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CURRENT STATUS AND THREATS TO FISHING CAT *PRIONAILURUS VIVERRINUS* (BENNETT, 1833) IN GODAVARI MANGROVES, ANDHRA PRADESH, INDIA

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ABSTRACT

Godavari Mangroves the second largest patch along the east coast of India with an extend of 33,263.32 ha. are located in Godavari Estuary of East Godavari District, Andhra Pradesh. Coringa Wildlife Sanctuary is the part of Godavari Mangroves, which supports many unique flora and fauna including the globally threatened fishing cat. A comprehensive study was conducted to assess the current status and threats to the fishing cat in Coringa Wildlife Sanctuary through camera trapping, questionnaire surveys, direct sighting and indirect sign surveys. Totally 257 images of fishing cat were captured and 73 individuals were identified. The estimated population of fishing cat in Coringa Wildlife Sanctuary was 95-100 and estimated density was 0.7 animals / km^2 or 3 animals / 4 km^2. Fish and field rats were the preferred food for the fishing cats. It was mostly nocturnal as 74% the captures were during night times. The captured images also showed that the fishing cats followed the same tracks. Human animal conflicts were recorded and the conflict zones within the sanctuary were mapped. The existed human-fishing cat conflicts could be categorized into five different types *viz.* conflict between fishing cat and fishermen, aqua farmers, villagers, encounters during developmental activities and others like road kills, target killing, etc., Awareness programmes, radio-telemetry studies, responsible gap plantation and habitat restoration were recommended for conservation and management of the fishing cats in Coringa Wildlife Sanctuary.

Key words: Human-animal conflict, Camera trapping, Questionnaire survey, Activity pattern, Coringa.

Introduction

The Fishing Cat (*Prionailurus viverrinus*) is discontinuously distributed in Asia and occurs in India, Pakistan (Sindh), Nepal, Bangladesh, Sri Lanka, Thailand, Cambodia and Java (Pocock, 1939; Cutter, 2009; Cutter and Cutter, 2009). In India, the fishing cat is primarily distributed in the eastern parts (West Bengal, Assam, Orissa, parts of Andhra Pradesh) and along the foothills of the Himalaya in the Terai tract (Pocock, 1939; Sunquist and Sunquist, 2002). There are records from Keoladeo National Park, (Nowell and Jackson, 1996; Sunquist and Sunquist, 2002; Mukherjee *et al.*, 2012) and Ranthambhore Tiger Reserve (Sadhu and Reddy, 2013). It is an endangered species with decreasing population trend within its distribution range in South and Southeast Asia (Mukherjee *et al.*, 2010). Destruction of wetland and floodplain habitat due to development activities, illegal hunting, commercial aquaculture, rural and urban land policy, brick industries and agriculture are some of the threat to fishing cat around its distribution range in India. A similar decline is anticipated over the next 18 years in the absence of intensive habitat protection of fishing cats (Mukherjee *et al.*, 2010). Although fishing cats are recognized as an endangered species, there is a great paucity of information with respect to its foraging and breeding biology, and its social ecology (Inskip and Zimmerman, 2009; Mukherjee, 1989; Haque and Vijayan, 1993; Cutter and Cutter, 2009; Adhya, 2011). Likewise, its current distribution is poorly documented.

Human conflict with wildlife is a significant and growing conservation problem around the world. Conservationists have long been concerned about the effects of human disturbance on wildlife (Carney and Sydeman, 1999). Man - animal conflicts are manifested by such incidents as a human-being killed or injured by wild animal on the one hand and any wild animal is injured or killed by a man on the other hand. Wild animals like tiger, leopard, bear, bison, wild boar, wolf, elephant and crocodile are potentially powerful of harming human-beings or their livestock, crops and property. Impact of human and smaller animal conflict is relatively low but, the price paid in return is the death of the animal or sometimes local extinction of the animals.

The study, conducted through camera trapping, questionnaire surveys, direct sighting and indirect sign revealed that the estimated population of fishing cat in Coringa Wildlife Sanctuary was 95-100 and estimated density was 0.7 animals / km^2 or 3 animals / 4 km^2.

