country's southernmost viable wild population. This project focused on two critically threatened vulture species namely, White-rumped (*G. benghalensis*) and Long-billed Vulture (*G. indicus*) to determine population status, nesting ecology, threats from Diclofenac and other NSAIDs, etc. This study recorded totally 7 nesting colonies: 4 colonies of White-rumped Vultures and the remaining 3 of Long-billed Vultures. We found the White-rumped Vulture nesting colonies located at an average distance of 2 kms from human habitation while it was 2.28 kms in the case of Long-billed Vulture. Previous literature were also supported that the location of breeding Colonies near to human habitation in Nepal and Gujarat (Baral *et al.*, 2005; Baral and Gautam, 2007; Dave, 2011; Harris, 2013). The distribution of vultures in the study area showed remarkable variation according to vegetation and habitat types with most sightings and nesting colonies in Thorn Forest areas mainly because of its open vegetation structure. Thus vegetation structure played a vital role on the vulture's ability to find out animal carcasses with their acute eyesight. Brown (1985) established two hypotheses concerning vegetation structure and carcass finding by vulture species in South-West Africa, Namibia. In his first hypothesis, he had quoted that the increased vegetation density caused by bush encroachment decreases the likelihood of vultures locating a carcass, as they rely almost entirely on eyesight when foraging. In the second hypothesis, vultures, which are heavy birds adapted for soaring and unsuited for flapping flight in confined spaces, will not land at carcasses they have located if they do not have sufficient space in which to take off again. This hypothesis was supported by Schultz (2007), who showed that Cape Vultures (*Gyps coprotheres*) in the Waterberg region of Namibia were unable to locate carcasses when the vegetation density was greater than 2,600 trees per ha. Land-use patterns influence raptor diversity and density (Herremans & Herremans-Tonnoeyr 2000).

Although this project focused on White-rumped Vulture and Long-billed Vulture, information on Red-headed vultures (*Sarcogyps calvus)* was also collected. We recorded a total of 60, 40 and 14 individuals of Red-headed Vultures in NNFD, STR, and MTR respectively. Earlier literature revealed that Red-headed vultures are fresh carcass feeders in nature and will track the predator's presence for their food (Naoroji, 2006; Chhangani, 2007). This is substantiated by the evidence of 6 Red-headed Vultures recorded in 8 incidences where the movement of tigers was high in our study areas (Ramakrishanan *et al.*, 2012; Samson *et al.*, 2016b). This study observed a fluctuation in White-rumped Vulture numbers ranging between 33 and 82 in Jagalikadavu, 1 and 16 in Siriyur and 29 and 54 in Anaikatty and 29 and 34 at Ebbanad nesting colonies. A similar trend was also noticed for Long-billed Vulture population 1 and 3 in Ebbanad, 1 and 3 in Moyar Falls, and 2 and 6 in NES range during our field work from June 2015 to May 2016. In the month of June, the vulture populations were less in the nesting colonies and gradually increased and reached its maximum numbers at the end of the breeding season in May. A similar pattern was also noted by Baral *et al.* (2005) for White-rumped Vulture population in Nepal and in Rajasthan by Chhangani and Mohnot (2004). During non-breeding seasons the adults flew far away from the nesting colonies in search of food, and sometimes away for as much as 2 days to acquire food. With food availability close to their nests it enabled them to spend longer time in parental care and feeding their young in the breeding season. Therefore, maximum number of vultures was seen in and around nesting colonies mainly during breeding months. This study observed breeding season was from September to May and non-breeding season from June to August in NBR. In all 4 nesting colonies, the White-rumped Vulture preferred to construct their nests on *Terminalia arjuna* trees. This could be due to tree height and basal girth, which kept away people and other wild animals, especially elephants (Road, 2010). The *Terminalia arjuna* is the only tallest tree species seen abundantly along the riparian forests of Southern India. We observed that the White-rumped Vultures usually preferred the same tree for nesting and roosting in the study area. Our observation is also in accordance with Baral *et al.*, (2005), as single tree preference (Kapok tree) by White-rumped Vultures in Nepal. The total white-rumped vulture population at four nesting colonies altogether ranging between 92-186 individuals in 52 constructed nests and 23 occupied nests with 58% breeding success. The previous studies in Rampur Valley showed that there were 72–102 individuals of White-rumped Vultures in six nesting colonies during their breeding season, with 50% breeding success at 70 occupied nests (Baral *et al.*, 2005). In Pakistan, a total of 2281 occupied nests were recorded between 2000 and 2004 and the nest success was observed in 1231 nests with the breeding success of 51% (Gilbert *et al.* 2006). In Africa, it was estimated that 48% of breeding success in White-backed vultures (*Gyps africanus*) (Martinez *et al.*, 1997). Among earlier studies in Asia as well as Africa this study has recorded highest percentage of breeding success despite the various disturbances cited in the preceding section makes for a strong argument of the viability of this wild population. In this study we also observed a total of 56% (n=29) of nest abandoned White-rumped Vulture species during the breeding season from October to December 2015. Newton (1979 & 2002) stated that certain pairs may occupy a territory for only a few days or a few weeks, or may even build a nest, but the process stops here. Not all raptor pairs occupying nesting territories lay eggs every year. A major factor influencing egg laying is food supply and in poor food years, territorial pairs in

some populations fail to lay eggs. On the other hand, nest abundance was seen due to mortality of chicks and nesting pair (Baral *et al.* 2005) and anthropological threats in the nesting areas would also cause the nest abundance criteria (Moran Lopez *et al.* 2006). We observed troops of Hanuman langur (*Presbytis johinii*) and Bonnet macaque (*Macaca radiate*) near nesting trees and this may cause disturbance to a breeding population of white-rumped vulture in nesting colonies. Their play antics of jumping and shaking the branches of nesting trees could make the nesting adults to abandon their nest (n=14). The literature review supported that the langurs were causing a disturbance in the nesting of vultures in Nepal (Subadi 2007), and also in Africa monkeys and baboons have been reported to interfere in the normal breeding of African vultures (Mundy *et al.* 1992; Emmett 2003; Roche 2000 & 2006). This study found that most of the livestock holders were illiterate and depended on livestock as their major livelihood. Awareness about the Diclofenac and its effects on vulture populations was very poor. On the other hand knowledge on vulture's importance and their role in the ecosystem was well known by the livestock holders. The livestock holders opined that the vulture population is declining in their area. Generally, the livestock holders treat their injured livestock by traditional methods and sometimes they bring veterinary doctors or quacks only for extreme cases. The questionnaire survey from the veterinary doctors revealed that they use Melaxicum as a painkiller (a safe drug for vultures). It was gleaned from the vulture mortality records also. So far none of the vulture deaths were scientifically or clinically proved to be caused by Diclofenac, and instead attributed to poisoning of the carcass (Laboratory Report is enclosed as Annexure-I). Hence this study strongly suggests that education is needed for the livestock holders to change their attitude towards retaliatory killing.

A similar effort has to be made to the forest department also in order to ensure adequate and quick payment of compensation/exgratia to the livestock holders to stop the further poisoning of the carcass, which is considered as a severe threat to this vulture population rather than Diclofenac. Davidar (2002) reported that the retaliatory killing activity of livestock holders was the reason for declining of Tiger and vultures in the Sigur Plateau followed by Ramakrishnan *et al* (2010) stated that the Diclofenac is not a culprit for declining vulture population in this region as the vultures feeding on wild carcasses (including tiger killed livestock) as their major diet. Arumugam & Arivazhagan has recorded dead Hyena (1) and White-rumped vultures (1) and Jungle Crow (1) in Mudumalai Wildlife Sanctuary (MTR interpretation center). Three Wild dogs deaths due to ***Organophosphorus and Urea*** also had been recorded in Mudumalai Tiger Reserve (Vijayaragavan Pers. Comm.). The reason for this issue is mainly because of increasing tiger population in a contiguous stretch of Tiger Reserves on both ends of the Sigur Plateau. As of now even though negative effects of Diclofenac was not recorded scientifically in this vulture population, multiple awareness programmes are needed for the proper disposal of contaminated carcasses and Diclofenac use in veterinary practice. Green *et al* (2004) stated that based on demographic modeling, it has been found that less than 1% of lethal level of Diclofenac can cause a rapid population decline to vulture. Therefore, educating livestock holders, farmers and veterinary personnel may help to secure healthy food for vultures.This presence of Organo-Phosphorus and Urea of White-rumped vultures envisages that long-term monitoring is needed by establishing a laboratory for the analysis of various poisonous chemicals as well as NSAIDSs (Diclofenac) from the tissues of dead vultures. The toxicology analysis by Oaks *et al.*, (2004) on many dead vulture tissues in Pakistan found the presence of Organochlorides, Organophosphate, Carbamates and heavy metals.

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STATUS OF VULTURES IN BANDIPUR TIGER RESERVE

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ABSTRACT

Gyps vulture populations are declining rapidly due to the non-steroidal anti-inflammatory drug (NSAID) diclofenac across the Indian subcontinent. Secured breeding areas for vultures in the present context are Wildlife sanctuaries, National parks, Tiger and Elephant (Elephas maximus)reserves with statutory binding and rigorous protection under the wildlife act of 1972. Looking into the broader spectrum of protection, conservation and efficacies of species survival declared protected areas in India act as the only hope for the endangered species of vultures. The decline of vulture population was quite sudden, 97 per cent of vultures have disappeared from India's skies in the past 15 years. Hence the fly ways and flight records of vultures are also outside the protected areas it appears keeping vigil of breeding, foraging and feeding areas within the protected areas that gives protection of its survival. We regularly surveyed for vultures using **AREA SEARCH METHOD** from 2003 to 2016. We looked into earlier data of our bird surveys conducted in 2002-2003. Where 17 sites were surveyed for one year in four phases in BNP and at 12 sites *Gyps* vulture species were recorded. On wards a continuous area search on regular interval, to record vulture sightings and its breeding sites in BNP was done, this report is a compilation of all the sightings including breeding sites. In 2003 around 125 birds *INCERT pub 2005* were counted, in 2007 only7 birds, in 2008(*2) 60 birds, in 2010*(pub KFD report*²)* around 479 birds were recorded. In 2013 a total of 311 birds were reported *"Ecological study in Bandipur Tiger Reserve" pub report ksfmbc-jica project.* During 2012, 169 birds and 2016, 251 birds were counted.

Byladakuppe in Moliyur range of BTR had a breeding cliff that was disturbed because of a road and fire watch tower built by the forest department. Before 1996 breeding record was mentioned by forest department staff and by my personal observation during "*Status study of Indian Black woodpecker in Western Ghats 1996*¹*. Rampura bordering waynaad wildlife sanctuary had 3 breeding trees and Banoor had 2 breeding trees that are still habited by vultures

Kabini River and Nugu River back waters where Elephant *(Elephas maximus)* congregation generally happens during peak summer makes a good feeding site at Kabini River and Nugu River back waters and Elephant (Elephas maximus) deaths occurs due to natural reasons, live stock death also occurs along border villages make another good feeding sites. Compilation of data from 2003 to 2016 will encourage management strategies in the conservation of vultures and to monitor their habitat in the park, and also for future evaluation on conservation of avi-fauna in Bandipur Tiger Reserve (BTR). We looked into the availability of Diclofinac in Gundlupet town, Chamarajanagar district, H.D.Kote and also with veterinary attendees in villages surrounding Bandipur Tiger Reserve and found it was very easily available. Save vulture pamphlets in local language were given in schools and colleges in the surrounding villages of BTR. A bike rally was conducted with the help of Arulagam in Gundlupet that was supported by Karnataka Forest Department BTR.

Key Words: Vulture, Bandipur Tiger Reserve, Karnataka

Preface

Birds as Bio indicators and vultures as the primary indices were the theme in this study. During the bird survey conducted in BNP in 2002-2003. Totally 17 sites were surveyed in BNP and at 12 sites gyps vulture species were recorded. This report is a compilation of all the sightings. The future work on birds will orient vulture species diverse adaption in BTR (BNP). The authenticated data on birds compiled during 2003 by the ornithologists and amateurs puts a clear picture of bird research is the last in line of inquire to understand the correlation of avifauna in our protected areas. But this compilation of random data from 2007-2016will encourage management strategies in the conservation of bird life and to monitor their habitat in the park, and also for future evaluation on conservation of avi-fauna in Bandipur Tiger Reserve.

Introduction

Looking at the broader spectrum of conservation and management of National parks, wildlife sanctuaries and Indian wildlife in general, birds are among the least considered. Today 13% of world birds have been recorded in India including 141 endemic to the country, the richness in species contributed by varied climate, geographical position coupled with rich vegetation and the overlap of three bio-geographical areas, Viz. Palaearctic, Indo-malayan and Afro-tropical. Identifying, cataloguing and compiling of bird data is in practice since the British days, which has helped in prompt management of sites required for wildlife and natural history. Birds as bio-indicators subsequently have proven in identifying the rich bio-diversity of particular site, as primary indicators, they have even proved the degradation by their disappearance. Bandipur Tiger Reserve being situated en-route to Mysore-Ooty Road was declared a National Park and brought under Project Tiger in 1973. The park is one of the richest wildlife areas in India, and lies on the northern most part of the Nilgiri biosphere reserve which is considered a major hotspot in the Western Ghats and Western Ghats is one of the 25 bio hotspots of the world. Bandipur Tiger Reserve is flanked by Rajeev Gandhi National Park (Nagarahole Tiger Reserve) to Northwest, Mudumalai Tiger reserve and National park to the South and Waynad Wildlife Sanctuary to Southwest and is quite famous for its big Mammal's assemblage and unique diversity.

Location of Bandipur Tiger Reserve

11° 35° 34° N, 76° 12° 17° E, 11° 57° 02° N, 76° 51° 32° E. **Total Area**: 1020 Sq. Kms National Park, 882 Sq Kms Tiger Reserve. **Total Ranges**: 13.

Vegetation

Five different vegetation types which are primarily found in Bandipur Tiger Reserve (BNP), looking into the importance of vulture sightings and breeding locations this report was generated.

The southern tropical moist deciduous type

The west parts of Begur, Ainur marigudi and Beerambadi constitute the typical moist deciduous type covering Bambusa arundinacea and species of top canopy are Tectona grandis, *Lagerstroemia lanceolata, Terminalia tomentosa, Terminalia balerica, Dalbergia latifolia, Angiesus latifolia, Stereospermum xylocarpum, Ficus infectoria and ficus sps.*The lower canopy consists of *Emblica officianalis, Mallotus philippinensis, Zyzyphus xylocarpus, vagueria spinosa, Grewia tiliaefolia, Gmelina arborea, Bridelia fetusa, Bauhinia racemosa, cassia fistula,.etc.* The under growth consists mainly of *Kydia calycina ,Solanum ferox and Solanum indicum,Helicteris isora, Hemidesmus indicus, Holarhena antidysenterica, Lantanacamara,Eupatorium,* etc.

Diverse habitat spread over 3 south Indian states and Nilgiri Biosphere Reserve. Congregation of elephants in Kabini and Nugu river backwaters. Tiger, leopard and other carnivore and relative Herbivore population is an excellent assemblage for Gyps vultures' survival in Bandipur.

The Southern tropical dry deciduous type:

The central area covers the above type with poor growth of vegetation and open canopy predominantly *Anogeissus latifolia, Tectona grandis, Terminalia tomentosa,T Belerica, T Chebula T paniculata, Pterocarpus marsupium,Dalbergia latifolia, Santalum album,Kydia calycina, Bridelia fetusa, Shorea talura, Cassia fistula.*

The under growth covered mostly with grasses and Lantana bushes breaking with eupatorium, Phoenix humilis has come up in-between this.

1.Scrub Jungle : Mainly confined to eastern most part of Moyar with poor rainfall, stunted tree growth, rising on shallow hard soil with almost no humus and open canopy, usually the vegetation comprises of *Terminala chebula, Shoria talura, Santalum album, Anogeissus latifolia, Azadirachta Indica, Acacia leucophloea, Acacea catechu, Zizyphus sps*, Desmodium which usually form the undergrowth. *Acacia intsia* is the common climber, grass is generally abundant.

2. Riverine: Nuguriver or Moolehole as it is called when running inside the park area and Kabini river back waters are the two major Riverine area considered for the bird survey.

3. Grassy hills: Gopalaswamy hills were selected for the survey as one of the important grass hills present covering Shola type of forest within the hill range.

Climate

November to mid February the cold season vale the forest and trees look leafless, the hot season continues from mid February to mid June. Wet season starts with monsoon showers from June to September. The hottest days experienced during March and April, and the coldest being February.

Temperature:

A moderate mean annual temperature of the park being 24$_{o}$C with maximum 30°C andMinimum of 18$_{o}$C. Fog usually during winter and rainy season experienced at Gopalswamy hills, Bandipur and Moolehole areas.

Rain fall:

The southwest mansoon effects from mid June upto September with an average rainfall of 1270mm – Kalkere, Ainoormarigudi and Bandipur sharing evenly. The western parts bordering Kerala receive the highest rainfall and the lowest being Moyar.

Altitude:

The highest peak in Bandipur range being Gopalswamy hills ranging 1454 Mtrs. The lowest altitude is along Varanchi stream, and Bandipur stands at 995.8 mtrs.

Water sources:

Numerous artificial ponds pocket the Tiger Reserve (BNP) with perennial rivers like Nugu River (Moolehole) and its tributaries Hebballa, Varanchi and Chippanahalla flowing northwards join hands. The Kabini river backwaters and its tributaries like Kannegala hole And Paladakadu in the Northwest part of the park constitute major water bodies.

Previous studies on Avifauna:

- The rich bird life of Bandipur Tiger Reserve had attracted Dr.Salim Ali during 1939, around 134 species was recorded from 15$_{th}$ to 26$_{th}$ November 1939.
- In the Management plan prepared by the Karnataka Forest Department recorded 179 bird species in Bandipur Tiger Reserve during 1974.
- The Wildlife department Kabini river lodge- Karapur, Mysore Dist. has recorded 274 species.
- Krupakar & Senani recorded 225 species during 1977.
- Dr.Ameen Ahmed and K.Yekantappa,IFS. Recorded 104 species as part of their survey on birds in Bandipur Tiger Reserve during 1998 and compiled list of all these was prepared.

Bird survey 2002 – 2003 Pre-monsoon or 1st phase of the Bird survey was conducted during 18th April to 21st, 4 bird surveys were conducted during a period of 1 year to consolidate data for analysis and comparison.

Methodology

- **Area search method** was used during all the vulture surveys in Bandipur Tiger Reserve.
- 2 times in a year a random survey was conducted to find gyps vulture status in Bandipur Tiger Reserve.

- Total number of birds, place and species were noted on a standard data sheet
- Field notes were made about activities like feeding, roosting, courtship, territorial display and breeding etc
- Sites were covered by walking in a slow pace. Vehicle was used on road, Boat was used to cover Riverine site.

Current knowledge

- The current knowledge of birds available on Bandipur Tiger Reserve and on vultures was more of a checklist, which was taken as the base for this survey.
- Egyptian vulture (*Neophron percnopterus*) 2 birds were recorded in BNP tourism area, 1 bird in 2003 near Chigare kadu Anti poaching camp in Moyar. 1 bird in Mangala village in 2008, 2 birds from Mangala village in 2010 and 2 birds near Melukamanahalli in 2011,
- Bird survey conducted in BNP during 2002-03 for 4 different seasons
- Compilation of personal observations and earlier records
- Status survey of distribution of Indian white bellied wood pecker (*Driocopus javenses*) in 1996-98. Records of vulture sightings and breeding sites are included.

Gyps vulture sightings recorded in BNP.

Years	RHV	LBV	WRV	EV	Total
2003	2	2	120	1	125
2007			7		7
2008	2	12	45	1	60
2009	4	15	135	2	156
2010	4	125	350		479
2011	1	6	122	2	131
2012	40	52	76	1	169
2013	50	44	215	2	311
2014	65	112	120	1	298
2015	15	58	7	2	82
2016	102	12	135	2	251

- Red headed vulture (*Sarcogyps calvus*) is a resident bird of BNP, with protection status from wildlife act of 1972 it is declared a Schedule I bird
- During 1996 this data is derived from the survey we did while working on Status survey of White bellied wood pecker (*Driocopus javensis*) no breeding record
- 2002-2003 bird survey recorded - 2 birds, 2008 – 2 birds, 2009 - 4 birds and 4and 1 in 2010 and 2011 respectively
- Long billed vulture (Gyps indicus) 1996 - 25 birds recorded from different areas during our survey on White bellied wood pecker (*Dricopus javensis*). 2 nos in 2003, during bird survey of Bandipur. 2008 – 2 birds, 2009 15 birds in Rampura area, 2010 again in Rampura, in 2011 – 6 birds from BNP tourism area
- Indian white backed vulture (*Gyps bengalensis*) being a resident and breeding bird of BNP, 132 birds were area, 2007 – 7 birds, 2009 - 350 birds, from Gundre - Banur area feeding on young Elephant (*Elephas maximus*) calf, 122 birds again from Kabini river back waters
- Birds of Bandipur 2008-09. “Estimation of population density of birds using food guilds” records of gyps vulture sightings and breeding sites which is the entrance gate to BTR (BNP). Several other records from outside the park boundary were noted but not included in this. Long billed vulture (Gyps indicus) is a resident bird in BNP and breeding records are quite rare, except for a few places from BNP. In 1996 found breeding in Rampura near Moolehole. Sharing trees with white backed vulture. 2002 and 03 bird survey conducted in BNP revealed breeding records from Rampura in Molehole range and Banur from Gundre range in BNP. 2008, 2009 2010 and 2011 breeding records from Rampura and Banur. This states that byladakuppe breeding site has been abandoned, but a long gap from 1996, 2003, it seems work was supposed to be done in this area for clear findings.
- Indian white backed vulture (*Gyps bengalensis*) is aresident and breeding in BNP. During 1996 breeding recorded in Byladakuppe* cliffs in Hediyala rangein BNP. Group of 40 birds were sighted. 2002-03bird survey in BNP revealed breeding groups from Rampura Moolehole range, Banur in Gundre range. 2008,2009,2010,2011 breeding records from Rampura and Banur in Gundre range in BNP. Regularly sighted by amateurs and once near BNP reception devouring Bonnet macaque (*Macaca radiata*) infant which had died. The bird was found pulling the dead animal towards lantana bush away from disturbance

Selecting isolated group of trees with high canopy provides security and also a vantage for look out. It also evades competition from other birds of prey.

Nesting birds are very silent and adults fly away when approached, perched nearby they keep vigil of the nest from faraway tree. Both *Gyps bengalensis* and *indicus* nest together in a single tree with different nests keeping social distance.

Elephant *(Elephas maximus)* deaths due to electrocution:

Elephant (Elephas maximus) deaths due to electrocution happens close to the forest, instead of burning the carcass the same can be lifted using cranes to shift it inside the forest after post-mortem. Natural deaths of calf or even adult should be left alone for scavengers like vultures and other mammals.

Appendices:

6. List of Globally Threatened Birds:

Birds under this category are those included in Threatened Birds of India – B N H S, Envis. IUCN threatened taxa.

Major threats:

- People in India traditionally have been conserving Birds and Wildlife with religious thinking that forbid them from killing animals, birds and destroying forest, which had socio-religious values.
- The development activities curbing the near need for modernity, over population, conversion of forested land to arable land and commendable change in the rural and urban life style are a few threat to bird life in India
- Fuel wood, collection of timber, cattle grazing at the fringes of the national park is a few serious threats to birdlife.
- Pesticides, detergent input, over fishing, and vanishing wetlands, are some threats to resident and migratory water birds.

Threats to gyps vulture species:

- Forest fire during dry season.
- Diclofinac is still available easily in Gundlupet, Sargur, Hediyala, Chamarajanagar district that are 20 kilometres in radius from Bandipur.
- Cattle population has increased predominantly surrounding Bandipur, hence demand for natural manure from neighbouring coffee and tea gardens has increased Cattle grazing inside forest.
- Livestock distribution to villages near nest sites from government agencies is adding threat.
- Cattle infestation near nesting trees is observed.
- Disturbance from people inside BNP for illegal NTFP collection and fire wood.
- Disturbance at nest sites from people, who visit the temple, water source nearby.
- Competition from relative birds of prey near nest sites.
- Burning of Elephant (*Elephas maximus*) carcass inside BNP by forest department has deprived vulture source of primary food. The energy transfer level as animal protein from Elephant (Elephas maximus) meat to vultures is at stake.

Recommendations:

- An annual vulture watch has to be organized by preparing a team of forest watchers, ornithologists and amateurs to help record vultures regularly in Bandipur.
- Neighbouring Moyar in Tamilnadu state and Waynaad in Kerala state borders ignored for conservation helps strategize Nilgiri biosphere reserve as one platform for conservation.
- Diclofinac should be banned from nearby areas.
- Disturbance from humans, temple tourism near breeding sites should be stopped.
- Elephant (Elephas maximus) deaths inside protected area should be left as it is after post-mortem, instead of burning or burying it.
- Elephant (Elephas maximus)deaths due to electrocution outside the protected areas should be lifted into protected area and left away for scavengers. Energy source from Elephant (Elephas maximus) to scavengers will be met.

Vulture conservation plan – WCF

- Total ban on availability of diclofinac in nearby towns and cities.
- Current status of gyps' vulture species in BNP to be done regularly.
- Stop all cattle grazing inside National Park.
- Keep distance from vulture breeding sites, and trees to be avoided even by beat guards.
- Keep constant vigils on gyps' vulture breeding trees?
- Avoid temple tourism near vulture breeding sites, even old and abandoned ones. Hence vultures re-visit nesting sites and re-build it.
- Propaganda of vulture conservation plan to stake holding villagers surrounding BNP.
- Keep record of vulture sightings by vulture watchers from the forest department.
- Protection of National parks as the last lung space for the in-numerable life forms.
- Use of alternative energy source, indirectly release pressure on forest.
- These are some of the acute elements, which is much talked than done, a local community headed conservation strategy should be planned to save the vultures.

Conclusion:

Each of the field study conducted to identify Gyps vultures was part of our study on "Birds of Bandipur" bird watchers from southern India participated in this exercise and findings has carved a new paradigm in correlating bird diversity in protected areas as bio indicators. Link tiger population to healthy vulture population is executed through these studies. Tiger as an umbrella species transfers energy

food source to other relative scavenging mammal species through its kill dispersal, helping scavengers like vultures through its kill as a major account. Tiger execute correlation with vulture population in particular biome.

The numbers of sightings, group and species status were recorded by bird watchers, apart from my own personal observations.

During 1996, while conducting field surveys in Byladauppe*, in Hediyala range in Bandipur, the adjacent cliff facing the Mahadeshwara temple, breeding records of White backed vulture was observed.

Today human population and temple tourism has disturbed the breeding vulture group, above all the hill top watch tower constructed by forest department hinder in condensing the breeding population and to abandon the cliff.

Rampura near Moolehole bisects Karnataka with Kerala state by Rampura river (Moolehole) which is close to waynaad wildlife sanctuary recorded 3 major trees full of gyps vultures White backed and long billed. The breeding vultures have shifted from Rampura to Waynad- 2002-03.

The above exercise is just an open expression of collective information but in no way a claim to conduit legitimate information totaling vulture population in Bandipur Tiger Reserve, instead evenly formatted information which can be evaluated for future.

We wish future Birders, Naturalists, Scientists, Wildlife managers or common man who is interested in bird life will agree to upgrade the information available in this paper, and commit to conserve nature and its resources.

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*2: Report on “*Density of birds using food guilds in BTR”* by *Rajkumar.D 2008*

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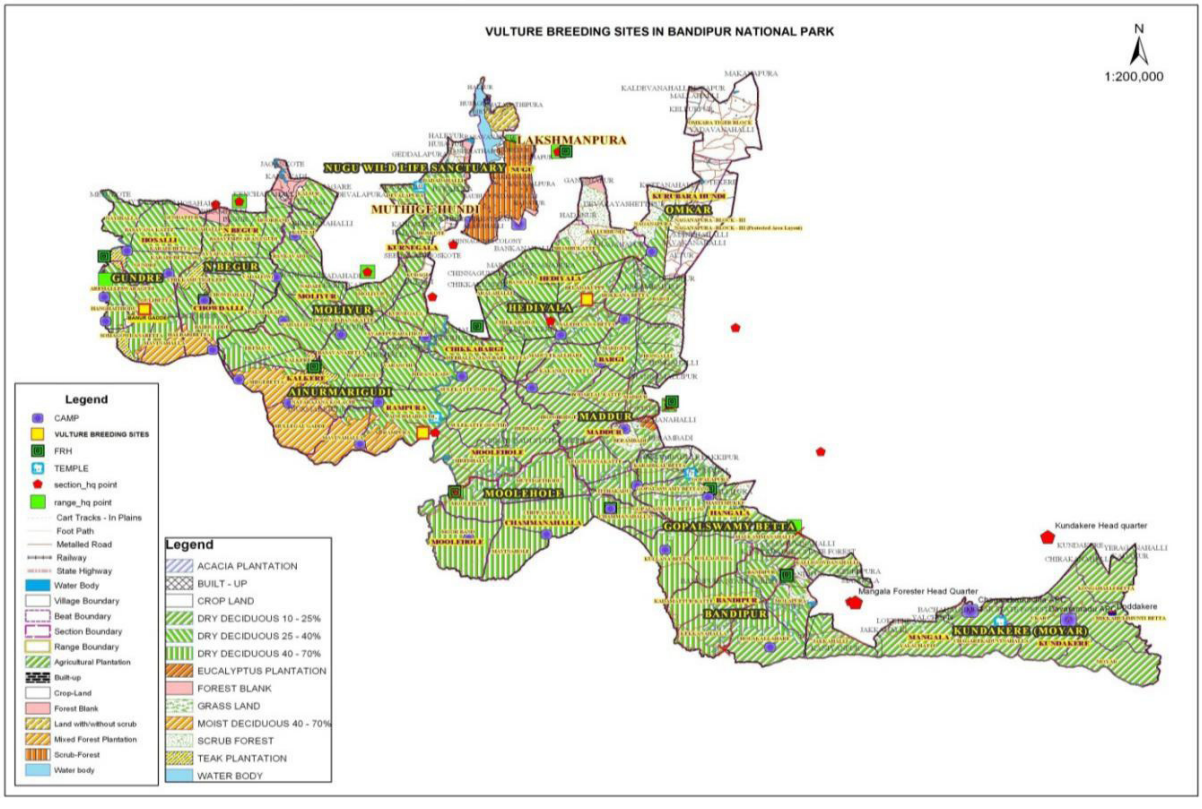
Breeding sites in BNP:

Banur, Rampura and Byladakuppe* are the Vulture breeding sites recorded in BNP.



7. Map of Bandipur Tiger Reserve where Gyps vultures breeding sites recorded.

POPULATION, BREEDING ECOLOGY AND CONSERVATION THREATS OF LONG-BILLED VULTURES (GYPS INDICUS) IN THE RAMADEVARABETTA VULTURE SANCTUARY (RVS) IN RAMANAGARA HILLS, KARNATAKA.

