IN THE HIGH COURT OF KARNATAKA AT BANGALORE

PRESENTATION FORM

W.P No. 919 /2010

Bangalore District

Between

Anup. B.P. & and another

And

State of Karnataka and others

Serial No. ____________

Advocate Sri

P. ANU CHENGAPPA,
B.A.L., LL.M, D.C.S.,
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*-IN THE HIGH COURT OF KARNATAKA AT BANGALORE

W.P.NO. /2010 (PIL)

BETWEEN

Sri. Anup.B.P. & another — Petitioners

AND

State of Karnataka & others — Respondents

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Bangalore

Advocate for Petitioner

Date:

IN THE HIGH COURT OF KARNATAKA AT BANGALORE

W.P.NO. /2010 (PIL)

BETWEEN

Sri. Anup.B.P. & another Petitioners

AND

State of Karnataka & others Respondents

DATES OF EVENTS

Sl. No.	Date	Events
01.	03-06-09	Order issued by the Fourth Respondent banning night traffic in NH 212 and NH 67.
02.	10-06-09	Order issued by the Fourth Respondent withdrawing Annexure-B.
03.	23-01-09	Letter written by the Fifth Respondent to the Fourth Respondent mentioning the nefarious activities and adverse impacts of the roads in Bandipur National Park.
04.	24-12-2009	A news report in the 'Hindu 'about an animal kill due to speeding vehicle.
05.	11-11-2008	Order of the Honourable Supreme Court in Application no.1064 in W.P. 202/95.09-03-2007 permitting repair of road in Nagarahole National Park.
06.	11-07-2008	Order issued by the Deputy Commissioner, Mysore District mandating night closure of vehicular traffic on the Mysore-Mananthavadi Road (SH 17D) falling within the Nagarahole National Park
07.	20-08-2009	Letter stating closure of the Hyderabad-Srisailam road passing through the Nagarjun Sagar Srisailam Tiger Reserve from 9 pm to 6 am.
08.	10-03-1998	Letter written by the Government of India to Government of Rajasthan granting aid for road construction.

SYNOPSIS

This Petition pertains to the withdrawal of night ban on traffic in NH 212 and NH 67 passing through the Bandipur National Park as also the proposed expansion of the said Highways and lack of speed calming measures on the said roads. The Bandipur Tiger Reserve and National Park is a very important and eco-sensitive wildlife habitat. Understanding the importance of the said area, night traffic on the two national Highways namely NH 212 AND NH 67 was banned by an Order dated 03-06-09 as in **Annexure-B**. However, bowing to pressure from vested groups the said order was withdrawn by the Fourth Respondent through another Order dated 10-06-09 as in **Annexure-C**. It is seeking the quashing of the said Annexure-C that the Petitioners are approaching this Honourable Court through the present Public Interest Litigation. Further, despite the adverse impact highways have on wildlife, the Sixth Respondent has planned to expand both NH 212 and NH 67 into four lane highways as per its annual work plan as in **Annexure L.** Scientific studies have clearly established that wild animals are very vulnerable especially at night due to speeding vehicles **as evidenced in Annexures- G1 and G2**. Wild animals of the Bandipur National Park are being killed regularly as evidenced in **Annexures-E- E6**. These two roads (NH 212 and NH 67) are also used for carrying out illegal activities such as timber smuggling, wildlife poaching, etc. in the Bandipur Tiger Reserve especially at night as written by the Fifth Respondent to the Fourth Respondent in his letter as in **Annexure-F.** Currently even during day time wildlife are killed by road accidents and no speed calming measures have been introduced to mitigate the same as is the need of the hour. The National Wildlife Action Plan (2002-2016) (**Annexure-H)** clearly stipulates that roads should be avoided within National Parks or mitigation measures such as restricting night traffic should be adopted. The Guidelines for Preparation of Tiger Conservation Plan (**Annexure-H1)** also specify regulation of traffic flow. Night traffic ban is in place in several protected areas in India and in other parts of the world. For e.g. night traffic on all roads within Nagarahole National Park is closed. The Honourable Supreme Court of India in its order dated 11-11-2008 in Application no.1064 in W.P. 202/95 (**Annexure- J)** has ordered the Mysore-Manathavadi Road (SH 17D) to be closed between 6 p.m. to 6 a.m. based on a recommendation of the Central Empowered Committee (**Annexure- J1). The** Deputy Commissioner, Mysore District had initiated night closure of vehicular traffic on the Mysore-Mananthavadi Road (SH 17D) falling within the Nagarahole National Park by an Order dated 11-07-2008 (**Annexure- J2)**. Recently in a meeting of the Monitoring Committee of the Mysore- Mananthavadi road, held on 07-10-09, it was decided that a 14 Km diversion should be taken up to completely avoid the usage of 10 Kms. of the existing Mysore- Mananthavadi road passing through the Nagarahole National Park to ensure greater protection to the wildlife of the region as per **Annexure- J3**. Similarly the Hyderabad-Srisailam road passing through the Nagarjun Sagar Srisailam Tiger Reserve is closed from 9 pm to 6 am as per **Annexure-J4**. The Honourable Supreme Court of India in IA no 2068 (W.P. 202/95) has ordered closure of night traffic in Sariska Tiger Reserve, Rajasthan (**Annexures- K**). The Government of India has also provided funding to the tune of Rs. 03,50,00,000/- (rupees three crores and fifty lakhs only) to Government of Rajasthan to construct a bye-pass outside Sariska Tiger Reserve for the Jaipur-Alwar State Highway no.13 as per **Annexure- K1**. Alternate roads are available to NH 212 AND NH 67 as per Annexures- M & M1. Emergency services and some state transport buses are being permitted as exemptions to the night ban as per Annexures- **Q, R & R1**. Thus, there is absolutely no public inconvenience caused due to the said night ban despite which the Fourth Respondent has issued Annexure-C. Annexure C and the proposed road expansion as per item 39 in Annexure L are violative of the Wild Life Protection Act, 1972, the National Wildlife Action Plan and The Guidelines for Preparation of Tiger conservation Plan as also the Supreme Court directions and guidelines issued in similar instances. Further, despite

repeated requests, no speed claming measures are being introduced in the said highways, thus jeopardizing the life and limb of the wildlife of the Bandipur National Park. It is challenging all such arbitrary actions and inactions of the Respondents that the Petitioners are approaching this Honourable Court as also asserting Rights of the citizens to clean environment and ecology as guaranteed under Article 21 of the Constitution of India. Wherefore, this Honourable Court may be pleased to quash Annexure-C, direct the sixth Respondent not to expand NH 212 and NH 67 and direct all the Respondents to introduce speed calming measures immediately to preserve and protect the wildlife of the Bandipur National Park in the interests of justice and equity.

Advocate for Petitioner

Bangalore
Dated:

6

IN THE HIGH COURT OF KARNATAKA AT BANGALORE

W.P.NO. /2010 (PIL)

BETWEEN

1. Sri. Anup.B.P.,
S/o Prakash B.S.,
aged about 24 years,
No 6, Sneha Apartments, 3rd Cross,
SVG Nagar, Bangalore – 560 072.

2. Waynaad Prakruthi Samrakshna Samithi
Naikatty House, Naikatty post,
Sulthan Batheri Taluk,
Waynaad District- 673592
Kerala,
Represented by its President
Sri.N.Badushah

Petitioners

AND

1. State of Karnataka,
Represented by: Chief Secretary,
Vidhana Soudha,
Bangalore-560001.

2. Principal Secretary, Forests, Ecology & Environment,
Government of Karnataka,
M.S. Building,
Bangalore-560003.

3. Chief Wildlife Warden,
Karnataka Forest Department,
4th floor, Aranya Bhavan,
18th Cross, Malleswaram, Banglore-560003.

4. The Deputy Commissioner,
Chamrajnagar district,
Chamrajnagar.

5. The Deputy Conservator of Forests,
Project Tiger Division,
Bandipur,
Gundlupet Taluk,
Chamrajnagar.

6. Chief Engineer,
National Highways Authority of India,
Annexe Building, 2nd Floor,
K.R.Circle,
Bangalore - 560 001.

Respondents

MEMORANDUM OF WRIT PETITION UNDER SECTION 226 AND 227 OF THE CONSTITUTION OF INDIA

FACTS

1. The First Petitioner has been undertaking wildlife conservation activities since the past four years. He has carried out several awareness campaigns about preservation of wildlife and forests in Karnataka including Bandipur National Park. His particular interests include educating vehicle drivers using roads within national parks and wildlife sanctuaries. He was part of several education programs conducted in Bandipur and Nagarahole National Parks. The Second Petitioner is a registered organization working in the field of wildlife conservation in the state of Kerala. The organization is involved in educating people on wildlife conservation issues in Waynaad district of Kerala and also in the Karnataka-Kerala border which includes Bandipur National Park. The Second Petitioner undertakes awareness programmes pertaining to forest fires, wildlife poaching and other such subjects. The said Petitioner has also successfully filed petitions in the past pertaining to illegal capture of elephants and forest land encroachments. A Copy of the registration Certificate of the Second Petitioner is produced as Annexure-A. The Bandipur Tiger Reserve and National Park is a very important and eco-sensitive wildlife habitat. Understanding the importance of the said area, night traffic on the two national Highways namely NH 212 AND NH 67 was banned by an Order dated 03-06-09. A copy of the said Order is produced as Annexure-B. However, bowing to pressure from vested groups the said order was withdrawn by the Fourth Respondent through another Order dated 10-06-09, a copy of which is produced as Annexure-C. It is seeking the quashing of the said Annexure-C that the Petitioners are approaching this Honourable Court through the present Public Interest Litigation.

2. The Bandipur Tiger Reserve is one of most critical wildlife habitats in the country and supports one of the highest densities of tigers (13tigers/100 sq km) in the world. It is contiguous with Nagarahole Tiger Reserve, Mudhumalai Tiger Reserve and Waynaad

Wildlife Sanctuary forming one of the best wildlife habitats in the country. Bandipur Tiger Reserve is acclaimed as one of the last strongholds of highly endangered wildlife species in the world including tigers and Asian elephants. A map of the area is produced here as **Annexure D**. Due to this factor it was declared as one of nine Project Tiger Reserves in the country as early as 1973. It forms a part of Tiger Conservation Landscape-66 (TCL-66) as identified by renowned wildlife conservation organizations including Wildlife Conservation Society, World Wildlife Fund, Save the Tiger Fund and other organizations depicting the importance of the landscape. The area is also part of the Mysore Elephant Reserve as declared by the Ministry of Environment and Forests, Government of India giving it utmost importance for elephant conservation. Due to its high ecological and biological value it is declared as part of the Nilgiri Biosphere Reserve as identified by Government of India and United Nations Educational Scientific and Cultural Organisation (UNESCO) under its Man And Biosphere Reserve Program. The Bandipur Tiger Reserve is also contiguous with Nagarahole Tiger Reserve, Waynaad and Mudhumalai Wildlife Sanctuaries and other reserved forests in the Western Ghats forming an important and indispensible corridor for wild animals of the said region. The said corridor is crucial for healthy dispersal and breeding patterns of the various endangered and indigenous species listed in Schedule -1 of the Wild Life Protection Act, 1972.

3. Despite Bandipur being declared a National Park, two highways NH 212 (Gundlupet-Ooty road) and NH 67 (Gundlupet- Sulthan Bathery road) cut the Bandipur Tiger Reserve. These roads apart from fragmenting the habitat for wildlife especially of endangered animals that need large home ranges such as the tiger, Asian elephant, Asiatic wild dog and others also causes death to wildlife in the form of road kills due to speeding vehicles. Scientific studies have clearly established that wild animals are very vulnerable especially at night due to speeding vehicles. Some pictures of wildlife killed on these highways are enclosed as **Annexure-E series**. These two roads are also used for carrying out illegal activities such as timber smuggling, wildlife poaching, etc. in the Bandipur Tiger Reserve especially at night. All these facts are evidenced by the letter dated 23-01-09 written by the Fifth Respondent to the Fourth Respondent. A copy of the said letter is produced as **Annexure-F**. Currently during day time also some wildlife has been killed by road accidents. A copy of one such news report is produced as **Annexure G**. Some scientific papers describing the adverse impacts of roads in wildlife habitats are produced as **Annexures- G1 and G2**. The Fourth Respondent after a thorough site inspection realized the truth of the above mentioned

facts and ordered the closure of vehicular traffic on NH 212 and NH 67 as per Annexure-C. However, in a shocking turn around, within a week thereafter, the same officer bowing to pressure from vested interests withdrew Annexure-C by an Order as per Annexure-D. Thereafter, in Writ Petition 17498 / 2009 this Honourable Court by order dated 27-07-2009 was pleased to grant an interim order staying the operation of Annexure-D.