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Godavari Mangroves are the second largest mangrove forest in the East Coast of India with an extent of 33,263.32 ha. It supports a wide range of flora and fauna that include 35 species of mangrove and associated species, 277 benthic organisms, 615 Finfish species, 269 bird species, 26 species of reptiles and 18 species of terrestrial mammals. By recognizing its biological importance, part of the Godavari Mangroves was declared as Coringa Wildlife Sanctuary. Fishing cat is the top predator in the Godavari Mangroves. As per the Forest Department census records and findings, it was understood that the population of the fishing cat was in decreasing trend. The reason for the decline and declining trend were very much unfamiliar to the wildlife managers, researchers and scientific communities in this region.

Ravishankar *et al*. (2004) predicted that the introduction of aquaculture and prawn farms are potential threat to the fishing cat in the future, because of large aquaculture projects are established around the Coringa Wildlife Sanctuary. Hence, a comprehensive study was carried out in Coringa Wildlife Sanctuary to assess the current status, activity patterns, distribution and existing threats in Coringa Wildlife Sanctuary.

Material and Methods

Study area and design: 'Coringa Wildlife Sanctuary' is located between 16°44' to 16° 53` N and 082° 14` to 082° 22` E and at the confluence of the river Godavari with the Bay of Bengal in the East Godavari District of Andhra Pradesh (Map. 1). The sanctuary is a part of the Godavari Estuary and has extensive mangrove cover. The total area is 235.7 km^2. The average temperature of the region is 17°C to 40°C. Average Rainfall is greater than 1,000 mm. The Northern part of sanctuary is covered by the back waters of the Kakinada Bay and covers an area of about 100 km^2. Survey for monitoring of fishing cat was designed in such a way to cover the entire mangrove areas of the sanctuary. The total mangrove area was divided into 1 Km^2 grids by using Arc GIS. Totally 134 grids were obtained excluding the Kakinada Bay and the Hope Island. The coordinates of four corners of each grid were obtained through the Geographical Information System (GIS) and fixed in the Global Positioning System (GPS). These points were used for identification of each grid position in the sanctuary.

Methods

Pugmarks and scat: Pugmarks and scats were searched in all the 134 grids to ascertain the distribution and movement of the animals. These areas were marked by using GPS for further analysis.

Direct sightings: The direct sighting locations of fishing cat were marked in the GPS for mapping. Time and behavior of the fishing cat were also recorded.

Camera trapping: Camera Trapping was carried out from June 2014 to July 2015. Each grid was surveyed to find out the frequenting areas of fishing cats based on indirect sings and direct sightings to deploy the camera. Camera traps were fixed at a height of 30cm – 70cm above ground level and facing each other (but slightly staggered so the flash would not interfere with the photos from the opposite camera) in order to determine the best angle for photographing the pelage characteristics needed for identification (Henschel and Ray, 2003; O'Brien *et al*., 2010; TEAM Network, 2011). Totally 60 cameras were deployed and the cameras were kept 15 days in each grid to cover one each spring and neap tides.

Data analysis: All the captured image data were pooled and defined the activity pattern as day-time for photographs of cats obtained during 0601–1759 hours and night-time for those taken during 1800–0600 hours (Azlan and Sharma, 2006). The images of the individual cat captured repeatedly within few minutes differences were not taken for analysis. The individual fishing cats were identified by pelage pattern (Cutter, 2009). Activity patterns of fishing cat in accordance with the tidal effects were also analyzed by using the capture time registered in the images. The tidal variations of the particular day were obtained from the open web sources (http://www.tides4fishing.com/as/india/kakinada).

Questionnaire surveys: Interview-based survey was carried out in four stages between May and November, 2012; March and September, 2013; January and May, 2014; and May and August, 2015, to know the past and present distributional range of fishing cat in Coringa Wildlife Sanctuary, existing threats to this species, knowledge levels of villagers on the enforcement of laws, protection status and attitudes towards fishing cat protection (Dietrich, 1995; Rabinowitz, 1997; Brooks *et al.,* 1999; Conforti and de Azevedo, 2003; Marino, 2003).

Result and Discussions

A total of 20 grids were covered between June and August, 2014 and the remaining 114 grids were covered between December, 2014 and July, 2015 for indirect sign surveys, direct sightings and camera trapping. Over 20 pugmark traces found in different areas within a grid were categorized as high movement zone, 10-20 as medium movement zone and < 10 were low movement zone.

