

PERSPECTIVE SURVEY ON THE IMPACT OF VERTEBRATES IN AGRI-HORTICULTURAL ECOSYSTEMS IN AND AROUND SELECTED VILLAGES ADJOINING THE WESTERN-MARGINS OF BANNERGHATTA NATIONAL PARK

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ABSTRACT

A questionnaire survey was undertaken to record the status of vertebrates and the conflict mitigation measures adapted in settlements adjoining the Bannerghatta National Park (BNP) in Bengaluru south taluk of Bengaluru urban district, Karnataka. Ragi (*Eleusine coracana*) was found to be the most depredated crop while ornamental flowers, ridge gourd (*Luffa acutangula*) and chilli (*Capsicum annuum*) were less preferred. Increasing incidence of crop depredation by wild animals has led to the use of several traditional mitigation measures followed by local farmers to protect their crops. Barriers in the form of wire fence and mesh netting was the largely followed measure (25.45 %) and toxicants/fumigants was least followed (2.5 %) indicating a preference for economic and long term measures. Active deterrents were predominant compared to passive deterrent approaches adapted by local farmers. Our results indicated that the level of control and mitigating threat from vertebrate pests on respondents property was incidental and did not involve systematic mitigation measures. Owing to the success of deterring wildlife most of the methods though traditional are still in practice widely and modern methods like early-warning systems are not followed.

INTRODUCTION

Crop raiding is a cause of much conflict between farmers and wildlife throughout the world and more so along the boundaries of protected areas (Regmi *et al.*, 2013). About fifty species of vertebrates are implicated in causing damage to horticultural crops in India (Chakravarthy, 2004). Conflict causing vertebrates including birds, mammals, or reptiles that cause damage to agricultural crops and causing loss of human life have been widely documented in different parts of India with; Nilgai, *Boselaphus tragocamelus* (Rajpurohit and Mohnot, 1988; Chauhan and Singh, 1990); Wild Asian elephant, *Elephas maximus* (Sukumar, 1991); Rodents, birds and wild boars (Chakravarthy, 2004; Sridhara, 2006; Chauhan *et al.*, 2009). Some of these species losing their natural habitat and adapting themselves to the man-altered situation is the main cause for human-animal conflict. Many studies have been carried out on Human Elephant Conflict (HEC) both in Asia and Africa, but despite the lessons learnt and the wide range of measures and management strategies that have been employed to mitigate HEC, the intensity of the problem is clearly increasing (Perera, 2009). Human population pressure and increasing human-animal conflicts has also led to the emergence of vertebrate-pathogen-fruit orchard interactions (Chakravarthy, 2004). The Bannerghatta National Park (BNP) in Bengaluru south taluk of Bengaluru urban district, Karnataka, belongs to one of the last largest remaining scrub forest of the country, placed on the confluence of the Eastern and the

Western Ghats (Varma *et al.*, 2009). Human settlements in proximity with BNP are prone to human –animal conflict, particularly human-elephant conflict (Varma *et al.*, 2009). Hence, a questionnaire survey was undertaken to record farmers preception concerning vertebrate depredation and their management in four settlements adjoining the BNP. This study was designed to generate basic information about incidence rate of wildlife (vertebrates) in selected four settlements and the percentage of crop damage by wild animals in agricultural fields. With this background the paper deals with the survey on the types of crops cultivated and crop damage by wild animals on agriculture crops in the selected settlements.

MATERIALS AND METHODS

Survey area

Four settlements *viz.*, Taralu village, Taralu estate, Gopalpura and Tatiguppe situated in close proximity (2-3 km) from the BNP boundary lying on the western margins of the protected area were surveyed during the present study. Proximity to BNP and continuously altering landscape of the settlements to satisfy the growing livelihood needs of the local community were reasons for their inclusion in this survey. All the selected areas practice agri-horticulture all through the year causing levels of habitat modifications and changes.