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ABSTRACT

Ramanagara is famous for some of the world's oldest granite outcrops and is also known as South India's earliest rock climbing hub. It is located about 50 kilometers southwest of Bangalore, on the busy Bangalore-Mysore highway. The region is covered in scrub forest and the hills are home to threatened bird species such as the Long-billed Vultures (LBV). Apart from its geological importance, Ramanagara is the home for the country's first vulture sanctuary called the *Ramadevarabetta Vulture Sanctuary (RVS)*. The hills at Ramanagara are one of the few locations in the inland South India where Long-billed Vultures nest in the present day. However, as per reports, Long-billed Vultures have suffered a steep and sudden decline of 97% since mid-1990s, as the vulture species faced serious threats, either by way of habitat destruction or, diclofenac - a widely used non steroidal anti-inflammatory (NSAID) drug in veterinary. With an effort to conserve the tiny population in the Ramanagara, a study was conducted in 2005 by a team of bird watchers lead by Dr. S. Subramanya, Ornithologist, towards the conservation of this threatened vulture specie. Through the process of declaration of Ramanagara as an important breeding habitat for the Long-billed Vultures, all stakeholders such as the Karnataka Forest Department, Department of Ecology-Government of Karnataka, research students, conservationists and filmmakers came together for the cause. This study lead to the declaration of 346.14 hectares of Ramanagara as Ramadevarabetta Vulture Sanctuary on 31st January 2012 by Government of Karnataka. As a recent update on numbers in 2010-11, there are about 15-20 Long-billed Vultures observed by the local people of Ramanagara, however, not documented through a study. As per the International Union for Conservation of Nature and Natural Resources' (IUCN) Red List of Threatened Species published in 2015, the Long-billed Vulture (Gyps indicus) is Critically Endangered (CR). Thus, one cannot remain complacent that a small population of Long-billed Vultures have found a safe home at Ramanagara, and a long-term observation based study needs to be started at the earliest. In the above context, the study initiated by Save Tiger First and commissioned by Karnataka Forest Department was in continuation to the study conducted in 2005. The aim was to study the habits and habitat of Ramanagara to estimate the present population of Long-billed Vulture (Gyps indicus), and monitor them. As part of the study the presence and absence of the Long-billed Vultures revealed that there are 4-5 LBVs currently that roost on the cliffs of Ramadevarabetta hill. Occasionally there are 7 LBVs seen. The study could only throw light on the disappearance of LBVs from other bettas and recorded human disturbance and natural predatory conflicts.

Key Words: Long-Billed Vultures, Ramanagara Vulture Sanctuary, Karnataka

Introduction

Vultures perform a vital role in nature's sanitation process by eating meat from carcasses (Houston 1974). While feeding, vultures reduce the potential spread of diseases that could affect other animals and humans (Ogada *et al.* 2012). The Long-billed Vulture also known as Indian vulture (Gyps indicus) is one of the three native, resident Gyps species in India and are part of a non- migratory scavenging raptor complex that was once widely distributed across most of northern India and Pakistan (Houston, 1985; Prakash, 1999; Gilbert *et al.*, 2002). Long-billed vultures nest almost exclusively in colonies on cliffs and ruins, although in areas, where cliffs are absent, they have been recorded nesting in trees (Rasmussen & Anderton 2005). The species is classified as Critically Endangered (IUCN Red List) because of a catastrophic decline of 90–98 % in the population of Gyps species (Prakash *et al.* 2007) due to diclofenac poisoning (Gilbert *et al.* 2004; Green *et al.* 2004). Other reasons that could have contributed in a minor way to the decline include changes in human meat consumption (BirdLife International 2013), carcass disposal practices (Chaudhry *et al.* 2012), and disease. The aim of the present study was to examine the population status and breeding ecology and conservation threats of Long-billed vultures in the Ramadevarabetta Vulture sanctuary in Ramanagara Hills, Karnataka.

Study Area

Ramadevarabetta Vulture Sanctuary (RVS) is situated in Ramanagara Taluk of Ramanagara District in the State of Karnataka and lies between the North Latitudes 12º 45' 963" to 12º 45' 115" N and between the East Longitudes 77º 18' 291" and 77º 17' 466" and is spread over an area of 346.42 hectares. It forms an important part of the drier forests in the state of Karnataka and River Arkavathy which is an important tributary of Cauvery River flows through the Sanctuary the sanctuary is part of the Mysore Elephant Reserve and supports highly endangered and endemic Vulture (Gyps benghalensis) and Long-billed Vulture (Gyps indicus). The sanctuary harbours leopard, wild dog, striped hyena, sloth bear, jackal, chital and the sanctuary has good population of sloth bear Sree Ramadevara Temple is present inside the Sanctuary as an enclosure.

Methodology

The population estimation of Long billed vulture in RVS was done by nest site count method. A total of four visit per month (Seven days interval) was done to estimate the

population size of the Long-billed vulture in the roosting and nesting colonies in the morning (0630 to 0930 hrs.) and in the evening (1530 to 1830 hrs.) (Baral, 2005). To study the nesting and breeding ecology of Long-billed Vulture, a total of six visits (Five days interval) in a month during breeding season (September to May) to check the status and number of vultures present in the nesting colony. All observations were with binoculars (Nikon 52×10) from an appropriate distance (100-300m) in nesting colonies. All observations were made in the morning from 0630 to 0930 hrs and and in the evening from 1530 to 1830 hrs. Nests were identified by the presence of the fresh nesting material and whitewash (excreta) below the nest or by the presence of the incubating vulture in the nest. Confirmation of active (occupied) and abandoned (unoccupied) nests were based on the criteria laid down by Postupalsky (1974). Breeding success was calculated based on the number of fledglings divided by the number of breeding pairs. Information on mortality, especially of adult mortality was recorded at nesting colonies (Baral *et al.,* 2005; Steenhof & Newton, 2007).

Results

A total of 253 sightings of Long-billed vultures were recorded in 76 visits with an average of 3.30 vultures per visit in Ramadevarabetta Vulture Sanctuary between September 2015 and March 2017 (19 months). Maximum seven and minimum one individuals at a time, were observed in this sanctuary. The highest number of Long-billed vulture sightings were observed in the month of October 2015 - a total of 27 sightings were observed in four visits in that month with an average of 6.25 individuals per visit. The lowest number of sightings was observed in the months of May, June and August 2015 - a total of 7 sightings were observed in four visits in each of these months with an average of 1.75 individuals per visit. A total of 2 nests were observed from 2015 to 2016 breeding season and one nest was recorded in 2016 to 2017 breeding season so far. Successful mating of the pairs, as well as incubation was observed in both the breeding seasons, however no chick appearance was recorded in both the breeding seasons. Therefore, considering this, both the breeding seasons were a failure for Long-billed Vultures in Ramadevarabetta Vulture Sanctuary.

Discussion

The Ramanagara hills are home to a wide variety of flora and fauna and the forest-covered slopes are of significant ornithological importance, supporting over 150 species of birds including the endemic Yellow-throated Bulbul *Pycnonotus xantholaemus.* Although the Hills of Ramanagara form part of the Important Bird Area (IBA) network in India (Islam & Rahmani 2004), they are threatened by quarrying and also plans of statues carving into the hills. Subramanya (2004) reported that Ramanagara hills have been a home to critically and globally endangered vulture species for a long time. Subramanya & Naveein (2005) observed that a total of eight Long-billed Vultures were on the ledges of the steep and high rocky cliffs in Ramadevarabetta State Forest, Ramanagara, Karnataka. These Long-billed vultures, according to the Bombay Natural History Society, appear to be the only known and last surviving population of the species in inland southern India (Vibhu Prakash verbally, June 2005). The first official record for Long-billed vulture breeding was registered in Ramadevarabetta hills in Ramanagara, Karnataka was in the year of 2006 a total of three nests with two chicks were observed with 9 to 10 individuals of Long-billed vultures (Subramanya & Naveein, 2006). In the year of 2012 January 31 extent of 346.14 hectares to declare as “Ramadevarabetta Vulture Sanctuary” to protect the Long-billed vultures in this landscape.

After 2006, this is the first work to monitor the Long-billed Vulture population and breeding in Ramadevarabetta Vulture Sanctuary. As part of the study, the presence and absence of the Long-billed Vultures revealed that there are 4-5 LBVs currently that roost on the cliffs of Ramadevarabetta hill. Occasionally, there are 7 LBVs seen. In present scenario, breeding sites of Ramadevarabetta Vulture Sanctuary facing the problems of habitat loss, anthropogenic activities such as festivals, movies shooting in historical monuments and uncontrolled tourism leads to the disturbance in the food chain. The study could only throw light on the disappearance of LBVs from other bettas and recorded human disturbance and natural predatory conflicts.

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STATUS OF VULTURES IN TELANGANA AND ANDHRA PRADESH

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ABSTRACT

The total nine variety of vulture species present in India, among these three vulture species found in Telangana and Andhra Pradesh i.e. Oriental white-rumped Vulture (*Gyps indicus*), Indian long-billed Vulture (*Gyps indicus*) and Egyptian Vulture (*Neophron percnopterus*). The *Gyps* vultures' population declined in India by 97% and by 92% in Pakistan. The widespread usage of Diclofenac drug led to the rapid population decline of vultures. Due to this, three vulture species were listed as 'Critically Endangered' by the IUCN and Egyptian Vulture is listed as Endangered. A very few population of vultures is observed in Andhra Pradesh Telangana especially sighting of Indian long-billed vultures at Palarapu cliff during 2013, then Telangana Forest Department has initiated the project entitled "Conservation of Indian long-billed Vulture (*Gyps indicus*) at Palarapu cliff" on 1st January, 2015-and still ongoing with the major objectives such as to find out the status of vultures in Telangana and Andhra Pradesh and to know the status of long-billed vultures in isolated habitats of Telangana.

We surveyed vultures across Telangana and Andhra Pradesh states from September to October, 2017. Road transect survey was carried out on state highways and roads which are running through the protected areas. No transects were repeated, at least 30 km gap was maintained between the transects. Initially past records of vulture locations were surveyed to confirm the occurrence of vultures in both states.

Breeding colony of Indian long-billed vulture (*Gyps indicus*) was located on the southern face of 80-90 meter high elevated rock cliff (108 meter total height of the cliff), named **"**Palarapu cliff" in the Bejjur Reserved Forest nearby the Nandigaon village at the confluence of Peddavaagu stream and Pranahita river. This habitat is located in Bejjur Reserved Forest of Kaghaznagar division, Telangana state. It is located near to the border of Telangana and Maharashtra states. The vegetation is southern tropical dry deciduous forest dominated by Indian Black wood (*Hardwikkia binata*). A 'machan' was erected on the river bank in front of the Palarapu cliff from where the breeding colony of vulture was monitored using Nikon 12x50mm binocular. After marking all the nests and roosting points, we counted all the individuals in regular basis during the day time.

During our survey two *Gyps* species have been reported in three locations from Andhra Pradesh i.e. Long-billed Vulture *Gyps indicus* (Sriharikota, n=2 and Domalapenta-Srisailam Tiger Reserve, n=1) and white-rumped Vulture *Gyps bengalensis* (Mamandur-Thirupathi, n=1). Only 9 individuals were recorded at the initial stage of the project named 'Conservation of Long-billed Vulture (*Gyps indicus*)' by the Telangana Forest Department at Palarapu cliff during the year 2013. Now this population is grown up to 26 individuals in 2015, 30 individuals in 2016 and 32 individuals in 2017. The Egyptian Vultures *Neophron percnopterus* were recorded from Kesreragutta-Municipal yard (n=6), Rajendra Nagar (n=3), Ameenpur Lake (n=4) and Bejjur Reserved Forest (n=1).

The vulture population is very low in both Telangana and Andhra Pradesh with an average of 30 matured individuals of Long-billed vultures which are existing at Palarapu cliff, Telangana. In this paper we have described on three vulture species population and their locations.

Key Words: Vulture, Telangana, Andhra Pradesh

Introduction

Totally there are nine species of vultures in India, among these three vulture species are found in Telangana and Andhra Pradesh i.e. Oriental white-rumped Vulture (*Gyps bengalensis*), Indian long-billed Vulture (*Gyps indicus*) and Egyptian Vulture (*Neophron percnopterus*). The Gyps vulture has declined in India 97% and 92% in Pakistan (Virani, 2006). Because of the evidence of widespread and rapid population decline, all three vulture species were listed by IUCN, the World Conservation Union, as 'Critically Endangered' (BirdLife International, 2013). And Egyptian Vulture is listed in Endangered category of IUCN. Very few populations of vultures are observed in Andhra Pradesh, in Telangana a unique site of Indian long-billed vultures was identified at Palarapu cliff in 2013, Telangana Forest Department has initiated project entitled "Conservation of Indian long-billed Vulture (*Gyps indicus*) at Palarapu cliff" on 1st January,2015, it is an ongoing project.

Methodology

We surveyed vultures across Telangana and Andhra Pradesh, from September to October 2017. Road transects were mostly on state highways and on roads running through protected areas. No transects were repeated, and adjoining transects were separated by at least 30 km. and also based on past records of vulture locations in both states have been surveyed.

Breeding colony of Indian long-billed vulture (*Gyps indicus*) is situated on the southern face of 80-90 meter high elevated rock cliff (108 meter total height of the cliff) , named **"**Palarapu cliff", in the Bejjur Reserved Forest near Nandigaon village at the confluence of Peddavaagu stream

and Pranahita river. This habitat located in Bejjur Reserved Forest of Kaghaznagar division, Telangana state. It is located near to the border of Telangana and Maharashtra states. The vegetation is Southern tropical dry deciduous forest dominated by Indian Black wood (*Hardwikkia binata*). In front of the Palarapu cliff (Breeding colony of vulture), a 'machan' was erected on the river bank from where the habitat was monitored using Nikon 12x50mm binocular. After marking all the nests and roosting points, we counted all the individuals in regular basis during the day time.

Results

During our survey two gyps species have been reported in three locations from Andhra Pradesh i.e. Indian long-billed Vulture *Gyps indicus* (Srihari kota, n=2 and Domalapenta-Srisailam Tiger Reserve, n=1) and Oriental white-rumped Vulture *Gyps indicus* (Mamandur- Thirupathi, n=1).

In the initial of project 'Conservation of Indian long-billed Vulture (*Gyps indicus*)' by Telangana Forest Department at Palarapu cliff, only 9 individuals found, this population has grown up to 26 individuals in 2015(Ravikanth & Ram Mohan, 2016), 30 individuals in 2016 and 32 individuals in 2017 were recorded. And Egyptian Vultures *Neophron percnopterus* are recorded from Kesrera gutta- Municipal yard (n=6), Rajendra Nagar (n=3), Ameenpur Lake (n=4) and Bejjur Reserved Forest (n=1).

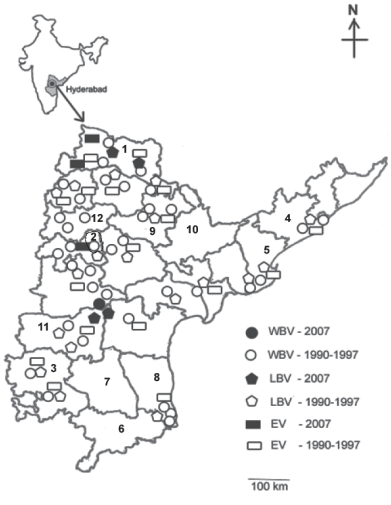

Fig – 1 Past Vulture sightings

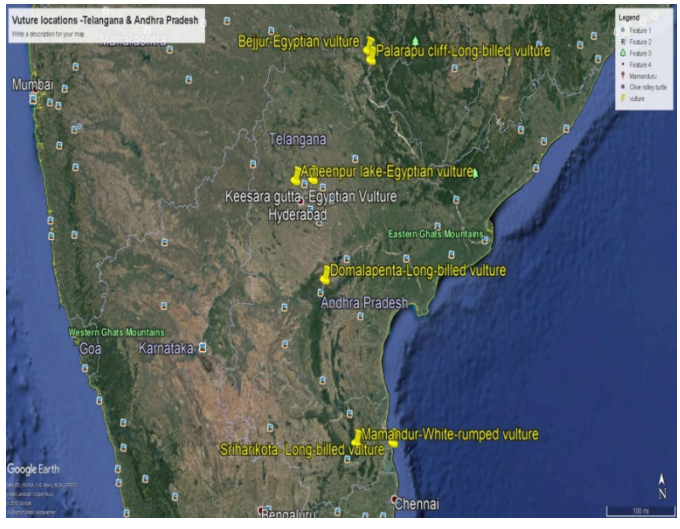

Fig 2 – Present Vulture sightings

CONCLUSSION

In collaboration with Central Zoo Authority (CZA) forest department established conservation, research and captive breeding program for Long-billed Vulture at Nehru Zoological Park, in Telangana State to increase population. Most detailed studies have taken place in Northern India, where vultures occurred at their highest densities in the past; less information is available from Southern India. Historically, six species of vultures: White-rumped Vulture *Gyps bengalensis*, Long-billed Vulture *G. indicus*, Indian Griffon Vulture *G. fulvus*, Egyptian Vulture *Neophron percnopterus*, King Vulture *Sarco Gyps* calvus and Cinereous Vulture *Aegypius monachus* are recorded in Andhra Pradesh (Ali & Ripley, 1983). Approximately 8,615 of Long-billed Vultures was recorded across 39 sites in 15 districts include both Andhra Pradesh and Telangana states. Especially in Telangana state they sighted vultures at Mancherial, Kawal and Utnoor in Adilabad District (Srinivasulu & Srinivasulu 1999). A small colony (N = 7 nests) of Long-billed Vultures was recorded in Pocharam Wildlife Sanctuary, Medak District, Telangana until 1998. Since then on, nevertheless, no individuals were sighted in this area (C. Srinivasulu, in litt. 02 August 2014). Recently, around 13 Long-billed Vultures were reported from Markapur in Srisailam Tiger Reserve, Mattadiguda in Utnoor and Dharmaraopet in Bellampally within Adilabad District, Telangana (Umapathy *et al.,* 2009). The vulture population is very low in both Telangana and Andhra Pradesh, an average of 30 matured individuals of Indian long-billed vultures are existing at Palarapu cliff (Ravikanth, M. *pers.comm*), Telangana. And Egyptian Vultures *Neophron percnopterus* are recorded from Keesrara gutta- Municipal yard (n=6), Rajendra Nagar (n=3), Ameenpur Lake (n=4) and Bejjur Reserved Forest (n=1). In Andhra Pradesh vulture population found is very low, Indian long-billed Vulture *Gyps indicus* (Srihari kota, n=2 and Domalapenta- Srisailam Tiger Reserve, n=1) and Oriental white-rumped Vulture *Gyps indicus* (Mamandur- Thirupathi, n=1).

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Table showing the vulture sightings

Species	Scientific name	Year or Date of sighting	Number of individuals	Location	District or Protected area	Coordinates	
Indian long-billed vulture	*Gyps indicus*	2015	26	Palarapu cliff, Bejjur RF	Kumrambheem Asifabad	19°21'29"8 N	79°91'38"3 E
Indian long-billed vulture	*Gyps indicus*	2016	30	Palarapu cliff, Bejjur RF	Kumrambheem Asifabad	19°21'29"8 N	79°91'38"3 E
Indian long-billed vulture	*Gyps indicus*	2017	32	Palarapu cliff, Bejjur RF	Kumrambheem Asifabad	19°21'29"8 N	79°91'38"3 E
Egyptian Vulture	*Neophron percnopterus*	5-Sep-2017	1	Bejjur	Kumrambheem Asifabad	19°21'3.14"N	79°51'28.45"E
Egyptian Vulture	*Neophron percnopterus*	9 Sep-2017	4	Ameenpur lake	Hyderabad	17°31'13.02"N	78°20'6.63"E
Egyptian Vulture	*Neophron percnopterus*	16 Sep-2017	6	Keesrara gutta	Hyderabad	17°31'47.94"N	78°41'17.70"E
Indian long-billed vulture	*Gyps indicus*	5 Oct-2017	2	Sriharikota	Nellore	13°44'41.18"N	80°12'47.98"E
Indian long-billed vulture	*Gyps indicus*	11 Oct-2017	1	Domalpenta	Srisailam Tiger Reserve	16° 6'19.75"N	78°53'54.93"E
Oriental white-rumped Vulture	*Gyps bengalensis*	24 Oct-2017	1	Mamanduru	Tirupati	13°44'51.42"N	79°27'47.54"E

TECHNICAL SESSION – II
CONSERVATION THREATS

DIFFUSE POLLUTANTS OTHER THAN NSAIDS–ANY POTENTIAL CONCERN FOR VULTURES IN INDIA?

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ABSTRACT

While the reason for the population decline in vultures in Southeast Asia is proved beyond doubt, we kept tract of a few potential diffuse pollutants, namely organochlorine pesticides, polychlorinated biphenyls, polycyclic aromatic hydrocarbons and heavy metals with the main aim to check if they did contribute to the calamitous population reduction over the years in India. Samples of tissues from four species of vultures, namely *Gyps bengalensis, Gyps fulvus, Gyps himalayensis and Neophron percnopterus* were collected on opportunistic basis from Gujarat, Tamil Nadu, Assam, Delhi and Punjab between 1999 and 2015. Samples were brought over ice to the laboratory at SACON, Coimbatore and processed adopting standard protocols, and analyzed through Atomic Absorption Spectrometer, Gas and Liquid chromatography with appropriate detectors. While varying concentrations of the referred chemicals were detected in all the species of vultures, none of the birds had levels indicative of poisoning. Since no historical data on the residue levels of any of the group of chemicals tested is available in vultures in India, data generated in this study can serve as guidelines for future research. In the light of the information available in the literature on vultures and other species of birds in India and elsewhere in the world, it can be inferred that the chemicals studied may lead to impairment of reproduction, behavioral and neurological functions, and suppression of immunity if the exposure levels increase or even remain the same over a period of time. With particular reference to the level of *p,p'* DDE recorded in the eggs, we need to be watchful owing to its persistence and potentiality to create eggshell thinning, hatching failure and impair reproduction. Unfortunately, we still have fresh input of DDT into the environment. Considering the precarious position of vultures in India, continuous monitoring of the levels of select contaminants and their effects on vultures is inevitable. It is further recommended that attention may be paid, particularly in breeding areas across their distribution range in the country.

The author refused to submit the paper for some official reasons any information regarding this paper please contact Dr. S.Muralidharan, Principal Scientist, SACON, Coimbatore. E.Mail: ecot_mur@yahoo.com

IMPACT OF DICLOFENAC, OTHER NSAIDS AND INDIRECT POISONING ON VULTURES

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This article deals with pathophysiology of diclofenac, other NSAIDs and indirect poisoning on vultures. Vultures are social birds, scavengers, sanitary workers feed on dead and decaying materials in the forest area. They play an important role in keeping the ecosystem clean and healthy. It is observed that during 1900 there were thousands of vultures present all over India. In southern parts of India, vultures were scattered in Tamilnadu, Kerala and Karnataka states. Four species of vultures were found all over Tamilnadu, namely Oriental White-backed vulture (OWBV), Indian (Long-billed) vulture (LBV), Red-headed vulture (RHV) and Egyptian vulture. From the records of bird watchers, vultures were often sighted as leather tanneries in Chrompet Dindugal. In Vallam village, outskirts of Tanjore and also seen in Tirunelveli, Ramnad, Madurai, Sivangangai, Coimbatore etc.

Moyar valley is located in Nilgiri Biosphere Reserve, it is a part of Western and Eastern Ghats and moyar valley is considered as a biodiversity hotspot. Perennial and semi perennial rivers drain into Moyar river. Along the basin Mudumalai, Bandipur and Sathyamangalam Tiger reserves are located. It is a dry deciduous forest and largely forested by dry thorns, suitable nesting and roosting habitat including cliff are found along Moyar valley. Diclofenac usage is remarkably less due to the presence of committed veterinarians. In India, decline of vulture population was first observed during 1980 at Keoladeo Ghana National Park, Rajasthan. At the end of 20th century the number of vulture population was drastically reduced.

Before the period of decline, the neck drooping phenomenon was observed in Eurasian vultures. The birds exhibited this behavior for over several weeks before falling from tress. This was an important behavior was monitored and recorded more frequently in higher proportions of weak and sick birds. Initial hypotheses for declining of vulture population were non availability of dead livestock and epidemic diseases. Later, from the investigation study carried out by researchers working abroad had found visceral gout was reasoned for 85% of dead vultures. It is a condition in which uric acid gets accumulated within tissues and on the surfaces of internal organs. The cause of death is due to renal failure as a result of metabolic, infectious or toxic disease. Histopathology revealed that there was severe renal tubule damage, indicating a toxic cause. No conclusive report of any epidemic disease was found as reason for declining vulture population. Though toxic is major cause, there are several causes affecting vulture population in minor level. Persecution by cattle herders through poisoning, Carcass unavailability and Habitat degradation.

In India, White revolution came into existence from late 1970 to 1996. It was divided into 3 phases. 1st phase was implemented from 1970 to 1980, 2nd phase was from 1980 to 1985 and 3rd phase was from 1985 to 1996. As a result, more high yielding exotic cattle breeds such as Jersey, Holstein replacing our native ones which resulted in decline of Indian breeds. Though exotic cattle were high yielding, they were more susceptible to diseases. In India, the introduction of diclofenac started from late 1980s to treat the livestock especially and at the same period white revolution was in a full swing all over the country. In non forest areas it was a common practice to dispose the dead livestock near to graveyard, unused open places and dump yard. Government policies and court orders discouraged open disposal of dead livestock. Despite the orders on dead livestock treated with diclofenac was also disposed in open places and vultures continued to feast on them. In the last 10 years of 20th century scores of vultures died. Several studies were conducted to identify the reason for decline of vulture population. Researchers found similarity in death pattern and postmortem lesions.

Diclofenac is a Non-steroidal anti-inflammatory drug (NSAIDs), which has been used since 1990s in Indian subcontinent for treatment of inflammation and pain in domesticated ungulates. The vultures would possibly scavenge on carcasses of dead livestock treated with diclofenac, death occurred within a few days as a result of severe kidney damage and visceral gout were observed in postmortem. It is finalized that vultures are highly susceptible to diclofenac.

According to the Nilgirs and surrounding forest areas, vulture population highly depends on tiger carcasses. When tiger population decreases the vulture population also decreased. Tigers are providing food for vultures because they prefers large herbivores like sambar and gaur and cannot always hide them completely. Leopard hide their prey on tree tops and wild dogs devour them completely. Tigers vanished from our country mostly due to retaliatory killing or revengeful killing/attitude over the cattle kills in the forest areas by people using poison than by shooting, snaring etc. The poisoning of tigers is also an important cause for declining of vulture population in these areas. Generalization of cause may not be completely correct. Landscape problems and localized issues, traditional and cultural factors also play an important role in increased mortality rate of vultures. From my personal observation of 25 years in the Forest Department, revival of tiger population along with vulture population in Moyar river belt is another indication of relationship. The protection measures given by the Forest Department immensely helped for the revival of

population slowly and steadily. The conservation programs are recommended by workshops which demanded for phasing out veterinary use of diclofenac. There were many workshops held in different parts of country are as follows. International workshop at Kathmandu, Nepal viz. in Parwanoo in February 2004, Haryana in February 2004, National Workshop at New Delhi in April 2004, Second Meeting of the National Board for Wildlife (NBWL) on 17th March 2005, International Conference on Vulture Conservation at New Delhi from 31st January 2006 to 1st February 2006. Meloxicam was found to be safe at 2.5 x LD50 of diclofenac, it has been concluded that at a dose rate equal to or more than amount of scavenging birds could consume as drug residue though feeding on animal carcass may be considered safe.

VULTURES AND NSAID'S

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ABSTRACT

Gyps vultures in the Indian Subcontinent have been undergoing a major decline in population since the late 1990's. It has been empathetically proven that the major cause of the vulture decline, is the use of the veterinary NSAID diclofenac. Diclofenac causes damage to the kidneys and in turn results in an increase in the uric acid levels in the blood of vultures, resulting in mortality due to gout. Diclofenac happened to enter the food chain of vultures due to the long elimination time (half-life) it takes to be totally excreted from the body.Hence it is important to note that we must ensure that the drugs injected in livestock are not only safe for the animals in which they are being injected but also safe for the animals and birds that would be scavenging on their carcasses should they die. Therefore, other drugs used in livestock should also be tested for their safety on the scavenging species. Other NSAIDS like aceclofenac, ketoprofen, carprofen, flunixin and nimesulide have been found to be toxic or potentially toxic for vultures while the safety of other NSAID's like aspirin, phenylbutazone, paracetamol, etc. needs to be tested. It is important to assess the situation and educate the veterinarians about the harmful effect of these NSAID's on vultures and ensure that the veterinarians in turn dissipate the knowledge to the farmers. It is also imperative to test other NSAID's and other routinely used drugs in cattle for safety to vultures and other scavengers. This will ensure a safe environment for the vultures in the Indian subcontinent.

Key words: Gyps, vultures, NSAID, diclofenac, ketoprofen, aceclofenac.

Introduction

The vulture decline in the Indian sub-continent was first reported from the Keoladeo National Park in 1999 by Dr Vibhu Prakash (Prakash, 1999). Scientists from all over the world worked and rallied to find the cause for the decline. Numerous causes such as infectious disease, persecution, food shortage and environmental contaminants were considered to be the reasons behind the decline (Pain *et al.,* 2003). After many months of research and testing, Dr Lindsey Oaks and his team discovered that the cause of the decline was the veterinary drug formulation of Diclofenac, which had found its way into the food chain of the birds (Oaks *et al,* 2004) due to its long half life period. This finding therefore, conveys a strong implication on the safety or potential toxicity of human and veterinary drugs in scavenging birds.

In the past, before the discovery and administration of diclofenac, NSAIDs (Non-Steroidal Anti-Inflammatory Drugs) like Paracetamol, Phenylbutazone, Analgin (dipyrone), etc., and their combinations were being used for the treatment of inflammatory symptoms. However, with the phasing out of Analgin, (due to its toxic side-effects), use of diclofenac became popular due to its efficacy, availability and low cost. The potential ecologically toxic effects of human and veterinary pharmaceuticals pose a major concern especially now after Dr Lindsey's discovery.

Current Scenario

After the ban on the use of veterinary Diclofenac (GOI, 2008), other NSAID compounds like aceclofenac, flunixin, ketoprofen, carprofen, nimesulide and meloxicam are being administered in livestock. In order to provide a safe alternative to diclofenac, safety testing in vultures was carried out for other anti-inflammatory compounds. During the safety trials, Meloxicam was found to be safe for vultures (Swan *et al.*, 2006; Swarup *et al.*, 2007) however Aceclofenac was not found to be safe as it metabolized to diclofenac in vivo (Sharma, 2012; Galligan *et al.,* 2016). Ketoprofen too was tested to check for toxicity to scavenging vulture and was deemed toxic (Naidoo *et al.,* 2010 a,b). Toxicity trials were also conducted for Carprofen, Flunixin and Phenylbutazone and the drugs were deemed unsafe as administration of the drug killed a few but not all the vultures tested in the trial (Cuthbert *et al.,* 2007; Ramzan *et al.,* 2012; Zorilla *et al.,* 2014; Fourie *et al.,* 2015; Naidoo *et al.,* 2018). Safety and toxicity studies for Nimesulide are yet to be carried out however, based on empirical data it is currently deemed as unsafe for vultures. Aspirin, Dipyrone (Analgin), Ibuprofen, Phenylbutazone, Piroxicam, Mefenamic acid, Naproxen and Tolfenamic acid are all NSAIDs of unknown toxicity to vultures. Safety testing on Gyps vultures is the necessary direct evidence that is needed to determine whether a certain NSAID is toxic or non-toxic to vultures. It is not possible to predict whether these NSAIDs are toxic by simply comparing their structure or classification to that of actually toxic NSAIDs and studies need to be carried out in vivo.

Discussion

When new drugs are discovered, they are tested for their efficacy and safety. Their median lethal dose is calculated and the dose ranges at which it is safe in the target species is determined. It is perhaps time that pharmaceutical manufacturers also consider determining the potential toxic effect that a drug or compound could or will have on the environment. Reports of secondary poisoning of scavenging birds by organophosphates, other pesticides as well as barbiturates (Henny *et al.,* 1985; Langelier, 1993) are becoming more frequent. The world almost lost 3 species of Gyps vultures and three other species of vultures are now endangered only because we did not have the foresight to carry out an ecological toxicity trial for drugs that enter and

become part of an ecological food chain. The need of the hour therefore, is to test and provide for the potential ecologically toxic effect for all drugs used in livestock and humans, be they antibiotics, sedatives, NSAIDs or anthelmintics.