Population estimation: Totally 1722 vertebrates were captured during the 11,520 trap days. Though a total of 257 fishing cats were captured during the study period,

the quality was not good enough to identify the individuals in 30% of the captured images. Hence, 70% (172) of the pictures were used for identification of different individuals. Of the 257 images captured, 132 were right flanks. Those photographs were compared for identification of individuals. Markings on the head, face, front and back thighs, upper body markings were examined for identifying the individuals. Totally, 73 individuals were identified through the pelage patterns. Based on the pugmark, scat surveys, direct sightings and camera trapping, it was estimated that there were about 95-100 individuals of fishing cats in the Coringa Wildlife Sanctuary.

Till the comprehensive study was started, there was no constant mechanism of monitoring of fishing cat population in Coringa Wildlife Sanctuary except the animal census which was done as part of the tiger census in the district by the Forest Department. The Forest Department census records showed that there was a deep decline (76%) in fishing cat population between 2002 and 2012 and the reasons were unknown. The estimated population fishing cats in the Coringa Wildlife Sanctuary was 29 and 30 during 2011 and 2012 (Table 1) respectively (unpublished Forest Department Census data).

The estimated fishing cat numbers in Coringa Wildlife Sanctuary based on indirect sings, direct sightings and questionnaire was 70 during 2012-2013 (Sathiyaselvam unpublished data). In the present study, it could be estimated that there were 95-100 individuals in the Coringa Wildlife Sanctuary. These results indicated that there was a marginal increase in the fishing cat numbers in the sanctuary from 2012 to 2014-2015.

Density: The density of fishing cat in Coringa Wildlife Sanctuary was calculated by using the following formula

$$\text{Density (D)} = \frac{\text{No. estimated individuals}}{\text{Total mangroves cover area in the Coringa Sanctuary}} = \frac{95 \text{ or } 100}{134} = 0.7$$

The calculated density of fishing cat in Coringa Wildlife Sanctuary was 0 .7 animals / Km^2 or 3 animals per 4 Km^2.

Activity pattern: Totally 257 images captured were grouped and analyzed. Of them 46% of the captures were during night times between 1800 and 2400 hrs, 28% captures were between 00.00hrs and 06.00hrs (Fig. 1). It showed that the fishing cats were mostly nocturnal. In the Coringa Wildlife Sanctuary, the non-captured / least captured timings coincided with the closing and starting timings of the fishing activities respectively. It further indicated that the fishing cats avoided the human presence.

Activity Pattern with reference to the Tidal factors: Timings captured in the images were compared with the tidal factors of the particular time and date to understand the behavior patterns of the fishing cats with reference to tidal variations. For analysis, the tidal factors were categorized into four types *viz.* rising, high, residing and low tides. Fishing cat activities were high (36%) during residing tide followed by rising tide (25%). The minimum activity was captured during low tide time (13%) (Fig. 2). Fishing cat has been reported as opportunistic predator and a large portion of fishing cat diet consists of fish (Haque and Vijayan, 1993; Sunquist and Sunquist, 2002). During this study, it was observed that fishes entered into the small ditches and canals in the mangrove areas when the tide started rising. This finding corroborated with the observations by Nagulu *et al*. (2001) in Coringa Wildlife Sanctuary. The fishes entered into the shallow areas often stuck or obstructed by the Pneumatophores of the mangrove species during residing tide. It led to the speculation that the fishing cats might be benefited during rising and residing time of the tides to catch the prey easily.

Field rats were common and found most part of the sanctuary. Totally 602 field rat images were captured from 102 grids. The activity patterns of the field rats were analyzed to understand the prey predator relationship as both fishing cat and field rat were nocturnal. Overall 80% of the captures of field rats were during night hours and the peak activities were obtained between 0000 hrs to 0600 hrs (55%) and remaining 45% were between 1600 – 0000 hrs. The activity timings of field rats coincided with the peak activity timings of the fishing cats (Fig. 3).