4. The National Wildlife Action Plan (2002-2016) clearly stipulates that roads should be avoided within National Parks or mitigation measures such as restricting night traffic should be adopted. A copy of the said Action Plan is produced as **Annexure-H.** Guidelines for Preparation of Tiger conservation Plan also specify regulation of traffic flow. A copy of the said guidelines is produced as **Annexure-H1**. Night traffic ban is in place in several protected areas in India and in other parts of the world. For e.g. night traffic on all roads within Nagarahole National Park is closed. The Honourable Supreme Court of India in its order dated 11-11-2008 in Application no.1064 in W.P. 202/95 has ordered the Mysore-Manathavadi Road (SH 17D) to be closed between 6 pm to 6 am based on a recommendation of the Central Empowered Committee appointed by the Honourable Supreme Court The Order of the Honourable Supreme Court and the recommendations of the Central Empowered Committee are produced as **Annexures- J & J1**. Even before the Honourable Supreme Court orders were passed the Deputy Commissioner, Mysore District had initiated night closure of vehicular traffic on the Mysore-Mananthavadi Road (SH 17D) falling within the Nagarahole National Park by an Order dated 11-07-2008 a copy of which is produced as **Annexure- J2**. Recently in a meeting of the Monitoring Committee of the Mysore-Mananthavadi road, constituted based on the order of the Honourable Supreme Court, held on 07-10-09, it was decided that a 14 Km diversion should be taken up to completely avoid the usage of 10 Km. of the existing Mysore-Mananthavadi road passing through the Nagarahole National Park to ensure greater protection to the wildlife of the region. A copy of the Minutes of the meeting is produced as **Annexure- J3**. Similarly the Hyderabad-Srisailam road passing through the Nagarjuna Sagar-Srisailam Tiger Reserve is closed from 9 pm to 6 am. A copy of a correspondence in this regard dated 20-08-2009 is produced as **Annexure-J4**. Similarly, the Honourable Supreme Court of India in IA no 2068 (W.P. 202/95) has ordered closure of night traffic in Sariska Tiger Reserve, Rajasthan. The Government of India has also provided funding to the tune of Rs. 03,50,00,000/- (rupees three crores and fifty lakhs only) to Government of Rajasthan through letter dated 10-03-

1998 to construct a bye-pass outside Sariska Tiger Reserve for the Jaipur-Alwar state highway no.13. Copies of the order of the Honourable Supreme Court and the letter of Government of India are produced as **Annexures- K & K1**.

5. Despite the adverse impact highways have on wildlife, the Sixth Respondent has planned to expand the Gundlupet-Sultan Battery road (NH 212) and Gundlupet-Ooty road (NH 67) into a four lane highway. The proposed expansion by the implementing agency is mentioned in its annual work plan which is produced herein as **Annexure L.**

6. Some of the justifications given by the Fourth Respondent for passing Annexure-C are that there is no other alternative available to the two highways sought to be closed for night traffic, that transportation of perishables and essential commodities will be affected, that there will be a decline in the number of vehicles plying on the said roads, that pilgrims will not be able to travel to the Ayyappa Swamy temple at Sabarimala, that ambulances will not be able to ply after closure, that vehicles will pile up at the ghat section just outside the Bandipur National Park and that public transport (buses) will be affected. However, all the above excuses are imaginary and have no shred of truth in them.
7. Other alternate highways/roads are available to reach north Kerala and Tamil Nadu. The alternate alignment for NH 212 passes through Hunsur, Gonikoppa, and Kutta will also improve the connectivity to Kutta and Gonikoppal in Kodagu that are important coffee growing areas and is only 42km longer than the current alignment. Map of alternate roads is attached as **Annexure-M**. The alternate road to reach Ooty passes through Chamarajnagar, Sathyamangala, and Mettupalyam and is 75 km longer. The map of alternate road is enclosed as **Annexure-M1**. Thus, viable options to both NH 212 and NH 67 are available contrary to the claims of the first Respondent.

8. As for claims that transportation of essential commodities, trucks carrying these products still ply till 9 pm by which time most of the vegetables are harvested and sent to Kerala. There is no decline in the number of transport vehicles that are passing to Kerala and Tamil Nadu as reported by the Road Transport Authority check post at Gundlupet. Details of the same are enclosed as **Annexure-N**. The Ayyappa Swamy pilgrimage centre in southern Kerala attracts pilgrims only during the months of mid November, December and January. It is true that pilgrims from Karnataka also go to this shrine in large numbers. However there are several alternate routes to the said pilgrimage centre. For pilgrims from Mysore district the nearest alternate route is

through Chamrajnagar, Sathyamangalam, Coimbatore, Palakkad, Thrissur and Kottayam and is only 51 km longer than the current route. Also it is a tradition that the pilgrims generally do not take the shortest route as they visit several other temples enroute to Sabarimala. Hence the argument that the visits of pilgrims have been curtailed holds no truth. A map of routes to Sabarimala is enclosed as **Annexure-P.** As for the argument that trade is affected due the night closure is an exaggeration. On an average, chicken at the rate of 7 loads per week, sugar at the rate of 24 loads per week eggs at the rate of 8 loads per week, milk at the rate of 2 containers per week and vegetables at the rate of 70 loads per week are transported through NH 212 and NH 67. Such transportation is not only negligible but is also invariably undertaken during daytime. Thus by no stretch of imagination can it be said that trade is affected due to night closure of the said roads.

9. As for the argument that people will be deprived of emergency medical services due to night closure of NH 212 and NH 67 is not valid as it is clearly mentioned in the order as in Annexure-C that emergency services such as ambulance will be allowed despite the night closure. **Annexure-Q** listing such passage of emergency vehicles evidences the same. Moreover, several such high quality medical facilities are already available in Kalpetta and Calicut in North Kerala. Some of the excellent hospitals in Kalpetta are also charitable in nature providing free services to the economically weaker sections. Calicut which also lies on NH 212 has excellent medical facilities. Thus, adequate medical facilities are available in Kerala and people do not have to travel to Mysore for this reason. A list of some such medical facilities is produced as **Annexure-Q1.** Similarly, 16 Road Transport Corporation buses are permitted to ply through NH 212 and NH 67 despite night closure. Copies of the letters written by the fourth Respondent to the concerned officer of the Tamil Nadu and Karnataka Road Transport Corporations are produced as **Annexures- R & R1.**

10. The assertions that there is a vehicle pile up causing a traffic jam due to the night closure are absolutely false. Records maintained by the Karnataka Forest Department at the various check posts of the Bandipur Tiger Reserve clearly show a steady decline in the number of vehicles waiting at the check posts as the commuters have adjusted their travelling time according to the night closure being implemented. Copies of the records maintained at two such check posts namely the Kekkanahalla and the Moolehole check posts are produced as **Annexures-S & S1.**

11. Despite all the above facts and circumstances, the Fourth Respondent has passed an order as in Annexure-D to resume night traffic in NH 212 and NH 67. In view of the said circumstances, the Petitioners have no other alternate or efficacious remedy but to approach this Honourable Court in the present Petition. The Petitioners submit that they have not filed any other writ or other such proceeding on the same facts and circumstances, either before this Honourable Court or before any other Court of Law.

GROUNDS

12. Annexure-C is violative of the mandate stipulated in the National Wildlife Action Plan as in Annexure-H and in the Guidelines for Preparation of Tiger Conservation Plan as in Annexure- H1.

13. Annexure –C is also violative of the general practice in most of the Protected Areas both within and outside India, wherein night traffic is banned to protect wildlife.

14. Annexure-C is also violative of the objectives as stipulated in Chapter IV of the Wildlife Protection Act, 1972 wherein stringent prohibitions on the use and access to Protected Areas have been mandated.

15. The night ban on traffic between 9.00 p.m. to 6.00 a.m. as per Annexure-B is less stringent than similar bans in other protected areas which exist from 6.00 p.m. to 6.00 a.m.

16. Annexure-C is not in consonance with the guidelines laid down by the Honourable Supreme Court in similar instances, as in Annexures-J & K.

17. The so-called economic and trade losses projected by the First Respondent are imaginary and baseless. Moreover, the Honourable Supreme Court through a catena of cases has held that ecological concerns are invariably predominant to economic interests.

18. The proposed expansion of NH212 is in blatant violation of the Wildlife Protection Act, 1972 as also of Annexures- H and H1 and the Supreme Court guidelines issued in such matters.

19. In view of all the above mentioned facts and grounds, this Honourable Court may be pleased to grant the Prayers as sought for hereunder.

GROUNDS FOR INTERIM PRAYER

Due to unregulated rash and negligent driving through NH 212 and NH 67 passing through the Bandipur National Park, wild animals are getting killed even during day time. If immediate speed calming measures such as road humps, rumble strips and chicanes are not installed on NH 67 and NH 212, more endangered and endemic animals are bound to be killed on the said highways. Further, the road expansion of the said highways serves to only further jeopardize the life and limb of the wild animals of the Bandipur National Park. Hence, this Honourable Court may be pleased to direct the Respondents to install speed calming measures and to stop all steps initiated to expand NH 212 and NH 67 with immediate effect.

PRAYER

WHEREFORE, it is humbly prayed that this Honourable Court be pleased to grant the following reliefs:

1. Issue a Writ of Certiorari quashing the order dated 10-06-2009, bearing No. MAG (1): MLO. 18/09-10 produced as Annexure-C.
2. Issue a Writ of Mandamus directing all the Respondents to strictly implement the Order dated 03-06-2009, bearing No. MAG (1): MLO. 18/09-10 produced as Annexure-B.
3. Issue a Writ of Mandamus directing the Sixth Respondent not to widen the existing NH212 and NH 67 into four lane highways.
4. Issue a Writ of Mandamus directing the Respondents to introduce speed calming measures on NH 212 and NH 67 to mitigate animal kills due to speeding vehicles.
5. Pass any other such orders or directions that this Honourable Court deems fit to pass in the interests of justice and equity.

INTERIM PRAYER

For the reasons mentioned in the Grounds for Interim Prayer, this Honourable Court may be pleased to direct the Respondents to install speed calming measures and to stop all steps initiated to expand NH 212 and NH 67 with immediate effect.

Bangalore

Date: Advocate for Petitioner

ADDRESS FOR SERVICE:

P. ANU CHENGAPPA,
'Sainekethan,' No. 400,
5th Main, 6th Block,
Banashankari-III Stage, II Phase,
Bangalore-560085.

IN THE HIGH COURT OF KARNATAKA AT BANGALORE

W.P.NO. /2010 (PIL)

BETWEEN

Sri. Anup.B.P. & another — Petitioners

AND

State of Karnataka & others — Respondents

AFFIDAVIT

I, Anup.B.P., S/o Prakash B.S., aged about 24 years, residing at No 6, Sneha Apartments, 3rd Cross, SVG Nagar, Bangalore – 560 072, , do hereby swear on solemn oath and affirmation as follows:

1. I am the First Petitioner in the above matter and am conversant with the facts of the case. Hence I swear to this affidavit.

2. The averments made in paragraphs 1- of the accompanying application are true to the best of my knowledge and information.

3. I hereby state that all that is stated above is true to the best of my knowledge, information and belief and that the name mentioned herein and the signature affixed hereunder are mine.

Anupprakash

Identified by me — Deponent

Advocate

Bangalore
Date:

Annexure - B 16

ಜಿಲ್ಲಾಧಿಕಾರಿಗಳು, ಹಾಗೂ ಜಿಲ್ಲಾ ದಂಡಾಧಿಕಾರಿಗಳು, ಚಾಮರಾಜನಗರ ಜಿಲ್ಲೆ, ಚಾಮರಾಜನಗರ ರವರ ನಡವಳಿಗಳು

ವಿಷಯ:- ಬಂಡಿಪುರ ರಾಷ್ಟ್ರೀಯ ಹೆದ್ದಾರಿ ಸಂ.212 ಗುಂಡ್ಲುಪೇಟೆ-ಸುಲ್ತಾನಬತೇರಿ ಹಾಗೂ ರಾಷ್ಟ್ರೀಯ ಹೆದ್ದಾರಿ ಸಂ.67 ಗುಂಡ್ಲುಪೇಟೆ-ಊಟಿ ಮಾರ್ಗಗಳಲ್ಲಿ ರಾತ್ರಿ 9.00 ಗಂಟೆಯಿಂದ ಬೆಳಿಗ್ಗೆ 6.00 ಗಂಟೆಯವರೆಗೆ ವಾಹನ ಸಂಚಾರವನ್ನು ನಿಷೇದಿಸುವ ಬಗ್ಗೆ.