Questionnaire survey

Questionnaire survey were conducted in *rabi* 2013 for farmers (n = 77) i.e. 30, 17, 10 and 20 farmers each from Taralu village, Taralu estate, Gopalpura and Tatiguppe respectively, whose farms adjoining BNP. Information pertaining to crop diversity, vertebrate menacing in the area and management measures undertaken were sought from the interviewees. During the 20-30 minute interviews, respondents were asked a series of questions pertaining to farmer's socio-economic status, details of their farming strategies and their experiences of crop damage by wild animals were recorded. The demographic data from the random sampling approach encompassed 40% of respondents belonging to the age class (40-60 years) followed by 30-40 years (27%), 15-30 years (18%) and senior citizens of the age group 60-80 years comprising 5%. Majority of the farmers surveyed were small land holders, 0.5-5 acre (79.55%), 5-10 acres (11.36%) and 10-15 acre (2.27%). Observational method to record the crops cultivated (Table 1) and crop damage was noted inspecting the cultivated lands in and around the settlements. Using a free listing method the list of vertebrate fauna inflicting crop damage and in conflict with human was generated. The aforesaid methods were devised consulting similar works undertaken in different countries experiencing crop raiding by vertebrates (Regmi *et al.*, 2013)

RESULTS AND DISCUSSION

Crop cultivation and damage

Of the 77 interviewees only 53 were involved in crop cultivation, among whom 62.26% cultivate crops for both household consumption and as market goods, 22.64% farmers responded that they cultivated for household consumption only and 15.09% respondents cultivate crops for selling them as market goods. The study areas manifest rich crop diversity dominated by ragi (*Eleusine coracana*) and maize (*Zea mays*) followed by coconut plantation (*Cocos nucifera*) (Fig. 1), cereals and millets (4 species), fruit crops (4)

and other horticultural crops, most of which are found to be depredated by vertebrates. The severity of crop depredation was maximum in Gopalpura followed by Tatiguppe, Taralu village and Taralu estate (Fig. 1). Based on the percent opinion ragi (70%) was the most depredated crop among cereals and millets, sapota (42.11%) among fruit crops, red gram (20%) among pulses and oil seeds, mulberry (10%) among cash crops, coconut (57.89%) among plantation crops and flat beans (30%) among vegetables.

Conflicting fauna

An array of vertebrates ranging from snakes, birds and mammals were known to cause damage to crops cultivated in the study region assuming 'pest status' during the present survey. The percent wise major recordings are listed in Table 2. The wild Asian elephant, *Elephas maximus* was the most serious threat followed by the wild boar, *Sus scrofa* while snakes and lagomorphs posed least threat (1.47%). Crop-raiding by wild life is observed on all crops, the high percentage of crop damage occurred by elephants followed by wild boar, field rats and monkeys. Unlike other vertebrates in the list snakes (poisonous) were threat to human.

Management initiatives

Proximity to forest has rendered the villages prone to threat from wild animals both to human and their crop lands. Increasing incidence of crop depredation by wild animals has led to the use of several methods by local farmers to protect their crops (Table 3). Incidence of different vertebrates with difference in foraging regimes (diurnal and nocturnal) and size (rodents to elephants) has compelled farmers to adopt diverse mitigation measures. Barriers in the form of wire fence and mesh netting was the largely followed measure (25.45%) and toxicants/fumigants was least followed (2.5%) indicating a preference for economic and long term measures. Active deterrents in the form of guarding were predominant compared to passive different methods. Our results indicated that the

Table 1: List of crops grown in the settlements

Crop type	Crops Common name	Scientific name
Cereals and millets	Ragi	<i>Eleusine coracana</i>
	Maize	<i>Zea mays</i>
	Paddy	<i>Oryza sativa</i>
	Jowar	<i>Sorghum sp.</i>
Fruit crops	Mango	<i>Mangifera indica</i>
	Banana	<i>Musa sp.</i>
	Sapota	<i>Manilkara zapota</i>
	Jackfruit	<i>Artocarpus heterophyllus</i>
Oil seeds and Pulses	Red gram	<i>Cajanus cajan</i>
	Groundnut	<i>Arachis hypogaea</i>
Cash crops	Sugarcane	<i>Saccharum officinarum</i>
	Mulberry	<i>Morus alba</i>
Plantation crops	Areca nut	<i>Areca catechu</i>
	Coconut	<i>Cocos nucifera</i>
Aromatic and ornamental flowers	Ornamental flowers	
Vegetable crops	Cucumber	<i>Cucumis sativus</i>
	Ridge gourd	<i>Luffa acutangula</i>
	Chilli	<i>Capsicum annuum</i>
	Leafy vegetables	
	Tomato	<i>Solanum lycopersicum</i>
	Flat beans	<i>Phaseolus vulgaris</i>