Moreover, captured images also showed that fishing cats capturing the field rats. It could be understood that besides fish, field rats were the preferred food for the fishing cats. Pugmark tracks of the fishing cats were more near to the field rat nests locations. During day time fishing cats were observed to do fishing in the shallow creeks. Hence, it lead to the conclusion that during the day time fishing cat depended on fish and at night time it preferred both rats and fish.

Table 1: Population Status of the fishing cat in the Coringa Wildlife Sanctuary in the past

Year	2002	2003	2004	2005	2011	2012
Fishing Cat	112	121	121	124	29	30

Movement: The captured images showed that two different individuals crossed a particular camera trap location within 5 minutes time interval. The same two individuals were re-captured at the same place after four days in 58 minutes time interval (Pic. 1). The capture and recapture of same individuals after four days interval predicted that fishing cat follows same pathways / track. Camera Trap studies conducted at khao Sam Roi-agricultural landscape in Thailand proved that both male and female fishing cats use the same area and use the same travel routes often during the same night (https://felids.wordpress.com/2011/03/02/thailand-fishing-cat-research-update/). It was also noticed from the captured images that two adults and adults with kittens moving together. Apart from that two to three different individuals were captured in one location. These results showed that fishing cat has the behaviour of moving together and no competition for territory and food. It was an indicative of abundant prey availability in the sanctuary.

Use of new technology for monitoring of the fishing cat: For the live monitoring of the animals in Coringa Wildlife Sanctuary, a new technology was developed by using Closed Cicuit Television (CCTV) Camera after several trial and errors. The model was developed in such a way that the CCTV camera were powered by batteries. Solar panels were used for recharging the batteries. Ultra High Frequency (UHF) Modem was used for live data transfer to the nearest base station located within the 10-15 kilometers radius of the CCTV locations. The entire setup was fixed on one pole (Pic. 2). From the base station the live data were shared with different stakeholders through team viewier.

Human animal conflict: Totally 497 people living in 20 fringe villages were interviewed to get the facts about the human animal conflict and other threats to the fishing cats in and around Coringa Wildlife Sanctuary (Fig. 4). Economic loss to fishermen, aqua farmers and villagers by fishing cat due to predation were also considered in the questionnaire survey. The human-fishing cat conflicts suggested by the villagers could be categorized into five different types.

Fishermen-fishing cat conflict: Fishermen have the rights for fishing in the sanctuary and the adjoining mangrove forest areas. The survey revealed that the conflicts occurred between the fishermen who were spreading the nets up to 300 to 400 meters length along the shorelines of the creeks and canal during high tide. Fishing cats tended to have the behavior of attending the fishing net and consume fish from the nets thereby causing fish loss. Fishermen dazzled the fishing cats with light and beaten up/ killed them while attending the nets to avoid the damage to nets and fish loss. The predicted approximate quantum of fish/prawn loss to fishermen by fishing cat was 10 – 20 kgs / year / fisherman, and the monitory value of loss was ` 1000 – 1500 / fishermen / year.