ಉಲ್ಲೇಖ:- ಉಪ ಅರಣ್ಯ ಸಂರಕ್ಷಣಾಧಿಕಾರಿಗಳು, ವನ್ಯ ಜೀವಿ ವಿಭಾಗ, ಹುಲಿ ಯೋಜನೆ, ಬಂಡಿಪುರ ವಿಭಾಗ, ಗುಂಡ್ಲುಪೇಟೆ ತಾಲ್ಲೂಕು ಚಾಮರಾಜನಗರ ಜಿಲ್ಲೆ ರವರ ಪತ್ರ ಸಂ.ಎ4/ಎನ್.ಹೆಚ್ ರಸ್ತೆ/ಸಿಆರ್-26/2008-09 ದಿನಾಂಕ:23.01.09

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ಪ್ರಸ್ತಾವನೆ :-

ಬಂಡೀಪುರ ರಾಷ್ಟ್ರೀಯ ಅಭಯಾರಣ್ಯವನ್ನು ಭಾರತ ಸರ್ಕಾರವು 1986ರಲ್ಲಿ ರಕ್ಷಿತ ಅರಣ್ಯ ಪ್ರದೇಶವೆಂದು ಘೋಷಿಸಿದ್ದು, ಈ ಅಭಯಾರಣ್ಯವು ತಮಿಳುನಾಡಿನ ನೀಲಗಿರಿ, ಮಧುಮಲೈ ಅರಣ್ಯ ಪ್ರದೇಶ, ಕೇರಳ ರಾಜ್ಯದ ವೈನಾಡು ಅರಣ್ಯ ಪ್ರದೇಶಕ್ಕೆ ಹೊಂದಿಕೊಂಡು ನಾಗರಹೊಳೆ ಅಭಯಾರಣ್ಯದವರೆಗೆ ವಿಸ್ತರಿಸಿದೆ. ಈ ಅರಣ್ಯದ ಗಡಿ ಭಾಗವು ಮೈಸೂರು ಜಿಲ್ಲೆಯ ನಂಜನಗೂಡು ಹಾಗೂ ಹೆಚ್.ಡಿ.ಕೋಟೆ ಭಾಗವನ್ನು ಒಳಗೊಂಡಿದ್ದು, 990.51 ಚದರ ಕಿ.ಮೀ. ವಿಸ್ತೀರ್ಣತೆಯನ್ನು ಒಳಗೊಂಡಿರುತ್ತದೆ. ಸದರಿ ರಾಷ್ಟ್ರೀಯ ಉದ್ಯಾನ ಬರಿ ವನ್ಯಜೀವಿ ಧಾಮ ಮಾತ್ರವಲ್ಲದೆ ಹುಲಿ ಯೋಜನೆಗೆ ಅಳವಡಿಕೆಯಾದ ತಾಣವಾಗಿರುತ್ತದೆ ಹಾಗೂ ಏಷ್ಯಾದ ಆನೆಗಳಿಗೆ ಮತ್ತು ಹುಲಿ ಸಂತತಿಗೆ ಹಸಿರುವಾಸಿಯಾದ ಅರಣ್ಯವಾಗಿರುತ್ತದೆ. ಈ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಹಾದುಹೋಗಿರುವ ರಸ್ತೆಯಲ್ಲಿ ಸಂಚರಿಸುವ ವಾಹನಗಳಿಗೆ ವನ್ಯಜೀವಿಗಳು ಸಿಲುಕಿ ಸಾವಿಗೀಡಾಗಿ ಅವುಗಳ ಸಂತತಿ ಕ್ಷೀಣಿಸುತ್ತಿದೆ ಎಂದು ಉಲ್ಲೇಖಿತ ಪತ್ರದ ರೀತ್ಯ ಪ್ರಸ್ತಾಪಿಸಿರುತ್ತಾರೆ. ವನ್ಯಜೀವಿಗಳ ಅಮೂಲ್ಯ ಸಂಪತ್ತನ್ನು ಉಳಿಸಲು ರಾತ್ರಿ ವೇಳೆ ಸಂಚಾರವನ್ನು ನಿಷೇಧಿಸಲು ಉದ್ದೇಶಿಸಿ, ರಾಷ್ಟ್ರೀಯ ಹೆದ್ದಾರಿ ಸಂಖ್ಯೆ 67 ಗುಂಡ್ಲುಪೇಟೆ-ಊಟಿ ಅರಣ್ಯ ಮಾರ್ಗ ಹಾಗೂ ರಾಷ್ಟ್ರೀಯ ಹೆದ್ದಾರಿ ಸಂಖ್ಯೆ 212 ಗುಂಡ್ಲುಪೇಟೆ-ಸುಲ್ತಾನ್ ಬತ್ತೇರಿ ಅರಣ್ಯ ಮಾರ್ಗದಲ್ಲಿ ರಾತ್ರಿ 9.00 ಗಂಟೆಯಿಂದ ಬೆಳಿಗ್ಗೆ 6.00 ಗಂಟೆಯವರೆಗೆ ವಾಹನ ಸಂಚಾರವನ್ನು ನಿಷೇಧಿಸುವ ಸಂಬಂಧ ಈ ಕೆಳಕಂಡಂತೆ ಆದೇಶಿಸಿದೆ.

ಆದೇಶ

ಸಂ. ಎಂಎಜಿ(1)ಎಂಎಲ್ಒ/18/2009-10 ದಿನಾಂಕ : 03-06-2009

ಪ್ರಸ್ತಾವನೆಯಲ್ಲಿ ವಿವರಿಸಿರುವಂತೆ ಮನೋಜ್‌ಕುಮಾರ್ ಮೀನಾ, ಭಾ.ಆ.ಸೇ. ಜಿಲ್ಲಾಧಿಕಾರಿ ಹಾಗೂ ಜಿಲ್ಲಾ ದಂಡಾಧಿಕಾರಿ, ಚಾಮರಾಜನಗರ ಜಿಲ್ಲೆ, ಚಾಮರಾಜನಗರ ಆದ ನಾನು ಮೋಟಾರು ವಾಹನ ಕಾಯ್ದೆ 1988 ಸೆಕ್ಷನ್ 115 ಕರ್ನಾಟಕ ಮೋಟಾರು ವಾಹನ ನಿಯಮಾವಳಿಗಳು 1989ರ ನಿಯಮ 221-ಎ (5)ರಲ್ಲಿ ಪ್ರದತ್ತವಾಗಿರುವ ಅಧಿಕಾರವನ್ನು ಚಲಾಯಿಸಿ, ಬಂಡಿಪುರ ರಾಷ್ಟ್ರೀಯ ಹೆದ್ದಾರಿ ಸಂ.212 ಗುಂಡ್ಲುಪೇಟೆ - ಸುಲ್ತಾನಬತೇರಿ ಹಾಗೂ ರಾಷ್ಟ್ರೀಯ ಹೆದ್ದಾರಿ ಸಂ.67 ಗುಂಡ್ಲುಪೇಟೆ- ಊಟಿ ಮಾರ್ಗಗಳಲ್ಲಿ ಎಲ್ಲಾ ಮೋಟಾರು ವಾಹನಗಳ ಸಂಚಾರವನ್ನು ಈ ಕೆಳಕಂಡ ಷರತ್ತುಗಳಿಗೊಳಪಟ್ಟು ದಿನಾಂಕ: 03-06-2009 ರಿಂದ ಜಾರಿಗೆ ಬರುವಂತೆ ರಾತ್ರಿ 9-00 ಗಂಟೆಯಿಂದ ಬೆಳಿಗ್ಗೆ 6.00 ಗಂಟೆಯವರೆಗೆ ನಿಷೇಧಿಸಿ ಆದೇಶ ಹೊರಡಿಸಿರುತ್ತೇನೆ.

ಈ ಆದೇಶದಿಂದ ಈ ಕೆಳಕಂಡವರಿಗೆ ವಿನಾಯ್ತಿ ನೀಡಲಾಗಿದೆ.

1. ಸಾರ್ವಜನಿಕರಿಗೆ / ಗ್ರಾಮಸ್ಥರಿಗೆ ಅನುಕೂಲವಾಗುವಂತೆ ರಾತ್ರಿ 9.00 ಗಂಟೆಯಿಂದ 10.00 ಗಂಟೆಯವರೆಗೆ 2 ಬಸ್ಸುಗಳನ್ನು ಮಾತ್ರ ಸಂಚರಿಸಲು ಅನುಮತಿ ನೀಡಲಾಗಿದೆ.

2. ತುರ್ತು ಸಂದರ್ಭಗಳಲ್ಲಿ ಚಿಕಿತ್ಸೆಗಾಗ ಆಸ್ಪತ್ರೆಗೆ ತೆರಳುವಂತಹ ಸಂದರ್ಭಗಳಲ್ಲಿ ಅನುಮತಿ ಪಡೆದಂತಹ ವಾಹನ ಹಾಗೂ ಅಂಬುಲೆನ್ಸ್ ವಾಹನಗಳಿಗೆ ಮಾತ್ರ ಈ ಭಾಗದಲ್ಲಿ ಸಂಚರಿಸಲು ಅನುಮತಿಸಿದೆ. ಚೆಕ್‌ಪೋಸ್ಟ್‌ನಲ್ಲಿ ಇಂತಹ ವಾಹನಗಳನ್ನೂ ಸಹ ತಪಾಸಣೆ ಮಾಡುವುದು.

ಈ ಆದೇಶವನ್ನು ನನ್ನ ಸಹಿ ಹಾಗೂ ಮೊಹರಿನೊಂದಿಗೆ ದಿನಾಂಕ: 03-06-2009ರಂದು ಹೊರಡಿಸಲಾಗಿದೆ.

ಜಿಲ್ಲಾಧಿಕಾರಿ ಹಾಗೂ ಜಿಲ್ಲಾ ದಂಡಾಧಿಕಾರಿ
ಚಾಮರಾಜನಗರ ಜಿಲ್ಲೆ, ಚಾಮರಾಜನಗರ

ಪ್ರತಿಯನ್ನು ಈ ಕೆಳಕಂಡವರಿಗೆ ಅವಗಾಹನೆಗೆ ಸಲ್ಲಿಸಿದೆ.