Table 2: Percent incidence of vertebrate fauna in the survey areas

Species	IUCN 3.1 Conservation status	Taralu village		Taralu estate		Gopalpura		Tatiguppe		Mean %
		No.	%	No.	%	No.	%	No.	%	
Reptiles										
Snakes	*	0	0	1	5.88	0	0	0	0	1.47
Birds										
<i>Pavo cristatus</i>	<i>Least Concern</i>	0	0	2	11.76	1	10	1	5	6.69
Mammals										
<i>Sus scrofa</i>	<i>Least Concern</i>	9	30	9	52.94	8	80	13	65	56.99
<i>Macaca radiata</i>	<i>Least Concern</i>	7	23.33	12	70.59	2	20	10	50	40.98
<i>Elephas maximus</i>	<i>Endangered</i>	8	26.67	8	47.06	8	80	16	80	58.43
<i>Axis axis</i>	<i>Least Concern</i>	3	10	6	35.29	5	50	3	15	27.57
<i>Funambulus palmarum</i>	<i>Least Concern</i>	6	20	5	29.41	2	20	10	50	29.85
Field rodents	*	4	13.33	8	47.06	6	60	10	50	42.60
Bats	*	0	0	1	5.88	0	0	0	0	1.47
<i>Melursus ursinus</i>	<i>Vulnerable</i>	0	0	1	5.88	0	0	1	5	2.72
Lagomorphs (hares)	*	0	0	0	0	1	10	0	0	2.50

*Species unidentified hence conservation status not assigned.

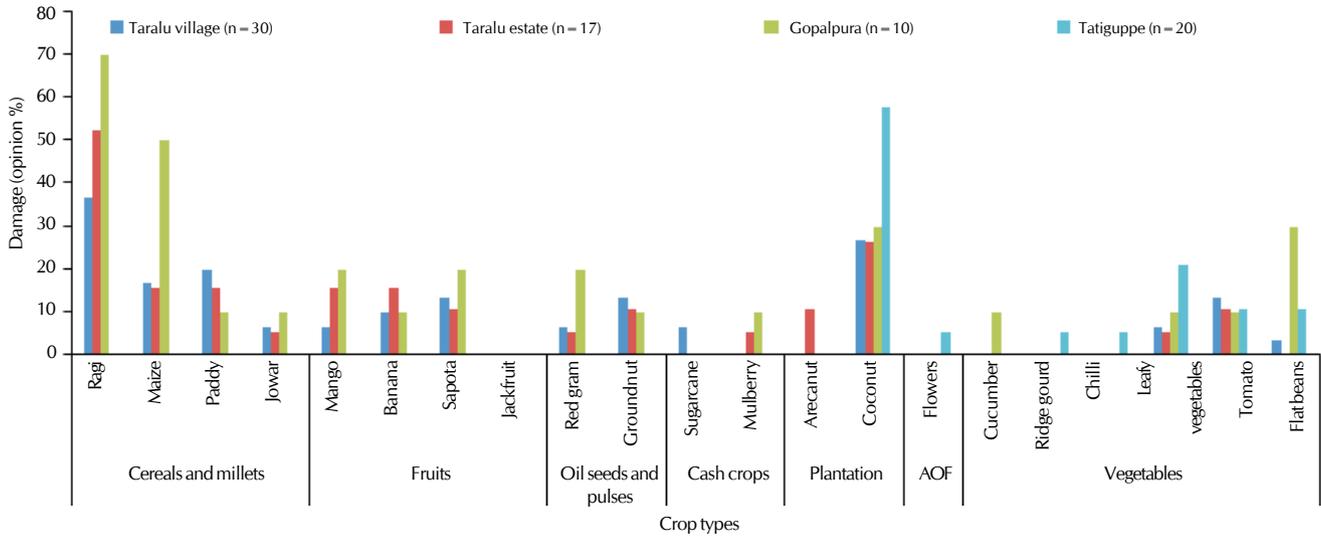
Table 3: Percentage of mitigation measures followed by farmers to prevent crop damage