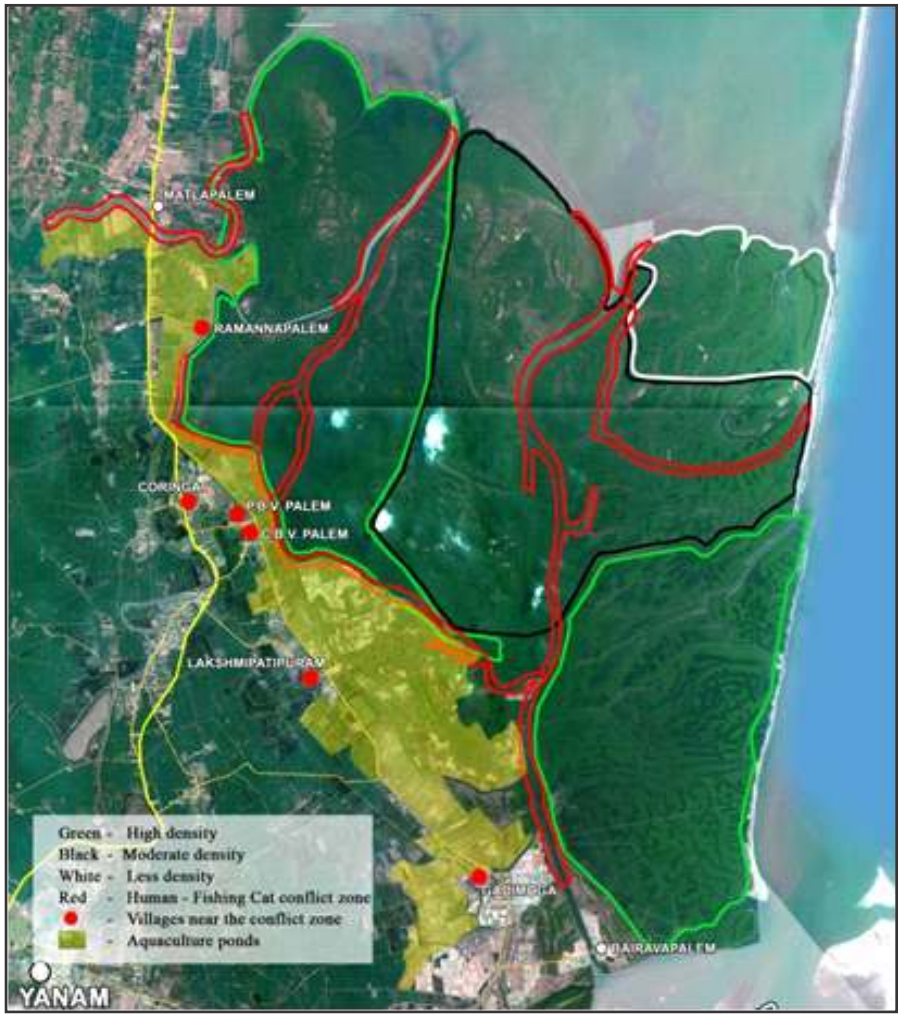
The traditional perception descended to the crab collectors living near the Coringa Wildlife Sanctuary was that the fishing cat would attack the people and would pluck the eyes when it is encountered. Many people still believe this myth and beat them to death due to fear whenever they are confronted proximity to them.

Aqua farmers – fishing cat conflict: The aqua farmers revealed that the fishing cats frequently visited the Aqua-farms particularly fish farms and caused damage. Pugmark tracks were also found near the aqua farms in Chollangi, Ramannapalem, Matlapalem, Chinnavalasala and Gadimoga, which indicated that frequently fishing cats visited aqua farms adjacent to the sanctuary. Camera taps were also set up on the path to understand the movements to the nearby aqua farms. Camera trapped images showed that the usage of gaps in the aquaculture pump houses by fishing cats during night time (Pic 3). Electric fencing with normal wires was used by the aqua farmers to keep them at bay which in turn killed the animal as well. Fishing cats were also beaten to death when they entered into the fish or prawn farms. The predicted overall monetary loss to the aqua farmers due to predation by the fishing cat was < ` 5000 / acre/ year. Cutter (2015) reported fishing cats from aquaculture areas in Thailand.

Villagers and fishing cat: Villagers informed that the fishing cats were venturing into nearby villages in search of food and killed poultry and lambs. Frequency of visit to the villages were more during summer months. During such times, the villagers killed the animals either by setting up snares along the path/track or dazzled with light and beaten to death.

Encounters during the developmental activities: The areas around the Coringa Wildlife Sanctuary witnessed rapid economic growth in the last two decades and lot of industries has been set up in the areas. Huge industrial set ups keep them away from the regular traditional tracks, which increased the risk of animals and human encounters. It could be learnt that fishing cats were mostly killed during such encounters. Over 14% of the aqua farms have also been established in the revenue mangrove areas (UNDP, 2011) adjacent to the Coringa Wildlife Sanctuary, which led to the shrinkage of habitats and forced the animals to move to the vulnerable areas that also increased the man – animal conflict.