1. ಮಾನ್ಯ ಮುಖ್ಯ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕರ್ನಾಟಕ ಸರ್ಕಾರ, ವಿಧಾನಸೌಧ, ಬೆಂಗಳೂರು.
2. ಸರ್ಕಾರದ ಪ್ರಧಾನ ಕಾರ್ಯದರ್ಶಿಗಳು, ಲೋಕೋಪಯೋಗಿ ಇಲಾಖೆ, ವಿಧಾನ ಸೌಧ, ಬೆಂಗಳೂರು.
3. ಸರ್ಕಾರದ ಪ್ರಧಾನ ಕಾರ್ಯದರ್ಶಿಗಳು, ಒಳಾಡಳಿತ ಮತ್ತು ಸಾರಿಗೆ ಇಲಾಖೆ, ವಿಧಾನಸೌಧ, ಬೆಂಗಳೂರು.
4. ಸರ್ಕಾರದ ಪ್ರಧಾನ ಕಾರ್ಯದರ್ಶಿಗಳು, ಅರಣ್ಯಜೀವಿ, ಪರಿಸರ ಇಲಾಖೆ, ವಿಧಾನಸೌಧ, ಬೆಂಗಳೂರು.
5. ಸರ್ಕಾರದ ಪ್ರಧಾನ ಕಾರ್ಯದರ್ಶಿಗಳು, ಸಾರಿಗೆ ಇಲಾಖೆ, ವಿಧಾನಸೌಧ, ಬೆಂಗಳೂರು.
6. ಸಾರಿಗೆ ಆಯುಕ್ತರು, ಕರ್ನಾಟಕ ಸರ್ಕಾರ, ಬಹುಮಹಡಿಗಳ ಕಟ್ಟಡ, ಬೆಂಗಳೂರು.
7. ಪ್ರಧಾನ ಅರಣ್ಯ ಸಂರಕ್ಷಣಾಧಿಕಾರಿಗಳು, ಅರಣ್ಯಭವನ, ಮಲ್ಲೇಶ್ವರಂ, ಬೆಂಗಳೂರು.
8. ಪ್ರಾದೇಶಿಕ ಆಯುಕ್ತರು, ಮೈಸೂರು ವಿಭಾಗ, ಹುಣಸೂರು ರಸ್ತೆ, ಮೈಸೂರು.
9. ಇನ್ಸ್‌ಪೆಕ್ಟರ್ ಜನರಲ್ ಆಫ್ ಪೊಲೀಸ್, ದಕ್ಷಿಣ ವಲಯ, ಮೈಸೂರು.
10. ಸರ್ಕಾರದ ಮುಖ್ಯ ಇಂಜಿನಿಯರ್, ಲೋಕೋಪಯೋಗಿ ಇಲಾಖೆ, ರಸ್ತೆ ಮತ್ತು ಸಂಪರ್ಕ, ದಕ್ಷಿಣ ಕೆ.ಆರ್.ವೃತ್ತ, ಬೆಂಗಳೂರು.
11. ವ್ಯವಸ್ಥಾಪಕ ನಿರ್ದೇಶಕರು, ಕೇಂದ್ರ ಕಛೇರಿ, ಕ.ರಾ.ರ.ಸಾ.ಸಂಸ್ಥೆ, ಶಾಂತಿನಗರ, ಬೆಂಗಳೂರು ರವರಿಗೆ ಮಾಹಿತಿಗಾಗಿ ಹಾಗೂ ಸೂಕ್ತ ಕ್ರಮಕ್ಕಾಗಿ ಸಲ್ಲಿಸಿದೆ.
12. ಜಿಲ್ಲಾ ಪೊಲೀಸ್ ವರಿಷ್ಠಾಧಿಕಾರಿಗಳು, ಚಾಮರಾಜನಗರ ಜಿಲ್ಲೆ, ಚಾಮರಾಜನಗರ ಇವರಿಗೆ ಸೂಕ್ತ ಕ್ರಮಕ್ಕಾಗಿ ಹಾಗೂ ಸ್ಥಳೀಯ ಪೊಲೀಸ್ ಅಧಿಕಾರಿಗಳು ಈ ಆದೇಶ ಉಲ್ಲಂಘಿಸಿ ಸಂಚರಿಸುವ ವಾಹನಗಳ ವಿರುದ್ಧ ಮೊಕದ್ದಮೆ ದಾಖಲಿಸುವುದು ಮತ್ತು ನಿರ್ಬಂಧನೆ ಕ್ರಮವಹಿಸಿ, ರಾತ್ರಿ ಸಂಚಾರ ನಿರ್ಬಂಧಿಸಿ, ನಿಲುಗಡೆ ಒದಗಿಸುವುದು. ಈ ಪ್ರದೇಶದ ಜನವಸತಿ ಯವರಿಗೆ ತುರ್ತು ಸಂದರ್ಭಗಳಲ್ಲಿ ಪರ್ಯಾಯ ವ್ಯವಸ್ಥೆ ಕಲ್ಪಿಸುವುದು.
13. ಅರಣ್ಯ ಸಂರಕ್ಷಣಾಧಿಕಾರಿ, ವನ್ಯಜೀವಿ ವಿಭಾಗ, ಚಾಮರಾಜನಗರ ಹಾಗೂ ಉಪ ಅರಣ್ಯ ಸಂರಕ್ಷಣಾಧಿಕಾರಿ, ಹುಲಿ ಯೋಜನೆ ವಿಭಾಗ, ಬಂಡೀಪುರ, ಗುಂಡ್ಲುಪೇಟೆ ತಾಲ್ಲೂಕು ರವರಿಗೆ ಸೂಕ್ತ ಕ್ರಮಕ್ಕಾಗಿ ಮತ್ತು ಅಗತ್ಯ ಸೂಚನಾ ಫಲಕಗಳನ್ನು ಅಳವಡಿಸುವುದು, ರಾತ್ರಿ ಸಂಚಾರ ನಿರ್ಬಂಧಿಸಿ ಕ್ರಮವಹಿಸುವುದು ಮತ್ತು ಆ ವ್ಯಾಪ್ತಿಯ ಪ್ರದೇಶದ ಜನವಸತಿಯವರಿಗೆ ತುರ್ತು ಸಂದರ್ಭಗಳಲ್ಲಿ ಪರ್ಯಾಯ ವ್ಯವಸ್ಥೆ ಕಲ್ಪಿಸುವುದು.
14. ಹಿರಿಯ ವಿಭಾಗೀಯ ನಿಯಂತ್ರಣಾಧಿಕಾರಿ, ಕ.ರಾ.ರ.ಸಾ.ಸಂಸ್ಥೆ, ಗ್ರಾಮಾಂತರ ವಿಭಾಗ, ಬನ್ನಿಮಂಟಪ, ಮೈಸೂರು-570015 ರವರಿಗೆ ಅಗತ್ಯ ಕ್ರಮಕ್ಕಾಗಿ ಕಳುಹಿಸಿದೆ.
15. ಪ್ರಾದೇಶಿಕ ಸಾರಿಗೆ ಅಧಿಕಾರಿಗಳು, ಚಾಮರಾಜನಗರ ಜಿಲ್ಲೆ, ಚಾಮರಾಜನಗರ ರವರಿಗೆ ಮಾಹಿತಿಗಾಗಿ ಹಾಗೂ ಸೂಕ್ತ ಕ್ರಮ ಕೈಗೊಳ್ಳಲು ಕಳುಹಿಸಿದೆ.
16. ತಹಶೀಲ್ದಾರ್, ಚಾಮರಾಜನಗರ/ಗುಂಡ್ಲುಪೇಟೆ ರವರಿಗೆ ಸೂಕ್ತ ಕ್ರಮಕ್ಕಾಗಿ ಕಳುಹಿಸಿದೆ.
17. ಆರಕ್ಷಕ ಉಪ ಅಧೀಕ್ಷಕರು, (ಡಿವೈಎಸ್‌ಪಿ), ಚಾಮರಾಜನಗರ / ಗುಂಡ್ಲುಪೇಟೆ ರವರಿಗೆ ಸೂಕ್ತ ಕ್ರಮಕ್ಕಾಗಿ ಕಳುಹಿಸಿದೆ.
18. ಆರಕ್ಷಕ ವೃತ್ತ ನಿರೀಕ್ಷಕರು/ಆರಕ್ಷಕ ಉಪ ನಿರೀಕ್ಷಕರು, ಚಾಮರಾಜನಗರ/ ಗುಂಡ್ಲುಪೇಟೆ ರವರಿಗೆ ಸೂಕ್ತ ಕ್ರಮಕ್ಕಾಗಿ ಕಳುಹಿಸಿದೆ.
19. ಸಹಾಯಕ ನಿರ್ದೇಶಕರು, ವಾರ್ತಾ ಮತ್ತು ಪ್ರಚಾರ ಇಲಾಖೆ, ಜಿಲ್ಲಾ ಆಡಳಿತ ಭವನ, ಚಾಮರಾಜನಗರ ರವರಿಗೆ ಮಾಹಿತಿಗಾಗಿ ಹಾಗೂ ಆದೇಶದ ಮಾಹಿತಿಯನ್ನು ಜಿಲ್ಲೆಯ ಎಲ್ಲಾ ಪ್ರಮುಖ ದಿನಪತ್ರಿಕೆಗಳಲ್ಲಿ ಸರ್ಕಾರಕ್ಕೆ ವೆಚ್ಚವಾಗದಂತೆ ಪ್ರಕಟಿಸುವ ಸಲುವಾಗಿ. 25 ಪ್ರತಿಗಳನ್ನು ಲಗತ್ತಿಸಿದೆ.
20. ತಾಲ್ಲೂಕು ವೈದ್ಯಾಧಿಕಾರಿಗಳು, ಗುಂಡ್ಲುಪೇಟೆ ತಾಲ್ಲೂಕು ರವರಿಗೆ ಮಾಹಿತಿಗಾಗಿ ಹಾಗೂ ಅಗತ್ಯ ಕ್ರಮಕ್ಕಾಗಿ ಕಳುಹಿಸಿದೆ.
21. ಜಂಟಿ ನಿರ್ದೇಶಕರು, ಸರ್ಕಾರಿ ಮುದ್ರಣಾಲಯ, ರಾಜ್ಯ ಪತ್ರ ಮತ್ತು ಪ್ರಕಟಣೆಗಳ ಕಛೇರಿ, ಸರಸ್ವತಿಪುರಂ, ಮೈಸೂರು ರವರ ಮಾಹಿತಿಗಾಗಿ ಮತ್ತು ಮುಂಬರುವ ರಾಜ್ಯ ಪತ್ರದಲ್ಲಿ ಸಾರ್ವಜನಿಕ ಮಾಹಿತಿಗಾಗಿ ಪ್ರಕಟಿಸುವ

ಅರ್ಜಿ ಕೊಟ್ಟವರು: ...
ನಕಲಿಗೆ ಅರ್ಜಿ ಕೊಟ್ಟ ದಿನಾಂಕ: 05.12.09
ನಕಲು ಸರಿ ಇದೆ

Translation of Annexure B (18) (19)

PROCEEDINGS OF THE DISTRICT COMMISSIONER AND DISTRICT MAGISTRATE, CHAMRAJNAGARA DISTRICT, CHAMRAJNAGARA

Subject: About closure of vehicular traffic on National Highway No.212 Gundlupete-Sultanbattery in Bandipur National Park and National Highway No.67 Gundlupete-Ooty.

Reference: Letter of Deputy Conservator of Forests, Wildlife Division, Project Tiger, Bandipur Division, Gundlupete taluk, Chamrajnagar district. no.A4/N.H road/CR-26/2008-09 dated 23.01.09.

PREAMBLE:-

The Government of India declared Bandipur National Park as a protected area in 1986 and this protected area is adjacent to other forests such as Nilgiri, Mudhumalai forest area in Tamilnadu, Waynaad forests in Kerala and is spread upto Nagarahole. The border of this forest includes Nanjangud and H.D.Kote in Mysore district and is spread over an area of 990.51 sq km. This is not only a national park but is also included as a Project Tiger area and is famous for tigers and Asiatic elephants. In the above reference letter it is discussed that wildlife species are dying due to accidents due to vehicles passing through roads in this forest. The below given order is to protect valuable wildlife wealth by banning night vehicular traffic on National Highway no.67 Gundlupete-Ooty forest route and National Highway no.212 Gundlupete-Sultan Battery forest routes between night 9.00 pm and morning 6.00 am

ORDER

No.MAG (1)MLO/18/2009-10 Date: 03-06-2009

As explained in the foreword I, Manoj Kumar Meena, I.A.S. District Commissioner and District Magistrate, Chamrajanagara District, Chamrajanagar under the powers given under Motor Vehicles Act 1988 section 115 Karnataka Motor Vehicles Rules 1989 rule 221-A(5) issue orders that all vehicular traffic subject to given conditions below is banned in Bandipur, National Highway no.212 Gundlupete-Sultan Battery and National Highway No.67 Gundlupete-Ooty roads which is to be implemented from 03-06-2009 from night 9.00 pm to morning 6.00 am.

The following are exempted this order.
1.It is permitted to allow only two buses from night 9.00 pm to 10.00 pm to help general public / villagers.

2.Vehicles and ambulances that are going to hospitals for emergency treatment are permitted to travel on this route. These vehicles are to be checked at the check posts.

This order is issued with my signature and seal on 03-06-2009.