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USE OF THE NSAID DICLOFENAC IN THE RURAL VETERINARY PRACTICE

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ABSTRACT

The use of Diclofenac (NSAID) in the veterinary practice resulted in the catastrophic declines of *Gyps* Vultures. Being a scavenger in habit, vultures preys upon the carcasses of livestock died soon after the treatment with Diclofenac and they dies within few days. The residues of diclofenac in the muscles of livestock carcass consumed by vultures causes kidney damage, increased serum uric acid concentration, visceral gout and death. The same result accurs with other drugs like carprofen, flunixin, Meglumine, Phenylbutazone, Aspirin, Salicylate or corboxilic acid derivatives, Propionic acid (Ibuprofen, Naproxan) Fenamates, Oxicams. Even after the ban of Diclofenac by the Government of India the related harmful drugs are still available in the market in various forms produced by different companies. In the rural area the unqualified para veterinarians are using the NSAIDs available for veterinary use. If it is not available they are going for human preprations of diclofenac for their use. The harmless anti-inflammatory drugs available in the market. But the above people are reluctant to use the same drugs. The presence of the vultures in the ecosystem and its effects on human and other wild animals are highly important. Safe anti-inflammatory, analgesic, antipyretic combination drugs can be used instead of NSAIDs.

Key Words: NSAID, Rural, Practise, Diclofenac, Tamil Nadu

Introduction

The term NSAID describe compounds that are not steroidal and suppress Infalammation. Inflammation occurs in the vascularized tissue in the body. The signs are redness, heat, swelling, pain and loss of function. Vasoconstriction occurs first and the predominant cells infiltrating the area of inflammation are polymorphoneuclear leucocytes (PMN). The accumulation of lysed cells commonly refered as pus.

NSAIDS

Aspirin: it's the earliest components of herbal therapy and it's the progenetor of NSAID

NSAID: Broadly classified into

a. Salicylate or carboxylic acid derivatives includes indole (indomethacin)
b. Propionic acid(Ibuprofen and naproxan)
c. Fenamates (meclofenamic acid)
d. Oxicams (pyroxicam) or pyrozolones or enolic acids(Phenylbutazone and dipyrone)

NSAIDs are well absorbed after oral and parentral administrations.

Bioavoilability varies between animals unbound drug is distributed to extra cellular fluid. Small portion of pharmacologically active drug reaches periferal tissues.

Adverse reactions in animals

1. Gastro intestinal : a) Gastroduodenal erosion b) Ulceration C)mucus secretion d) epethelization and blood flow.
2. Haematopoietic a)able to impair Platelet activity.
3. Renal : Analgesic nephropathy in human being but does not occur frequantly in domestic animals

Veterinary use of NSAID diclofenac in south asia has resulted in catostropic decline in the population of three vulture species of genus Gyps since early as 1990. The loss of tens of millions of vultures over the last decade has had major ecological consequances across the Indian subcontinent that pose a potential threat to human health. These three vulture species under genus Gyps are 1) oriental white backed (Gyps Bengalensis 2) Long billed (Gyps Indicus) 3) Slender billed (Gyps tenuirostris) are now at high risk of global extinction declared by IUCN in 2004

Vultures the scavenging bird dies within days when they prey over the carcasses of livestock's treated with diclofenac (NSAID) shortly before death. The residues of diclofenac found in the flesh of Livestocks carcasses caused the kidney damage, increased serum uric acid concentration, viseral gout and death in vultures within days of consumption. Consumption of one kg of meat from an animal that died shortly after a veterinary course of the NSAID could be exposed to doses close to or within the range of doses 1-5 mgms per kg^{-1} cause mortality.Ban announcements from Indian government come on the veterinary use of diclofenac by September 2005.Apart from diclofenac other drugs like carprofen, flunixin, meglumine, ibuprofen, phenylbutozone also cause mortality.The NSAID still available in markets are Nimesulide & paracetamol in the name OXALGIN and Rely NP bolus and 100 ml vial Nemovet in 15,50 and 90 ml vials. Safe antiinflammatory analgesic, antipyretic drugs are available like meloxicam, tolfenamic acid. We can use these drugs without any side effects to lives tocks and will not affects vulture species also in turn.

Because there is no awareness among the rural unqualified persons going for animal's treatment over the adverse effects of diclofenac, there is chances for usage of this drug is possible. Even though high court turns down plea of pharmaceuticals from Haryana and Madhya Pradesh that the multiple dose packs of diclofenac for human use would be economical. But single dose pack containing a maximum of 3ml in each vial available now. In the absence of veterinary diclofenac and multidose human pack there is chance for going to single dose human diclofenac drug.

In my service in forest department in five years from 2000 to 2005 and also in the fringe areas of forest in animal husbandry department I did not come across any postmortem over vultures death confirmed for diclofenac.

In many places populations of feral dogs (canis familiaris) have benefited from the disappearance of Gyps vultures as the main scavenger of wild and domestic ungulate carcasses. Associated with the rise in dogs numbers is an increased risk of human cases of rabies. If rat (Rattus Species) populations also increase at carcass dumps in and near settlements the risk of transmission of diseases including bubonic plague to humans may also increase. Vultures also helped to control livestock diseases such as brucellosis, tuberculosis, and anthrax by disposing of infected carcasses. . Zoroastrian pavsi community who traditionally use vultures to dispose of human corpses. It's absolutely necessary to screen the live stocks deaths wether inside or fringe areas of forests suspected for any type of poisoning must includes diclofenac and other NSAIDS also.

The following measures can be taken to save the vulture species.

1. Awareness to be created in depth among veterinarians, pharmacysts, medical store people and general public regarding the ill effect of NSAID.
2. Unqualified persons going to treat lives tocks to be curtained with effective rules.
3. Appropriate advice can be made to government to stop production of NSAID in veterinary use.
4. Awareness to be created among general public in the proper disposal of car cases of live stocks in the fringe area of forests.
5. Safe anti inflammatory, analgesic, drugs can be used in veterinary practice instead of NSAID.

SECONDARY PHORATE POISONING OF LARGE CARNIVORES IN INDIA

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ABSTRACT

India, with its huge human population and fragmented wildlife habitat, is plagued with human–animal conflicts. In conflict areas, large carnivores are often primary targets for malicious poisoning. The effects of certain poisons do not stop with the target animal but also affects other species of wildlife in the form of secondary poisoning. This paper describes incidences of secondary poisoning of a tiger (*Panthera tigris*) and a black panther (*melanistic Panthera pardus*) in the Nilgiri Biosphere Reserve. Wild boars (*Sus scrofa*), which are considered pests in horticultural plantations, were the primary targets in both cases and were poisoned using phorate, a highly toxic organophosphorus compound. Tigers and leopards hold significant position in the upper most trophic level of the ecological pyramid and are grouped in schedule I of the Wildlife Protection Act of India. The tiger, as a species, is currently waging a grim battle of survival in the wild. The world over, leopard populations are also dwindling. The implications of the death of these endangered apex predators due to the increase in population of the ubiquitous wild boars are analyzed. The merits of introducing a policy of selective culling of wild boars in conflict areas are discussed.

Key Words:

Disclaimer

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Secondary phorate poisoning of large carnivores in India

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Abstract India, with its huge human population and fragmented wildlife habitat, is plagued with human–animal conflicts. In conflict areas, large carnivores are often primary targets for malicious poisoning. The effects of certain poisons do not stop with the target animal but also affects other species of wildlife in the form of secondary poisoning. This paper describes incidences of secondary poisoning of a tiger (*Panthera tigris*) and a black panther (melanistic *Panthera pardus*) in the Nilgiri Biosphere Reserve. Wild boars (*Sus scrofa*), which are considered pests in horticultural plantations, were the primary targets in both cases and were poisoned using phorate, a highly toxic organophosphorus compound. Tigers and leopards hold significant position in the upper most trophic level of the ecological pyramid and are grouped in schedule I of the Wildlife Protection Act of India. The tiger, as a species, is currently waging a grim battle of survival in the wild. The world over, leopard populations are also dwindling. The implications of the death of these endangered apex predators due to the increase in population of the ubiquitous wild boars are analysed. The merits of introducing a policy of selective culling of wild boars in conflict areas are discussed.

Keywords Secondary poisoning · OPC · Phorate · Tiger · Leopard · Wild boar

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Introduction

The tiger (*Panthera tigris*), the largest living feline on earth, is waging a battle of survival (Chundawat et al. 2008), with <1,500 animals alive in the wild in India. The reduction in the population of this apex predator from the niches in India has served as a blessing in disguise for the leopard (*Panthera pardus*), which is now emerging as the primary predator in many of the sanctuaries in India. However, the status of leopards the world over has been revised to 'Near Threatened' (Henschel et al. 2008) from 'Least Concern', clearly pointing to a reduction in their wild population. Habitat fragmentation has brought these versatile predators into a direct conflict situation with humans.

These large carnivores are usually primary targets of intentional poisoning, in response to cattle lifting and man eating. They also become victims of secondary poisoning due to their occasional scavenging habits. The present paper reports incidences of death of a tiger and a black panther (melanistic variant of *P. pardus*) due to secondary poisoning. These animals had consumed meat of wild boars (*Sus scrofa*) killed using phorate, a granular organophosphorus compound (OPC) pesticide, in two separate incidents at Nilgiri Biosphere Reserve, Tamil Nadu, India. The necessity to document these studies was felt, considering the importance of these species of carnivores in terms of conservation as well as their part in ecology and a dearth of literature on such incidents.

Materials and methods

In January 2008, intact carcasses of Indian wild boars (a nursing sow and two piglets) and an Indian mongoose (*Herpestes javanicus*) were found in a tea estate, near a banana plantation located in Gudalur range, Nilgiri Biosphere Reserve. An empty plastic insecticide cover, inscribed '10% Phorate', was retrieved from a bush nearby. Necropsy was conducted on all four carcasses by the local veterinarian. Three days later, the Forest Veterinary Assistant Surgeon, Mudumalai Tiger Reserve (senior author), was informed of the presence of a carcass of a male tiger in the same tea estate within a distance of 300 m from the wild boar carcass. A detailed necropsy was conducted on the tiger carcass. Composite sample (250 g) containing stomach and intestinal loop with contents and portions of liver were collected in sealed containers from the tiger carcass in saturated sodium chloride solution as preservative and sent along with plain preservative as control to the Regional Forensic Science Laboratory (RFSL), Government of Tamil Nadu, Coimbatore, for toxicological analyses.

The second incident happened in June 2009 in Kannerimookhu, Kuntha range, also in the Nilgiri Biosphere Reserve. This involved the death of a melanistic leopard whose carcass was also found in a tea estate adjoining horticultural fields with crops like carrot and potato. An elaborate necropsy was conducted by the above stated. About 100 g each of stomach contents, intestinal loop with contents, liver, kidney, lung, and heart was collected separately in 400 ml of saturated sodium chloride solution as described above and sent for toxicological analyses.

The samples were analysed using thin-layer chromatography followed by gas chromatography–mass spectrophotometry at RFSL.

Results and discussion

Circumstantial evidence, necropsy lesions and laboratory confirmation revealed that the tiger and leopard had died due to secondary poisoning with OPC (phorate).

The report on the necropsy findings on the wild boar carcass as described by the local veterinarian is as follows: The wild boar sow was found to have three functional udders, whilst only two piglets were found dead in the area. Fresh, undigested, unripened bananas and banana tubers were found in the stomachs of wild boar carcasses. Other signs of toxic lesions like pulmonary edema, dilated and fluid-filled intestinal tract with haemorrhages and degenerative and necrotic changes in kidney and liver were observed in the wild boars. Similar findings were recorded in the mongoose carcass also.

The carcass of the tiger, which was a young male of about 4 years, was in a putrefied state and was infested with maggots, the largest measuring about 1.5 cm long. Necropsy revealed the presence of 4–5 kg of undigested meat in the stomach. Closer examination of the stomach contents revealed the presence of pieces of skin with typical hair, as well as portions of hooves of a wild boar piglet. The gastric mucosa was congested. Slight pulmonary oedema and frothy discharges in trachea and bronchial trees were noticed. The composite sample from tiger was found to contain 3.9 g% of insecticide equivalent to phorate.

Enquiries revealed that the workers of the plantation had used phorate-impregnated bananas to get rid of wild boars, which had caused immense damage to their banana plantation. Only two of the poisoned piglets were found in the vicinity of the dam. It is known that the number of functional teats in a wild boar sow corresponds to the number of live, suckling piglets (Fernández-Llario and Mateos-Quesada 2005). It can be surmised that the tiger had predated or scavenged on the carcass of one of the poisoned piglets and died of secondary OPC poisoning. The circumstantial evidence was corroborated by laboratory results, which showed the presence of OPC in the composite sample, confirming death due to OPC poisoning. The recovery of empty phorate cover from the vicinity of the carcasses of wild boar and the history of poisoning incriminates phorate as the specific OPC involved in this case.

The leopard carcass revealed a picture of generalized congestion and haemorrhage. The visible mucous membranes were brick red in colour and there was a string of mucoid blood from the nostrils. Carrion blowfly larvae were found in the buccal cavity. Rigor mortis was present. Necropsy revealed that the peritoneal cavity contained about 1 l of serosanguinous fluid (Fig. 1a). Trachea was haemorrhagic (Fig. 1b). The heart showed pericardial effusion with the pericardial sac being filled with about 100 ml of blood-tinged fluid (Fig. 1c). There were petechiae on the epicardium and the endocardium was severely congested (Fig. 1d). There was pulmonary oedema and generalized haemorrhage of all lobes of lungs (Fig. 1e). About 1 kg of darkish, partly digested content was found in the stomach (Fig. 1f). Whilst no distinct body parts were identifiable in the gastric content, numerous stiff hair and bristles, which were indistinguishable from those of wild boars, were found. The kidney showed severe subcapsular haemorrhage (Fig. 1g) with severe congestion of the cortex (Fig. 1h) and cortico-medullary junction (Fig. 1i).

In the case of the leopard, no circumstantial evidence could be retrieved from the region. However, the presence of wild boar flesh in the stomach and type of lesions noticed instigated a suspicion of poisoning. The RFSL confirmed the presence of phorate in stomach and intestinal content (0.78 g%), liver (11.26 g%) and kidney (4.55 g%) of the leopard, whilst the heart and lung tested negative.

Large carnivores usually remain as target species for primary poisoning and are usually baited using carcasses

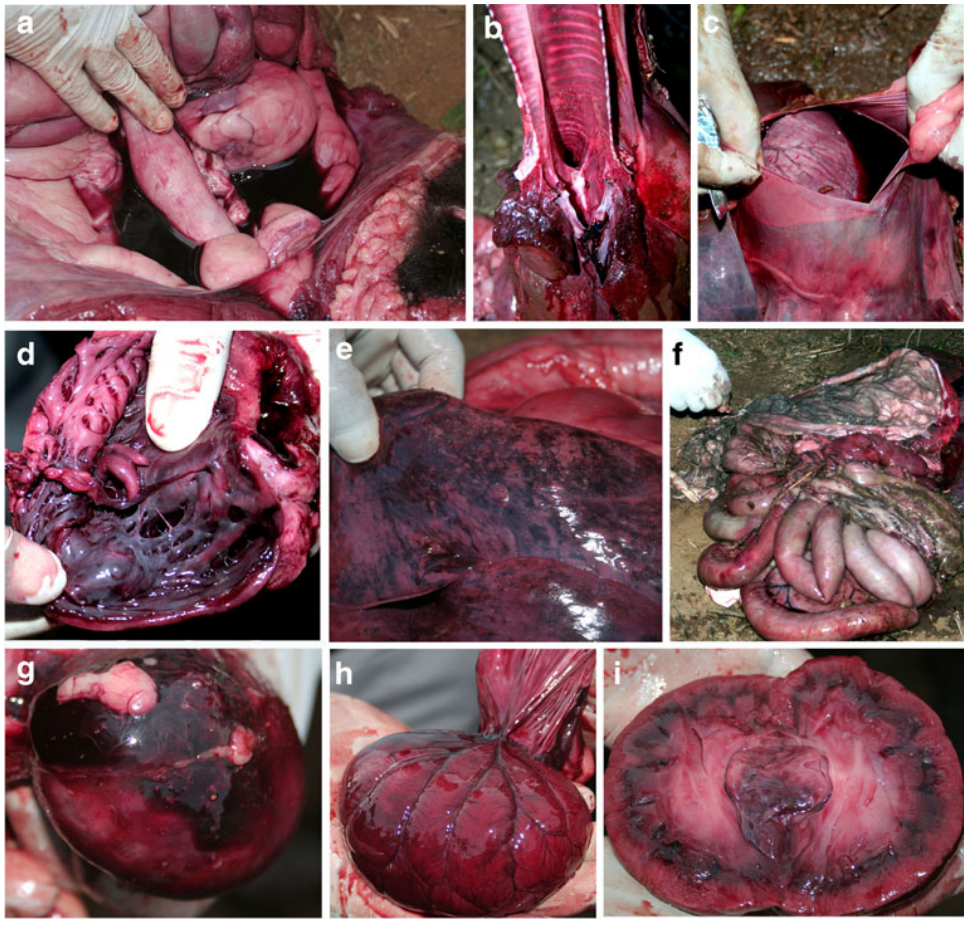

Fig. 1 Necropsy lesions of the leopard: **a** Peritoneal cavity containing serosanguinous exudate, with generalized congestion of all visceral organs. **b** Severe congestion of trachea. **c** Congestion of pericardium with the pericardial sac containing about 100 ml of sanguinous fluid. Congestion of the epicardium is also noticed. **d** Congestion and petechiae of endocardium. **e** Lungs showing generalized, diffuse, patchy haemorrhages. **f** Stomach containing partly digested content. The intestinal mucosa shows patchy congestion and engorgement of mesenteric blood vessels. **g** Severe subcapsular haemorrhage of kidneys. **h** Congestion of the cortical surfaces and capsule of the kidneys. **i** Cut section of kidney showing congestion of the cortico-medullary junction

laced with poison. Venkataramanan et al. (2008) reported an incident of poisoning of leopard in the same region by baiting with cattle carcass laced with carbofuran. Several lions had succumbed to carbofuran in Kenya and other parts of Africa (Given 2007). Scavengers and carrion eaters like vultures, crows, Indian magpie, black kite, Brahminy kite and hyena are the most common non-target species that bear the brunt of secondary poisoning (Wobeser et al. 2004; Martinez-Haro et al. 2008). The two incidents reported herein is a testimony to the fact that large carnivores like the tiger and leopard, which usually hunt live prey, also can fall victim to secondary poisoning due to their occasional scavenging habits.

In India, there are reports involving poisoning of wildlife with other OPC compounds like phosphamidon, malathion and monocrotophos (Gureja et al. 2002; Arora 2003; Pain et al. 2004). However, a search of literature reveals that use of phorate in incidences of poisoning of wild animals in general and large carnivores in particular has not been reported

The tiger carcass was putrefied, with the presence of fully developed maggots, whilst larvae were noticed in the buccal cavity of the leopard carcass, which was reasonably fresh. Gunatilake and Goff (1989) demonstrated the presence of OPC compounds in larvae of *Chrysomya megacephala* and *Chrysomya rufifacies* from a putrefied human carcass proven to have died due to malathion poisoning. The findings in the present cases also support the theory that maggots can develop in carcasses of animals that die due to insecticide poisoning.

The animals affected in these two incidents, the tiger and the leopard, fall under the 'Endangered' and 'Near Threatened' categories, respectively. Even though the bait was for the wild boar, classified under the 'Least Concern' category of the IUCN and protected under Schedule III of the Wildlife Protection Act of India 1972 (WPA), it has claimed the lives of two important wildlife species listed under schedule I of the Act. The population of wild boar has been kept under check within the protected areas (PA) by predators, whilst it has increased exponentially in plantations outside the PA due to restrictions in hunting, coupled with reduced pressure from predators. As a result, this animal has emerged as a major threat of most of the horticultural crops and has earned undue notoriety among the farmers. The affected farmers try to get rid of them by illegal means using explosives hidden in food ('flour balls' which explode when bitten, leading to damage of the jaws and a painful lingering death) and poisoning. Poisoning is usually through baits like bananas laced with poison, as

established in the case of the tiger. The poisoned boars can potentially act as a source of secondary poisoning to other wildlife, as seen in the two incidents.

The practice of selective culling of wild animals, to prevent their population reaching nuisance levels, has been followed in many countries. In Spain, selective killing of wild boars, called as Monteria, is carried out seasonally to keep the population in check (Fernández-Llario and Mateos-Quesada 2005). The two instances of secondary poisoning discussed highlight the necessity of a programme for controlling wild boars to be introduced in India also. Presently, the Government of Tamil Nadu is considering downgrading the status of wild boar from schedule III to V, which will permit farmers to kill the animals when found raiding their farm lands (Anonymous 2009). Otherwise, such setbacks can act to dampen the effort of preserving the biodiversity of India.

Acknowledgements We thank Dr. Rajashekhar, Veterinarian, Aavin, Ooty, for communicating the details of the necropsy of the wild boars and mongoose. Thanks are also due to Dr. N.V.K. Ashraf, Director, Wild Rescue, Wildlife Trust of India, for his critical analysis of the manuscript.

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POST MORTEM ANALYSIS OF WHITE-RUMPED VULTURES IN MUDUMALAI TIGER RESERVE

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Short Note

The Nilgiri Biosphere Reserve which is the first biosphere reserves in India. It is located in the confluence of Western and Eastern Ghats which has an incredibly rich diversity of fauna and flora is one of the mega biodiversity areas of the nation. Further it is being the most important landscape for tiger, leopard, elephant, bear, wild dog etc. Besides the Nilgiri biosphere reserve protects many avian species, especially Mudumalai Tiger Reserve core and buffer area conservation acts as a heritage for vultures. Vultures are very important in forest conservation. Vultures are largest avian scavengers. By their feeding action they keep the ecosystem clean and healthy. Vultures are controlling many pathogens which are growing rapidly in the rotten meat. The vulture population is almost going to extinct but it is reviving presently. In this juncture death of vulture in Moyar valley is of great concern.

On 24.12.2014 seven vultures were found dead by the forest staff during their routine patrolling at Masinagudi range of Mudumalai Tiger Reserve with regurgitated symptoms among the seven one was alive which was struggling for life at the same day one wild dog carcass was also found nearby. Wildlife veterinary team from Theppakadu, Mudumalai Tiger Reserve, rushed to this spot and rescued the wild bird and necessary treatment was given. Despite of all efforts, the vultures were died. The dead birds and the wild dog were undergone to detailed post-mortem was conducted by the team of Veterinarians with the presence of forest staff and biologists. Biological samples were collected and sent to the forensic and pathological laboratories. After the post-mortem necessary samples were collected and all the carcasses of vultures, wild dog were completely burned. The samples were collected in sterile containers and preserved in saturated salt solution and sent to the Regional Forensic Science Laboratory by following standard procedures. The results were obtained from the concerned laboratory and found that ***Organophosphrous and urea*** poisoning was reasoned for the above deaths. The necropsy found that no lesions in the joint cavity, no drug residues at visceral organs revealed by forensic lab.

A week after, one buffalo carcass was found where the vultures were died. Flesh samples of the buffalo carcass was examined, collected and sent to the laboratory. The results found that ***Organophosphorus and urea*** poisoning were contaminated in the buffalo carcass. Few days after one vulture was found dead at Segur range. The necropsy found no lesions in the joint cavity, no drug residues at visceral organs revealed by forensic lab. Astonishingly these samples were also noticed same ***Organophosphorus and urea*** poisoning from the laboratory result. Here I concluded that vultures deaths in this landscape was mainly due to deliberate poisoning of carcasses. No doubt every safe disposal of livestock carcasses would definitely save the critically endangered vulture species in this region rather than drug residues.

Enclose

Regional Forensic Science Laboratory report

உள்ளடக்கங்கள் :
Enclosures :

Sub: Examination of viscera of Vulture and Male Elephant.

பார்வை :
Reference :

Ref : Your letter dated 05.01.15.

The following items were received here on 08.01.15 with proper labels through Mr. K. Siddaraj, Forest Guard, under unbroken seals which corresponded with the sample sent.

The results obtained on examination are noted against each viz.

1. Vulture Crop contents.

   Detected Organophosphorus compound and Urea.

2. Vulture Intestinal contents.

   Detected Organophosphorus compound and Urea.

3. Male Elephant.

   Did not detect poison.

4. Preservative.

   Did not detect poison.

Note: Organophosphorus compounds are poisonous and are used as insecticide and urea is a diamide and is used as fertilizer.

(Dr. P.KIRUBAKARAN, M.Sc.,Ph.D. B.L.,)
Dy. Director and Asst. Chemical Examiner to Govt.

(V. Sivasubramanian, M.Sc.,)
Junior Scientific Officer.

Note : In case of Evidence summons may kindly be issued to V. Sivasubramanian, M.Sc., Junior Scientific Officer.

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* அழைப்பாணைகள் ஏதும் வழங்கும்போது த.அ.து. பார்வை எண்ணைக் குறிப்பிடவும்.
* While issuing summons, if any, please quote FSD reference Number.

THE SURVEY ON PREVALENCE OF NON STEROIDAL ANTI-INFLAMMATORY DRUGS (NSAIDS) IN THE NILGIRIS, TAMIL NADU

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ABSTRACT

Veterinary use of the non-steroidal anti-inflammatory drug diclofenac on domesticated ungulates caused populations of resident *Gyps* vultures in the Indian sub-continent to collapse. The birds died when they fed on carrion from treated animals. Veterinary diclofenac was banned in 2006 and meloxicam was advocated as a 'vulture-safe' alternative. We examine the effectiveness of the 2006 ban, whether meloxicam has replaced for diclofenac in veterinary practices and other NSAIDs prevalence survey in medical shops in the Nilgiris. The diclofenac prevalence study was conducted in 107 medical shops in 18 locations from the Nilgiri district. Of which Ooty area holds more (n=25) number of medical shops followed by Coonoor (n=19), Gudalur and Kotagiri (n=13). On the other hand lowest number of medical shops was found in Kolapally, Nellakotai each one shop respectively. Among the 107 medical shops and 19 medical shops sold veterinary as well as human medicines and remain 88 shops sold human medicines only in the Nilgiris. 3 ml human used Diclofenac vial sale was observed in the all medicals shops. 93 medical shops personal were aware about the ban of diclofenc. The reason for ban of diclofenac drug related issues most of them were (n=61) clearly know about the ban for the effect an vulture population considerable among (n=2) the shop keepers opined that the diclofenac was banned its effect on side effect and scavenging birds,few of them (n=12) that the drugs side effect on all animals. Knowledge on other NSAID harmful drugs such as ketoprofen, Acelofenac, Flunixin and Nimesulid to vultures questionnaire result showed that the most of the (n=86) medical shop keepers were well aware. Among the 107 medical shops intensive survey was carried out on the 19 medical shops sold veterinary as well as human medicines medical shops for NSAIDs prevalence the result shows that drugs was purchased mainly by livestock holders as per the veterinary doctor's prescription and they all are very well knowledge on diclofenac ban and the reasons. Knowledge on other NSAID harmful drugs such as Acelofenac, Flunixin and Nimesulid to vultures questionnaire result showed that the most of the (n=11) medical shop keepers were not aware. Total of 8 medical shops were aware of ketoprofen ban and withdrawn from Tamilnadu state Animal Husbandry Department was known. It's interesting to note that Meloxicam was the fastest selling pain killer in all 19 medical shops. In a nutshell more awareness is needed for medical shops to aware of other NSAIDs in Nilgiris.

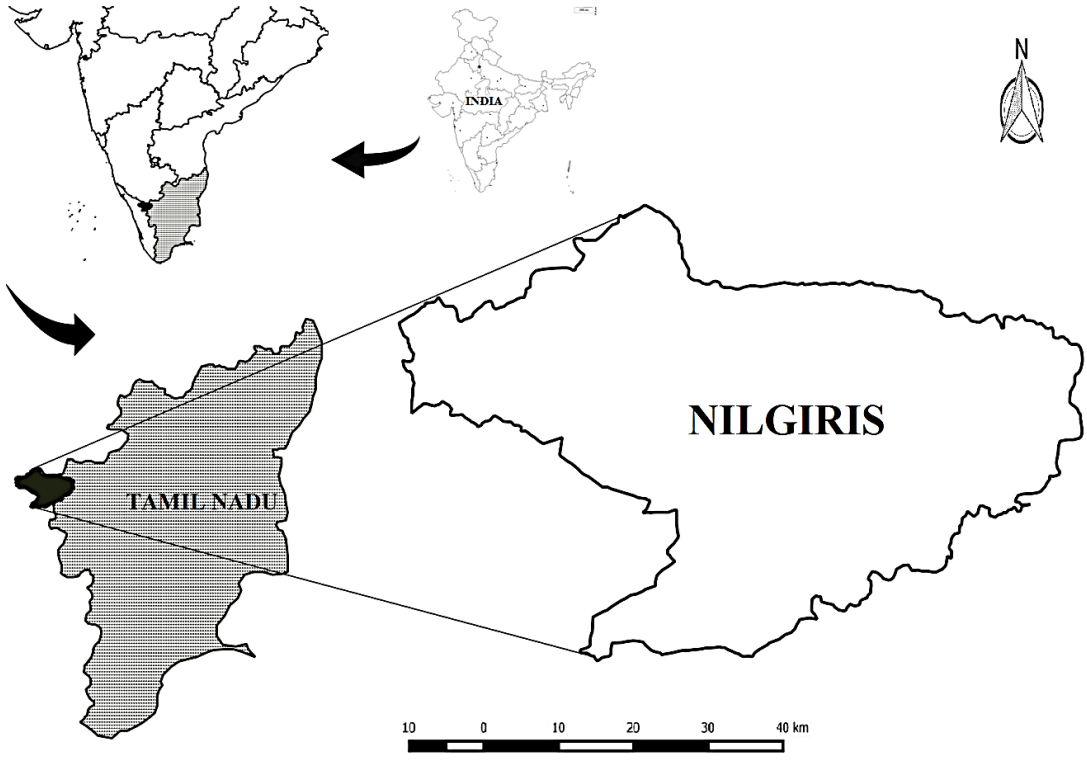
Keywords: non-steroidal anti-inflammatory drugs, vultures, diclofenac, meloxicam, medical shops scavengers.

Introduction

Veterinary use of the non-steroidal anti-inflammatory drug diclofenac on domesticated ungulates caused populations of resident *Gyps* vultures in the Indian sub-continent to collapse. Three species of vulture, endemic to South Asia, White-rumped Vulture *Gyps bengalensis*, Indian Vulture *G. indicus,* and Slender-billed Vulture *G. tenuirostris* are endanger of extinction because their food supply is contaminated with diclofenac, a non-steroidal anti-inflammatory drug (NSAID) used for veterinary treatment of livestock (Oaks *et al.,* 2004). Surveys of livestock carcasses across India indicate that over 10per cent contained diclofenac residues (Taggart *et al.,* 2009) that occur at sufficient concentrations, in relation to dose-dependent mortality of the Oriental white-backed vulture (*Gyps bengalensis)*, indicating that diclofenac is the sole cause of the population crash (Green *et al.,* 2007). Safety testing has established that the NSAID meloxicam is an effective and vulture-safe alternative to diclofenac (Swan *et al.,* 2006b).However, although meloxicam is now used in South Asia and the manufacture and sale of veterinary diclofenac has been banned, meloxicam remains more expensive and human formulations of diclofenac are being used to treat livestock. In this paper, we describe safety-testing experiments on Gyps vultures for ketoprofen, an NSAID already in use in South Asia, following the protocols recommended by Swan *et al.* (2006b). Previous data indicated that the clinical treatment of vultures and other scavenging birds with ketoprofen resulted in no confirmed mortality associated with kidney damage (Cuthbert *et al.,* 2006), and that it is rapidly eliminated in livestock (EMEA 1995). Therefore, NSAID survey was adopted in 2017 as part of the 107 human and veterinary Medicines in Nilgiri district on behalf of Arulagam(NGO). In two phases, only 19 medical shops were sold both the veterinary and human durgs. And then those 19 shops were surveyed again for the further details.