Management Methods	Taralu village (n=30)	Taralu estate (n=17)	Gopalpura (n=10)	Tatiguppe (n=20)	Mean (n=56)
Passive deterrent methods					
Wire fence and mesh netting	20.0	11.8	40.0	30.0	25.45
Scarecrows	13.3	11.8	30.0	20.0	18.77
Toxicants/Fumigants	0.0	0.0	10.0	0.0	2.5
Solar fencing	0.0	29.4	20.0	0.0	12.35
Flying/flashing ribbons or plastic strips	0.0	0.0	30.0	0.0	7.5
Traps (smaller vertebrates)	0.0	5.9	0.0	0.0	1.47
Active deterrent methods that do not cause harm to wildlife					
Guarding and human shouts	0.0	47.1	50.0	45.0	35.52
Fire scare	33.3	5.9	0.0	0.0	9.8
Throwing stones	0.0	0.0	0.0	0.0	0
Scare shooting	0.0	0.0	0.0	0.0	0

level of control and mitigating threat from vertebrate pests on respondents property (residence/field) was incidental (when opportunity presented itself) and did not involve systematic mitigation measures. Owing to the success of deterring wildlife most of the methods though traditional are still in practice widely and modern methods like early-warning systems are not followed.

The extent and intensity of damage may vary depending on the cropping patterns, wildlife population density, seasonality and behaviour, and food availability in wild habitats. During the present survey the impact of wildlife incidence on crops and human habitats was recorded. Wildlife incidence rate is high on farms, gardens and agricultural fields which are adjacent to a forest area network. The magnitude of pestilence imparted on farm/cultivated areas were found to be more compared to residential areas. Incidence of large mammal penetration into Taralu village and Taralu estate has minimised due to the presence of the Central Reserve Police Force (CRPF) camp between the settlements and BNP. Besides their pestilence leading to crop loss, elephant onslaught on farmers guarding the fields at night is a serious concern. Perhaps guarding the open fields they are more vulnerable for wild animal attacks. Although poisonous snakes don't impact crops but threaten life during accidental encounters. Crop guarding impacts negatively on the prospects of socio-economic life of the affected farmers as it warrants man power. In local tradition,

elephants, monkeys and snakes are sacred animals to be revered and protected, but as humans and animals begin to compete for similar resources or wild animals become nuisances, causing crop damage and injury to humans, the traditional bond loses its relevance leading to human-animal conflict. The Asian elephant (*E. maximus*) and sloth bear (*M. ursinus*) are considered endangered and vulnerable species (IUCN 3.1). Nonetheless, communities living in close proximity to elephants may be supportive of elephant conservation measures if the authorities address the problems of elephant attacks and economic losses (Bandara and Tisdell, 2003). Chakravarthy (2004) suggests a harmonious blend of passive deterrent methods of crop protection and public awareness of the role of vertebrates in orchards to promote conservation of natural resources and sustain good quality fruit yields. Also, passive deterrents practiced along with timely harvests and clean cultivation, wrapping or covering of fruits, mulching the base of fruit trees, seasonal pruning, shade regulation, animal-proof trenches, polyculture, baiting and provisioning the orchards with alternative foods for the vertebrates are useful management tools. Both passive and active deterrent methods to mitigate crop damage by wild animals has been proposed/ reported separately or in combination depending on the extent of threat (Chauhan *et al.*, 2009; Thuppil and Richard, 2015). However, extreme measures like capture-translocation, reproductive management of nilgai (Chauhan, 2011),



Legends: AOF = Aromatic and Ornamental flowers

Figure 1: Crops cultivated and damage (opinion %) caused by vertebrates during the study period

termination of wild boar (Chhangani and Mohnot, 2004), are also reported and recommended.

Crop raiding represents a serious threat to the survival for many producers and the proximity to the National Park has and is expected to significantly increase the rate of reported frequency of crop raiding. Development of mitigation measures need to be strategic, logical, and economical and above all must be legally appropriate considering the inclusion of many conflicting animals protected under the ambit of wildlife Protection Act. 1972. Analysing habitat degradation and destruction of the protected areas adjacent to crop lands and encroachment of cropping into protected areas need to be monitored and addressed. Also, management strategies should target biodiversity conservation without impeding socio-economic condition of the people (Sinha *et al.*, 2012). Considering the delicate issue of crop raiding around protected areas as an impeding factor for conservation efforts, measures involving farmers, conservationists and forest department to mitigate human-wildlife conflict needs focus.

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