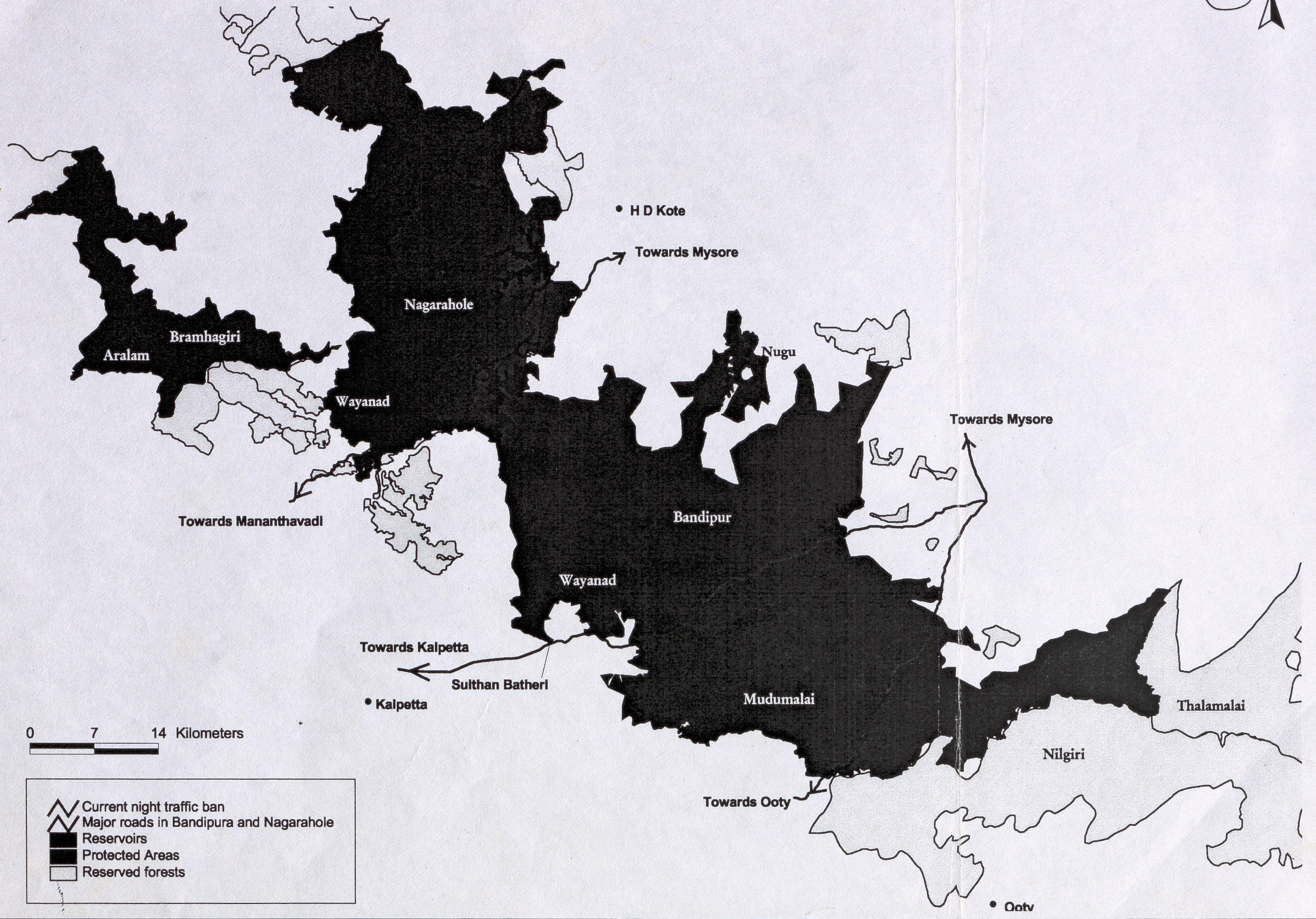
Sd/-
District Commissioner and District Magistrate
Chamarajanagar District, Chamrajnagar

Copies are submitted to the following

1. Chief Secretary to Government, Government of Karnataka, Vidhana Soudha, Bengaluru.
2. Principal Secretary to Government, Public Works Department, Vidhana Soudha, Bengaluru.
3. Principal Secretary to Government, Home Department, Vidhana Soudha, Bengaluru.
4. Principal Secretary to Government, Forests, Ecology and Environment Department, Vidhana Soudha, Bengaluru.
5. Principal Secretary to Government, Transport Department, Vidhana Soudha, Bengaluru.
6. Commissioner for Transport, Multi Storied Building, Bengaluru.
7. Principal Chief Conservator of Forest, Aranyabhavana, Malleshwaram, Bengaluru.
8. Regional Commissioner, Mysore Division, Hunsur Road, Mysore.
9. Inspector General of Police, South Zone, Mysore.
10. Chief Engineer to Government, Public Works Department, Communication and Buildings (South), K.R. Circle, Bengaluru.
11. Managing Director, Central office, K.S.R.T.C, Shanthinagar, Bengaluru for kind information and suitable action.
12. The Superintendent of Police, Chamarajanagara District, Chamarajanagara for suitable action and to book cases against vehicles violating this order, to implement the ban, restricting night vehicular movement and organize vehicular parking. To organize suitable alternatives to people in this area during emergency situations.
13. Conservator of Forests, Wildlife Division, Chamarajanagara and Deputy Conservator of Forests, Project Tiger Division, Bandipura, Gundlupete taluk for suitable action and to install necessary sign boards, take steps to close night traffic and to provide alternative arrangements for general public of that region during emergency situations.
14. Senior Division Controller, K.S.R.T.C., Rural division, Bannimantapa, Mysore-570015 to take suitable action.
15. Divisional Transport Officer, Chamarajanagara District, Chamarajanagara for kind information and suitable action.
16. Tahashildar, Chamarajanagara/Gundlupete for suitable action.
17. Deputy Superintendent of Police (DYSP), Chamarajanagara / Gundlupete for suitable action.
18. Circle Inspector / Sub Inspector, Chamarajanagara / Gundlupete for suitable action.
19. Assistant Director, Karnataka Information Department, District Administrative Office, Chamarajanagara for kind information and to publicize the order details on all daily news papers in the district without financial burden to the Government. 25 copies attached.
20. Taluk Health Officer, Gundlupete taluk for kind information and suitable action.
21. Joint Director, Government Press, Office of the State Gazetteer and Notifications, Saraswathipuram, Mysore for kind information and to publish in State Gazetteer notification for public information.

Contiguous wildlife habitats and road networks in Bandipura Tiger Reserve

~~22~~



Annexure-1

201

Annexure-C -9- (20)

PROCEEDING OF THE DEPUTY COMMISSIONER, CHAMARAJANAGAR DISTRICT, CHAMARAJANAGAR.

Sub: Closure of Night Traffic on Gundlupet-Sulthan Bathery NH 212 and Gundlupet-Ooty 67 Extn. In Bandipura National Park Forest limits. -reg.
Ref: This Office proceedings Dated 03-06-2009.

PREAMBLE:-

On 03-06-2009 this Office has issued an order to stop the vehicular traffic in night from 9.00pm to 6.00am within the limits of Bandipur National Park on National Highway 212 and National Highway 67, Which was suppose to come into effect from 10-06-2009.

After the Notification of the said order this office has received Memorandum from P. Krishna Prasad, Hon'ble MLA, Sulthan Bathery, and Assistant Transport Officer, K.S.R.T.C., Kalpetta, Wayanad , stating that this order might cause inconvenience to the people of wayanad and other parts of Kerala. Hence this order.

ORDER

No.MAG(1):MLO.18/09-10 Date: 10-06-2009

After examine the Memorandum, I find it reasonable to withdraw the order provisionally.

DEPUTY COMMISSIONER AND
DISTRICT MAGISTRATE,
CHAMARAJANAGAR DISTRICT,
CHAMARAJANAGAR.

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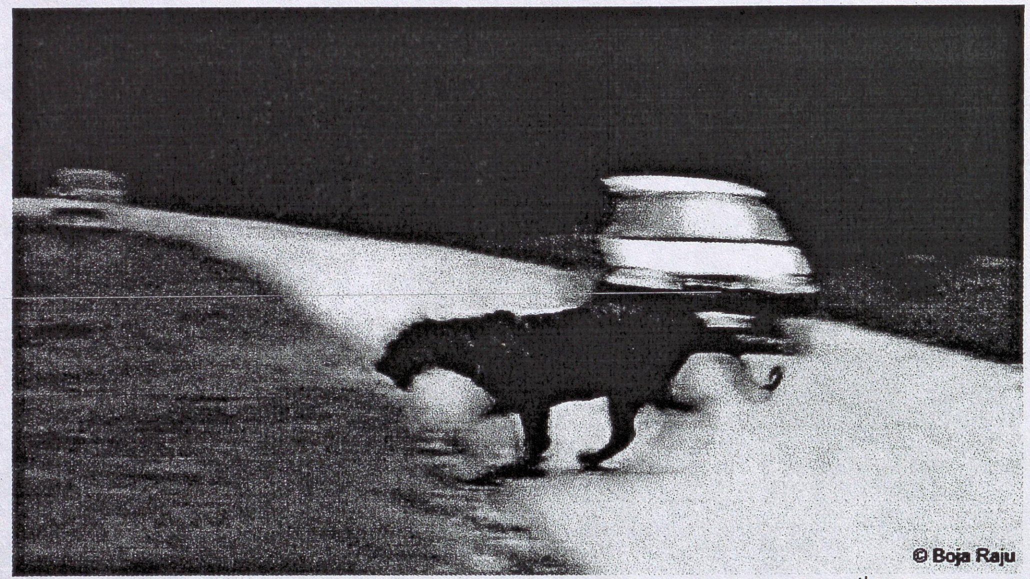
ಚಾಮರಾಜನಗರ ಜಿಲ್ಲೆ, ಚಾಮರಾಜನಗರ

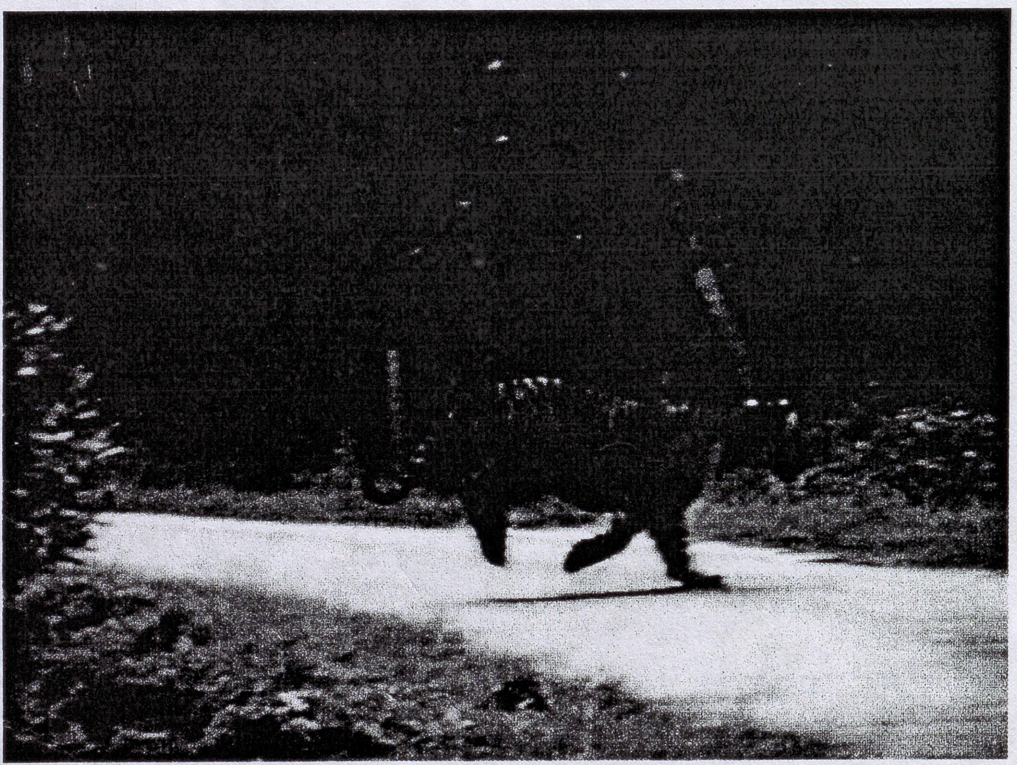
Copy to:

1. The Chief Secretary to Government, Government of Karnataka, Bangalore.
2. The Principal Secretary to Government, PWD, Bangalore.
3. The Principal Secretary to Government, Home Department, Bangalore.
4. The Principal Secretary to Government, Forest, Ecology and Environment Department, Bangalore.
5. The Principal Secretary to Government, Transport Department, Bangalore.
6. The Commissioner, Transport Department, M.S.Building, Bangalore.
7. The Chief Conservator of Forest, Arayana Bhavan, Malleshwaram Bangalore.
8. The Regional Commissioner, Mysore Division, Mysore.
9. The Inspector General of Police, Southern range, Mysore.