Study area

The Nilgiris or "Blue Mountains" is a major part of the Nilgiri Biosphere Reserve. The Nilgiris is situated (11, 12' and 11, 43' North and 76, 14 and 0 77, 1' East) in the North Western corner of Tamil Nadu in Southern India. They are bounded on the North by the State of Karnataka and in the West and South West by Kerala and East and South by Coimbatore district of Tamil Nadu (Map 1). The Nilgiris occupies a total area of 2542.49 sq. km and the elevation of the Nilgiris ranges from 300 to about 2,700 meters. Nilgiris, as the most forested district of the state, signifies an important stretch of Western Ghats in Tamil Nadu and is the junction of the Western and Eastern Ghats. The peak of Doddabetta is the highest elevation in Nilgiris with an altitude of 2637 meters. There are other hills namely Elk hills, Devarshola hill, Hulical hill and Cairn hill. The present study was conducted in the Upper Nilgiris (above 1000 m MSL).



Map 1. Descriptive pamp of the Nilgiris

Methodology

This NSAID Prevalence survey has been taken in pharmacies in 100 kilometers of areas covered by the Vulture save zone. The malfunction took place in the Nilgiri area of 107 pharmacies**.** The diclofenac prevalence study was conducted in 107 medical shops in 18 locations from the Nilgiri district. Of which Ooty, Coonoor, Gudalur. Kolapally, Nellakotai. The study was aimed to explore the NSAID prevalence in drug stores were collected using questionnaire survey in Nilgiris**.** Two sets of questionnaire were developed for this study. On was "Precise and Closed" and other one was "Broad and Open ended. The respondents were briefed about the purpose of the visit and verbal consent was taken for voluntary participation in interviews. Face to face interviews were made it easier to clear any ambiguity had about the question.

Result and Discussion

Veterinary diclofenac was banned in 2006 and meloxicam was advocated as a 'vulture-safe' alternative. We examine the effectiveness of the 2006 ban, whether meloxicam has replaced for diclofenac in veterinary practices and other NSAIDs prevalence survey in medical shops in the Nilgiris. The diclofenac prevalence study was conducted in 107 medical shops in 18 locations from the Nilgiri district. Of which Ooty area holds more (n=25) number of medical shops followed by Coonoor (n=19), Gudalur and Kotagiri (n=13). On the other hand lowest number of medical shops was found in Kolapally, Nellakotai each one shop respectively. The diclofenac prevalence survey on medical shops shows that among the 107 medical shops only 19 medical shops were used for veterinary use and remaining 88 shops were human purpose only. The medical shops owners were well known about the ban of diclofenac and other ban drugs on their effect on vulture population. 3 ml human used Diclofenac vial sale was observed in the all medicals shops. 30ml veterinary used Diclofenac vial note sale was observed in the all medical shops. 93 medical shops personal were aware about the ban of diclofenc (figure 2). The reason for ban of diclofenac drug related issues most of them were (n=61) clearly know about the ban for the effect an vulture population considerable among (n=20) the shops keepers opined that the diclofenac was banned an its effect on side effect and scavenging birds, few of them (n=12) that the drugs side effect on all animals (Figure3). Diclofenac sale was observed the entire medical shops particularly cattle holders were buy the diclofenac drug most of the time (figure1). According to Diclofenac is widely used in human medicine globally, but it was established to the veterinary market on the Indian subcontinent during the early 1990s. The drug is cheap and extensively used in the treatment of inflammation, pain and fever in livestock. Knowledge on other NSAID harmful drugs such as ketoprofen, Acelofenac, Flunixin and Nimesulid to vultures questionnaire result showed that the most of the (n=86) medical shop keepers were well aware (Table1). Among the 107 medical shops intensive survey was carried out on the 19 medical shops sold veterinary as well as human medicines medical shops for NSAIDs prevalence the result shows that drugs was purchased mainly by livestock holders as per the veterinary doctor's prescription and they all are very well knowledge on diclofenac ban and the reasons. Total of (n= 8) medical

shops were aware of ketoprofen ban and withdrawn from Tamilnadu state Animal Husbandry Department was known. Knowledge on other NSAID harmful drugs such as Acelofenac, Flunixin and Nimesulid to vultures questionnaire result showed that the most of the (n=11) medical shop keepers were not aware. Of which (n=8) medical shop keeper was aware .It's interesting to note that Meloxicam was the fastest selling pain killer in all 19 medical shop. This present study revealed that most of the livestock holders are illiterate and they do not aware about the Diclofenac and their uses. But they were known about the vulture conservation in forest ecosystem. The present study have been supported that a positive conservation altitude is the key for garnering local support for vulture conservation. Education campaigns, such as street theatres and allocating posters in local languages stress forecast and threats of vulture conservation, should be performed to explain the general public. These programmes may improve the awareness of people to a broad range of the values of vultures. Another significant approach would be to educate livestock holders, farmers and veterinary personals on the negative effects of Diclofenac and on the suitable throwing away of contaminated carcasses. Green et al (2004) stated that based on demographic modeling, it has been establish that less than 1% of lethal level of diclofenac can reason a hasty population crash to vulture.

Conclusion

Educating livestock holders, farmers and veterinary personnel may help to secure healthy food for vulture. A long-term solution would be the incorporation of environmental education in school and colleges and to pay more compensation for securing the country's southern most vulture population. In a nutshell more awareness is needed for medical shops to aware of other NSAIDs in Nilgiris. Major vulture population is in Southern India in Moyar. Hence I request Tamil Nadu veterinary department to take over the responsibilities to carry out the NASID prevalence survey in Nilgiris in order to conserve the last southern most wild viable vulture population in Moyar valley Nilgiris.

Figure 1. Details of diclofenac purchase

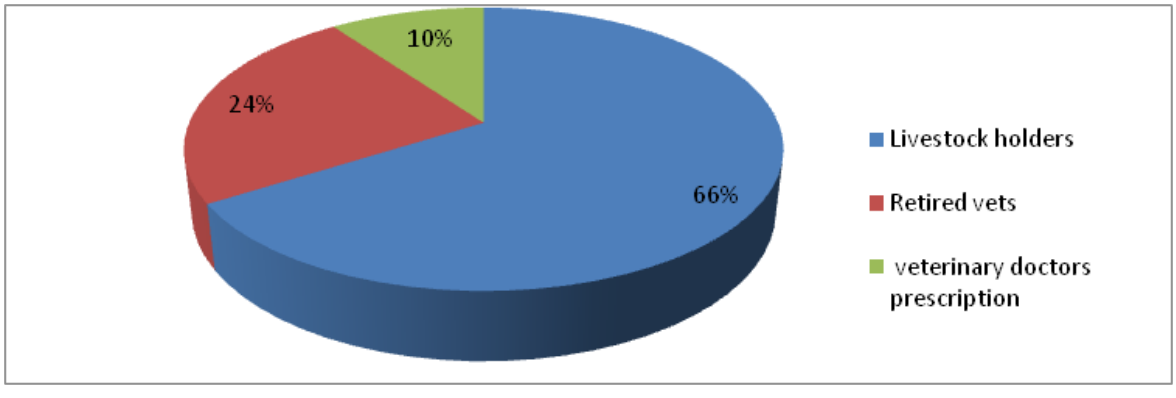


Figure 2. Knowledge on diclofenac ban related issues among the medical shops

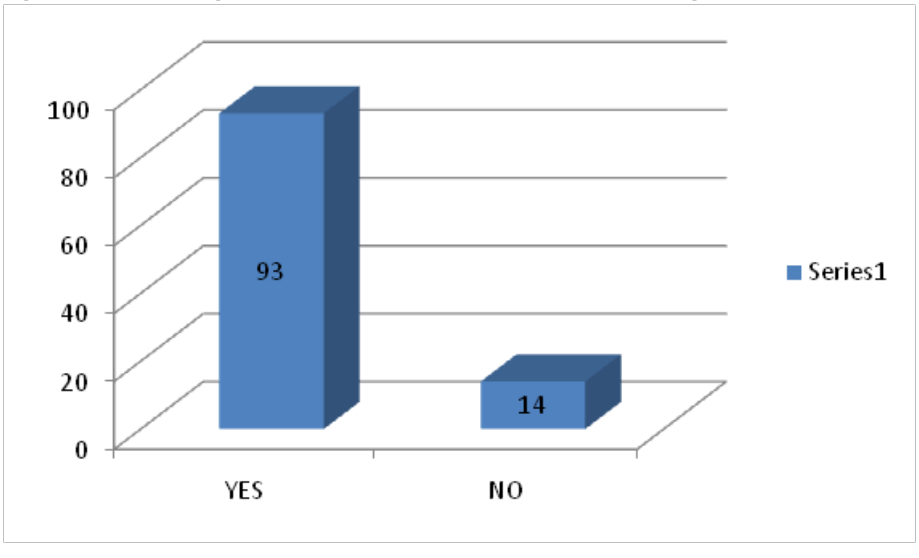


Figure 3. Knowledge on diclofenac drug effect on vulture population among the medical shops

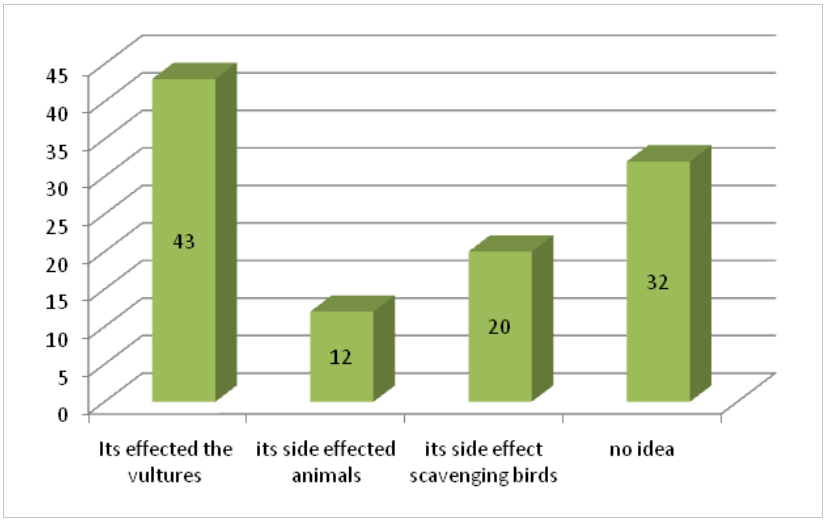


Table 1 knowledge on other banned NSAID drugs among the medical shops

Total number of respondent	Do you know other harmful drugs such as ketoprofen, Acelofenac, Flunixin and Nimesulid to vulture	
107	**Yes**	**No**
	86	21

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LEGAL BATTLE TO REMOVE THE STAY ON THE BAN OF MULTI DOSE VIALS OF DICLOFENAC

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Abstract:

The Union government's decision to ban multi-dose vials of painkiller drug diclofenac for veterinary use, sparked hopes for the survival of the critically-endangered vulture species, the nature's clean-up crew!

The drug was still available in large multi- dose vials of 30 ml labelled '*not for veterinary use*', facilitating the illegal veterinary use of the drug, which caused further decline in vulture populations.

As a big boost to vulture conservation, the union ministry of health and family welfare, passed a total ban on multi-dose vials of diclofenac, through a notification issued on July 17, 2015. The notification said that the diclofenac formulation for human use will henceforth be available only in single dose vials of 3ml.

This ban was challenged by a pharmaceutical company and the stay was issued on 29th December, 2017 by the Madras High Court. It took 2 years for the hearings to be completed and a judgement was passed by the High Court in October, 2017 which reinstated the sense of hope to vulture conservation.

Keywords:

Vulture, multi-dose vials of diclofenac, impugned provision, petition, affidavit,

Introduction:

A notification issued on July 17, 2015 by the health ministry states that the diclofenac formulation for human use will henceforth be available only in single dose pack. This brought a relief to vulture conservationists, but that relief was short lived. While I made a casual visit on the morning of 29-12-2015, to meet Dr.Vijaykumar, a veterinary doctor, he showed me the news item appeared in the newspaper "High Court Stays the prosecution over the ban of Multi Dose Vials of diclofenac. It was a shock and I was stunned for a moment. After a while, I started thinking what to do next. The task was humungous - limited resources, lack of legal expertise, the urgency of conservation of vultures all in front of us and a formidable adversary in the form of the pharma companies. The sad news was shared with fellow conservationists and they expressed their concern over the news. I wanted to collect the case details based on this news. I had no previous experience in court proceedings. I was forced to face the situation head-on.

Way forward overcoming constraints

I contacted *Lajapathirai* , an Environmentalist Advocate known to me. Since he is practising in the Madurai High Court, he directed me to contact an Advocate *Thilakeswaran,* who practises in the Madras High Court.

When I contacted him, he asked me to come in person. I travelled to Chennai the very next day and explained to him about vultures and the urgent need to save them. He wanted to know the details of the writ petition by the drug companies to prepare a Petition for impleading and said that this might take a few weeks and he would call me after collecting the details. His words encouraged me when he said, he would not demand fees, and accept what I can afford, as he wanted to be part of this good cause.

He called me within a week and informed that he had collected the case documents. He also informed me that the document copy could be collected from his office before 6pm. It was already 5pm then.

I contacted *Nagaraj*, my friend, who was near the advocate's office and I requested him to collect the documents. He collected the documents within an hour and called me. After that, I contacted and requested my friend *Britto* to scan and send me the documents. It was already 8pm and he could not do it. Then I contacted *Ragunath Krishna,* a volunteer of Arulagam. He agreed to help and sent the scanned copy to me by email the same night.

I went through the details. I was not able to grasp most of the ground raised by the petitioner. I was kept on reading and extracted following points from the affidavit filed by the company.

The Details of the Case

The writ petitioners attacked the provision in the ban of Diclofenac injections and its formulations in animal use on various grounds and they can be summarized as follows:

a. The basis for introduction of the ban is not supported by any systematic, scientific and long duration study and the same has not been documented by any Governmental Agency.
b. The ban has been brought in, not on account of misuse on human beings, but on suspicion that vultures die on feeding on carcasses of animals, which were administered the Drug, i.e., Diclofenac 72 hours before their death;
c. Diclofenac injections in 30 ml multi dose packs are supplied only to specialty hospitals and Nursing Homes, besides registered Medical Practitioners. They are economical and efficacious;
d. MDV of Diclofenac injection are absolutely essential for treatment as an analgesic i.e., as an NSAID for various conditions in human beings.
e. There are malafides behind the introduction of the ban as the same has been brought in to promote one particular pharmaceutical company.

f. There is no evidence on record to show that Diclofenac has been misused and diverted in large scale for use in animals.
g. The ban was issued prior to conclusion of Drugs Technical Advisory Board (DTAB) constituted for this purpose which held its 63rd and 64th meetings held on 16.05.2013 and 19.07.2013 respectively.
h. If the diclofenac drug for human use is used illegally to treat animals, there are many ways to control the misuse.
i. The drug was manufactured prior to the ban order and distributed all over India and it is not possible to withdraw all of them. Hence, action on pharmacists by authorities should be stopped immediately.

Experts' Role

Due to my knowledge is limited, I shared the case details with experts in this field namely *Vibhu Prakash*, Sashikumar, *Chris Bowden* and *Toby Galigan* and requested them to send scientific details to respond to this writ petition. They sent all scientific documental evidences published in international journals and ban orders for diclofenac in Nepal, Bangladesh, Pakistan and Iran issued in their official gazettes. We attached the proven claim by Professor *Rhys Green* of University of Cambridge that just 1% of diclofenac residue in a carcass is sufficient to kill thousands of vultures.

I also shared the details and got the opinion of K. Mohanraj, Homi RSK, Devendra Swaroop and Jagati. I collected and submitted all the above documents to the advocate, but he expressed his time constraints to read all the research papers and requested us to highlight the relevant sections. *Sasikumar* of Malabar Natural History Society helped in this exercise and attached remarks, which were submitted to the advocate.

The advocate wanted to include the details such as my background and what motivate me to show interest in this case. I provided him the details that I have been working for 25 years in environmental conservation and I have been working to conserve vulture species in Tamil Nadu during the past five years. Besides, I have written 3 books and more than 200 articles in Tamil language on wildlife and environmental issues. He included those details and submitted the impleading petition.

Our Response to the petition

Our submissions can be broadly summarized and encapsulated as below:

a. Vultures play the critical role of sanitizing the ecosystem as a keystone species. They are irreplaceable.
b. There is enough statistical and scientific proof to show the decline in vulture population and that diclofenac is the major cause.
c. Since they are critically endangered, collecting carcasses of vultures for test of contamination of diclofenac is very difficult.
d. The ban was introduced in public interest on the basis of sanctified precautionary principle.
e. People prefer to use diclofenac as it is cheaper than the alternate safe drug.
f. Using 30 ml vials on many people or repeatedly on a single individual may cause contamination.
g. Since it is people that purchase drugs for both cattle and themselves, it is difficult to know who they are purchasing them for.
h. The judgement given by Justice *K. S. Radhakrishnan* on "Protection of Wild Buffalo" is a precedent where the judgement was given without full scientific evidence considering the gravity of the situation.
i. India is a signatory to the 1992 Biodiversity Convention and therefore should not allow the decline of vulture population, as the objective of the biodiversity convention is that, wherever there is threat of reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat.

The day arrived

18-02-2016, It was the first time I entered the court proudly for a public interest case.There were a lot of cases to be heard on that date and I was eagerly waiting. Our case was taken only in the late afternoon session for hearing. Our advocate felt that it would be more appropriate if senior advocate *Radhakrishnan* appeared for this case and requested him to do so.

So, *Radhakrishnan* appeared and pleaded that there are strong evidences to prove that diclofenac is the cause for reduction in vulture population and even though the drug is banned but the pilferage continued. Moreover, banning the drug is the policy decision taken by government of India. Hence the stay order to be vacated.

The Objections by the Pharma Companies

The advocate appearing for the Pharma Company objected my intervention stating that I don't have a scientific background and I have no rights to respond. And that only the union government should respond to us. Moreover, all the information that I submitted were downloaded from the internet. Hence his impleading petition to be dismissed.

Intervener

However, the honourable judge allowed me to continue as an intervener. This gave me an opening to witness and get periodic updates about what was going on in the hearings. Vibhu prakash and Sashikumar gave me a moral support by joining me couple of time during the hearings.

Judge remarks

The honourable judge questioned the urgency of announcing the ban without waiting for the DTAB report. The government responded stating that the ban was not on the drug itself, but only on the size of the vials and hence there was no need of waiting for the expert opinion. But the honourable judge did not accept this argument. He ordered the drug control office to form a committee and submit a report. The case was adjourned to next hearing.

Another threat

Based on the traction that *Laborate* got from this case,

another company named *Alpa* joined as a second petitioner, whereby they would benefit from the proceedings.

Court order

Since there was no progress in forming a committee until the next hearing, the honourable high court in its hearing dated 17th June, 2016 directed: "minutes of DTAB dated 16th May 2013 should be given affect to and committee of the persons mentioned aforesaid stands constituted to submit its report to the DTAB with a copy to be placed before us. The committee may also obtain the opinion of the petitioner".

The hearings were repeatedly postponed for the next 6 months due to non-receipt of the expert committee report. Meanwhile, *Seshan*, a wildlife enthusiast, joined as an impleader and advocate *Yogeshwaran* appeared for him.

The Petitioner's Response:

Table 1

Financial Year	30 ML	3 ML
2007 - 08	3321180	2817500
2008 - 09	7868970	3246000
2009 - 10	10532225	2301550
2010 - 11	6243384	4095194
2011 - 12	7624220	4755000
2012 - 13	8566180	8753500
2013 - 14	10065550	13554050
2014 - 15	17029175	9321750
2015 - 16*	18929070	5840650

Finally, the committee submitted their report during January 2017 after sitting through as many as 9 meetings.

The Committee Report

In that report, committee pointed out that the decision of DTAB was minuted in 2013 but the notification was issued two years later. The reasons for this gap were not clear.

Questions to the petitioner

As per the direction of the court, the committee also tried to obtain the petitioner's view by raising the following questions

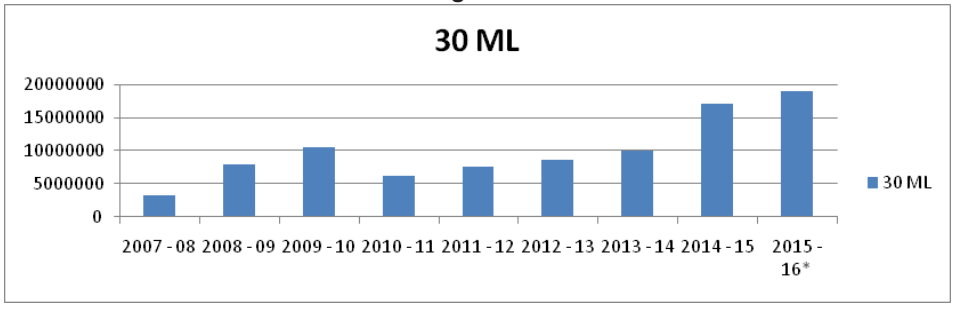
a. Production data of diclofenac injection of all pack sizes manufactured by you year wise since 2008 till date.
b. Market share of your formulations of diclofenac injections
c. Financial loss suffered due to the restriction of pack size of diclofenac injection
d. Number of other manufactures of MDV of diclofenac

The petitioner responded only for the production details of year-wise production. They have not responded to the rest of the questions. From the figures we can deduce that they have not faced any financial loss, but substantial increase in the sale of 30 ml and 3 ml vials.

*Our visualisation based on figures provided by the petitioner can be seen below in figures 1 & 2.

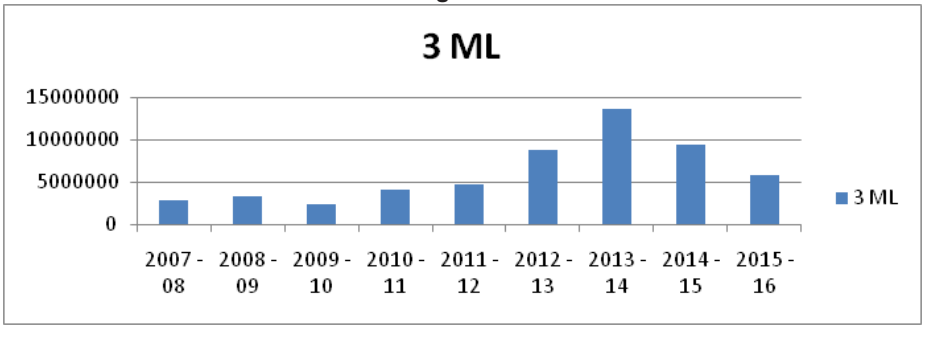
This showed the production grew significantly (25 times increase) when there was an expectancy of ban coming through. This seemed to have been deliberate.

Figure 1



*It is to be noted that the figures pertaining to 2015 – 16 only shows their production from April to June 15th (just 75 days). This is only in the case of the 30 ml vials.

Figure 2



Recommendations by the Expert Committee

The expert committee also obtained the views of the department of Drug control, MoEF & CC, Animal Husbandry and scientist Dr.Vibu Prakash. Based on those, the committee recommended as below.

The prohibition of diclofenac resulted in significant reduction rate of death of vultures as demonstrated by modelling studies. This justifies the continued prohibition of use of diclofenac in animals. Further, additional measures of reducing the environmental contamination of diclofenac and other pharmaceutical products namely other NSAIDs, antibiotics, anticancer drugs etc. be enforced. This can be done by a synergy and comprehensive approach by regulatory bodies, pharmaceutical industry, public awareness, stringent enforcement of biomedical waste regulations etc..

1. Although the correlation of diclofenac residue has been shown with reduction in vulture population, still stronger evidence is required. Therefore, continued adequately powered well-structured epidemiological studies and casualty studies are required.
2. As far as the MDV pack size of diclofenac injection meant for human use is concerned, there is no strong evidence of its pilferage leading to its misuse in animals, which is sufficient to cause significant adverse impact in vulture population. However, the possibilities of its misuse in animals as alleged by NGO's cannot be ruled out.
3. The committee is of the opinion that no disadvantage to the patient community will occur by withdrawing the MDV of diclofenac as a precautionary approach. More evidence based data and not the opinion or perception is required to take a considered view on withdrawal of MDV of diclofenac for human use. This also includes feedback from practising physicians, clinics, nursing homes and hospitals.

Though the report was unbiased, it was a double-edged sword and we could not make much headway with the same. But honourable judge drew valid point from the report like …'misuse of the drug cannot be ruled out'.

Response from the Deputy Drug Controller

Mr. Manivannan, Deputy Drug Controller submitted the counter-affidavit to the petition with passion and enthusiasm. This was a shot-in-the-arm to our case. The grounds on which Union of India defended the impugned provision can be broadly crystallized and summarized as follows:

a. Vultures are universally accepted as Natural Scavengers and absolutely essential for environmental and ecological balance. Therefore, preservation of vulture population is non-negotiable.
b. The ban has been introduced in public interest.
c. The ban has been introduced after taking into account the views of stakeholders. Views of stakeholders were obtained by publication of draft rules and inviting objections and suggestions from the stakeholders and public on the proposed impugned provision.
d. The possibility of misuse of 30ml packs in animals and the possibility of diversion for use in animals cannot be ruled out even according to the report of the Expert Technical Committee appointed by this Court.
e. As a corollary to the preceding point, Government of India would submit that they have brought in the ban on the basis of the sanctified precautionary principle impelled by public interest.
f. The pharma companies seem to have just their commercial interest, without social responsibility.

Argument by senior Government Counsel

Senior Government Counsel *Rajagopalan* refuted the argument from the petitioner that the government institutions have not done any study on the role of misuse of diclofenac and their impact on vulture population. In support of this, he quoted a study done by the Indian Veterinary Institute, where it has been clearly documented how the drug was being misused with state-wise data. He also brought the judges' attention the judgement against Macleods Pharmaceuticals Limited, which was given on the basis of precautionary measures without sufficient scientific evidence.

Summary of discussions and judgement

On patient hearing of both parties, the Hon'ble Ms.Indira Banerjee, Chief Justice and The Hon'ble Justice Mr. M.Sundar delivered their historic milestone judgement in protecting not only vulture species but also other endangered species.

One of the highlight in the verdict was the court chose to use the term 'Natural Sanitary Worker' instead of the term 'Natural Scavenger'.

Vultures are universally accepted as sanitary workers, which clear carcasses of domestic livestock/cattle and thereby protect ecological balance. 'Vulture population in India is on the decline, it has an adverse impact on the ecological balance / environment and therefore, such decline in vulture population needs to be arrested' - this is the central theme of the genesis of this lis.

There is no dispute amongst the parties to the lis before us that the aforesaid vultures are critically endangered species and the nucleus is a pharmaceutical product, which goes by the name Diclofenac.

The expert committee filed its detailed report in this Court on 01.02.2017. The findings returned by the expert committee to the effect that the possibility of misuse of Diclofenac in animals has, as urged by Non-Governmental Organisations (NGOs) cannot be ruled out.

The Committee is of the opinion that no disadvantage to the patient community will occur by withdrawing the MDV pack size of diclofenac injection as a precautionary approach.

One crucial aspect of the matter to be noted is that the petitioners were given adequate opportunity by the Expert Committee, but the writ petitioners replied to just one of the many questions.

The study was not conducted just by the NGOs, but also by the Indian Veterinary Research Institute, which conducted a state-wise study of the presence of Diclofenac-

positive ungulate samples, which shows the rampant use of diclofenac.

We cannot wait till we get complete evidences and researches; it will be too late to act. The precautionary principle and the polluter pays principle have been accepted as part of the law of the land.

The state shall endeavour to protect and improve the environment and to safeguard the forest and wildlife of the country, to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures.

There is a need for an exclusive parliamentary legislation for the preservation and protection of endangered species, so as to carry out the recovery programs before many of the species become extinct.

a. Article 21 of the Constitution of India guarantees protection of life and personal liberty.
b. Articles 47 of the Constitution talks on duty of the State to raise the level of nutrition, the standard of living and to improve public health;
c. Articles 48A of the Constitution guarantees Protection and improvement of environment and safeguarding of forests and wild life;
d. Articles 51 A(g) of the Constitution guarantees to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures.

As we are accepting the precautionary principle theory advanced as an argument by the learned Solicitor, lack of decline in vulture population post 2012 argument of writ petitioners also pales into insignificance.

Moreover, referred to what the Supreme Court had to say in a judgment; National Wildlife Acton Plan- NWAP (2002-2016) has already identified species like the Great Indian Bustard, Bengal Florican, Dugong, the Manipur Brow Antlered Deer, over and above Asiatic Lion and Wild Buffalo as endangered species and we are therefore inclined to give a direction to the Government of India and the MoEF to take urgent steps for the preservation of those endangered species as well as to initiate recovery programmes.

Petition dismissed

Finally, the Court dismissed the writ petition by Laborate Pharmaceutical India Ltd. and Alpa Laboratories Ltd and upheld the ban on MDV of diclofenac and the drug will be available only in single dose vials of 3ml. This judgement is an important one and will save vulture species and the environment.

Appreciation by the court

In the judgment, Honurable Judge appreciated our role and mentioned as two public spirited individuals *Seshan* and *S.Bharathithasan* for submitting various documents.

Acknowledgments:

My contribution in this court case is limited; however I should mention many individuals who helped voluntarily.

All hearings will be notified only on the previous day late evening and Mr. Sundar, assistant to government counsel informed the same to me each time through text messages by night. I record my sincere thanks to him.

Lenin and Nagaraj, Volunteers of Arulagam made arrangement for travel tickets and stay etc for every visit to Chennai for attending the court hearings. Mac Mohan needs a mention here for giving advices including the Precautionary principle. Encouragement from Jack Tordoff, Sashikmar, Chris Bowden, Vibhu, Toby, Homi RSK, also should be mentioned here.

Bird enthusiast, Mr. Chandrasekar gave the book “Aftermath of diclofenac & Vulture conservation in NBR”.

I would like to mention the contribution of the following persons in this case. Advocates Thilageswaran, Radhakrishnan, Yogeswaran, Santhanaraman of the Green Tribunal, Junior Advocates – Vetriselvan Surya and Nila. I also would like to mention my appreciation for the timely hep of the following persons Britto, Vasanthi Rubert, Kalaivani Anand, Seshan, Logeswari and Rammohan. I also want to express my sincere thanks to the media especially The Deccan chronicle and The Hindu.

That I could spend the better part of the last 2 years with peace of mind was entirely due to the limitless love and patience of my family. Their support ensured that I remained strong and willing to take up any challenge that came my way.

I also would like to mention and extend my sincere thanks to Mr. Kalyanasundaram and Raghunath for translating this article from Tamil to English.