Map 1: Coringa Wildlife Sanctuary



Map. 2: Fishing Cat distribution and human-Fishing Cat conflict zones in and around Coringa wildlife Sanctuary

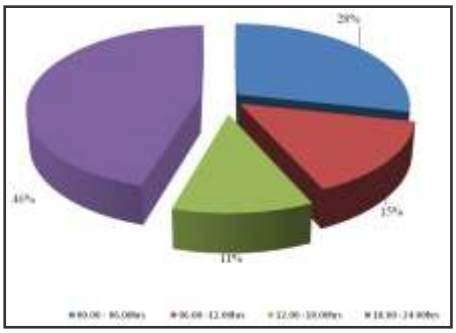


Fig. 1: Activity patterns of fishing cat

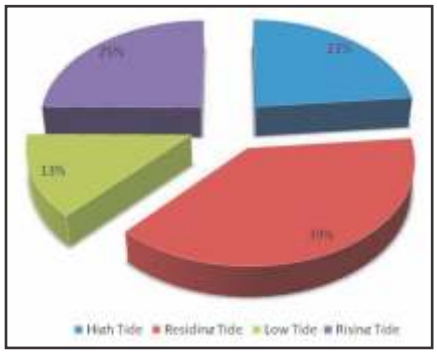


Fig. 2:Activity pattern of fishing cat with reference to tidal factors

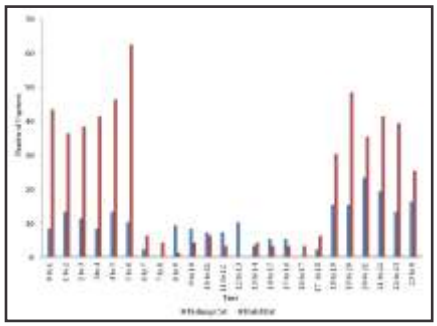


Fig. 3: Activity pattern of fishing cat and field rat in Coringa Wildlife Sanctuary

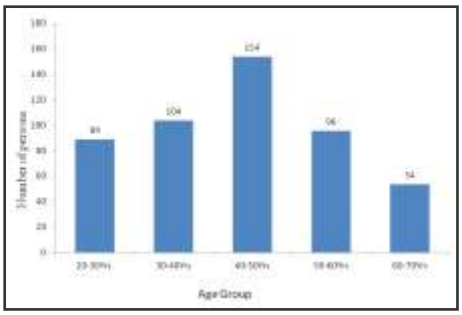


Fig. 4: Age group of people interviewed

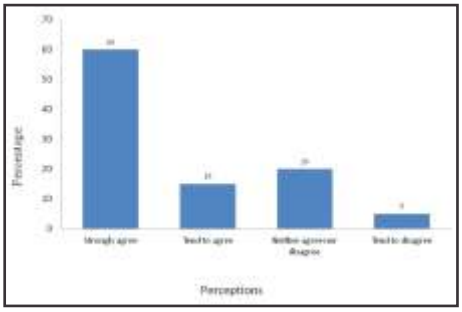
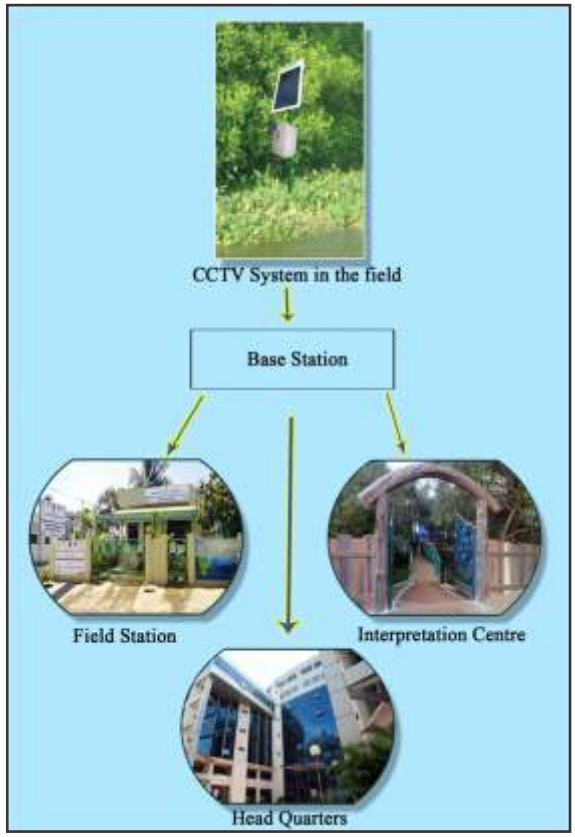
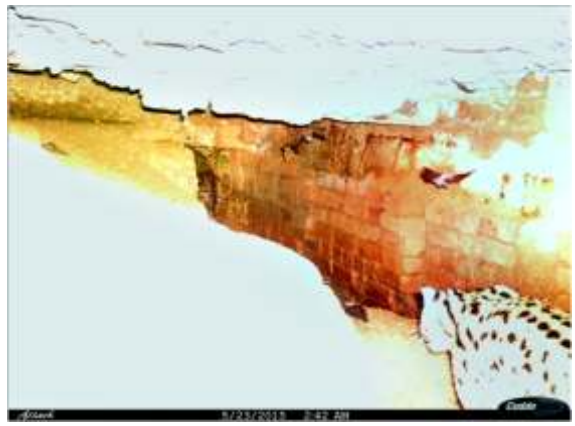