ANNEXURE – E



A speeding car just misses hitting a tiger on Bandipur-Ooty highway on 26th October 2009



A tiger cub crossing the Bandipur highway on 12th December 2009

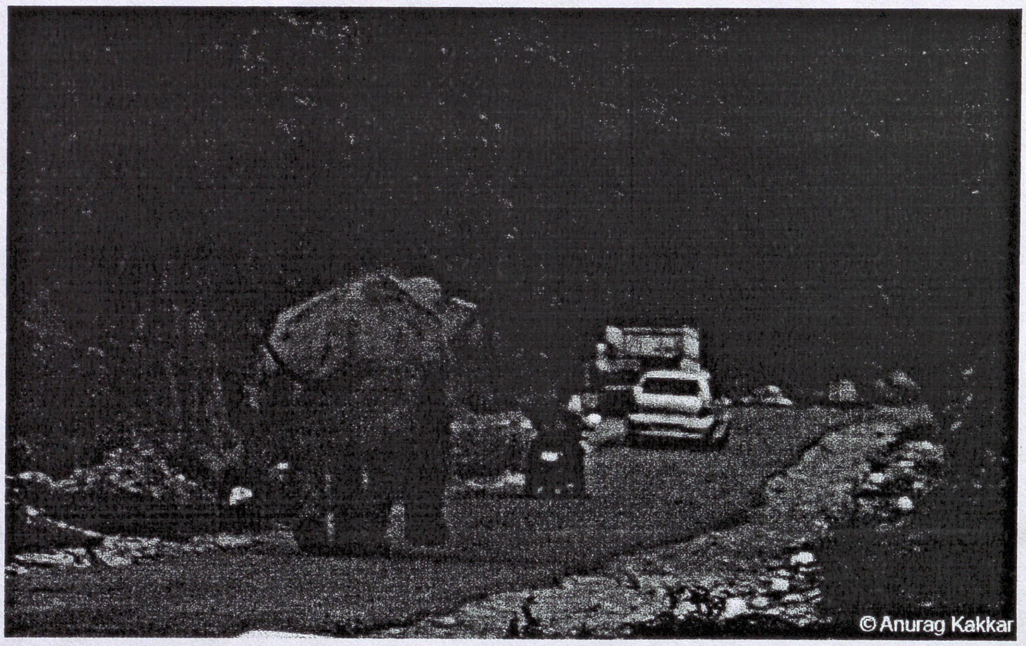
(23) (24)

Annexure E1

A Tiger killed in Bandipur Tiger reserve photographed by Deputy Conservator of Forests Sri. D. Yathish Kumar

An elephant calf killed by a truck on Bandipur highway photographed by Deputy Conservator of Forests Sri. D. Yathish Kumar

Annexure E2

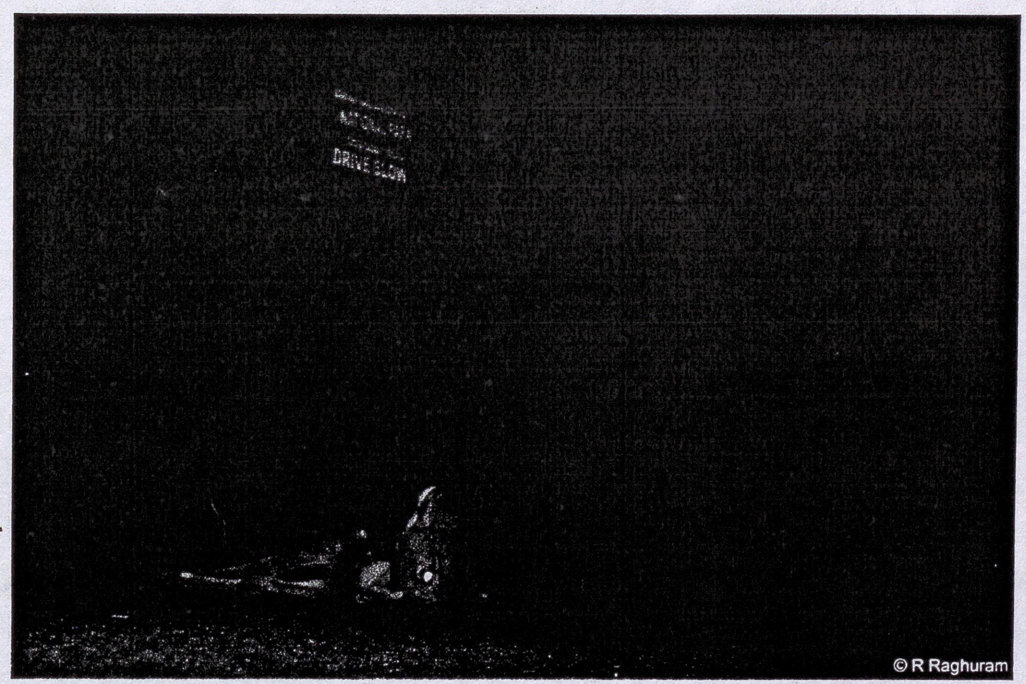


An irritated elephant chases vehicles after being teased by commuters

A leopard cat killed by speeding vehicle on Bandipur highway on 3rd November 2009

Annexure E3

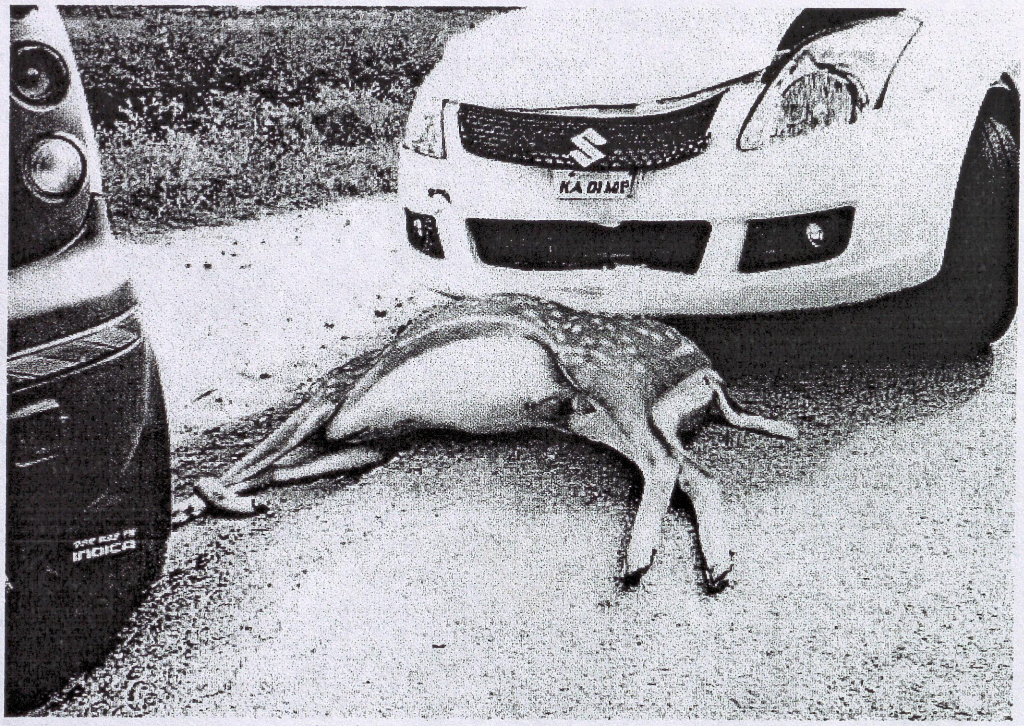
A rusty spotted cat, the world's smallest wild cat, killed at Bandipur-Ooty road on 22nd sept. 2009



A spotted deer killed by a Toyota Innova on Bandipur Highway on 1st Aug. 2009

(26) (24)

Annexure E4



Spotted deer run over by speeding vehicle on Bandipur highway on 23rd December 2009

A langur killed by a speeding vehicle on Bandipur highway on 14th August 2009

27

Annexure E5

A small Indian civet killed in a road accident on Bandipur Highway on Feb. 2009

An Indian hare killed by a speeding vehicle on Bandipur Highway

28

~~29~~

Annexure - E6

A rat snake run over by a speeding vehicle on Bandipur Highway on 3rd Feb. 2009

Dr. R. Raju *I.F.S.*
Deputy Conservator of Forests
Project Tiger Division
Bandipur, Gundlupet Tq.
Chamarajanagar Dist.

GOVERNMENT OF KARNATAKA Annexure - F ~~30~~ 29

KARNATAK FOREST DEPARTMENT

Ph.: 08229-236043 (O)
08229-236044 (P)
dcf_bandipur@yahoo.com
dcf.bandipur@gmail.com

No.A4/NH Road/CR26/2008-09

Date: 23-1-2009

To,
The Deputy Commissioner and
District Magistrate
Chamarajanagar Dist.

Sir,

Sub: Closure of Night Traffic on Gundlupet-Sulthan Bathery NH 212 and Gundlupet-Ooty NH 67 Ex 1. in Bandipura National Park Forest limits. -Reg.

The global famous "**Bandipura National Park**" and "**Tiger Reserve**" is one of the mega bio-diversity area known for its rich and invaluable Fauna and Flora more particularly the National Flagship species like Elephant and Tiger. Geographically most important part of the Park spread in Gundlupet Tq. of Chamarajanagar district and other parts in Nanjangud and H.D. Kote Taluk of Mysore district. The total extent of this National Park and Tiger Reserve including the recently added buffer forest area is **990.51 Sq. k.m.** which geographically encompasses between the North Latitude $11^0 35'34"$ and $11^0 55'02"$ and between the East Longitude $76^0 12'17"$ and $76^0 51'32"$

The Park is situated in the foot hills of **Nilgiri Hills** and bounded by **Madumalai Tiger Rererve** to west, **Wyanad Wildlife Sanctuary** to Northwest and **Nagarahole National Park** and **Tiger Reserve** to North side and thus this landscape is naturally constituted as one of the Dense Wildlife Reserve in the Nation and Globe. This area is supporting a very high congregation of innumerable number of invertebrate species, butterflies, insects and herbivores. The large predatory carnivores like Tiger, Leopard, Dholes and foxes are found very commonly in this Park. The assemblage of seven large ungulate species like Chital, Muntjac, Sambar, Chousingha, Gaur, Wild pig and Elephant is the other uniqueness of this Pristine forest landscape.

The greater assemblage of very many different Fauna with the Tiger at apex in this eco-system made this area to be declared as "**Tiger Reserve**" way back in 1973 and followed by "**National Park**" in 1984 by the Policy makers. Presently **Bandipur Tiger**

Attested

Deputy Conservator of Forests
Project Tiger Divison
Bandipur

Reserve is housing 11-15 number of Tigers per 100 Sq. Km forest and which supposed to be the second largest Congregation of Tigers as **Khana National Park** and **Tiger Reserve** of Madhya Pradesh is being number one in the nation.

The largest Congregation of Asiatic Elephants in this Park numbering between 1700-1800 prompted the Govt. of India to declare this entire landscape as part of **Mysore Elephant Rererve**. Thus the **Bandipura National Park and Tiger Reserve** also became an important component area of **Mysore Elephant Rererve**. The Presence of 1700-1800 Asiatic Elephants in an area of 990.51 Sq. Kms makes this area as the unique landscape with highest elephant density in the Asian Sub-Continent.

The diversity in Fauna and Flora, the uniqueness of landscape and geo-physical and geo-morphological reasons blended with the cultural heritage of the local people living in this region makes this area to be significant at Global bio reserves scenario. Hence this landscape is also been declared as **Bio-sphere Reserve** by Govt. of India, MOEF New Delhi during 1986 under the mandates of UNESCO. Thus the **Bandipura National Park and Tiger Reserve** has become one of the most important component area of **Nilgiri Biosphere Reserve.**

The Protection and Preservation of the rare and endemic Fauna and Flora in this Park has become a challenge to serving Foresters. The existing road network in the park has been a serious threat as they are paving the way for smuggling of invaluable forest and wildlife produces from this area during night. Due to heavy road traffic during night, the large number of road accidents are taking place killing the innocent wild animals in their home range. The inhabituated Wild animals are not using their habitat peacefully during day and night due to continued vehicular traffic disturbance. The following two roads passing through the Parks are causing sustained disturbance to the inhabituated wildlife.