The Chronology of Events

Chronology of events		
S No	**Hearing Date**	**Event**
1	27.11.15	Gazette Notification dated 14.6.15 on Ban of MDV of diclofenac challenged by laborate pharma
3	29.12.15	Stay order issued by the court, because the ban was issued by drug controller before obtaining the expert committee report
4	17.2.16	Impleading petition filed by me
6	18.2.16	Drug Controller Report submitted to the court
7	07.4.16	Judge questioned why did the ban was not formed
8	17.6.16	Judge ordered to form the Committee
9	23.8.16	Court itself formed the committee
10	01.2.17	Expert Committee Report submitted
11	24.10.17	Stay removed

Supported documents

1. Collapse of Asian Vulture Population -- Rhys E.Green et all. - Journal of applied ecology
2. Diclofenac residues as the cause of Vulture population decline - Pakistan - Lindsay oaks et all - Letters to Nature
3. Diclofenac poisoning is widespread in declining vulture populations across the Indian Subcontinent - Susanne Schultz et all - Proceedings of The Royal Society
4. Toxicity of diclofenac to Gyps vultures - Gerry E swan et all Bilogy letter
5. Rate of decline of oriental WBV - Rhys E.Green et all. - PLOS one
6. Recent Changes of population - V.Prakash et all - JBNHS
7. Assesing the ongoing threat - Richard J.Cuthbert et all - Oryx
8. The population decline of Gyps vultures in India and Nepal - Vipu prakash et all - PLOS one
9. Postmortem report- SACON, India - Dr. Muralidharan, SACON
10. Continuing mortality of vultures in India - Richard J.Cuthbert et all - Oryx
11. Diclofenac monitoring in cattle and buffalo carcasses surveyed in 2009-10 & investigating other causes of mortality in vultures in India - IVRI & BNHS
12. Action plan for Vulture Conservation in India, MoEF-GOI
13. Supreme Court of India- TN Godavarman Thirumalpad Vs Union of India - Judgement by Justice KS Radhakrishnan
14. The urgent need and justification for ban of all multi dose human diclofenac vials larger than 3ml - Chris Bowden
15. Regional Declaration on the conservation of South Asia's Critically Endangered Vulture Species - Governments of Bangladesh, Nepal, India & Pakistan

MALIGNED HERO-BIRDS: IMPORTANCE OFCONSERVATION AWARENESS PROGRAMMES ON VULTURE CONSERVATION

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ABSTRACT

Education is crucial to conserving vultures. Zoo Outreach Organization, on realizing the enormous decline of vulture population by ingesting a drug, initiated its vulture conservation education programs in 1990 by carrying out a survey on status and management of vultures in Indian zoological Gardens. Utilizing the data generated, education materials were developed for a range of target groups. In 2004 vulture conservation education programme was extended for South Asian countries. In 2012 the vulture education materials were revised for updated information. All these materials were well received and utilized by a range of wildlife and environmental educationist across India and South Asian countries that created measurable impact on vulture conservation. The principle, approach, contents of the education programmes, education tools and methods, feedback from the educators, and future conservation recommendations are discussed in detail.

A SYNOPSIS OF VULTURE SAFE ZONE ACTIVITIES UNDERTAKEN BY ARULAGAM 2012-17

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ABSTRACT

Vulture Safe Zone (VSZ) concept is implemented in 2013 by covering four districts in Tamil Nadu namely, The Nilgiris, Coimbatore, Erode and part of Tirupur districts. Concerted efforts were given by joining hands with diverse stakeholders. Various programmes right from the street theatre, puppet show, rally, human chain, exhibition, survey, sports event, carnivals, advocacy for policy change and etc., were organized for sensitizing the stake holders. Remarkable impacts like withdrawn of ketoprofen from animal husbandry department, periodic raids conducted by the department of drug control, vulture conservation resolution in *gramasabha*, legal battle in removing the stay order for diclofenac, and etc., were made. Conservation of the critically endangered vulture species is an enormous task. However, the rate of decline has stalled by the timely intervention of great naturalists and scientists from all over the world. Arulagam did its level best in Tamil Nadu.

Key words: Stake holders approach, Vulture Safe Zone, Vulture Conservation, diclofenac

Introduction

There are four species of vultures, Oriental White-backed Vulture (OWBV); Indian (Long-billed) Vulture (LBV); Red-headed Vulture (RHV); and Egyptian Vulture recorded in Tamil Nadu. Egyptian vulture is categorised as endangered and rest of three vultures are critically endangered. Arulagam is trying to establish Moyar valley as a permanent safe zone for vulture with the support of diverse stakeholders.

Objectives

Arulagam is working in the Moyar valley for the past five years with following objectives.

- To establish a network with diverse stakeholders to join hands in vulture conservation
- To ensure a safe and secure environment for the revival of vulture species in sustainable level in South India.
- To monitor vulture breeding colonies

Project Outputs

The following are the highlights of our projects.

- Resolutions to protect vulture species were passed at the Gram Sabhas (local administration) in the districts of Coimbatore, The Nilgiris and Erode. With pride, we would like to record that it is a pioneering model even at the National level
- Due to the intervention of 'Arulagam', the Drug Control Department, Government of Tamil Nadu is undertaking periodic inspections so as to ensure that the banned drug is not available in core areas such as Coimbatore, The Nilgiris and Erode
- The first breeding record of Indian long-billed Vultures (LBV) (five pairs) was recorded in Nilgiri North Forest Division.
- New breeding colonies of Oriental White-backed Vulture (OWBV) and LBV nests were recorded in Moyar Valley for the first time
- Cinereous vulture, Himalayan Griffon Vulture and Eurasian Griffon Vulture were recorded for the first time in the landscape on different occasions. (It was published in Social media and daily newspapers)
- Vulture Working Group has been initiated in South India
- Arulagam has developed "Recovery plan for vultures in Tamil Nadu" and submitted to the higher officials in Forest, Drug Control and Animal Husbandry Department

Initiative by Animal Husbandry Department of Tamil Nadu

- At the behest of Arulagam the Animal Husbandry Department has withdrawn the procurement of ketoprofen (another drug akin to diclofenac) which has been proved inimical to vultures. With satisfaction, we would like to record that this is the first achievement in the whole world. It was instrumental to ban the ketoprofen drug for the veterinary use in Bangladesh
- Circulars with warning message were issued to the Veterinary Doctors in and around NBR about the misuse of the banned drug by the Department of Animal Husbandry

Initiative by Forest department

- Vulture Watchers were appointed for ensuring better protection of Vultures in Sathyamangalam Tiger Reserve
- Naturally dead wild animal carcasses are allowed to vultures. It ensures and increases the availability of safe food
- Vulture Conservation Agenda was included in the management plan of Mudumalai & Sathyamangalam Tiger Reserve of State Forest Department, Government of Tamil Nadu
- State Forest Department has initiated "Society for Wildlife Interface and Forestry Training" (SWIFT) with Vulture conservation as one of the three focal scheme
- By Arulagam's genuine efforts and guidelines 'Vulture Conservation Agenda' was included in the working plan of the Nilgiri North Division of Forest Department, Government of Tamil Nadu with the support of Mr. Sugirtharaj Kovilpillai, then DFO, and Mr. Kalairajan, then A.C.F., Gudalur.

Recognition

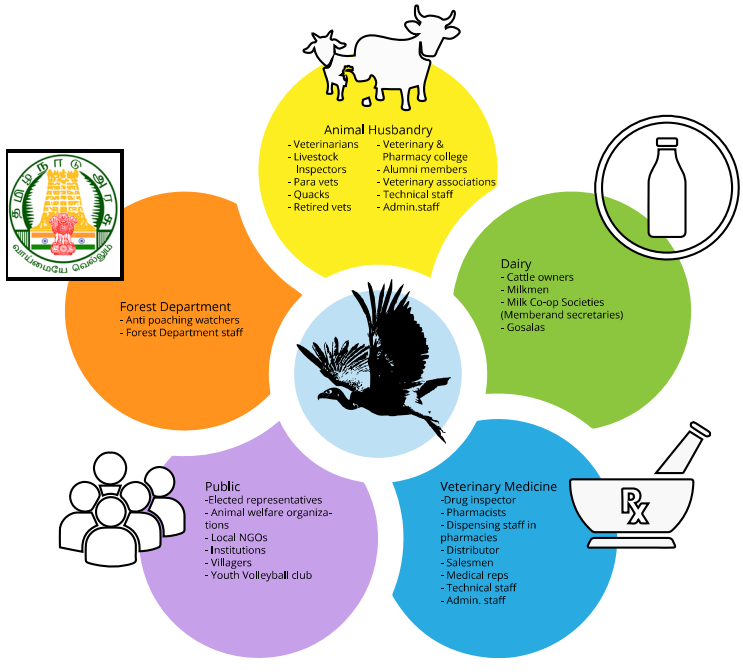
- Arulagam has been selected as Associate partner in SAVE consortium.
- Auroville Foundation, Puducherry, India has awarded Biodiversity Award in 2015 for the conservation of environment and vultures
- Arulagam's exemplary work has been recognized by International organization, Critical Ecosystem Partnership Fund (CEPF) and has selected Arulagam's Secretary, Bharathidasan Subbaiah as a Bio- diversity Hot Spot Hero in 2016
- Oriental Bird Club (OBC),UK through March Conservation Fund of Tide's Foundation, California, USA has also recognized Arulagam's work and awarded the best project award for the year 2015.

Personal level

- I myself had impleaded in the writ petition against the Multi Dose Vials of diclofenac ban issue and submitted the necessary documents to the high court of Madras. Now the court has upheld the ban
- I have presented two papers one is at Africa chapter and another one is at Asia chapter in world conservation congress in IUCN, Hawaii, 2016
- I shared my experiences in the recently held 7th SAVE meeting at Bangladesh in Nov, 20th 2017. I also have been invited to share our experience in 2014, 2015, 2016 of SAVE meeting
- I have written three books in wildlife and including a book on Vulture in Tamil.
- R.Venkitachalam awarded his Ph.D. thesis entitled "Status and Ecology of threatened Vulture Species in Moyar Valley of Tamil Nadu, India" with the support of Arulagam. This is the first scientific report on Vultures in the Nilgiri landscape.

Activities and Approach

We categorized the stakeholders into 5 groups.



Attitude Survey Conducted

We conducted a survey in the project area and asked the cattle owners the following questions.

Why was diclofenac banned? Was there a connection between vultures disappearing and diclofenac? When was the last time you used diclofenac in cattle? Which is the safe alternative drug recommended by the government? Can we use multiple dose of the human drug on cattle?

The objective of the survey was to find out the level of awareness prior to the commencement of our project. We chose the following stakeholders - the cattle owners, veterinary doctors and their likes.

A slightly different questionnaire for the drug dealers and pharmacists were asked like:

Which is the most popular NSAID? When was the last time you sold diclofenac for cattle? Are you aware of the drugs that cause harm to vultures?

Attitude and awareness survey also conducted among the professor in the Veterinary College. When we asked the question to a professor, why the drug diclofenac was banned? His reply was that he just knew that the drug was banned and he needed time to refer and get back to us as to why it was banned!

This gave us the indication of the gravity of the problem. If a professor should state he needs time to know regarding the ban, how can we expect the common man to know it?

We realised that even after 4 years of the ban, hardly very few people only knows about it and everyone should

be aware of the ban and the reason. It was indeed a tough proposition. We decided to take up the challenge and started in earnest.

Propaganda Materials developed

Based on the above inputs, propaganda prepared materials developed and printed that explained about vultures, the 4 extant species in South India, their role in the ecosystem, the status as endangered species, the cause for their decline, the steps needed to be taken to revive them and the role of people in the same.

Interaction by triggering the glorious past

memories are usually nostalgic to people and we used this aspect to start our conversation with them. We approached middle aged people and asked them when they had seen this bird last. Most of them replied that they had seen this bird in their childhood. This presented us the opportunity to open them up for further discussion. We asked if it hurt them that the bird that they once saw in huge numbers is now on the verge of extinction. We saw that this question really moved them.

We told them that Dr. Neelakandan, a bird researcher has documented that the number of vultures exceeded that of crows in Chennai in the year 1950! We presented the story of *Thirukazhugukundram*, where 2 vultures would come to consume the *prasadam* from the priest of the temple at noon everyday till about 30 years back. Now they have disappeared forever. We shared references regarding vultures that appeared in our *sangam* literature, *Kamba Ramayanam* etc and the stakeholders listened to these and shared their knowledge passionately.

The next step was to change the general perception of vultures among the public. Vultures were routinely portrayed in bad light by cartoonists and writers alike. They sought to show vultures where they wanted to show cunning, death, desolation etc. If looks are not your forte and you have bad press to boot, how could you make it to stardom? It is difficult, but possible. All that is needed is an image makeover with proper positioning. We collected data of the thankless service vultures were rendering for millions of years and how their not-so-elegant looks made them ideally suited for the role. We saw promising results in this PR activity.

We engaged them in a discussion as to where these birds have gone now and what happened to them. And then, through various means of communication such as printed materials, slogans, art and drama, we made them realise that we have inadvertently destroyed them by using harmful drugs like diclofenac on cattle and that they became critically endangered.

Pharmacists

We wanted the pharmacists to be aware of the ban and that we are following up on the ban and sent copies of the gazette notification on the ban via post and email. We hand delivered the notification as a reminder. We brought this up in the Pharmacists meet too. We also invited the drug and pharmacy association president and secretary as a chief guest in our programme and vulture conservation message delivered effectively through them.

Department of Animal Husbandry

We designed a focus group for the veterinarians and others in the field of animal husbandry and coined it 'Vet for Vultures". We connected with this fraternity through various methods such as taking part in their annual meetings, inauguration of new veterinary dispensary, Veterinary camps, events for free milch cattle distribution etc with or without invitation, mostly the latter. We utilised every opportunity to bring up the topic of the harmful drugs used on cattle killing vultures and requested them to shun the same.

I was invited by my friend Dr. Jaganmohan to his daughter's marriage. As he was a veterinarian and a lot of his fellow veterinarians would attend the function, we used the opportunity to discuss the topic of diclofenac and reminded them of the harmful effects of such drugs on vultures. We distributed pamphlets on the occasion. We have been taking part in the monthly meetings of the milk cooperative society in Sathyamangalam and imploring with them to shun diclofenac and such harmful medicines.We faced challenges in quick dissemination of the information and the temporary nature of wall posters. So we created a stencil and used it to paint on the walls of the milk society office and nearby places messages regarding the ban and the dangers of using the harmful medicines on cattle. They were quick to create and last as long as we need them to.

Public Events

We took part in the events where people gathered in large numbers namely cattle sandys, temple festivals etc by conducting exhibitions and distributing pamphlets and interacting with as many people as possible.We conducted events such as rallies, processions, street corner meetings, puppet shows, street theatre etc and created awareness among public. In spite of the lukewarm response from the people, we continued our efforts nevertheless. We have faced cynicism and acrid criticism from various people, but those only strengthened our resolve. Wherever we go, we show the video "Vanishing vultures" wherever possible.We go to places where people gather for MNREGA activities and distribute pamphlets regarding carcass poisoning and hazards of harmful medicines like diclofenac.

Motorcycle Rally

We conducted a 500 kms rally with TITA (Tiruppur Information Technology Association) starting from Tiruppur covering the 3 states of Tamilnadu, Kerala and Karnataka to spread awareness of vulture conservation and the need to shun harmful medicines like diclofenac on cattle. We distributed pamphlets, held meetings at important junctions, had interactions with cattle owners.

Vehicle: A Message bearer

On the way and displayed the messages on our vehicles too. The rally aside, our vehicle has covered more than 1,00,000 kms with the message. The display board made people curious enough to approach us wherever we park the vehicle.

Pals of Vulture

We wanted to give a positive message to the next generation praising the role of vultures and thanking them for the same. We also wanted children to know how to observe and learn from nature. We designed a unique event for vultures involving children, which is the first of its kind in the whole world. The event was named "**Gyps Carnival**". **Gyps Carnival** was focused on the theme of vulture the specialist and we portrayed their unique adaptations such as keen eyesight, unbelievable flight capability, disease resistance, enormous appetite, their harmless nature etc. We enlisted the support of the Indian Air Force and invited the wing commander to address the children. We had Air Force NCC cadets explaining the process of flight with a flight model and showed them how these would have been designed by inspiration from the birds. We conducted art competition across 4 age groups and had more than 3000 children participating in it. They learned about vultures and appreciated the bird by enthusiastically getting tattoos of vultures and masks.

Ladders Game

We took the game of *paramapadham* (snake and ladder) from our culture and developed a similar game with the theme of vulture conservation and we get children to play it in various gatherings and present vulture dolls as prize to them. (Designed the game in such a way that the game should not make a negative image on snake also).

Vulture Recovery Plan

We developed an action plan with the support of SAVE (Saving Asia's Vulture from Extinction) to bring the critically endangered species back from the brink and reached the same to the decision makers.

Vulture Trophy – Volley ball tournament

We saw that the youth in the Nilgiris love the game volley ball due to limited space. We used this for conveying the message among the youth and conducted a tournament called 'Vulture Trophy Volley Ball Tournament'. Using the public announcement system they had for commentary, we broadcast the message of vulture conservation and the effect of diclofenac, carcass poisoning, forest fire etc. at regular intervals as the spectators were our stakeholders. We enrolled them as volunteers under a group called 'Vulture Brigade'. We have been having tattoo sessions with vulture drawings to attract the youth.

Milestones

We would like to share with you some important achievements in vulture conservation. They are:

A Historic Resolution

As the Lok Sabha elections were underway, we were prohibited from using our propaganda vehicle. We had to be dormant during that time. As we were going through the newspapers, one news item caught our eye. It said that the Grama Sabha meeting held on the 1st of May every year would have to be shifted to 1st of June due to the election. We planned to use make use of this additional time of one month to get the grama sabha to pass the diclofenac ban as a resolution. It would make a huge impact as the grama sabha resolution will have far better reach to our stakeholders. *Archana Patnaik* was the collector of Coimbatore at that time. We met her and shared this idea. She had taken part in our event in Nilgiris when she was the collector of Nilgiris then. As she was aware of the precarious situation of vultures and was keen to do something to protect them, it was easy for us to convince her. She accepted our request to pass the resolution. We felt that passing it as a resolution in Coimbatore alone is not enough and we need to do the same in the other districts of Nilgiris and Erode which are part of our project area. We contacted the collector of Erode Mr. *Shanmugam*, IAS and placed the request. He too felt sad that it has become rare to see the bird nowadays. He ensured that the resolution was passed in Erode. The same resolution was then passed in Nilgiris. The then DFO of Nilgiris - *Badrasamy* IFS, and *Shankar* IAS were supportive to the cause. We sent letters to all the local elected representatives of the panchayats about the status of vultures, the need to protect them and the steps to be taken. Now we ensured that the ban on diclofenac on cattle has in fact reached the nooks and corners of our project area.To us at Arulagam, this is a milestone achievement. This is the first time a resolution has been passed to protect a species in all the three districts. This we consider a feather in the cap for our fieldwork. This made people sit up and take notice of Arulagam.

Vultures to soar again

I am sure all our efforts will ensure the revival of their population. However, they may face scarcity of food. Carcasses devoid of dangerous drugs should be made available to them by Cattle owners and forest department officials as a gesture to support the ecosystem. This will ensure not just the revival of vultures, but animals like flies like blue bottle, mynas, hyenas, wild boars and other carrion feeders. The carcasses of animals dying in and around villages are buried. This should change and we need to bring the change soon.

Animal Welfare Society

The 'Nilgiri Animal Welfare Society' kindly consented to our plea and agreed to let the carcasses of cattle that are not treated with any medicine in their gaushala to be feed by vultures. We are proud to have brought this change in attitude towards vultures.

We would like to place our gratitude to Aseervadham Trust for the support they provide by means of giving Rs. 1500/= to the bereaved cattle farmers in lieu of letting their cattle to be consumed by carrion eaters of the forest instead of burying them. We have started this activity now, but we have a long way to go.

Uncontaminated cattle grown by traditional methods

When we saw that even traces of drugs in the carcasses of cattle were enough to kill vultures when they consumed the carcasses, we were wondering what effect it will have on us when we consume dairy products albeit in the long run. After all vultures by their demise and decline

were merely announcing the dreaded message. We have started a movement by promulgating the message of organic maintenance of cattle in the Moyar region and helping the cattle owners realise better value of milk products in this process. We are eager to get your views and ideas in this movement.

Acknowledgement

We would like to record our thanks to C.Sashikumar of (Malabar Natural History Society) and Chris Bowden, Saving Asia's Vulture from Extinctions, (SAVE) Jayshree of Care Earth Trust for their cooperation in executing this project. Also we would like to thank, C. Paraman, Ms. J. Revathi, K.Sakthivel, Prakash and R. Murugesh, Co-ordinators, of Arulagam for their help in many ways. We also would like to convey our sincere thanks to K.mohanraj, M. Lenin, Raghunath Krishna, Amsa, Kalyanasundaram perumal for their volunteer contributions in many ways. At this juncture, we express our sincere gratitude to various institutions such as Tamil Nadu Forest Department, Animal Husbandry Department, Critical Ecosystem Partnership Fund (CEPF), Central Institute of Classical Tamil, Bombay Natural History Society, World Wide Fund for Nature (WWF - India), Oriental Bird Club (OBC), Royal Society for Protection of Birds (RSPB), and Hill Area Development Programme (HADP), Udhagamandalam, Ashirvadam Foundation, Mohamed Bin Zayed Species Conservation Fund, Rufford Foundation, MIVA and Tirupur Information Technology Association (TITA).

Ref;

VSZ concept of Nepal

VSZ initiative of Bangladesh

PEOPLE'S PERCEPTION ON VULTURE CONSERVATION IN TAMIL NADU PART OF THE NILGIRI BIOSPHERE RESERVE, SOUTHERN INDIA

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ABSTRACT

Vultures play an essential role in environmental health by scavenging meat from carcasses in Asian countries especially in India. Being a scavenger in habit, the vultures prevent spread of dangerous diseases such as anthrax and rabies, which could cause havoc to the wild animals, livestock and human. Therefore the vultures play vital role in the terrestrial ecosystem as a scavenger. The vulture populations from India has also undergone rapid decline that causes low awareness among people about its ecological importance. For declining species that have large range and are mostly associated with humans, people's attitudes can have direct effects on their survival because of the multiple linkages and potential for both positive and negative impacts of human behaviour for these large scavengers. Therefore, we conducted a study in Mudumalai Tiger Reserve, Nilgiri North Forest Division and Sathyamangalam Tiger Reserve in the Tamil Nadu Part of the Nilgiri Biosphere Reserve to assess the vultures' and livestock population status and human relations using questionnaire surveys respectively. White-rumped Vulture (*Gyps bengalensis*), Long-billed Vulture (*Gyps indicus*), Red-headed Vulture (*Sarcogyps calvus*) and Egyptian Vulture (*Neophron percnopterus*) were commonly found in this regions. Totally three hundred and ninety-one livestock holders were interviewed in twenty-six hamlets. Of which most of them were tribal (Irrular) and illiterate (53%; n=213). A total of 8531 livestock were recorded. Of which cattle were dominant (n=3621). The livestock holders were making money mainly from dung (Rs.35,12,000/annum). Totally 8191 livestock were lost by 391 people during the past five years. Of which, most of them (n=5631) were lost due to various diseases and considerable (n=2548) amount of livestock were lost due to wild animal's depredation. This was an important outcome of this present project envisaged that the need of adequate and timely compensation/exgratia to the livestock holders in order to curtail poisoning of carcasses as retaliatory killing. Most of the (n=217) livestock owners were just thrown away their livestock carcasses into the forest areas not far away. On the other hand, 174 respondents have buried their dead livestock carcasses. These two findings are a valuable outcome of this present project to initiate food security to vultures through the proper long-term mechanism. The information on diclofenac in relation to vulture conservation was interviewed to the livestock holders. The result revealed that a considerable number (n=137) of people known about diclofenac at the same time most of them (n=254) were not aware of diclofenac and its related issues. A sizable amount of respondents knew that the diclofenac is a pain killer (n=91) and it is an ordinary drug (n=46). It was very important to note that most of the livestock holders (n=84) thinks that the diclofenac is harmful to vultures and similarly good amount (n=53) of livestock holders were opined that the diclofenac is not threat to vulture population. Out of 391 persons, 339 of them were opined that vultures does scavenger role in the forest ecosystem. The majority of the people (n=313) responded that the vulture population is declining when compared to past few years. Another notable conservation problem is that the feral dog's population has increased considerably when compared to past decade. This was mainly due to the availability of livestock carcasses as they were thrown very near to forest boundary. This present study found that almost all of them (n=386) were accepted the need of education for vulture conservation. It was unfortunate to note that most of them (n=388) were opined that the compensation amount paid by the forest department was inadequate and long procedures to be followed which consume more time to get the compensation. Therefore this present study emphasizes that long-term monitoring mechanism to be initiated to win the confidence of livestock holders against retaliatory killings.

Key Words: People's Perception, Vulture Conservation, Tamil Nadu, Nilgiri Biosphere Reserve and Southern India.

INTRODUCTION

Vultures of the genus Gyps are obligate scavengers on the carcasses of dead vertebrates; most commonly wild and domesticated ungulates. There are nine species of vultures recorded in the Indian sub continent namely King vulture (*Sarcogyps calvus*), Cinereous vulture (*Aegypius monachus*), Griffon vulture (*Gyps fulvus*), Himalayan Griffon vulture (*Gyps himalayensis*), Long-billed vulture (*Gyps indicus*), Slender-billed vulture (*Gyps tenuirostris*), White-rumped vulture (*Gyps bengalensis*), Egyptian vulture (*Neophron percnopterus*), and Bearded vulture (*Gypaetus barbatus* (Ali, 1995; Birdlife International 2007; Gadhvi and Dodia, 2006; Parsi, 2009). The decline (>95%) of the *Gyps* vultures was first recorded in Keoladeo Nation Park, Rajasthan (Prakash, 1999). Throughout the Indian subcontinent, populations of oriental white-backed vulture (*Gyps bengalensis*), long-billed vulture (*Gyps indicus*) and slender-billed vulture (*Gyps tenuirostris*) declined rapidly, beginning in the 1990s (Gilbert *et al.* 2006 , Prakash *et al.* 2007 , Chaudhary *et al.* 2012) and are now listed as 'Critically Endangered' (IUCN 2011). A wide range of evidence has established that veterinary use of diclofenac, a non-steroidal anti-inflammatory drug (NSAID), is the main cause of these population declines (Green *et al.* 2004

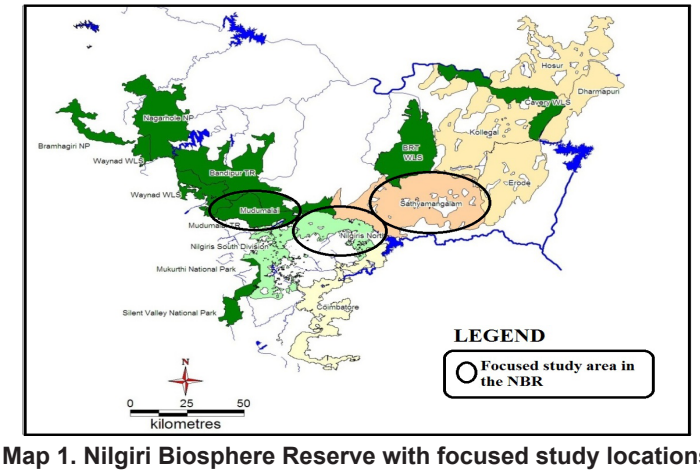
, Oaks *et al.* 2004 , Shultz *et al.* 2004). Vultures are exposed to diclofenac when they feed upon carcasses of domestic ungulates treated with this drug shortly before death. Conservation efforts in India have included research and captive breeding programs (Prakash *et al.* 2003, Umapathy *et al.* 2005, MoEF 2006).

In southern India there are seven species of vultures namely White-rumped, Long-billed, Red-headed, Egyptian, Himalayan Griffon, Eurasian Griffon and Cinereous vultures (Sashikumar, 2001; Davidar & Davidar, 2002; Thejaswi, 2004; Subramanya & Naveen, 2006; Davidar, 2007; Umapathy *et al.*, 2009; Ramakrishnan *et al.*, 2010, 2012 & 2014 ; Praveen *et al.*, 2014; Samson *et al.*, 2014a,b ; Venkitachalam & Senthilnathan, 2015; Venkitachalam & Senthilnathan, 2016; Samson *et al.*, 2015; Samson and Ramakrishnan, 2016a,b; Samson *et al.*, 2016a,b,c) were recorded.

The Tamil Nadu part of the Nilgiri Biosphere Reserve (Mudumalai Tiger Reserve, Nilgiri North Forest Division and Sathyamangalam Tiger Reserve) harbors four species of vultures seen commonly (Samson *et al.*, 2014a,b). The past studies clearly exposed that the Diclofenac plays a critical role for declining vulture population across the country. On the contrary Ramakrishnan *et al.* (2010) found that the Diclofenac was not a culprit for declining vulture population in the Moyar Valley which is a part of the Nilgiri Biosphere Reserve. It is need of the hour to ensure that is there any chance of diclofenac usage in livestock practice at landscape level. According to the literatures micro level usage of diclofenac more than enough cause havoc vulture population. Therefore this study was attempted to assess the livestock estimation, carcasses disposal mode, knowledge on diclofenac and mindset on vulture conservation.

STUDY AREA

The Nilgiri Biosphere Reserve (NBR) is the first and foremost biosphere reserves established in the year 1986 in India. The reserve is situated in the Western Ghats, in the Nilgiri Hills range of South India and is considered as an International Biosphere Reserve. It was declared under the Man and Biosphere Programme (MAB) of UNESCO and is also under consideration by the UNESCO World Heritage Committee for selection as one of the World Heritage Sites. The reserve encompasses 5,520 km² surrounded by Karnataka (1527.4 km²), Kerala (1455.4 km²), and Tamil Nadu (2537.6 km²) states. The Biosphere lies between 11o 36' to 12o 00' N Latitude and 76o 00' to 77o 15' E Longitude. Central location: 11°30'00 N, 76°37'30 E The NBR has protected areas namely, Mudumalai Tiger Reserve (321.1 km²), Sathyamangalam Tiger Reserve (745.9km²) Wayanad Wildlife Sanctuary(344km²), Bandipur Tiger Reserve (874km²), Nagarhole Tiger Reserve (643 km²), Nugu Wildlife Sanctuary, Mukurthi National Park (78 km²) and Silent Valley National Park (89.52km²). This reserve also includes Nilgiris North Division (448.3 km²) and Nilgiris District, South Division (198.8 km²) and Coimbatore Division (696.2 km²) in Tamil Nadu (Map1). The reserve extends from the tropical moist forests of the windward western slopes of the Ghats to the tropical dry forests on the leeward east slopes. Rainfall ranges from 500 mm to 7000 mm per year. The reserve encompasses three eco-regions, the South Western Ghats moist deciduous forests, South Western Ghats montane rain forests, and South Deccan Plateau dry deciduous forests. The Nilgiri Biosphere Reserve is very rich in plant diversity. About 3,300 species of flowering plants of which 1232 are endemic to the Nilgiri Biosphere Reserve. The fauna of the Nilgiri Biosphere Reserve includes over 100 species of mammals, 350 species of birds, 80 species of reptiles and amphibians, 300 species of butterflies and innumerable invertebrates. Of the vertebrate species recorded, 39 species of fish, 31 amphibians and 60 species of reptiles are endemic to the Western Ghats also occur in the Nilgiri Biosphere Reserve. The NBR is one of the critical catchment areas of peninsular India. Many of the major tributaries of the river Cauvery like the Bhavani, Moyar, Kabini and Chaliyar, Punampuzha, etc., have their source and catchment areas within the reserve boundary. The forests of NBR are spread over a vast area and cover various ecotypes. The overall classification of the different forest types are as follows: Evergreen, Semi-Evergreen, Moist Deciduous, Southern Montane Wet Temperate, Dry Deciduous, Dry Scrub Woodland, Grasslands and Evergreen Forest. This study was conducted in Mudumalai Tiger Reserve, Nilgiri North Forest Division and Sathyamangalam Tiger Reserve in the Nilgiri Biosphere Reserve, Southern India



Map 1. Nilgiri Biosphere Reserve with focused study locations

MATERIALS AND METHODS

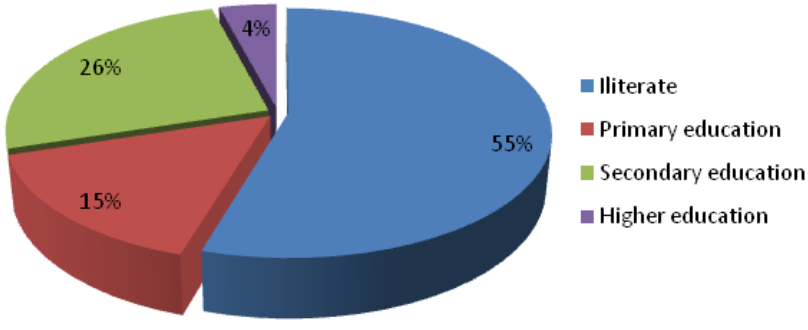
The study was aimed to explore the people perception on vulture conservation in was assessed through a questionnaire survey in the Tamil Nadu part of the Nilgiri Biosphere Reserve**.** Two sets of questionnaire were developed for this study. On was “Precise and Closed” and other one was “Broad and Open ended. The people in this plateau has more literate, so the questionnaire was prepared to understand easily and the questions were asked in local language for easy communication. The respondents were briefed about the purpose of the visit and verbal consent was taken for voluntary participation in interviews. At least one adult (≥ 18 years old) was interviewed in his/her residence. Face to face interviews were made it easier to clear any ambiguity had about the question.