Fig. 5: Attitude of the people towards fishing cat protection

Pic 1. Capture and recapture of two fishing cats following the same track



Pic. 2: CCTV Technology Concept



Pic 3. Fishing cats using the gaps in the aqua farm pump house

Other threats

Road kills: Fishing cats were killed by vehicles when they cross the road to enter in to the nearby villages occasionally. During the study period one road kill was recorded near Chollangi Village on 29th March, 2015.

Target killing: The villagers informed that sometimes the aqua farmers or villagers who are facing problem with fishing cats, engage trained poachers from other areas and killing the animals. During December – 2014, four fishing cats were killed like that near Chinnavalasala Village.

The human-animal conflict has been predicted as one of the main reasons for declining the numbers of the fishing cats. Fishing cats are elusive and nocturnal animals and the types of human-animal conflict were not studies well in most of their distributional ranges. As per the published reports, 10 radio collard fishing cats were killed at Khao Sam Roi Yot Area in Thailand due to poaching and retaliatory killing (Cutter, 2015). In India, Mukherjee *et al.* (2012) reported that killing of 27 fishing cats due to human-fishing cat conflict in West Bengal. During the study, five different types of human-fishing cat conflict could be reported in the Coringa Wildlife Sanctuary. Fishing cat distribution areas and human-animal conflicts zones in and around Coringa Wildlife Sanctuary were mapped (Map. 2)

Recommendations

The following actions are recommended for effective protection and conservation of fishing cat in Coringa Wildlife Sanctuary.

Awareness programme and campaign: During the surveys it could be understood that there was a knowledge gaps among the fishermen, aqua farmers, industrial staff and villagers, which led to the conflict reconciliation.

Over 90% of people were unaware of the protection status of fishing cat. Therefore Awareness campaigns need to be conducted for the conservation and management of the fishing cats in Coringa Wildlife Sanctuary. The survey also revealed that 60% of the people having an attitude of conserving fishing cat in Coringa Wildlife sanctuary and adjoining areas (Fig. 5). As human caring and understanding is crucial to save wild animals and protecting their habitats, a constructive dialogue between wildlife managers and local stakeholder's needs to be initiated, in order to increase mutual trust and information exchange.

Radio telemetry: Use of radio-telemetry has been proved as a very valuable tool in the field of wildlife management for uncovering new dimensions in the behavior and ecology of wild animals. It is recommended by many researchers that radio-collaring study is the only possible way to uncover the ecology of the fishing cat (Mukherjee *et al.*, 2010; Cutter, 2015). Because, the fishing cat is mostly nocturnal, elusive and difficult to study the habitat and movement pattern. Coringa Wildlife Sanctuary and the adjoining mangrove areas are one of the best strongholds for fishing cats. Knowledge about the habitat use, home range and seasonal movements of the fishing cats will be helpful for the better management. Therefore, it is recommended that at least five fishing cats (two males and three females) may be radio-collared in the sanctuary to unravel the truth.

Trainings: During questionnaire surveys, it could be understood that fishing cats were killed during the developmental activities in the adjoining areas of the Coringa Wildlife Sanctuary in the past one decade. On many occasions the conflict occurred when they entered into the industrial areas near to the sanctuary, in search of food or crossing the regular tracks. Therefore regular training and awareness programmes need to be organized for major industry people to take part in the fishing cat conservation and protection.