1. Gundlupet – Ooty Road (National Highway 67 extension) around 13.00 Kms in the Park.
2. Gundlupet - Sulthan Bathery Road (National Highway 212) around 20.00 Kms in the Park.

The recently concluded road traffic survey on these two roads conducted by this reflects that, on an average 30 vehicles are moving in every hour during night time between 8.00 PM to 6.00 AM.

The Deputy Commissioner and District Magistrate Chamarajanagar and Deputy Conservator of Forests, Project Tiger Division, Bandipur, have jointly inspected "Sulthan

Attested

Deputy Conservator of Forests
Project Tiger Divison
Bandipur

"heavy road traffic" during last week of December 2008 between Moole Hole and Maddur gate forest area. During the inspection, in a span of 30 minutes 44 vehicles have moved on this road. This confirms that, for every 0.41 minute there is a vehicle on the road. This issue of heavy road traffic continues disturbance in the forest and killing wild animals in road accidents have been also discussed with Chamarajanagar district in-charge secretary during their tour in this division during December 2008 and January 2009 and consciously resolved to close these two roads for Night Traffic between 9.00 PM to 6.00 AM (i.e., 10 hours) in the interest of Peaceful existence of Wildlife of this Pristine Park. The similar type of traffic road passing through Rajeev Gandhi National Park and Tiger Reserve has been closed for the night traffic by the Deputy Commissioner and District Magistrate, Mysore during 2007, in the interest of Forests and Wildlife of Nagarahole National Park and Tiger Reserve. The following are the Pertinent reasons warrants for the closure of night traffic on these roads.

Reasons:

1. In the illegal trade Market at International level "**Wildlife produces**" stands 2nd to **Narcotics**. As these two roads running in the Park has large chunk of rich Forests on an either side, it is difficult to assess and predict the Quantum of illegal collection and clandestine transportation of forest and Wildlife produce from this Park during night by the criminals as the traffic runs in the National Park independently under no regulations.
2. Due to heavy traffic during night time, the "road accidents" are taking place in the forest on a regular interval killing Tiger, Elephant and other many smaller and larger animals in the Park leading to social sensitivity at state and National level and public hue and cry has been witnessed rigorously all the time.
3. The sustained flow of vehicular traffic through out night create "**sound and light**" disturbance to the in habituated wildlife, particularly elephants. The light and noise disturbance irritates the behaviour of elephants and other animals and drive away them from the forests. Such disturbed and self driven elephants goes to neighbouring farmer's land and villages to sustain which is leading man-animal conflict normally resulted with causalities, crop and property damages. This is a very serious problem these days stimulated due to night traffic only.
4. The Night vehicular traffic is facilitating the **poachers, hunters and smugglers** as there is free flow of traffic through out night on these roads with no cheeks and

Attested

Deputy Conservator of Forests
Project Tiger Divison
Bandipur

regulations. Thereby the poaching of elephants and hunting of other wild animals and their ~~clandestine transportation are taking place~~ in these forests at regular intervals without any fear. The night traffic has been very convenient for the "**Interstate and local forest criminals**" to arrive and depart from this Park after the crime is committed during night.

5. This Park being a very large in extent i.e., 1000.00 Sq. Km. the bordering and other "**Interstate social criminals, Naxals**" can invade, hide and flee away with the help of Night vehicular traffic freely and independently after committing serious Crimes.
6. The continued Night traffic round the year affect the very behavioural biology like **Mating, Breeding, Nursing, Parental care** etc. of the wild animals in the Park, which will have a long term impact on the animal population and which would affect the Life Cycle of these animal species.
7. The **Nocturnal** (Night) life of many **diurnal wild life** and the active life of **Nocturnal** animals in the night in the park has been severely affected due to sustained **sound** and **light flow** on these roads through out night, which inturn affect the stability of entire eco-system in the park.
8. The night traffic has been the easy source for transport the illegally collected, highly valued **medicinal plants, ferns** and **smaller mammals and invertebrate animals** of **scientific** and **medicinal** importance from this park leading to damage the very "**Bio-diversity**" of this park.
9. It is estimated that around 11 to 15 Tigers per 100 Sq. Km and 17 to 25 other major mammals per Sq. Km live in this Park. The length of 20.00 Km road between **"Maddur – Moolehole on NH 212"** and 13.00 Kms between **"Melukamanahally – Kekkanahalla on NH 67"** totaling to 33.00 Kms in this Park is severely affected due to **sound** and **light** disturbance. This disturbance penetrate the forest atleast 2.00 Km on either side of the road i.e., 33Kms X 2 Km X 2 Km **= 132.00 Sq. Km area of this Park is severely affected due to night traffic disturbance, affecting the very life of atleast 14 number of Tigers and 2244 number of other larger mammals in which atleast 200 number of Elephants.** These disturbed wild animal population moves away from their natural habitat into Farmer's land villages and retaliate strongly resulting in heavy crop damage and human and property loss. Further they also become regular victim for human retaliation like shooting, electrocution, poisoning etc. leading to loss of many elephants and other wild animals.

Attested

Deputy Conservator of Forests
Project Tiger Divison

33 ~~34~~

10. Therefore, in the larger interest of protecting and preserving the magnificent and invaluable Flora and Fauna of this rich bio-diversity area and also for their **safety** and **security** reasons. Further in order to reduce the **"man-animal conflict"** it is strongly proposed to close the roads for vehicular traffic in the night on these two underneath roads between 9:00 PM to 6:00 AM as follows.

- Gundlupet – Sulthan bathery Road (NH 212) from **"Maddur forest checking gate to Moolehole Police Checking Gate."** (Kerala – Karnataka interstate boundary)
- Gundlupet – Ooty Road (NH 67 Extn) from **"Melukamanahally forest checking gate to Kekkanahalla forest checking gate."** Karnataka - Tamilnadu interstate boundary.

The early order closing the Night traffic as mentioned above on the said two roads may kindly be issued at an earliest and oblige in the interest of Conservation, Protection and Preservation of the magnificent wildlife and forest of this district.

Enclosed: Map of Bandipur National Park.

Yours Sincerely

23/01/09

(Dr. R. Raju)
Deputy Conservator of Forests
Project Tiger Division, Bandipur

Copy respectfully submitted to,

1. Chief Conservator of Forests, (Project Tiger), Mysore for favour of information.
2. Principal Chief Conservator of Forests, (Wildlife), Bangalore for favour of information.
3. Principal Chief Conservator of Forests, Bangalore for favour of information.
4. Principal secretary and District incharge secretary of Chamarajanagar ~~Circle,~~ Chamarajanagar district for favour information.

Attested

Deputy Conservator of Forests
Project Tiger Divison
Bandipur

Annexure G

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THE HINDU

Date:24/12/2009 URL: http://www.thehindu.com/2009/12/24/stories/2009122453490300.htm

Back

Karnataka - Mysore

Spotted deer killed near Bandipur

Special Correspondent

MYSORE: A spotted deer was killed late on Wednesday when a vehicle proceeding towards Mysore hit the animal, which was crossing the road at Melkamanahalli, not far from the Bandipur National Park limits.

Vehicle seiezed

The hapless animal died on the spot. The accident took place in front of a hotel, and a few members of the Eco-Development Committee who were witness to the accident reportedly seized the vehicle and informed the Department of Forests, said Deputy Conservator of Forests (Bandipur) Hanumnathappa.

As the accident took place outside the national park limits in Gundlupet range, the matter was brought to the attention of the Kollegal Forest Division, which has taken up the matter and is investigating.

This is the latest in a series of animal deaths reported recently. A rare rusty spotted cat was killed in Bandipur limits recently.

Restricting speed

While there is a ban on movement of vehicles through Bandipur National Park between 9 p.m. and 6 a.m., wildlife activists point out that little has been done to restrict the speed of vehicles.

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Annexure G1 (35) (36)

Effects of Roads and Human Disturbance on Amur Tigers

LINDA L. KERLEY,* JOHN M. GOODRICH,*†§ DALE G. MIQUELLE,*† EVGENY N. SMIRNOV,*‡ HOWARD B. QUIGLEY,*† AND MAURICE G. HORNOCKER*†

*Hornocker Wildlife Institute, 2023 Stadium Drive, Suite 1a, Bozeman, MT 59715, U.S.A.
†Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, NY 10460-1099, U.S.A.
‡Sikhote-Alin State Biosphere Zapovednik, Terney, Primorye Krai, 692150, Russia

Abstract: *Understanding the effects of human disturbance on endangered wildlife populations is critical to their conservation. We examined the effects of roads and human disturbance on the survivorship and foraging efficiency of Amur tigers (*Panthera tigris altaica*) on and near Sikhote-Alin State Biosphere Zapovednik, Primorye Krai (province), Russia. To evaluate the effects of roads, we estimated survivorship of radiocollared tigers and their cubs living in three types of areas: (1) areas with primary roads, (2) areas containing secondary roads, and (3) areas with minimal or no road access. We classified a tiger into one of these three treatments based on which types of roads bisected their 50% minimum convex polygon home ranges. Over a 9-year period (1991–2000), adult female survival was greatest ($\chi^2 = 12.2$, df = 2, p = 0.002) for radiocollared tigers in roadless areas. All adult female tigers in roadless areas survived their tenure in those locations (n = 2), whereas all died or disappeared prematurely from areas with primary roads (n = 6). Cub survival was lower in areas with primary and secondary roads than in roadless areas ($\chi^2 = 10.9$, df = 1, p < 0.009). We evaluated the effects of human disturbance at kill sites by examining 86 kills made by 15 tigers determining whether human disturbance had occurred at the kill site, and examining prey carcasses after tigers left, to estimate the percent meat eaten and whether the tiger abandoned the kill following human disturbance. Tigers undisturbed at kills consumed more meat (Z = 3.71, p = 0.0002) from each kill than disturbed tigers did. Undisturbed tigers also spent more time at each kill site than disturbed tigers did (Z = 2.3; p = 0.02). Abandonment of kills occurred in 63% of 24 instances when tigers were disturbed by people. Because roads decrease the survivorship and reproductive success of tigers, we recommend that in habitats managed for tigers, construction of new roads should be prohibited wherever possible and access to secondary roads (e.g., logging roads) should be reduced or prevented wherever possible. Protected areas seem to cease functioning as source populations where road access exists, and unprotected areas—the majority of Amur tiger range—cannot sustain stable populations with the increasing threat of human access to tiger habitat.*

Efectos de Caminos y Perturbación Humana sobre Tigres Amur

Resumen: *Entender los efectos de la perturbación humana sobre poblaciones de vida silvestre en peligro es crítico para su conservación. Examinamos los efectos de caminos y perturbación humana sobre la supervivencia y eficiencia de forrajeo de tigres Amur (*Panthera tigris altaica*) en y cerca de Biosfera Estatal Zapovednik Sikhote-Alin, Primorye Krai (provincia), Rusia. Para evaluar los efectos de los caminos, estimamos la supervivencia de tigres con radio-collares y sus crías en áreas de tres tipos: 1) áreas con caminos primarios, 2) áreas con caminos secundarios y 3) áreas con mínimo o sin acceso de caminos. Clasificamos un tigre en uno de estos tres tratamientos con base en cuales tipos de caminos dividen el 50 % mínimo del polígono convexo de sus rangos de hogar. En un período de 9 años (1991–2000), la supervivencia de hembras adultas fue mayor ($\chi^2 = 12.2$, g.l. = 2, p = 0.002) en tigres con radio-collar en áreas sin caminos. Todas*

§*Address correspondence to J. M. Goodrich, Hornocker Wildlife Institute/Wildlife Conservation Society, 2023 Stadium Drive, Suite 1a, Bozeman, MT 59715, U.S.A., email tiger372@yahoo.com*
Paper submitted June 10, 1999; revised manuscript accepted March 21, 2001.