The questionnaire had two sets of information i.e name, education, occupation, year of living etc. were collected by using “Precise and Closed” from the respondents.. This set of questions had asked for direct answers form the respondent (Ramakrishnsn .2008).Second set of information was collected through “ Broad and Open ended” questions giving the respondent an opportunity to express his her views freely without and inhibition (Balakrishnan and Ndhlova, 1992, Ramakrishnan, 2008). Totally 391 livestock holders were interviewed for this study.

RESULT

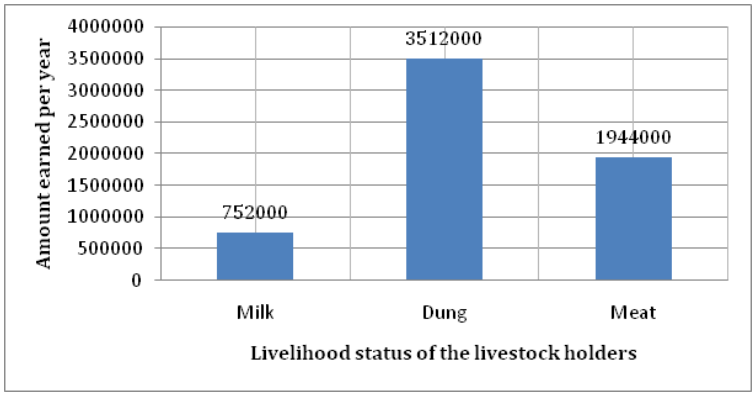
Totally 391 livestock holders were surveyed in 26 hamlets and result recorded a total of 8531 livestock. The cow was dominant (n=3621) followed by goat (n=2959), sheep (n=1212) and buffalo (n=739). The Sugilkuttai village attributed the maximum number of livestock (n=836) followed by Thengumarahada (n=689) and Achakarai (n=549) hamlets. Anaikatti, Masinagudi, Mavanalla, Moyar, Halli Moyar and Semmanatham villages held 400+ livestock. The least number of livestock population was observed in Yanna padi (n=5) which is located in the core area of Mudumalai Tiger Reserve (Table 1). Out of 391 respondents most of them were belonged to the tribal community (n=281) while a large number (n=110) were non-tribal. Male category was more (n=233) than the female (n= 158). The average age of the male respondents were 48.27±(1.12) and the female respondents were 47.91±(1.28). The literacy profile of the respondents revealed that more than half were illiterate (53%; n=213). A sizeable number of people were holding Secondary education (5th STD to 10th STD) (26%; n=101) and Primary education (1st STD to 5th STD) (15%; n=61). Very few of them (4% (n=16) completed their Higher education (12th STD to Degree) (Fig. 1).

Figure 3. Education profile of the livestock’s holders



Livelihood status of the livestock holders was determined. Results showed that for most of them (n=241) were depending livestock was their only source of livelihood. On the contrary, considerable number (n=150) of them said they earned from other sources i.e., agriculture labour. The livestock holders made money mainly from sale of dung (Rs.35,12,000/-) followed by meat (Rs. 19,44,000/-) and milk (Rs.7,52,000/-). 391 persons earned about Rs. 62,08,000/-

Figure 2: Income status of the livestock holders from livestock:



Totally 8191 livestock were lost by 391 people during the past 5 years. Most of the livestock (n=5631) were lost due to various diseases and considerable amount (n=2548) of livestock were lost due to wild animal predation. On average about 1638.2 livestock had been lost every year. Approximately, 1126.2 deaths were due to diseases and 509.6 individuals by wild animal predation in a year. Methods of livestock carcasses disposal were obtained from 391 livestock holders. Most of them (n=217) responded that they just threw away the livestock carcasses into the forest areas. On the other hand, 174 respondents said they buried their dead livestock carcasses (Fig 5).

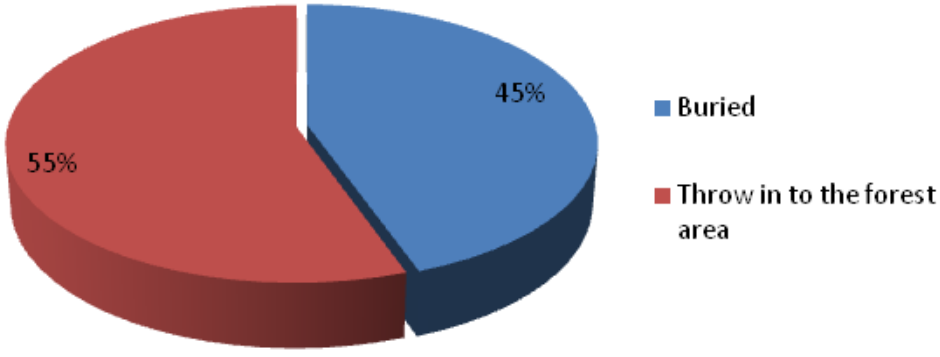


Figure 5: Mode of livestock carcasses disposal

The information on Diclofenac in relation to vulture conservation was obtained in interviews with livestock holders. The result revealed that a considerable number (n=137) of respondents knew about Diclofenac but at the same time most of them (n=254) were not aware of Diclofenac-related issues. A sizable number of respondents (n=91) and (n=46) knew that the Diclofenac was a pain killer and drug respectively. It was very important to note that most of the livestock holders (n=84) thought that the Diclofenac was harmful to vultures while a sizeable number (n=53) said that the Diclofenac was not threat to vulture population (Table 2). Totally 391 livestock holders were interviewed during the study period. It was a positive sign that most of the respondents had some knowledge about vultures (n=387). Out of 391 persons, 339 of them opined that vultures played the role of scavengers in the forest ecosystem. The majority of the people (n=313) responded that the vulture population was declining as compared to past few years. Respondents had accepted that vultures were beneficial to humans (n=370). An important issue to note was that the stray dog population had increased as compared to the past 10 years as per information gleaned from 347 respondents. Almost all of them (n=386) agreed that education on vulture conservation is warranted (Table 3).The status of compensation/ex gratia received by the livestock holders from the forest department was obtained. Although the compensation was recently increased by Tamil Nadu Forest Department the payment was still a lengthy process that resulted in delays as told by livestock holders (n=388).

DISCUSSION

The present study recorded that recorded that the cattle population was higher in our study area in twenty-six surrounding villages. The villagers keep livestock mainly for dung followed by meat and milk. There is a high demand of dung from upper Nilgiris inhabitants for mushroom culture, tea and coffee plantations. Silori and Mishra (1995) called this cattle as “Dung producing machine” in and around Masinagudi Village of the Sigur plateau. The statement of Silori and Mishra, (1995) was now evidenced by dung sale cost ofRs. 35,12,000/- per annum by 391 livestock holders in the study villages. It was quite interesting to note that Rs. 19,44,000/- was earned by selling their livestock to the butchers for slaughter houses. This is mainly because of the adjoining state of Kerala where the people consume both cattle and buffalo meat. Hence the selling cattle for meat was in second position followed by sale of milk. The milk production was the very low (Rs. 7,52,000/-) because of the scrub cattle are a country breed which produces lower quantity of milk, unlike cross breed varieties. The reserve forests are considered to be common pool resources which cattle owners enjoy at low-cost investment. This study has confirmed that most of the livestock carcasses (55%) were thrown out and made available for natural disposal and remaining (45%) of them were buried. Unfortunately, these carcasses were not thrown far away from the villages. They were thrown between 300 to 500 meters around the villages. Due to disturbances, these carcasses were not accessed by vultures. On the other hand, these carcasses were heavily utilized by wild boars and stray dogs. It was evidenced by the increase of stray dogs population in the villages thus resulted in behavioral change and health risks of human beings when they closely associated with them (Cunningham *et al.*, 2003; Pain *et al.*, 2003).

The carnivores’ depredation on livestock was recorded through a questionnaire survey. Although tiger, leopard, and wild dogs are reasons for loss of cattle attacks by the former were high on cows, bulls and buffalos. Ullas Karanth (2003) stated that livestock is the easiest prey for tigers when the cattle graze inside the forest areas. Leopards and wild dogs fed on goat, sheep and calves of cows and buffalos. Carcasses of wild dogs were quickly consumed by wild dog packs so were not available to vultures. Similarly, leopards hid their prey remain in branches of trees which were nor accessible to vultures. So most of the food for

vultures were obtained from tiger kills including lifestock that died natural deaths and from diseased animals. It is quite interesting to note that this landscape arguably holds the highest tiger population in the country. Therefore, the vultures in this landscape is heavily dependent on tiger kills and that are not poisoned by livestock owners in retaliation. This study found that most of the livestock holders were illiterate and depended on livestock as their major livelihood. Awareness about the Diclofenac and its effects on vulture populations was very poor. On the other hand knowledge on vulture's importance and their role in the ecosystem was well known by the livestock holders. The livestock holders opined that the vulture population is declining in their area. Generally, the livestock holders treat their injured livestock by traditional methods and sometimes they bring veterinary doctors or quacks only for extreme cases. The questionnaire survey from the veterinary doctors revealed that they use Melaxicum as a painkiller (a safe drug for vultures). It was gleaned from the vulture mortality records also. So far none of the vulture deaths were scientifically or clinically proved to be caused by Diclofenac, and instead attributed to poisoning of the carcass (Laboratory Report is enclosed as Annexure-I). Hence this study strongly suggests that education is needed for the livestock holders to change their attitude towards retaliatory killing. A similar effort has to be made to the forest department also in order to ensure adequate and quick payment of compensation/ exgratia to the livestock holders to stop the further poisoning of the carcass, which is considered as a severe threat to this vulture population rather than Diclofenac. Davidar (2002) reported that the retaliatory killing activity of livestock holders was the reason for declining of Tiger and vultures in the Sigur Plateau followed by Ramakrishnan *et al* (2010) stated that the Diclofenac is not a culprit for declining vulture population in this region as the vultures feeding on wild carcasses (including tiger killed livestock) as their major diet. This present study revealed that most of the livestock holders are illiterate and they do not aware about the Diclofenac and their uses. But they were known about the vulture conservation in forest ecosystem. The present study have been supported that a positive conservation altitude is the key for garnering local support for vulture conservation. Education campaigns, such as street theatres and allocating posters in local languages stress forecast and threats of vulture conservation, should be performed to explain the general public. These programmes may improve the awareness of people to a broad range of the values of vultures. Another significant approach would be to educate livestock holders, farmers and veterinary personals on the negative effects of Diclofenac and on the suitable throwing away of contaminated carcasses. Green et al (2004) stated that based on demographic modeling, it has been establish that less than 1% of lethal level of diclofenac can reason a hasty population crash to vulture. Therefore, educating livestock holders, farmers and veterinary personnel may help to secure healthy food for vulture. A long-term solution would be the incorporation of environmental education in school and colleges and to pay more compensation for securing the country's southern most vulture population.

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Table 1. Livestock population in and around vulture nesting colonies

S.No	Name of the hamlets	Total number of livestock holders	Livestock population				Total
			Buffalo	Cow	Goat	Sheep	
1	Achakarai	12	135	254	39	121	549
2	Anaikatty	11	212	226	-	-	438
3	Bothanathham	2	-	182	-	-	182
4	Chokkanalli	3	-	52	-	-	52
5	Kovil Patti	7	-	100	34	79	213
6	Kurumbar Padi	26	-	179	62	19	260
7	Kurumbar Pallam	16	-	61	99	22	182
8	Masinagudi	17	61	317	32	-	410
9	Mavanalla	25	-	199	185	36	420
10	Moyar	29	-	361	61	-	422
11	Semmanatham	13	90	152	148	70	460
12	Singara	5	-	68	18	-	86
13	Siriyur	9	72	231	10	50	363
14	Takkal	10	3	140	101	13	257
15	Thodulangi	23	-	17	237	101	355
16	Vazhaithottam	10	-	234	-	55	289
17	Yanna Padi	3	-	5	-	-	5
18	Hallli Moyar	21	-	131	239	82	452
19	Keezh.kalampalayam	12	-	120	175	58	353
20	Mel.kalampalayam	17	-	90	128	6	224
21	Gulithoraipatti	12	3	75	175	13	266
22	Puthukadu	22	-	25	273	11	309
23	Boothikuppai	12	-	46	123	27	196
24	Sithirampatti	18	27	17	153	66	263
25	Sugilkuttai	19	43	207	340	246	836
26	Thengumarahada	37	93	132	327	137	689
	Total	391	739	3621	2959	1212	8531

Table 2. Livestock holder's knowledge on Diclofenac

Total number of respondents	Diclofenac knowledge among respondent		What is Diclofenac		Diclofenac is harmful to vultures	
	Yes	No	Painkiller	Drug	Yes	No
391	137	254	46	91	84	53

Table 3. Livestock holders knowledge on vulture conservation

S.No	Questions asked to the livestock owners/managers	Respondents (n=391)	
		Yes	No
1	Do you Know vultures?	387	4
2	Vultures are doing scavenger roll in the environment?	339	52
3	Is vulture declining in your area?	313	78
4	Vultures are beneficial to humans?	370	21
5	It is important to educate vulture conservation to the people?	386	5
6	There are more stray dogs than before?	347	46

RESEARCH AND SURVEY OPERATION BY ENGAGING VULTURE WATCHERS IN THE NILGIRIS NORTH FOREST DIVISION, TAMIL NADU

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ABSTRACT

Vultures are valued for their ecological, social and cultural significance. Vultures scavenge on animal carcasses/ carrion, thereby helping clean environment and water resources. Vultures provide prime ecosystem services as top cleaners in cities, villages, and countryside. It was noticed back in the nineties that vultures were disappearing from the landscapes, skies and rotting carrions were not being attended by these scavengers. Vultures have appeared to be one of the fastest declining bird species in the world. Although captive breeding is under practice in north India, conservation of our country's southernmost wild viable vulture population in the Nilgiris is highly need of the hour. Considering the lacunae this research and survey operation was carried out by engaging vulture watchers in the Nilgiris North Forest Division under the centrally sponsored scheme of Project Tiger Buffer Zone Area works through the Department of Zoology & Wildlife Biology, Government Arts College, Udhagamandalam for a period between April 2016 and March 2017. Nesting sites were regularly monitored by the tribal vulture watchers.

Although this present study was supposed to look only for two nesting colonies, we had extended our survey and monitoring for seven nesting colonies used by two vulture species namely White-rumped (four nesting colonies) and Long-billed vulture (three nesting colonies). This present survey has recorded and monitored a total of 59 White-rumped vulture nests Of which the Jagalikadavu nesting colony has recorded maximum number of nests (n=31) Two tree species namely *Terminalia arjuna* (36 trees with 54 nests) and *Spondias mangifera* (one tree with 3 nests) were used for nest construction by White-rumped vultures. Among the 59 nests, 37 nests were recorded as active nests evidenced by frequent usage of nesting pairs. Out of 37 incubations, 21 hatchlings were came out with 56.8% of breeding success. Similarly this present survey has recorded five number of Long-billed vulture nests in three nesting colonies. Of which the Nilgiris Eastern Slope nesting colony had highest number of nests. Among five nests, four of them were recorded as active nests. Of which three hatchlings were came out from four incubations with 75% of breeding success. Although plenty of cattle deaths were found this year due to severe drought in this region, the breeding success of White-rumped vultures was about 50% only. Therefore this present study emphasizes that long-term monitoring is highly warranted to secure this population in this landscape.

Key Words: Research, Survey, Vulture, Watchers, Nilgiri Biosphere Reserve

Introduction

An ecosystem is deemed to be stable if it has different levels of organisms in their ecological niches without which it is considered to be an unbalanced state. Trouble to any of such organisms not only leads to the collapse of the food chain but also it makes disorder in the existing food web (Green *et al.*, 2004). It is noteworthy to mention that the scavengers occupy an imperative and last level of the food chain without which the recycling or proper disposal, especially that of dead and decaying materials will be either stopped or delayed. The vultures are important link in the food chain, being a scavenger in habit, and are preventing spread of dangerous diseases such as anthrax and rabies (Prakash *et al.,* 2003), which could cause havoc to the wild animals, livestock and human. Therefore, it is believed that their absence can lead to a grave crisis in the terrestrial ecosystem (Verner *et al.,* 1986). The vultures are excellent scavengers of dead bodies and their status is critically tagged with the present situations (Mandel *et al.,* 2008).

Among the threatened birds, vultures, especially *Gyps* species facing radical population crash in the country (Prakash, 2001). Well protected forests and the adjoining rural areas in the country had *Gyps* vultures as very common two decades ago are now catastrophically declined especially the White-rumped and Long-billed vultures throughout India (Prakash, 2001). Only few protected areas in the country are having small, significant and fragile population of *Gyps* vultures. The reason for the population crash of the *Gyps* vultures in the Indian subcontinent has been identified that the drug called "Diclofenac", a Non-Steroidal Anti-Inflammatory Drug (NSAID) used in veterinary practice as a culprit in Pakistan, India and Nepal. Oaks *et al.* (2004) first discovered and described that the *Gyps* vultures died due to renal failure when they ingested the drug diclofenac from the tissues of domestic livestock carcasses.

There are nine species of vultures found in the Indian Subcontinent. Of which, four of them are found in south India namely Egyptian Vulture (*Neophron percnopterus),* Red-headed Vulture (*Sarcogyps calvus),* White-rumped Vulture (*Gyps bengalensis)* and Long-billed Vulture (*Gyps indicus).* There has been a catastrophically decline in the populations of three species in the Indian subcontinent, White-rumped vulture, Long billed vulture and Slender billed vulture (Green *et al.*, 2007; Prakash *et al.*, 2003). Red headed vulture has also declined in the Indian subcontinent including Nepal (Cuthbert *et al.*, 2006) believed to be primarily due to diclofenac (Green *et al.*, 2004; Meteyer *et al*, 2005; Cuthbert *et al.*, 2006; Swan *et al.*,2006; and Naidoo *et al.*, 2010). This has resulted in the reclassification of this species to Critically Endangered (IUCN, 2012). Egyptian vulture is a

long lived species, which are classified as endangered because of their rapid population crash in India and Nepal (Cathbert *et al.*, 2006). However other causes such as habitat destruction, food shortage, human persecution, poisoning and pesticide use also have caused a gradual decline in vulture populations (BirdLife International 2001). According to the Birdlife International (2008) the decline rate of three *Gyps* vultures in the Indian subcontinent have occurred at least 48% every year. The critically endangered and endangered species may disappear if immediate scientific management efforts are not initiated. In south India, such scientific management activities are handicapped due to lack of strong scientific research findings. Therefore this present research and survey operation was carried out by engaging vulture watchers in the Nilgiris North Forest Division under the Centrally sponsored scheme of Project Tiger Buffer Zone Area works by the Department of Zoology & Wildlife Biology, Government Arts College, Udhagamandalam for a period between April 2016 and March 2017.

Study Area

The Nilgiri North Forest Division lies between the North latitudes 11.14'35.26", 11.36'60" and the East longitudes 76.31'52.86", 77.00'56.35". The geographical area of this division, consisting of forest and areas other than forests, is situated in Udhagamandalam, Coonoor, Gudalur and Kotagiri Taluks of the Nilgiris Revenue district. The total geographical area of this division is 543.32 Sq.Km. The division forms part of the internationally famous "Queen of Hills - The Nilgiris" and attracts tourists from all over the world throughout the year. This division is bounded on the North by the state of Karnataka and Talamalai Range of Sathyamangalam Tiger Reserve, where Moyar river forms the common boundary, on the East by Bhavani Sagar Range of Sathyamangalam Tiger Reserve, Erode District, in the southeast by Sirumugai Range and South by Mettupalayam Range of Coimbatore Reserve Forest Division of Coimbatore District. On Southwest and West it is bounded by The Nilgiris South and Gudalur Reserve Forest Divisions and on the northwest by Mudumalai Tiger Reserve within the Nilgiris District. It also forms part of The Nilgiris Biosphere Reserve, which is the UNESCO recognized first and foremost biosphere reserves of the country. The terrain of this division exhibits quit diverse configuration with a significant range of variation in altitude and vegetation. There are lot of valleys and plateaus in the tract now dealt with. The terrain of the division may be divided into three naturally distinct region which show variations in altitude and vegetation due to varying topographic, climatic and edaphic factors with forms the basis for rich biodiversity, wildjjplife richness and good weather. The regions are The Nilgiris Plateau, Sigur Plateau and Outer Slopes. The climate of the Nilgiris plateau is temperate. The mean month temperature varies between 16 ºc (May) to 11 ºc (December) the general temperature is equable shade with lesser diurnal variation, the average annual variation for the Nilgiris plateau. The maximum 21 ºc to 25 ºc and the minimum 10 º to 12 ºc in summer. During winter the maximum is 16 ºc to 21 ºc and the minimum is being of 2 ºc. At Coonoor the maximum and the minimum temperature is 27 ºc (July) and 9 ºc (January).

Materials and Methods

Population Estimation

Nest site count

A questionnaire survey was conducted to the local people and forest field staff in order to find out roosting and nesting colonies of vultures at the initial stage of the project. Once it was confirmed the monitoring was done twice in a month by vulture watchers to count all vultures under the guidance of the Principal investigator in the nesting colonies. Although only two nesting colonies were supposed to monitor as per the proposal, nevertheless seven nesting colonies were monitored from 1st April, 2016 to 31st March, 2017. The population size of each vulture species was counted at each nesting colonies in early morning (0630 to 0930 hrs.) and late evening (1730 to 1930 hrs.) by foot walk as described by Baral (2005). The nesting and roosting colonies were thoroughly searched for dead vultures to estimate mortality rate. Although four vulture species namely White-rumped, Long-billed, Red-headed and Egipsian vultures are frequently seen in the Nilgiri North Division, nesting colonies were recorded for only for two species namely White-rumped and Long-billed vultures so far. Therefore nesting and breeding ecology were confined only for these two vulture species.

Breeding ecology of two vulture species

Each nesting colony was visited twice in a month. All observations were made using binoculars (Nikon 52×10) from an appropriate distance (100-300m) to nesting colonies. Focal animal sampling method was used to record breeding ecology of two vulture species in nesting colonies (Postupalsky, 1974; Acharya *et al.*, 2009; Awan *et al.*, 2017). Ten minutes was spent for each observation for each nest as focal sampling time in a day. The observations were made from 7.00am to 12.00noon. Active nests were identified by the presence of fallen nesting materials, feathers and white wash (excreta) below the nesting tree or incubation of vultures in the nest **.** All the nests were identified and nesting trees were tagged and monitoring for future concern (Postupalsky, 1974). Nest exposure direction towards sunlight on the nesting trees as well as rocks was calculated using compass. Nesting locations viz either on the top of the tree or crown and limb (Offshoot growing directly out of a tree trunk) was estimated by visual estimation. Confirmation of active (occupied) and abandoned (unoccupied) nest was identified based on the criteria laid down by Postupalsky (1974). An active breeding pair was defined as with the presence of an egg in the nest. Non-breeding pair was one that occupied the nest at least for three week visits, but did not laid an egg. Breeding success was calculated from the number of fledglings fledged out divided by the number of breeding pairs. Successful fledged out from incubation was confirmed by whether two adult vultures were observed at the nest, one standing nearby and one on incubation or only one was on incubation or one adult with chick or a young chick alone was present in the nest. Information on mortality, especially of adult mortality was recorded at nesting colonies (Baral *et al.,* 2005; Steenhof & Newton, 2007). Finally an active nest was considered if it was occupied by at least an egg was presented in the nest (Xirouchakis and Mylonas, 2005).

Result

Population details

The population status of White-rumped Vultures at 4 nesting colonies the Jagalikadavu nesting colony recorded a maximum number of individuals (73.29±3.08) as well as adults (47.95±2.71) and immatures (25.95±0.09) followed by Anaikatty Nesting Colony (48.91±1.78), Ebbanad (31.54±1.07) and Siriyur nesting colonies (1.29±0.35). Long-billed Vulture population was high in Nilgiri Eastern Slopes nesting colony with the maximum number of population (5.08±0.36) as well as adults (3.16±0.22) and immature (1.91±0.19) followed by Kallampallayam nesting colony (2±0.17) and Ebbanad nesting colony (2±0.12)

Breeding Ecology

White-rumped Vulture

A total 59 nests in 34 nesting trees of White-rumped vulture was recorded in four nesting colonies altogether. Maximum number of nests (n=31) as well as nesting trees (n=19) were recorded in the Jagalikadavu nesting colony followed by Anaikatty nesting colony (17 nests in 7 nesting trees), Ebbanad nesting colony (9 nests in 6 nesting tress) and Siriyur nesting Colony (2 nests in 2 nesting trees). There were only two tree species preferred by the White-rumped vultures to construct their nests in all four nesting colonies. Of which *Terminalia arjuna* (33 trees with 59 nests) was highly preferred tree species than *Spondias mangifera* (one tree with three nests).Among 59 nests**,** 37 nests were observed as active nests evidenced by frequent usage of nesting pairs. The Jagalikadavu nesting colony has been recorded the maximum number of active nests (n=21) as well as abandoned nests (n=10) followed by Anaikatty nesting colony (10 active nests and 7 abandoned nests), Ebbanad nesting colony (6 active nests and 3 abandoned nests) and Siriyur nesting colony (only 2 nests and both of them were abandoned).

The breeding success was calculated from a total number of fledglings divided by a total number of nests seen under incubation. Overall 56.8% of breeding success was recorded in all four White-rumped vulture nesting colonies altogether. Among the four nesting colonies, Jagalikadavu nesting colony was recorded highest (71.4%) breeding successes followed by Ebbanad nesting Colony (66.7%) and Anaikatty nesting colony (30%). No incubation, no hatchlings and none of the fledglings was recorded in the Siriyur nesting colony during this year.

Long Billed Vulture

A total of five nests were recorded in three nesting colonies of Long-billed vulture on rocky slopes in the study area. Of which four of them were active nests concluded by frequent usages of nesting pairs. Nilgiri Eastern Slope nesting colony has recorded the maximum number of active nests (n=2) as well as abandoned nest (n=1). The Ebbanad Valley and Kalampalayam has recorded just one active nest respectively.

Among the five nests, there were four nests were seen under incubation for Long-billed vulture in the Nilgiri North Forest Division. Totally 75% of breeding success was recorded in three Long-billed vulture nesting colonies altogether. Of which, the Nilgiri Eastern Slopes (2 incubations seen with 2 hatchlings and 2 fledglings) and Kalampalayam nesting colonies (1 incubation seen with 1 hatchling and 1 fledgling) were observed 100% of breeding success. Although only one incubation was noticed in Ebbanad Valley nesting colony 0% breeding success was recorded which means no fledgling or hatchling was seen from one nest.

Discussion

Among the vulture species, the decline to *Gyps* vulture population was alarming in the Indian subcontinent involving high mortality rate and breeding failures (Prakash, 2001). It is likely to lead to their extinction if the problems are not urgently addressed (Birdlife international, 2001). Hence, this present research and survey operation was taken up in the Nilgiri North Forest Division, Tamil Nadu under the Centrally sponsored scheme of Project Tiger Buffer Zone Area works through the Department of Zoology & Wildlife Biology, Government Arts College, Udhagamandalam for a period between April 2016 and March 2017 in order to protect our country's southern most wild viable vulture population. Although this project supposed to look only two nesting colonies, but seven nesting colonies were looked after on two critically threatened vulture species namely White-rumped (*G.benghalensis*) and Long-billed Vultures (*G.indicus*) on the aspects of population status, nesting ecology, breeding success and usage of diclofenac and others.

Out of seven nesting colonies, four of them were used by White-rumped and three by Long-billed vultures. We found that the nesting colonies were located nearer to human habitations. Previous literature were also supported that the location of breeding Colonies near to human habitation in Nepal and Gujarat (Baral *et al.*, 2005; Baral and Gautam, 2007; Dave, 2011; Harris, 2013).

This present study has observed that there is a fluctuation in population estimation of White-rumped vulture numbers ranging between 40 and 91 in Jagalikadavu, 1 and 5 in Siriyur and 25 and 60 in Anaikatty and 20 and 38 at Ebbanad nesting colonies. A similar trend was also been noticed for Long-billed vulture population in all three nesting colonies areas viz. 1 and 3 in Ebbanad, 2 and 8 in Nilgiri Eastern Slopes and 1 and 3 at Kalampalayam nesting colonies. The vulture populations were very less in the month of June was gradually increased and reached its maximum numbers at the end of May. A similar pattern was also noted by Baral *et al.* (2005) for White-rumped vulture population in Nepal and by Changani and Mohnot (2004) in Rajasthan. This was mainly because of the adults flew far away from the nesting colonies in search of food and sometimes they spend overnight or even one or two days if they get food during non-breeding seasons. But they confine its range for food from where they could come back to their nests to continue parental care and feed their young ones during breeding seasons. Therefore the maximum number of vultures were seen in and around nesting colonies mainly during active breeding season (incubation, hatchlings, fledglings) from September to May months. Few numbers were seen from June to August as non breeding seasons in the Nilgiri North Forest Division.

All four nesting colonies, the White-rumped vultures preferably construct their nests only on *Terminalia arjuna*

trees. This could be due to its height and basal girth which would help them to avoid disturbances from people and other wild animals especially elephants (Road, 2010). The present study area is falling part of the Nilgiris and Eastern Ghats Landscape which is considered to be the single largest Asian elephant population area in the word (Sukumar, 2003). On the other hand, the *Terminalia arjuna* is the only tallest tree species available abundantly along the riverine forests of Southern India. We observed that the single tree preference by White-rumped vultures for nesting and roosting in the study area. Our observation is also in accordance with Baral *et al.*, (2005), as a single tree preference (Kapok tree) by White-rumped vultures in Nepal.