Fishing cat sanctuary: Through the study, it could be understood that Coringa Wildlife Sanctuary is supporting for the largest known population of fishing cats along the east-coast of India. It is globally endangered and protected under the Wildlife (Protection) Act, 1972. Therefore, the Ministry of Environment, Forest and Climate Change (MoEFCC), may pay attention to Coringa Wildlife Sanctuary under species recovery programme and declare the Coringa Wildlife Sanctuary as Coringa fishing cat sanctuary.

Responsible gap plantation and habitat restoration: Direct sightings and indirect sign surveys showed that *Suaeda maritima* dominated areas were utilized by the fishing cat to hide their kittens. It lead to the speculation that such areas are easy to monitor any threat to the kittens while the adult going for hunting. Such areas have to be protected and shall not be converted for mangrove cover expansion programme for the better management of the fishing cat population. It was observed during field visits that some creeks and canals were covered with *Eichhornia* sp. which leads to sediment traps in those areas. Some of such areas were closed due to siltation. Hence, restoration measures need to be undertaken in such areas to maintain the healthy habitat.

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गोदावरी कच्छ वनस्पति, आन्ध्र प्रदेश, भारत में फिशिंग कैट *प्रायोनेलूरस विवीरिनस* (वैनेट, 1833) का वर्तमान स्तर एवं संकट

पी. साथियासेल्वम, ईश्वर सत्यानारायणा एवं तरूण कथूला

सारांश

गेदावरी, कच्छ वनस्पति 33,263.32 हैक्टेयर के विस्तार के साथ भारत के पूर्वी तट के साथ-साथ दूसरा विशाल खण्ड़ है, जो पूर्वी गोदावरी जिला, आन्ध्र प्रदेश के गोदावरी मुहाने पर अवस्थित है। कोरिंगा वन्यजीव अभयारण्य गोदावरी कच्छ वनस्पतियों का भाग है; जो वैश्विक रूप से संकटस्थ फिशिंग कैट सहित कई विलक्षण वनस्पति एवं प्राणिजात को आश्रय देता है। कैमरा ट्रैपिंग, प्रश्नावली, सर्वेक्षण, प्रत्यक्ष साइटिंग और अप्रत्यक्ष चिह्न सर्वेक्षणों के जरिये कोरिंगा वन्यजीव अभयारण्य में फिशिंग कैट के वर्तमान स्तर एवं संकट का मूल्यांकन करने के लिए एक गहन अध्ययन किया गया। फिशिंग कैट के कुल 257 इमेजों को कैप्चर किया तथा 73 एकलों की पहचान की गई। कोरिंगा वन्यजीव अभयारण्य में फिशिंग कैट को आकलित आबादी 95-100 थी और आकलित घनत्व 0.7 पशु प्रति वर्ग कि.मी. अथवा 3 पशु प्रति 4 वर्ग कि.मी. था। फिशिंग कैटों के लिए मछली और क्षेत्र के चूहे पंसदीदा भोजन था। यह अधिकतर रात्रिचर था क्योंकि 74 प्रतिशत कैप्चर रात के समय थे। कैप्चर इमेजों ने यह भी दशार्या कि फिशिंग कैट ने उन्हीं रास्तों को अपनाया। मानव पशु संघर्षो को अभिलिखित किया गया और अभयारण्य के भीतर संघर्ष जोनों का मानचित्रण किया गया। विद्यमान मानव-फिशिंग कैट संघर्षो को पांच विभिन्न किस्मों में श्रेणीकृत किया जा सकता है उदाहरणार्थ- फिशिंग कैट और मछुवारों जलीय किसानों, ग्रामीणों के बीच संघर्ष, विकासात्मक कार्यकलापों के दौरान मुठभेड़ और सड़क वध, लक्ष्य वध आदि जैसे अन्य। कोरिंगा वन्यजीव अभयारण्य में फिशिंग कैट के संरक्षण और प्रबंधन के लिए जागरूकता कार्यक्रमों, रेडियो-टेलीमेट्री अध्ययनों, उत्तरदायी अन्तराल रोपणों एवं आवास पुनरूद्धार की संस्तुति की गई है।

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