The total white-rumped vulture population at four nesting colonies altogether ranging between 86 and 194 individuals in 59 constructed nests. Similar trend was noticed on the long billed vulture population also by ranging its numbers between 4 and 14 individuals. This present survey found that out of 59 nests 37 of them were incubated by white-rumped vultures. It was unfortunate to note that out of 37 incubations 21 fledglings were came out with 56.8% of breeding success. This was much better for long billed vultures. Out of 5 constructed nests 4 nests were incubated and 3 fledglings were came out with 75% breeding success. The previous studies in Rampur Valley showed that there were 72–102 individuals of White-rumped Vultures in six nesting colonies during their breeding season, with 50% breeding success at 70 occupied nests (Baral *et al.*, 2005). In Pakistan, a total of 2281 occupied nests were recorded between 2000 and 2004 and the nest success was observed in 1231 nests with the breeding success of 51% (Gilbert *et al.* 2006). In Africa, it was estimated that 48% of breeding success in White-backed vultures (*Gyps africanus*) (Martinez *et al.*, 1997). Among the earlier studies in Asia as well as Africa this present study has recorded highest percentage of breeding success which clearly envisages that this population is going in a positive trend towards their persistence as a wild and viable population in this region.

This present study we also observed that a total of 63.15% (n=36) of nests abandoned by White-rumped vultures during breeding season from October to December 2016. Newton (1979 & 2002) stated that certain pairs may occupy a territory for only a few days or a few weeks, or may even build a nest, but the process stops here. Not all raptor pairs occupying nesting territories lay eggs every year. A major influencing factor on egg laying in raptors was suggested that food supply and in poor food years, territorial pairs in some populations fail to lay eggs. On the other hand, nest abandon was seen due to mortality of chicks and nesting pair (Baral *et al.* 2005). Lopez *et al.* (2006) observed that severe anthropological threats in the nesting areas would also caused nest abandon criteria for Cinereous Vulture (*Aegypius monachus*) in the south west Iberian Peninsula. Apart from these reasons the langurs and monkeys also influenced some extent for abandon of nests by white-rumped vultures. The literatures supported that the langurs were causing disturbance in the nesting of vultures in Nepal (Subadi 2007) and also in African monkeys and baboons have been reported to interfere in the normal breeding of African vultures (Mundy *et al.* 1992; Emmett 2003; Roche 2000 & 2006). During this present survey we found the presence of Common langur (*Semnopithecus*) and Bonnet macaque (*Macaca radiata*) near to the nests of white- rumped vultures. Generally the Langurs and Monkeys behaves like playing, jumping and shaking the branches of nesting trees also. These activities might also caused deserted nesting trees (n=14) by white-rumped vultures. Therefore this present survey throw light on the need of long term studies to find various macro and micro level disturbances which might influence on the abandon of nests by white-rumped vultures for their long run conservation in this region.

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Poster Presentation

IS PEOPLES MOVEMENT AFFECT WHITE-RUMPED VULTURE NESTING COLONY: A CAUSE STUDIES FOR SIRIYUR NESTING COLONY, NILGIRI NORTH FOREST DIVISION, THE NILGIRIS, TAMIL NADU.

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Short note

Wildlife conservation today in areas of high human density is a very complicated undertaking (Woodroffe, Thirgood & Rabinowitz, 2005; Markovchick-Nicholls *et al.*, 2008). Habitat alteration, large infrastructures, poisons, biocides and illegal hunting are just some of the typical threats associated with urbanization. Habitat loss, electrocution on power poles and persecution by humans are the main threats to birds of prey in all around the world (Tucker & Heath, 1994). Persecution of raptors can take many forms, including destruction of nests, deliberate disturbance of nesting birds and poisoning, shooting and trapping adults and immature individuals (Sara & Di Vittorio, 2003; Whitfield *et al.*, 2004; Martınez *et al.*, 2006a).Disturbances affect some endangered species reducing the available breeding habitat (Sergio & Bogliani, 2000; Liberatori & Penteriani, 2001;Grande, 2006; Martınez, Pagan & Calvo, 2006b; Zuberogoitia *et al.*, 2006) and are a cause of breeding failure (Arroyo & Razin, 2006; Gonzalez *et al.*, 2006).

Vultures are highly associated with humans in nature the present study is highlighted the adverse effect on peoples activities in white-rumped vulture nesting in Siriyur nesting colony in Nilgiris North Forest Division, Nilgiris, Tamil Nadu. In the year of 2015 to 2016 the local people movement was intensively monitoring in Siriyur White-rumped vulture nesting colony which his closely associated with Siriyur Tribal settlement (250m). The observation quantifies the people's activities under the nesting colony such as bating, washing clothes, entertainment, livestock grazing, NTFP Collection, Bamboo cutting, Honey collection and Pilgrims threat. The threats was classified as minimum effect and maximum effect according to the threat impact as well as we priority the threats as low, medium and high. The results shows that bathing washing clothes, entertainment and livestock grazing are the regular activities observed under the nesting colony and these threats are classified as a minimum effects and low level threat priority. Bamboo cutting, Honey collection and Pilgrims threat are the short time threat but its highly disturbed the nesting colony due to the continuous disturbance to the particular time of the period these threats are classified as maximum effect and medium and high level threat priority for this kind of threats at the Siriyur nesting colony was abundant now and shift the nesting colony to the other places in this region. The causes of regression, breeding failure and distribution of hazards for species may show geographic variation, and causes absent in some areas may prevail in others. Because human recreational use of the natural environment is likely to increase in the future, the need to understand how wildlife responds to human activities is becoming increasingly important (Arroyo & Razin, 2006). Wildlife managers need appropriate tools to improve the protection of endangered species, demanding information about how, when or which types of human activity may be detrimental to wildlife in specific areas (Carney & Sydeman, 1999; Romin & Muck, 1999; Sitati, Walpole & Leader-Williams, 2005; Young *et al.*, 2005; Preisler, Ager & Wisdom, 2006). Some authors suggest that spatial and temporal restrictions are needed to protect the breeding and foraging sites of endangered species (Sara &Di Vittorio, 2003; Ontiveros *et al.*, 2004; Carrete & Donazar, 2005; Gonzalez *et al.*, 2006).

Table 1. Threat assessment on vulture in Sriyur nesting habitat

S.No.	Threat	Threat level	Threat priority
1	Bathing under the nesting tree	Minimum Effect	Low
2	Washing Clothes under the nesting tree	Minimum Effect	Low
3	Entertainment under the nesting tree	Minimum Effect	Low
4	Livestock Grazing in the Nesting habitat	Minimum Effect	Low
5	NTFP collection around the nesting habitat	Minimum Effect	Medium
6	Honey collection on the nesting trees	Minimum Effect	Medium
7	Pilgrims Threat around the nesting habitat	Maximum Effect	High

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IMPACT OF AWARENESS ON VULTURE CONSERVATION AMONGTHE SCHOOLS STUDENTS IN THE SIGUR PLATEAU, THE NILGIRIS

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ABSTRACT

The conservation of environment is embedded in the Indian culture and traditions. The art of living practiced nationwide imbibes respect and care for flora and fauna in the country. Attempts to generate awareness on environmental conservation in India were made by a few institutional mechanisms to provide a common platform for education in schools. Children are perceived to be the best messengers of waves of change. Lessons on values of moral education and natural resource conservation to children bring a fresh breeze of attitudinal and behavioural changes in society towards environment. The present study is aimed to create awareness on vulture conservation among the school students in Sigur Plateau, Tamil Nadu. A) To create awareness on the ecology and ethology of vultures and assess the awareness level of secondary school students on vulture conservation in relation to their community and residential background. B) To assess the class wise difference in the awareness level in vulture conservation among all the selected schools. C) To know the gender difference in the awareness level among all the selected schools.The present study is an attempt to examine the awareness level of secondary school students towards vulture conservation. Four schools were selected around Sigur Plateau for the study purposes. 1. Bokkapuram Government Tribal Residential School (BGTRS), 2. Mavanalla Government Tribal Residential School (MGTRS) and3. Vazhaithottam G.R.G Higher Secondary School, (VGRGHSS) and Masinagudi Good Sheppard High School, (MGSHS). A sample of 294 (141 boys and 153 girls) students from all three selected schools were participated in both the pre and post evaluation tests. The question paper contains vultures and their conservation relation questions, as broadly consists of five components, viz. (i) Vulture Morphology (ii) Vulture Biology (iii) Vulture Breeding Ecology (iv) Threats and (v) Vulture Conservation. There are 50 items in the question paper each carries the value of 1 mark, each wrong answer was given 0 marks. The pre-evaluation test result showed that middle school wise MGTRMC score better score compare than BGTRMS. Similarly in high school wise MGSHS score better score compare than VGRGHSS because of comprised of students from tribal and non- tribal community and also they are staying outskirts of the Sigur plateau and got lot of exposure to competitive tests. After the induction of vulture awareness classes to all the schools. The same results have been deploy during post- evaluation test MGTRMC score better score compare than BGTRMS. Similarly in high school wise on the contrary to the pre-evaluation test VGRGHSS score better score compare than MGSHS. Performance of improvement scale was estimated from the average marks scored in the pre-evaluation test subtracted from the average marks secured in the post evaluation test for each batch. The improvement scale was given as I (6-9 Marks), II (3-6 Marks) and III (1-3 Marks). Overall the improvement scale rating was higher in middle school wise MGTRMS similarly in high school wise VGRGHSS could be attributed to the impact of vulture conservation awareness classes coupled with improved confidence of students and their traditional knowledge induced them to perform better than the other schools. During the pre-evaluation test there was no significant average marks difference observed between all the classes of MGTRMS and MGSHS could be related to the same level of awareness on vulture conservation. There was a strong significant difference observed in middle school wise 6^{th} and 7^{th} and 8^{th} standard of MGTRMS could be related to the representation of non tribal community students and in MGSHS having exposure to competitive test and traditionally having sound academic background. During the post-evaluation test the class wise difference was observed between MGTRMS and VGRGHSS students could be related to the impact of awareness programme had improved their confidence level and induced them to perform better than other schools. There is no significant difference between male and female students. It is concluded that gender is not a factor affecting the awareness level; the main reason is that they are studying and learning together in the same teaching environment inside and outside the schools. However, The present study revealed that students residing inside the forest, especially tribal are academically very poor. After the vulture conservation awareness programme conducted they were little bit performed better than non- tribal students whose residences were in the periphery and outside the forests. Therefore more awareness campaign should be conducted to the students in the core as well as in the periphery to understand the ecology and behavior of vulture and to mitigate conflict and also the long term survival of the endangered species in the Sigur plateau region.

KEY WORDS: Impact of awareness, Vvulture conservation, Sschools students, Sigur plateau, Nilgiris

INTRODUCTION

The conservation of environment is embedded in the Indian culture and traditions. The art of living practiced nationwide imbibes respect and care for flora and fauna in the country. Attempts to generate awareness on environmental conservation in India were made by a few institutional mechanisms to provide a common platform for education in schools. Children are perceived to be the best messengers of waves of change. Lessons on values of moral education and natural resource conservation to children bring a fresh breeze of attitudinal and behavioural changes in society towards environment. Nature has created several ecosystems and millions of animal and plant species including micro-organisms within each ecosystem on mother earth and every life form has specific roles to play for auto-run of the ecosystem. All life forms are interdependent either to render services to one another or become food for the higher trophic level animals through a food chain or food web. If one species gets eliminated due to some reason or other, the food chain breaks consequently affecting the ecosystem automation process.

Man (*Homo sapiens*) is one of the species among millions of species created by nature and every animal or plant species has equal rights to live on earth as man has. We should also understand that they are not created to render services to the mankind alone, but to the nature as a whole. Man should not be a cause of extinction of other species, if not helpful for their existence. Wildlife is meant by all biotic elements on the Earth including all species of plants and animals excluding human beings, domestic animals and cultivated plants. Since time immemorial, our wildlife has been closely associated with our beliefs and folk lores. References on this can be drawn aplenty from our great epics and our rich history. Wildlife with their varied forms build up the balance of nature aside from making our lives more beautiful and meaningful on the planet. With a view to preserve the wildlife of India, particularly to take urgent steps to prevent extinction of any species, Government of India established the Indian Board of Wildlife (IBWL) in 1952, the highest body in the country established for laying down policy and issuing directives for proper management of Protected Areas. The Board has since been doing pioneering work to create public consciousness in favour of wildlife preservation. Therefore, in order to create a mass movement for protection of wildlife, the IBWL decided to observe the Wildlife Week from October 2 – 8 every year. During 2017 we are observing the 63^{ed} Wildlife week across the country. The World Bank estimates that forest provides habitats to about two-third of all species on the earth, and that deforestation of closed tropical rain forests could account for biodiversity loss of as many as 100 species a day. The destruction deplorably continues at an alarming rate due to encroachment, urbanization and industrialization resulting in reduction of forest density and extent. The depletion of wildlife can be attributed largely to deforestation and inroads of human civilization into the forest. Fragmentation of habitat and corridors isolate wild animals to small patches inviting inbreeding which starts of the process of extinction of the species from the earth. Wild animals are being poached ruthlessly to satisfy the greed of few rich persons for their luxury. International smuggling of wild animal trophies is next to narcotics smuggling and at par with arms smuggling. Millions of people representing a great variety of cultures and land-use practices live in or on the edges of tropical forests. Apart from the fact that they are somehow dependent on natural forest products, these people often do not have much in common. In recent years, however, a large number of them have experienced increasing difficulties in gaining access to local forests and their products owing to deforestation, logging, population pressure or increasing government regulations including declaration of state forests, national parks or wildlife reserves. In many countries, plans to protect forest ecosystems have failed to pay attention to the needs and knowledge of local people inhabiting them (Anan 1996, Tuxill and Nabhan 1998, Wily 1997, Kumar 2000). Thus participation of local people is essential for any conservation effort. With respect to forest conservation, participation is often associated with community forestry, which means that a forest is managed or co-managed by people who live close to the forest. Legal, political and cultural settings within which community forestry is practised vary considerably and accordingly, the term covers a range of different experiences and practices. Community forestry is often associated with South and Southeast Asia but it is also found in other regions (Wily 1997). While local participation is important in forest conservation, there are situations where it is absolutely necessary, i.e. under high population pressure and resource use conflicts, under communal ownership, and in smaller protected areas because of their vulnerability (Roche and Dourojeanni 1984). In such cases, conservation without local participation is doomed to fail. Nevertheless, participation itself provides no guarantee of success. This is because the outcome of participatory processes often depends on additional factors such as an institutional and legal framework or the education and interests of local people and other interest holders. As the case stories presented in this paper show, governments and their agencies play significant roles in participatory processes by providing - or by not providing – the 'enabling environment'. The present paper deals with different perspectives of participatory processes and, briefly, with key elements of enabling environments, i.e. appropriate institutional and regulatory frameworks, secure land tenure and various forms of capacity building. This presentation is based on the earlier paper by Isager and Theilade (2001) in which more detailed discussion on participation and forest conservation can be found. Our intention is to offer an overview of political and cultural contexts in which participatory processes inevitably take place. The present study is aimed to create awareness on vulture conservation among the school students in Sigur Plateau, Tamil Nadu.

STUDY AREA

Sigur Plateau is a plateau in the north and east of Nilgiri District in the Nilgiri Hills of Tamil Nadu, South India. It covers the 778.8 square kilometers. It comprises about 448.3 km^2 reserve forest of the Nilgiris North Forest Division, the 321 km^2 Mudumalai Tiger Reserve and about 16.2 km^2 of private lands. The average elevation of the Sigur plateau is 280 meters (919 ft). The boundaries of the Sigur plateau are Bandipur National Park to the northwest, Mudumalai

Tiger Reserve to the west, and Sathyamangalam Wildlife Sanctuary and Nilgiris East ranges to the east. The north side of the plateau is defined by the Moyar valley and the 260 metres (853 ft) deep Moyar Gorge. South of the Sigur Plateau is the higher Nilgiris Plateau. The Sigur Plateau is notable as an important wildlife corridor maintaining connectivity between the Western Ghats and the Eastern Ghats to sustain elephant and tiger numbers and their genetic diversity. It is an important link between several contiguous protected areas forming the Nilgiri Biosphere Reserve, the largest protected forest area in India. This area supports over 6,300 elephants, that represent the largest single population of elephant and tigers in India. The five major streams in the Sigur plateau are the Moyar River, the Sigur River, the Avarahalla River, the Kedarhalla River and the Gundattihalla River, which originate in the Nilgiris plateau. The Sigur Plateau is an important watershed area for the Cavery River and its ecological health is important to the many people dependent on the Cauvery

The Sigur Plateau is included in the list of important wildlife areas in the Nilgiri Biosphere Reserve (NBR). Sigur Plateau is connective junction of Western Ghats and Eastern Ghats. It's notable as an Important Bird Areas because it as a highest density of breeding critically endangered White-rumped vulture and small populations of another critically endangered Long billed vulture and Red headed vulture (Ramakrishnan *et al.*, 2010; 2012 and 2014 and Samson *et al.*, 2014; 2015; 2016 a.b.c). Although there are numerous numbers of tribal communities were residing in this plateau as well. There are two vulture nesting localities were recorded along the human settlements areas located near the river banks in the Sigur Plateau (Ramakrishnan *et al.*, 2014). Livestock cattle's populations were also high in these regions the tribal communities as well as non tribal communities were depending upon their livelihood for this livestock cattle's.

METHODOLOGY

The present study is an attempt to examine the awareness level of secondary school students towards vulture conservation. Four schools were selected around Sigur Plateau for the study purposes. 1. Bokkapuram Government Tribal Residential School (BGTRS), 2. Mavanalla Government Tribal Residential School (MGTRS) and 3. Vazhaithottam G.R.G Higher Secondary School, (VGRGHSS) and Masinagudi Good Sheppard High School, (MGSHS). A sample of 294 (141 boys and 153 girls) students from all three selected schools were participated in both the pre and post evaluation tests. The question paper contains vultures and their conservation relation questions, as broadly consists of five components, viz. (i) Vulture Morphology (ii) Vulture Biology (iii) Vulture Breeding Ecology (iv) Threats and (v) Vulture Conservation. There are 50 items in the question paper each carries the value of 1 mark, each wrong answer was given 0 marks. The researcher were personally visited the entire school during pre and post evaluation test and explained to the students how to respond the question in each section for the awareness test. Microsoft excel used for calculating mean and median marks scored by students during the test.

Pre-evaluation test

Pre evaluation test was conducted for the different school students to assess their knowledge about vulture and their conservation. The test comprised of multiple choices and true or false questions on various aspects of vulture. This test helped the students' knowledge about vulture before conducting the awareness programme.

Awareness programme for the students:

Awareness programme on vulture conservation using Power Point presentation had been done for all the school students. The main theme of the presentation was;

A. Vulture Morphology

Size, Shape and Morphological Characteristics

B. Vulture Biology

Digestive system, Defensive Mechanisms, Feeding, Bathing, Soaring, Carcasses finding

C. Vulture Breeding Ecology

Nesting Habitat selection, Mating, Nesting Behavior, Egg laying, Incubation, Chicks appearances, Parental Care

D. Threats

Human Disturbances, Livestock Grazing, Deliberate Poisoning and Diclofenac (NSAID) Threat

E. Conservation

Captive breeding Programme, Conservation Issues and Need for conservation action to ensure the healthy population of vultures in Sigur region

Post-evaluation test

After completion of the awareness programme, a Post-evaluation test was conducted all students in selected schools, separate question paper was framed for the post evaluation test. Post-evaluation test was carried out to examine the knowledge gained by the students. Marks scored by the students during the post-evaluation test were compared with pre-evaluation test.

Students improvement scale

Performance of improvement scale was estimated from the average marks scored in the pre-evaluation test subtracted from the average marks secured in the post evaluation test for each batch (Table. 5.3) The improvement scale rating was given as I (6-9 Marks), II (3-6 Marks) and III (1-3).

RESULT

The different schools and class students were participated in the pre and post-evaluation test. Among the middle schools wise, 8th standard students were participated higher 39%, followed by 7th standard 33% and 6th standard 28%. Followed by High schools wise, 6th standard students were participated higher 23%, followed by 9th standard 22%, 10th standard 20 %, 7th standard 19 % and 10th standard 16 %. In the present investigation, the level of awareness on vulture conservation has been identified on the basis of marks scored by the Middle school and high school students in all four selected schools. During the pre-evaluation test 294 students (52% of girls, 42% of boys) and post evaluation test 294 students (52% girls, 42% boys) were participated.

Average marks scored during the pre-evaluation test the middle school shows MGTRMS average score was 28.80 and BGTRMS 26.87. Followed by high school namely VGRGHSS average score was 29.49 and MGSHS 26.45. In the middle school level MGTRMS males and females were scored more marks in the pre-evaluation test the average score males was 40 and females average score was 27.63. On the other hand high school level MGSHS males and females were scored more marks in the pre-evaluation test the average score males was 29.65 and females average score was 29.30.

Middle schools wise MGTRMS score more marks in all component wise questions compare than BGTRMS the score wise maximum score was scored in vulture conservation (6.90) followed by vulture breeding (4.95), vulture biology (5.28), vulture morphology (5.76) and vulture threats (4.95). Similarly in the high schools wise MGSHS score more marks in all component wise questions compare than VGRGHSS the score wise maximum score was scored in vulture breeding (6.43) followed by vulture conservation (6.32), vulture morphology (5.70), vulture biology (5.56) and vulture threats (5.45)

Average marks scored during the post-evaluation test the middle schools shows MGTRMS average score was 38.66 and BGTRMS 35.03. Followed by high school namely MGSHS average score was 36.81 and VGRGHSS 34.46. In the middle school level MGTRMS males and females were scored more marks in the post-evaluation test the average score males was 42 and females average score was 38.51. On the other hand high school level MGSHS males were scored more marks in the post-evaluation test the average score males was 36.93 and VGRGHSS females were scored more marks in the post-evaluation test the average score was 37. 27.

Middle schools wise MGTRMS score more marks in all component wise questions compare than BGTRMS the average score wise maximum score was scored in vulture breeding (9.47) followed by vulture biology (8.04), vulture conservation (8), vulture morphology (6.70) and vulture threats (6.57). Similarly in the high schools wise MGSHS score more marks in all component wise questions compare than VGRGHSS the score wise maximum score was scored in vulture breeding (8.93) followed by vulture biology (7.69), vulture conservation (7.10), vulture threats (6.64) and vulture morphology (6.34).

Students improvement scale rating based on average marks obtained both pre and post evaluation test result shows that middle school wise MGTRMS improvement scale was all std student were scored first class (I) and BGTRMS improvement scale was 6^{th} and 8^{th} std students score First class and 7^{th} std score second class. Similarly in the high schools wise VGRGHSS improvement scale was all std student were scored first class (I) and MGSHS 8^{th} , 9^{th} and 10^{th} std were scored first class (I) and 6^{th} and 7^{th} std students score second class (II).

Pre and Post-evaluation test marks scored by both genders were taken for the analysis. The average mark scored during the pre- evaluation test was 27.75 and 26.82 for male and female students respectively and a Post-evaluation test average mark was 36.09 and 36.72 for male and female students and the improvement scale was both male and female score first class. Pre and Post-evaluation test marks scored by community wise were taken for the analysis. The average mark scored during the pre-evaluation test was 27.01 and 27.43 for tribal and non tribal students respectively and a Post-evaluation test average mark was 35.96 and 36.77 for non tribal and tribal students and the improvement scale was both tribal and non tribal students were scored first class.

DISCUSSION

In the present study, students from different community (tribal and non-tribal) and residential background were selected for conducting vultuure conservation awareness test. All selected schools were located in the vulture nesting habitat surroundings.

Percentage of student's participation

The finding of the present study revealed that students participated in both tests were equal number of representation from both gender, in a samples with female students slightly representing more than the male students could be related to the more number of female students representing in all the classes.

Pre and Post-evaluation tests

The pre-evaluation test result showed that middle school wise MGTRMC score better score compare than BGTRMS. Similarly in high school wise MGSHS score better score compare than VGRGHSS because of comprised of students from tribal and non- tribal community and also they are staying outskirts of the Sigur plateau and got lot of exposure to competitive tests. After the induction of vulture awareness classes to all the schools. The same results have been deploy during post- evaluation test MGTRMC score better score compare than BGTRMS. Similarly in high school wise on the contrary to the pre-evaluation test VGRGHSS score better score compare than MGSHS. This could be due to the impact of awareness programme (Hernandez *et al.,* 2001) which had improved their confidence level and induced them to perform better than other schools despite they are average in their studies.

Improvement scale

Performance of improvement scale was estimated from the average marks scored in the pre-evaluation test subtracted from the average marks secured in the post evaluation test for each batch. The improvement scale was given as I (6-9 Marks), II (3-6 Marks) and III (1-3 Marks). Overall the improvement scale rating was higher in middle school wise MGTRMS similarly in high school wise VGRGHSS could be attributed to the impact of vulture conservation awareness classes coupled with improved confidence of students and their traditional knowledge induced them to perform better than the other schools.

Class wise difference in vulture conservation awareness in pre and post evaluation test

During the pre-evaluation test there was no significant average marks difference observed between all the classes

of MGTRMS and MGSHS could be related to the same level of awareness on vulture conservation. There was a strong significant difference observed in middle school wise 6th and 7th and 8th standard of MGTRMS could be related to the representation of non tribal community students and in MGSHS having exposure to competitive test and traditionally having sound academic background. During the post-evaluation test the class wise difference was observed between MGTRMS and VGRGHSS students could be related to the impact of awareness programme had improved their confidence level and induced them to perform better than other schools.

Variation in vulture conservation awareness Gender wise

There is no significant difference between male and female students. It is concluded that gender is not a factor affecting the awareness level; the main reason is that they are studying and learning together in the same teaching environment inside and outside the schools. However, Daisy *et al.*, (2012) was observed significant difference between male and female students and perceived level of awareness after the environment education. The present study revealed that students residing inside the forest, especially tribal are academically very poor. After the vulture conservation awareness programme conducted they were little bit performed better than non- tribal students whose residences were in the periphery and outside the forests. Therefore more awareness campaign should be conducted to the students in the core as well as in the periphery to understand the ecology and behavior of vulture and to mitigate conflict and also the long term survival of the endangered species in the Sigur plateau region.

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CONSERVATION OF INDIAN LONG-BILLED VULTURE (GYPS INDICUS) AT PALARAPU CLIFF, TELANGANA, INDIA

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ABSTRACT

The Indian long-billed vulture (*Gyps indicus*) is a typical vulture, with bald head, very broad wings and short tail feathers. It is an avian natural scavenger, which is in the highest category of endangerment and listed in by IUCN and in Schedule I of the Indian Wildlife (Protection) Act 1972. The widespread usage of Diclofenac drug led to the rapid decline in population. Massive decline took place in 1996, greater than 97 % declined. Only about 30000 mature individuals are exiting in the wild of its range (India, Pakistan and Nepal). They are an important component of the ecosystem performing the role as scavengers by consuming dead and decaying animal carcasses, thereby keeping the environment clean and healthy. In Telangana a unique site of Indian long-billed vulture's breeding colony was identified at Palarapu cliff during 2013 near Nandigaon village in erstwhile Bejjur Forest Range. Telangana Forest Department has started vulture conservation project entitled "Conservation of Indian Long-billed Vulture (*Gyps indicus*) at Palarapu cliff" on 1st January, 2015. Monitoring of Birds, Diclofenac Survey, Publicity activities, providing feeding are the components in the Conservation Plan. The monitoring was carried out by direct observation using (12x-50mm) binoculars during the day time. The habitat is quite suitable for the Indian long-billed vulture. In this current paper, population trends of the Indian long-billed Vulture at Palarapu cliff in the past (3) years are discussed.

Key words: Indian long-billed vulture, Palarapu cliff, Population, *in-situ* Conservation

Introduction

Out of nine species of vultures, the population of three Gyps species; White-rumped Vulture (*Gyps bengalensis*), Slender-billed Vulture (*Gyps tenuirostris*) and Long-billed Vulture (*Gyps indicus*) in the wild has declined about 99% drastically over the past decade (Prakash *et al.*, 2012). The Gyps vulture declined in India 97% and 92% in Pakistan (Virani, 2006). Because of the evidence of widespread and rapid population decline, all three vulture species were listed by IUCN, the World Conservation Union, in 2013 as 'Critically Endangered' (BirdLife International, 2013). The Indian long-billed vulture (*Gyps indicus*) is a typical vulture, with bald head, very broad wings and short tail feathers. It is an avian natural scavenger, which is the highest category of endangerment and listed in Schedule I of the Indian Wildlife (Protection) Act 1972. The widespread usage of Diclofenac drug led to the rapid population decline. Massive decline in 1996, greater than 97 % declined. Only the total 30000 mature individuals are exiting in the wild of its range (India, Pakistan and Nepal). In Telangana a unique site of Indian long-billed vulture's breeding colony was identified at Palarapu cliff during 2013, then Telangana Forest Department has initiated project entitled "Conservation of Indian long-billed Vulture (*Gyps indicus*) at Palarapu cliff" on 1st January, 2015.

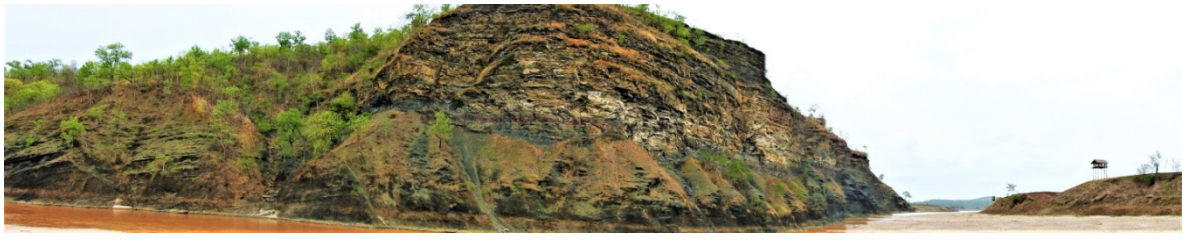
Importance of the species

The Vultures are social birds, feeding and roosting in colonies. They are an important component of the ecosystem performing the role as scavengers by consuming dead and decaying animal carcasses, thereby keeping the environment clean and healthy. Vultures are known to feed on rotting carcasses of ungulates, which may have died due to deadly diseases like Anthrax, Foot-and-mouth disease etc. A flock of vultures can consume a huge carcass within a half an hour and left over will be the bones, hooves and horns. They are long-lived birds with a life span of up to 50 years. They mature slowly too and start to breed only at the age of six or seven years. Genus *Gyps*, species breeds in loose colonies on trees or cliffs where twig nests are made. *Gyps* vultures lay only one egg in a clutch; the incubation period is 45 to 55 days and the young birds fledge when they are about three to four months old.

Methodology

Breeding colony of Indian long-billed vulture (*Gyps indicus*) is situated on the southern face of 80-90 meter high elevated rock cliff (108 meter total height of the cliff) , named "Palarapu cliff", in the Bejjur Reserved Forest nearby Nandigaon village at the confluence of Peddavaagu stream and Pranahita river. This habitat's geographical coordinates are 19°21'29''8 N latitude and 79°91'38''3 E longitude (**Fig.1**) of Nandigaon beat, Kammargaon section of Penchikalpet range of Kaghaznagar division, Telangana state. It is located near the border of Telangana and Maharashtra states. East side of this habitat has agriculture fields which extend up to Pranahita River, on South side Peddavagu, a perennial stream, is present and North and West parts are having forest area that are included in the Bejjur Reserved Forest. The vegetation is of Southern Tropical Dry Deciduous Forest type dominated by Indian Black wood (*Hardwikkia binata*).

A 'machan' is erected on the bank of the stream facing the habitat for continuous monitoring. Direct observation and also with (12x-50mm) binocular in the day time, the monitoring is carried out. Starting from the nest construction, the entire breeding season is watched.



Observations & Results

Our observation suggests that the habitat is quite suitable for the Indian long-billed vulture possibly due to following reasons: (**Fig.2**)

- Presence of ledges on the high elevated cliff suitable for nesting/roosting
- The habitat perfectly camouflage to the vultures. A trained eye can only locate the birds
- Availability of water, in adjoining perennial streams Peddavagu and Pranahita River
- Availability of nesting material (grass*, Themeda* sp.) around the habitat
- Presence of 40 white washed ledges (fecal droppings), which are indirect evidences of the birds' past usage
- More than 50 nests can be built in this habitat
- No hindrances while departing/ arriving in the nest. Plain bed of the stream useful for easy take off/landing
- Presence of trees of good height, viz., *Hardwickia binata* for roosting

At the beginning of "Conservation of Indian long-billed vulture (Gyps indicus) project" by Telangana Forest Department at this site, only 9 individual birds found. The population is stood at 26 individuals in 2015, 30 in 2016 and 32 in 2017.

Survey has been conducted in (20) villages that are falling in the vicinity of the habitat to know the administering Diclofenac drug to the cattle. It is observed from the survey that there is no usage of the said drug to cattle by the villagers. But, other observation is that cattle of old age and incapable of doing work and injured, are sold to slaughter house which result in less or no cattle mortality, which may in turn, result in scarcity of feed to the vultures.

Awareness is part of conservation of vulture; to know the importance of the vulture we conducted some awareness programs, classes. A brochure was designed in Telugu, with title "*Prakruthi Bandhuvu Raabandu*" which roughly translates as "The Vulture – well-wisher of the Nature", was distributed among officials, non-officials, students and people of Bejjur Range to create awareness regarding significance of Vultures and their role in eco-system and its conservation plan at Palarapu Cliff. Kalajatha Programs are being conduced in 66 villages across Kaghaznagar Forest Division. International Vulture Awareness Day on 2nd September, 2017 was celebrated at Kaghaznagar to create awareness among the students on vulture and its role in ecosystem.

***In-situ* CONSERVATION**

FEEDING CENTRE (Vulture Restaurant)

Supplementary feeding provided at feeding centre or vulture restaurants as major part of conservation, feeding provide to vultures were devised as general tool for the conservation of small scavenging birds population, being applicable to a number of species with differing feeding and life-history strategies (Mundy *el al.,* 1992; Piper, 2006; Gilbert *et al.,* 2007). Anticipating the scarcity of feed to the Vultures in the back drop of less or no cattle mortality in the surrounding villages, Vulture Restaurant (Feeding Centre) has been established by Forest Department in the vicinity of present habitat on the lines of Vulture Restaurants established in Gadchiroli District of Maharashtra and in Pathankot of Punjab. The selected site is on top of Palarapu cliff, which is the nesting site. No power lines are near, very far away (Piper, 2015). An area of one hectare is identified and chain linked fence has been erected to avoid the mammalian scavengers. The area is having trees suitable for perching and resting for vultures. For long term conservation and species recovery, this restaurant is useful to give Diclofenac-free carcasses to the vultures and help increase the population. So far 33 times, feed has been supplied since 2015, of these 7 times vultures fed themselves with a feeding success rate is 21.2 %.

Threats

The major threat of vultures is Diclofenac drug, after several researches, experiment result has shown that vultures killed by kidney failure in short period of feeding on carcass of an animal treated with normal dose 'Diclofenac Sodium' (Oaks, 2006). In India 'Neck dropping' was first recorded in Keoladeo National Park for several weeks before collapsing and falling out of trees at just prior to death (Prakash, 1999). This is an important indication where the birds under hot condition. In India and Nepal, and Pakistan similar of dead adults and sub adults of vultures with visceral gout and Diclofenac contamination, observed rate of mortality expected to be caused by Diclofenac (Green *et al.*, 2004).

VULTURE CONSERVATION IN INDIA

To increase population of Vultures in India, the Ministry of Environment and Forests, Government of India started implementation of Action Plan in 2006. To increase Vulture population, conservation and breeding centers are established in India by MoEF, Government of India at Pinjore (Haryana), Rajabhatkawa (Buxa Tiger Reserve, West Bengal), Rani (Assam) and also rescue and breeding centers were established in Nehru Zoological Park (Hyderabad), Bhubaneshwar (Orissa), Junagarh

(Gujarath) and Bhopal. And recently ten vulture restaurants are established in Kamlapur Range Sironcha Division of Gadchiroli Circle of Maharashtra State, where two species of Gyps such as Long-billed Vulture and White-rumpedd Vulture are recorded (Shukla & Lad, 2015). Banned usage of Veterinary Diclofenac drug in 2006, Government of India, advised to use Meloxicam drug (alternate pain killer), which leaves cattle carcasses safe for vultures and also Banned Multi-dose vials of Diclofenac drug for human formulations in September, 2015 by Ministry of Health, Government of India and only 3 ml. dose available. Vulture conservation Breeding Centre has established by Haryana Forest Department and Bombay Natural History Society (BNHS) at Pinjore, Asia's first 'Gyps Vulture Reintroduction Program' in June, 2016. It is an initial trial release of two Asian vultures (Himalayan Griffons) in India from the Jatayu Conservation Breeding Centre at Pinjore, Haryana. (*Source: www.jatayubreedingcentre.com*). In India's first vulture sanctuary established in Karnataka is Ramdevara betta Vulture Sanctuary, declared in 2012. (*Source: www.karnatakaforestdepartment.com*).

Conclusion

The southern Indian state of United-Andhra Pradesh has six species of vultures: White-rumped Vulture *Gyps bengalensis*, Long-billed Vulture *G. indicus*, Indian Griffon Vulture G. fulvus, Egyptian Vulture *Neophron percnopterus*, King Vulture *Sarcogyps calvus* and Cinereous Vulture *Aegypius monachus* (Ali & Ripley, 1983). An informal survey between 1990 and 1997 approximately 8,615 of Long-billed Vultures was recorded across 39 sites in 15 districts of the state (Srinivasulu & Srinivasulu 1999). And they sighted vultures at Mancherial, Kawal and Utnoor in Adilabad District, Telangana. A small colony (N = 7 nests) of Long-billed Vultures was recorded in Pocharam Wildlife Sanctuary, Medak District, Telangana until 1998. Since then on, nevertheless, no individuals were sighted in this area (C. Srinivasulu, in litt. 02 August 2014). Another survey conducted in 2007 by Umapathy *et al.,* (2009) that aimed to study the status and distribution of vultures, reported 13 Long-billed Vultures from Markapur in Srisailam Tiger Reserve, Mattadiguda in Utnoor and Dharmaraopet in Bellampally within Adilabad District, Telangana. Recently a paper has been published by Stotrabhashyam *et al.,* (2015) in the same study area; they well reported a total of 13 individuals among which, they recorded, in month of February and March, 2014. But our study clearly shows that the population of Long -billed Vulture is now increasing in the present study area, from mere (9) individuals to 26 individuals in 2015 (Ravikanth & Ram Mohan, 2016), 30 individuals in 2016 and 32 individuals in 2017. In order to protect and conserve the present area, a draft proposal for declaring as Vulture Sanctuary has been mooted by the Telangana State Wildlife Board and the proposals is being prepared.

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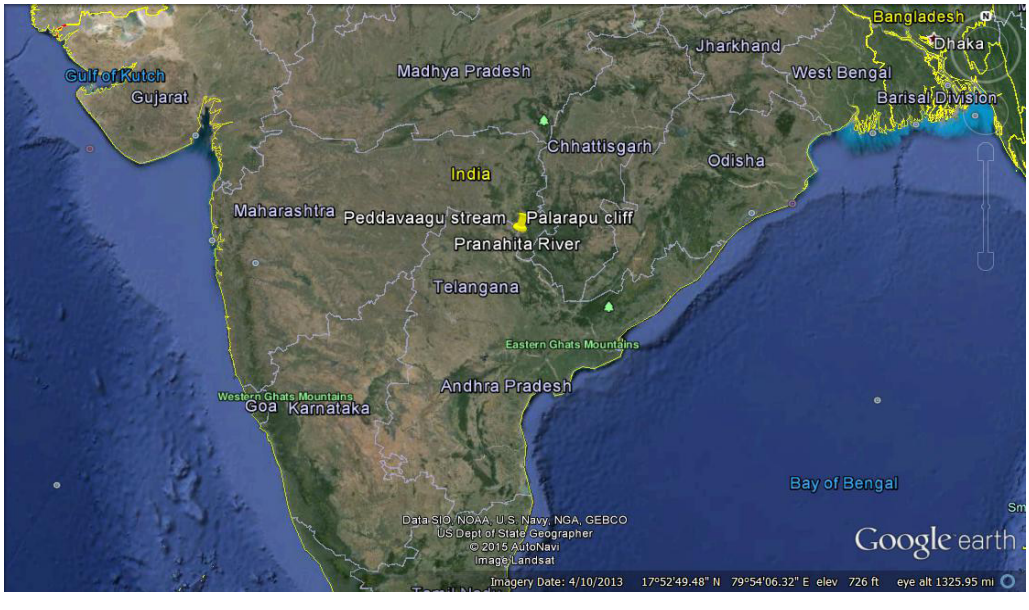

Figure 1: Google Earth map showing the location of breeding colony of Indian long-billed vulture, Palarapu cliff

Figure 2: A view of breeding colony of Indian long-billed vulture, Palarapu cliff

Indian long-billed vultures in the nests at Palarapu cliff

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POPULATION STATUS OF THE ENDANGERED VULTURE (GYPS BENGALENSIS), NILGIRI DISTRICT, TAMILNADU, INDIA

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ABSTRACT

The Oriental White backed vulture (*Gyps bengalensis*) once seen widely, but it has now shown decline in its population in many areas. This study was undertaken to collect information about population density of *Gyps bengalensis* in different localities like Masinagudi and Theppakadu. The study aimed at finding reasons and consequences of changing population pattern of vulture. The study was conducted over a period of ten months (November 2011 – August 2012). Regular field trips were made at intervals of one or two weeks. It was seen that the vultures inhabit in dense forest like evergreen, moist deciduous and teak forest areas. There is a definite decline in their number over the past decade. This is because of deforestation, forest fire, loss of nesting sites, food sources, increase in predators and pollution.

Key Words : Gyps bengalensis, Population status, Nilgiris, Diclofenac, Endangered.

Introduction

India is characterized with unique richness and diversity of its vegetation and wildlife. India's dense forest reserves are the perfect abode for its equally dense wildlife which includes about 350 mammal species, more than 1200 species of birds in nearly 2100 forms and more than 30,000 species of insects. Besides this, there is rich wealth of marine life having number of species of fish, amphibian and reptiles. More than 75 National parks, 425 Sanctuaries cover over 4.5% of India's geographical area. Indian wild life has got important place in its rich heritage and culture. Many animals and plants are worshipped and are regarded as the companions in India. The country also has about 2000 species and sub-species of birds. The numerous sanctuaries across the country are not only breeding colonies for these feathered creatures, but serve as resorts for migratory birds from higher altitudes, as well. Indian wildlife has its share of native birds along with the migratory birds. Several hundred species of birds can be spotted across India. Many natural populations have been reduced in size due to increased human activities associated with landscape changes and persecution (Mace *et al.,* 2005). Concern exists because significant reductions in the size of large populations will likely cause a loss of genetic diversity due to drift and increase extinction risk by adversely affecting the ability of populations to adapt to changing environments (Willim *et al.,* 2006). Vulture is the name of a bird that mainly preys on dead animals and occasionally hunts its own quarry. It is found across the world, with the exception of Antarctica and Oceania. The vultures are all obligate scavengers, feeding primarily on the carcasses of large ungulates and nesting and roosting, often colonially, on cliffs or in trees. The Indian White-rumped vulture (*Gyps bengalensis*) is an Old World vulture in the family Accipitridae. It is closely related to the Gyps fulvus. So it was called as Oriental White-Backed Vulture. In the early 20th century, the Indian White-Backed Vulture (Gyps bengalensis) was abundant, and its distribution extended from the Thai-Malay peninsula and Indo-china in the east to the Indus River, running through Pakistan, in the west (Oak *et al.,* 2004). However, a recent survey in India indicated a catastrophic collapse in the population of G. bengalensis, which had been totally wiped out from 17 key areas in that country (Rae, 1935). G. bengalensis was regarded as "possibly the most abundant large bird of prey in the world" (Houston, 1985). White Rumped Vultures are typical vulture, with an unfeathered head and neck, very broad wings, short tail feathers, medium-sized and dark vultures. It has a white neck ruff. The adult's whitish back, rump and the under wing coverts contrast with the otherwise dark plumage. The body is black and the secondries are silvery grey. The head is tinged in pink and bill is silvery with dark Ceres. The nostril openings are slit-like. Juveniles are largely dark and take about four or five years to acquire the adult plumage. In flight, the adults show a dark leading edge of the wing and have a white-lining on the underside. The under tail coverts are black (Rasmussen and Anderton, 2005). Adults are 75 to 85 cm tall, their wing span is 180 to 210 cm, and their weight ranges from 3.5 to 7.5 kg. The sexes are approximately equal in size. Adults are darker than juveniles, with blackish plumage, a white neck-ruff, and a white patch of feathers on the lower back and upper tail. During flight, the white under wing coverts are highly visible. Usually the eyes are a yellowish brown colour and the legs are blackish. The bill is short, deep, and stout. Immature G. bengalensis are dark brown and the lower back and rump area are brown rather than white. The under wing coverts are dark brown. Eyes are dark brown and the legs are blackish but lighter than the adult. Generally, adults tend towards black colouration, while younger individuals are browner. All G. bengalensis can be distinguished by the white bar located on the underside of the wing. (BirdLife International, 2004 & Rasmussen and Anderton, 2005). According to the Red Data Book, Oriental White Backed Vulture has suffered an extremely rapid population decline, particularly across the Indian subcontinent, probably as a result of disease compounded by poisoning, pesticide use and changes in the processing of dead livestock (Threatened Birds of Asia, 2001).

Materials and Methods

The present study was taken to reveal the population capacity and addition of the Meloxicam drug an alternative for the Diclofenac toxicity of endangered vulture, Gyps bengalensis (Plate-1). The study was made in Nilgiri district, Tamilnadu, India.

Study area

Mudumalai sanctuary

The Mudumalai Sanctuary is as an important wildlife habitat, because of its strategic position. As a Wildlife corridor between several other protected areas that are a part of the Nilgiri Biosphere Reserve. At north to this the Bandipur National Park and Nagarhole National Park is there and in the west the Wayanad Wildlife Sanctuary and in the south Mukurthi National Park and Silent Valley National Park are there. At the east the Segur plateau which connects to the Sathyamangalam wildlife sanctuary and Reserve forests is located. There is a high diversity of animal life in the sanctuary with about 50 species of fishes, 21 species of amphibians, 34 species of reptiles, 227 species of birds and 55 species of mammal. Mammal diversity is higher in the dry deciduous and dry thorn forests than in the other habitats. Thirteen percent of all mammal species in India are present in Mudumalai wildlife Sanctuary. Eight percent of bird species in India occurring in Mudumalai Wildlife Sanctuary. Among the 227 bird species found in Mudumalai, 110 species are insectivores, 62 are carnivores, 23 species are fishivores, 12 species are omnivores and 20 species are grainivores.

Thengumarahada

Thengumarahada occupy the area of 28 sq.km and 9.4km away from Kotagiri taluk.

Climatic conditions

In Mudumalai sanctuary the winter season takes place from November to February. Normally it has the temperature from 18º C -20º C and average rainfall 1020mm. The hot summer season falls at March to May and the temperature ranges from 26º C -33º C, average rainfall 790mm and the rainy monsoon season usually arrives at June to September. This season has heavy rainfall 1840mm and the temperature ranges from 20ºC -24ºC. In Thengumarahada the winter season are from November to February. It has the temperature 20º C -22º C and average rainfall 870 mm. The hot summer season are from March to May and the temperature ranges from 28º C -32º C, average rainfall 640 mm and the rainy monsoon season usually from June to September. In this season has heavy rainfall 1450 mm and the temperature ranges from 20º C -24º C.

Catchment areas

The studies were done at two locations in Nilgiris district. They are Mudumalai sanctuary (Masinagudi, Thepakadu, Mudumalai) and Thengumarahada. The sanctuary has an area of 321Sq. Km with 108 Sq.km of National park area. The altitude ranges from 100' MSL to 1200' MSL. Thengumarahada occupy the area of 28 sq.km and 9.4km away from Kotagiri taluk.

Road transect method (Fuller and Mosher, 1987)

Road transect method is very useful for counting vulture ranging in wider areas. This method was employed to determine vulture species distribution in Mudumalai sanctuary and Thengumarahada. Roads and trails in the park provided convenient access to the study area were used as transects for survey carried out monthly in clear weather by a two member team about an hour after sunrise on a moving vehicle (with speed 20 km/hr) stopped at specified points to survey the vulture. This allowed large areas of the park to be searched efficiently for vulture. A pair of good binoculars and digital camera was used to aid identification of distant birds.

Encounter transects (Abdul Jamil Urfi, 2004)

Using prepared base map identifies (preferably randomly) the starting point of the transect, before starting our survey record the required transect information and weather conditions at the top of the data form: Bird Observation Form – Vulture.This method was employed to determine vulture species distribution in Mudumalai sanctuary and Thengumarahada. 0.5-2 Km are recorded as one transect, like that 23 transects were recorded in the survey area. Among these 19 transects in Mudumalai and 4 transects in Thengumarahada were studied. For each vulture detection, record the distance traversed along the transect. Vultures encountered along the transect must be recorded. Each transect should be surveyed in morning to evening.

Visual Scanning Method (Jathar and Rahmani, 2003)

The field survey for the vulture was carried out by the visual scanning method. Visual scanning involves purposeful scanning of treetops for locating the vultures. For this purpose, a binocular was used. Field trials for this method were taken to assess best times of the day for visual scanning. Early to mid-mornings and evenings were found to be the best times.

Data Collection Parameters

Macro and Microhabitat Assessment

From previous studies and literature, it was known that the vulture prefers dense forests and teak-bearing miscellaneous forests and can also be found in areas close to human habitation. We recorded a number of survey parameters at each survey point to determine the habitat preference of the species. We also carried out an assessment of threat due to human presence in the area. These are described below.

Field Survey Protocol

Composition of the Survey Team

The survey teams consisted of a field biologist and a field assistant and were generally accompanied by a guide, either a local villager or a staff member of the Forest Department. Presence of a staff member during the survey was useful in obtaining information about the area, location and compartment numbers of the site.

Selection of Survey Locations

Forest divisions having good quality vegetation cover were selected from the vegetation density maps of each state prepared by Forest Survey of India (Forest Survey of India, 2005). Forest Divisions having fragmented and low density forests were not included in the survey. Based on the premise that the vulture was found in ever green forestswe selected forest circles and forest divisions having evergreen

forests and moist deciduous forests, for the survey. These divisions were selected based on discussions with knowledgeable forest officers of the state.

Survey Itinerary

The route for the survey was planned prior to starting the survey. From the vegetation map of the state, districts having open dry deciduous teak forests were selected and marked on the map. Survey itinerary was finalized after assessing the area to be covered and the available time.

Discussion with Local Officers and Staff

Before beginning the survey in a forest division the survey team generally met the Deputy Conservator of Forests of the forest division and obtained information regarding the best ranges to survey. Ranges having fragmented and degraded forests were omitted. Ranges having open dry deciduous teak forests were selected for the survey. With the help of the range forest officer and field staff of the range we identified convenient roads and trails passing through the forests of that range for carrying out the survey. The survey was carried out in the forests along these roads and trails.

Season

Seasonal effects can be more difficult to cope with. Bird conspicuousness will probably change with season, and in tropical forests there may not be synchronization of breeding cycles between or even within species. In a species which is breeding, the males may be singing and calling to defend a territory and so may be easy to record, whereas the females incubating eggs may be the opposite. There can be no hard and fast rules about whether studies are better designed to avoid or coincide with the peaks of breeding activity, as this is better determined by the aims of the study.

Weather conditions

Adverse weather conditions such as low cloud, high winds, rainfall and even very high temperatures can affect census results in three ways. Firstly, bird activity can be directly affected (usually reduced), which will affect the efficiency and reliability of our data collection. Secondly, the conditions could reduce our chances of actually seeing or hearing the birds. Thirdly, we cannot pay adequate attention to counting if the conditions are too hot, too cold or wet. Census results can also be affected by conditions underfoot (during dry periods, fallen leaves may become very noisy to walk on), or by the noise of cicadas (whose activity is influenced, amongst other things, by temperature and humidity).

RESULTS

The survey areas are Masinagudi, Theppakadu, Mudumalai and Thengumarahada. The survey took place in the three different seasons, from October to September. Survey of vultures done in winter, hot summer and rainy monsoon seasons. In Mudumalai sanctuary winter season, temperature is very low at 18ºC to 20 ºC, hot summer season, temperature is very high at 33 ºC and in rainy monsoon season the temperature come to down at 22 ºC to 24 ºC. At end of the winter season only (Nearly February) the vultures can be seen frequently. In hot summer seasons the vultures were seen rarely because of high temperature, scarcity of food, water and mainly forest fire. In rainy monsoon season there will be heavy rainfall, it affects our survey and also birds were migrated to another place. In Thengumarahada winter season, temperature is very low at 20ºC to 22 ºC, hot summer season, temperature is very high at 28ºC to 32ºC and in rainy monsoon season the temperature come to down at 20 ºC to 24 ºC (Table 1).In Mudumalai sanctuary, highest rainfall 1840 mm in rainy monsoon season. In winter season 1020 mm rainfall and in summer season 790 mm rainfall was noticed. In Thengumarahada highest rainfall 1450 mm recorded in rainy monsoon season. In winter 870mm and hot summer 640 mm rainfall was registered (Table 2). In our survey most vultures are recorded in Mudumalai than other three regions. Only one vulture was observed in Thengumarahada. The survey has done by two different methods namely Road transect method and Encounter method. Road transect method done by moving vehicle. In road transect method, each transects are separated based on the kilometers. The study area was divided into nine transects. Each transects contain 10 Sq. Km. In road transect method, only three individual vulture were found in Theppakadu, Mudumalai and Thengumarahada. In this project there is no possibility to see the vultures in Masinagudi area in road transect method. Vultures seemed by road transect method in Theppakadu at 30-40 km ranges, in Mudumalai at 70-80 km ranges and in Thengumarahada at 10-20 km ranges (Table 3). Encounter transect method was done in same study area for counting the vulture population this method was very convenient. In encounter method each and every Sq. km surveyed. So this method is very accurate. Each transect was occupied every Sq. Km. of the areas. In Masinagudi, three vultures are observed in February and June. In Theppakadu and Thengumarahada three vultures was recorded in February and March in dense forest areas. The rich flora and fauna were found in Mudumalai area. The availability of food is more in this area. In this area only high numbers of vultures are recorded in January, February and July. In both of the transect methods, more number of vultures were recorded by Encounter transect method. In total, we covered 132 Sq. Km. across 89 Sq. Km. for road transect method and 43 Sq. Km. for encounter transect method. There, we saw 11 individuals of white- backed vultures in various habitats. Our study areas are rich in vegetation. So vultures are breed in those areas. In that nine white-backed vultures are found exclusively in the evergreen and moist deciduous forest. Other two individuals sited in teak forest. Evergreen forest contains high number of large trees. It is a good habitat for vultures, because vultures want to live in highest places.

DISCUSSION

In South Asia, the populations of the endemic Oriental White Backed (*Gyps bengalensis*), Slender Billed (*Gyps tenuirostris*) and Long Billed (*Gyps indicus*) vultures have declined dramatically by more than 95% since the early 1990s, and the evidence suggests that the few that are left continue to decline at between 15% and 50% per year.

These three species which, together, just 15 years ago, used to number tens of millions (possibly 40 million of one species in India alone), are now almost unbelievably at serious risk of global extinction and are listed as 'Critically Endangered' by the International Union for Conservation of Nature (IUCN, 2005). The decline of vultures is worrying from a biodiversity viewpoint, but also because a great number of carcasses are being left uneaten" Cunningham (2000) says, "Vultures play an important role in scavenging human and animal carcasses". For example, In India's 76000 strong Parsees community peoples bones do not buried but their bones are cleaned by vultures alone. In India, Gyps vulture's numbers diminished by several reasons. Extreme examples are G. bengalensis, which often lives in close association with humans. Humans may be a threat to G. bengalensis because of the usage of vultures as a source of medicines (Aminur Rahman, 2009), diseases, pesticides (DDT and HCH), environmental contamination, poisoning, habitat alterations, reduced food availability (Thiollay, 1998), calcium deficiency, reduced nesting habitat, nest predators, hunting (Pain et al., 2008), Climate change (Mc carty, 2001) and aircraft strikes (Bhatnagar, 1993).

Diclofenac is a widely available veterinary drug in the Indian subcontinent, where it is used for the symptomatic treatment and management of inflammation, fever, and/or pain associated with disease or injury in domestic livestock. Scientific evidence following the observation of waste disposal practices of carcasses confirms without doubt that the veterinary use of Diclofenac is the main cause of these declines (Green et al., 2004) throughout the Indian subcontinent. The realization that Diclofenac, a Non Steroidal Anti-Inflammatory Drug potentially nephrotoxic to birds, had become a widely used veterinary medicine led to the identification of Diclofenac poisoning as the cause of the decline. Surveys of Diclofenac contamination of domestic ungulate carcasses, combined with vulture population modelling, show that the level of contamination is sufficient for it to be the sole cause of the decline. Post-mortem examinations of vulture carcasses revealed visceral gout (deposition of uric acid crystals in the tissues) as the cause of mortality in most of the dead birds. As a consequence of the collapse of South Asian vulture populations, national and international conservation organizations have concluded that it is essential to ban the use of Diclofenac in domestic livestock so as to remove it as a toxic contaminant of the food of wild, scavenging vultures. At a meeting of the National Wildlife Board in March 2005, the Government of India announced that it intended to phase out the veterinary use of Diclofenac within six months. In 2006, the Governments of India banned the manufacture of Diclofenac. This sends a very clear signal and is welcome. However, retail sale of Diclofenac not manufactured for veterinary use remains legal in these countries, so full bans on retail sale for veterinary use may be necessary (Nita Shah, 2008).

CONCLUSION

The Governments of the respective countries may take immediate steps to completely phase out veterinary Diclofenac. This would have to be complemented by aggressive awareness campaigns about the adverse ecological effects of the drug. To conduct a reliable population estimate at State, country and regional levels. Efforts should also be made to raise strengthen education and awareness campaigns among veterinarians, pharmacists, livestock owners and general public, of the problem of Diclofenac contamination and availability of safe alternative Meloxicam. Captive holding and breeding of vultures until Diclofenac is controlled is recommended as a precaution to ensure the long term survival of the threatened species and to provide a stock of birds for vultures reintroduction programme. In situ and Ex situ conservation project, vultures should be fed on carcasses of animals that are known not to have been treated with Diclofenac in the week before death. Vulture restaurant will be a great solution for increasing the population of Gyps bengalensis to be with poisonless feeds. It will help the vultures from poison death and will increase in its genes. Setting up of a Task Force for the region to collaborate in vulture conservation programmes in these regions.

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Table 1: Temperature and seasons of the study areas

Survey area	Month	Season	Temperature (ºC)
Mudumalai sanctuary a) Masinagudi b) Thepakadu c) Mudumalai	October-February	Winter	18 ºC- 20 ºC
	March-May	Hot summer	26 ºC- 33 ºC
	June-August	Rainy monsoon	20 ºC- 24 ºC
Thengumarahada	October-February	Winter	20 ºC-22 ºC
	March-May	Hot summer	28 ºC-32 ºC
	June-August	Rainy monsoon	20 ºC-24 ºC

Table 2: Rainfall and seasons of the study areas

Survey area	Month	Season	Rain Fall
Mudumalai sanctuary a) Masinagudi b) Thepakadu c) Mudumalai	October-February	Winter	1020
	March-May	Hot summer	790
	June-August	Rainy monsoon	1840
Thengumarahada	October-February	Winter	870
	March-May	Hot summer	640
	June-August	Rainy monsoon	1450

Table 3: Vultures observed in study areas by Road transect method

Survey area	No. of Vultures observed in road transect (Sq. km)								
	1-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90
Mudumalai sanctuary a) Masinagudi	-	-	-	-	-	-	-	-	-
b) Theppakadu	-	-	-	-	-	-	-	-	-
c) Mudumalai	-	-	-	**	-	-	-	**	-
Thengumarahada	-	**	-	-	-	-	-	-	-

IMPACT OF MELOXICAM DRUG AN ALTERNATIVE FOR THE DICLOFENAC TOXICITY ON THE WHITE BACKED VULTURE (GYPS BENGALENSIS), NILGIRI DISTRICT, TAMILNADU, INDIA

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ABSTRACT

The Oriental White backed vulture (*Gyps bengalensis*) once seen widely, but it has now shown decline in its population in many areas. This study was undertaken to collect information about population density of *Gyps bengalensis* in different localities like Masinagudi and Theppakadu. The study aims at finding reasons and consequences of changing population pattern of vulture. The study was conducted over a period of ten months (November 2011 – August 2012). The majority of dead vultures had visceral gout, due to kidney damage. The realization that diclofenac, a Non-Steroidal Anti-Inflammatory Drug potentially nephrotoxic to vultures, had become a widely used veterinary medicine led to the identification of diclofenac poisoning as the cause of the decline. We conclude that the continual maintenance of multiple widely dispersed provisionally sites it will only ever be possible to reduce diclofenac contamination. Elimination of diclofenac in veterinary use is the most certain way to prevent vulture deaths from diclofenac exposure, although education of verterinarians and livestock owners to avoid treatment of terminally ill livestock, or to bury or burn carcasses of recently treated livestock, may also be helpful.

STATE OF VULTURE POPULATION AND ITS NEED FOR AWARENESS AMONG PUBLIC ABOUT THE ROLE OF VULTURES IN THE ECOSYSTEM

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ABSTRACT

Nine species of vultures are distributed in India and most of them are decreasing in recent decades. As recently as 1980s, there were about 80 million white-rumped vultures (*Gyps bengalensis*) in India; but today its population numbers only in thousands. In the past 15 years, the country's vulture population has declined by a whopping 99%. There are currently about 100,000 vultures left in India, compared with 40 million of them in the 1980s. When the birds eat carcasses of cattle treated with the drugs resulted kidney failure and die. India's introduction of diclofenac in the 1990s proved immediately calamitous to the country's vultures and the Indian white-rumped vulture declined by 99.9 percent. Many experimental studies showed that the amount of diclofenac a vulture might ingest from a carcass could kill it few days. Diclofenac is a veterinary drug now banned in India but still being illegally used as an anti-inflammatory agent for cattle. Unlike DDT, which devastated populations of birds of prey, diclofenac does not accumulate in the tissues of livestock or birds, but turns out as poison for the vultures. *Gyps* species were the most affected by diclofenac and between 1993 and 2002, its population fell 99.7%. The populations of the Indian vulture (*Gyps indicus*) and the Slender-billed vulture (*G. tenuirostris*) fell by 97.4%. Similarly, Egyptian vultures

(*Neophron percnopterus*), an endangered species whose global population (of 30,000–40,000 mature individuals) is declining (IUCN 2010) due to loss of wild ungulates, overgrazing by livestock and poisoning. The species in India was driven to rapid decline by Diclofenac. There are no outward indicators of age on raptors. Typically, Turkey Vultures will live an average of 10 years in the wild. The oldest recorded wild Turkey Vulture was 16 years, though this seems to be rare. People are usually known about vulture eating habits, but what they do not realize is the role of vultures in the ecosystem as carrion disposer that would otherwise be a breeding ground for disease. Therefore, awareness about role of vulture in ecosystem needs to be conducted for the local people, so as to avoid use of such drug that devastates the vulture population in India.