Conservation Biology, Pages 97–108
Volume 16, No. 1, February 2002

las hembras adultas en áreas sin caminos sobrevivieron su dominio en esas localidades ($n = 2$), *mientras que todas murieron o desaparecieron prematuramente en las áreas con caminos primarios* ($n = 6$). *La supervivencia de crías fue menor en áreas con caminos primarios y secundarios que en áreas sin caminos* ($\chi^2 = 10.9$, *g.l.* $= 1$, $p < 0.009$). *Evaluamos los efectos de la perturbación humana en sitios de depredación mediante el examen de 86 muertes causadas por 15 tigres, determinando si había ocurrido perturbación humana en el sitio, y mediante el examen de restos de las presas después de que se alejaron los tigres, para estimar el porcentaje de carne consumida y si el tigre abandonó su presa después de una perturbación humana. Los tigres no perturbados consumieron más carne* ($Z = 3.71$, $p = 0.0002$) *de cada presa que los tigres perturbados. Tigres no perturbados pasaron más tiempo con su presa que tigres perturbados* ($Z = 2.3$, $p = 0.02$). *El abandono de presas ocurrió en 63 % de 24 eventos cuando los tigres fueron perturbados por humanos. Debido a que los caminos reducen la supervivencia y el éxito reproductivo de los tigres, recomendamos que en los hábitats bajo manejo para tigres, se debe prohibir la construcción de caminos donde sea posible y se debe reducir o prevenir el acceso a caminos secundarios (e. g. caminos madereros) donde sea posible. Las áreas protegidas dejan de funcionar como poblaciones fuente donde existe acceso a caminos, y las áreas no protegidas (la mayor parte del rango de tigre Amur) no pueden sostener poblaciones estables con la incremento en la amenaza del acceso humano al hábitat de los tigres.*

Introduction

Understanding the effects of human disturbance is critical for effective management and conservation of endangered species. Roads can have a major effect on large-carnivore mortality directly via vehicle collisions, overhunting, and poaching, and indirectly by providing greater hunting access that can result in reduced prey availability (e.g., Brody 1984; Thiel 1985; Mattson et al. 1987; McLellan & Shackleton 1988; Mech et al. 1988; Noss et al. 1996). Human presence in wildlands can disturb animals, causing them to unnecessarily expend energy avoiding people, thereby potentially reducing reproductive success (e.g., Manville 1983; van Dyke et al. 1986; Goodrich & Berger 1994; Primm 1996) or increasing the likelihood of fatal encounters with humans (Kasworm & Manley 1990; Saberwal et al. 1994; Khramtsov, 1995; Mattson et al. 1996).

Tigers (*Panthera tigris*) are endangered throughout their range. Three subspecies have become extinct since the 1950s due to human disturbances, including habitat loss, population fragmentation, and poaching (Seidensticker 1986; Mills & Jackson 1994; Nowell & Jackson 1996; William & Rabinowitz 1996). Although fewer than 400 adult individuals remain in the wild (Matyushkin et al. 1996), the Amur (or Siberian) tiger (*Pantherea tigris altaica*) may have a greater chance of survival than other subspecies because it inhabits a large block of relatively unfragmented and undisturbed habitat in the Russian Far East with low human population density (Miquelle et al. 1993, 1999; Matyushkin et al. 1996). But with the breakup of the Soviet Union and subsequent changes in the political and economic structure of Russia, human disturbances within the Amur tiger's range are increasing (Smirnov & Miquelle 1999; Miquelle et al. 1999).

Although protected areas should adequately safeguard tiger habitat within their boundaries, human activities that affect tigers still may occur in these areas (Smirnov & Miquelle 1999). Tourism in protected areas and consumptive activities (e.g., hunting, logging, and collection of nontimber forest products) and nonconsumptive activities (e.g., recreation, tourism, filming, and photography) in unprotected areas are increasing in Amur tiger habitat as road densities increase, car ownership increases, and demand for forest products continues during a period of economic instability. Although the direct effects of human activities such as habitat loss and poaching are readily discernible, the effects of other human activities, such as those discussed above, are subtle and more difficult to document.

Successful conservation of Amur tigers must include a proactive approach to managing protected areas as source populations (Matyushkin 1996; Smirnov & Miquelle 1999; Miquelle et al. 1999) and reducing human effects in both protected and unprotected areas. Understanding the effects of human disturbance is essential to this process, but empirical data regarding the effects of human disturbance on Amur tigers is minimal or lacking (Kaplanov 1948; Nikolaev & Yudin 1993; Khramtsov 1995; Matyushkin et al. 1996).

We examined the effect of roads and human disturbance on Amur tigers living on and near Sikhote-Alin State Biosphere Zapovednik (Reserve) in the Russian Far East. Because of its protected status, the Zapovednik provided an opportunity to compare tigers in remote areas with those in areas with human access, including a mostly paved public (primary) road through the Zapovednik and adjacent unprotected areas with secondary road networks. To measure the effect of roads, we compared survivorship and reproductive success of adult female tigers in areas near roads to those in remote areas. To measure one effect of human access, we compared the behavior of tigers of both sexes that were disturbed and undisturbed by people at kill sites. We hypothesized that (1) female tiger survivorship and reproductive success is lower for tigers living in close proximity to roads and (2) tigers forage less efficiently when disturbed by humans at kill sites. Although we recognize that human access may have a variety of negative effects beyond the scope of our research, these two types of disturbances are prevalent in both unprotected and protected areas and have management implications for tiger conservation.

Methods

Study Area

We studied tigers on and near the 390,184-ha Sikhote-Alin State Biosphere Zapovednik (hereafter, Zapovednik), Primorye Krai (province) (Fig. 1). Russian Zapovedniks are highly protected lands with minimal human disturbance; access is restricted to scientists and forest guards

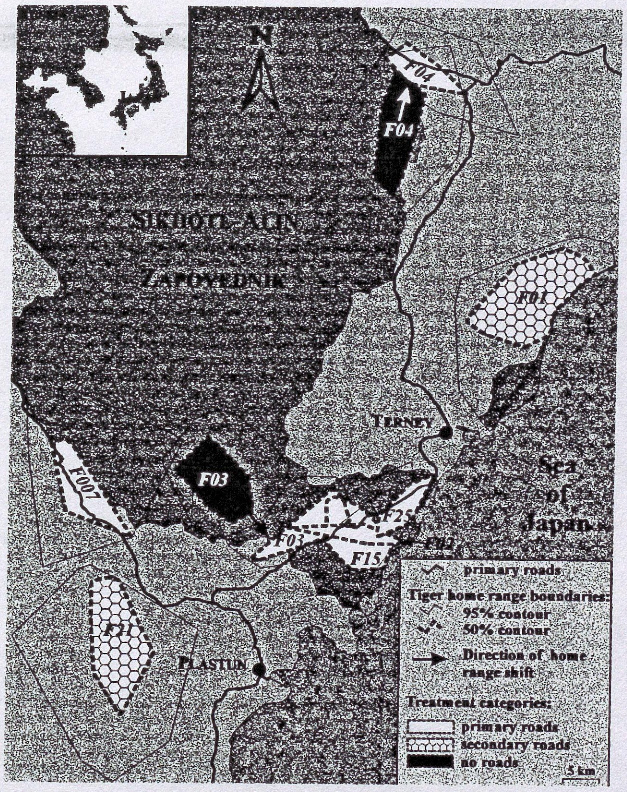

Figure 1. Map of study area showing tiger home ranges (50% and 95% convex polygons) in relation to their overlap with roads in and near the Sikhote-Alin State Biosphere Zapovednik, Primorye Krai, Russia, 1991–2000. Secondary roads were not mapped because they are numerous and their locations and numbers change frequently.

(Miquelle et al. 1996; Stepenitski 1996). The land surrounding the Zapovednik is sparsely populated (about 13,000 people live in five villages) and includes a 70,350-ha buffer zone ranging from 1 to 8 km wide. Human activities allowed in the buffer zone include fishing, hunting, tourism, and some agricultural practices such as livestock grazing and hay cutting. The region is primarily forested, the most common forest types being secondary Mongolian oak (*Quercus mongolica*) and birch (*Betula* sp.) upland forests, Korean pine (*Pinus koraensis*) forests, and spruce (*Picea ajanensis*)-fir (*Abies nephrolepis*) and larch (*Larix daburicus*) forests.

Effects of Roads

We defined a road as "primary" if it was maintained year-round and provided access between towns or villages and "secondary" if it was not regularly maintained but allowed public access into forested lands. Primary roads were paved or hard-packed dirt, allowing traffic to move at high speeds, whereas secondary roads were suitable only for four-wheel-drive vehicles for part or all of the year.

Most of the Zapovednik is roadless, but in 1972 a primary road was constructed through 22 km of the southeast section (Fig. 1). Although it is illegal for the public to leave the road corridor, traffic moves unrestricted through the Zapovednik and poaching of ungulates along this corridor is common (Zapovednik records; A. Astafiev, personal communication). Primary roads also border the northeast and southwest boundaries of the Zapovednik. Secondary roads are common in the buffer zone and on much of the state forestry lands adjacent to the Zapovednik. Traffic on primary roads was light during this study: the mean number of vehicles traveling the primary road through the Zapovednik was 4.2 per hour (SD = 3.3, n = 42 hours) between 1801 and 0600 hours and 16.6 per hour (SD = 8.1, n = 18 hours) between 0601 and 1800 hours. Traffic on secondary roads was lighter than that on primary roads and varied greatly with season.

To examine the effects of roads on tiger survivorship and reproductive success, we used data collected from 15 radiocollared tigers (8 adult females and 7 cubs) in and adjacent to the Zapovednik, from 1992 to 2000. Another adult female (F007) was not radiocollared, but we estimated her home range with location data from her two radiocollared male cubs before family breakup. The movements and reproductive status of some of these female tigers were known from snowtracking before their capture (since 1991), and we include these findings. We monitored and collected locations from radiocollared tigers from the ground on foot and in vehicles and from the air in an AN-2 biplane or a MI-8 helicopter. We obtained ground locations by triangulation, by approaching within 100–400 m and partially circling the tiger, by visual observation, and by subsequently locating tracks in an area where we detected a tiger from its signal. During the first 3 years of work, we flew to locate animals approximately once every 10 days, but later in the study when aircraft availability declined, we flew less frequently (once every 18 days). We collected locations year-round and most often (95%) during the day.

We estimated 50% (activity centers) and 95% convex polygon (Hayne 1949) home ranges (Fig. 1) for nine adult female tigers (eight radiocollared and one from data collected from her radiocollared cubs) (Fig. 2), with program CALHOME (Kie et al. 1994). The F25 individual was young (estimated 19–26 months) during the study period, so she could have been considered a subadult. But she dispersed from her natal home range, settled in an adjacent area, and demonstrated signs of estrus (vocalizations) and reproductive activity (regularly consorting with a male) (Schaller 1967; Sunquist 1981), so we included her as an adult in our analysis.

To avoid serial correlation, we used locations separated by at least 36 hours and 2 nights, which normally includes several shifts in tiger activity (Yudakov & Nikoleav 1987) and should result in independent locations (sensu Lair 1987; Minta 1993) for a given animal. For most tigers, we estimated home ranges based only on aerial locations to avoid bias associated with locating animals from roads. For F02, F25, and F03 (following her home-range shift), however, the number of aerial locations were too few (4–14 locations) for home-range estimation, so we used locations collected from the ground as well. This may have biased our home-range estimates, particularly for 50% contours, and this potential bias is important because these tigers had activity centers bisected by a primary road. That is, an activity center bisected by a road could be an artifact of our sampling scheme rather than a reflection of the time a tiger spent near a road. For F03 and F25, we examined this potential bias by estimating 50% minimum convex polygon home ranges from data collected during intensive monitoring periods when we attempted to locate both tigers every day (F25 was located on 54 of 56 consecutive attempts and F03 on 37 of 41). Both tigers had 50% contours bisected by a primary road, which indicates that the bias was minimal. Similar data were not available for F02, but considering she had a den site 2 km from a primary road where she stayed with her cubs for 1.5 months of the 4.8 months that she was tracked, we assumed this bias was also minimal for her.

We compared survivorship of cubs (χ^2) and adult female tigers (logistic regression) living in three types of areas (treatments): (1) areas with primary roads, (2) areas containing secondary roads, or (3) areas with minimal or no road access. For statistical comparison we combined treatment areas 1 and 2. We "placed" a tiger into one of these three treatments based on which types of roads bisected its 50% minimum convex polygon home range (Fig. 1). We used data collected from F007 to analyze cub survivorship but not adult female survivorship, because we could not monitor her after cub dispersal. Two tigers (F03 and F04) shifted their home ranges into different treatment areas during our study, and we counted those tigers in both treatments for the amount of time they spent in each. Home-range shifts were characterized by permanent abandonment of ≥50% of the former home range and expansion into adjacent areas. Individual F01 also shifted when she abandoned the northern half of her home range in the spring of 1998, but we ignored this shift in our analysis because it did not result in a change in treatment category and

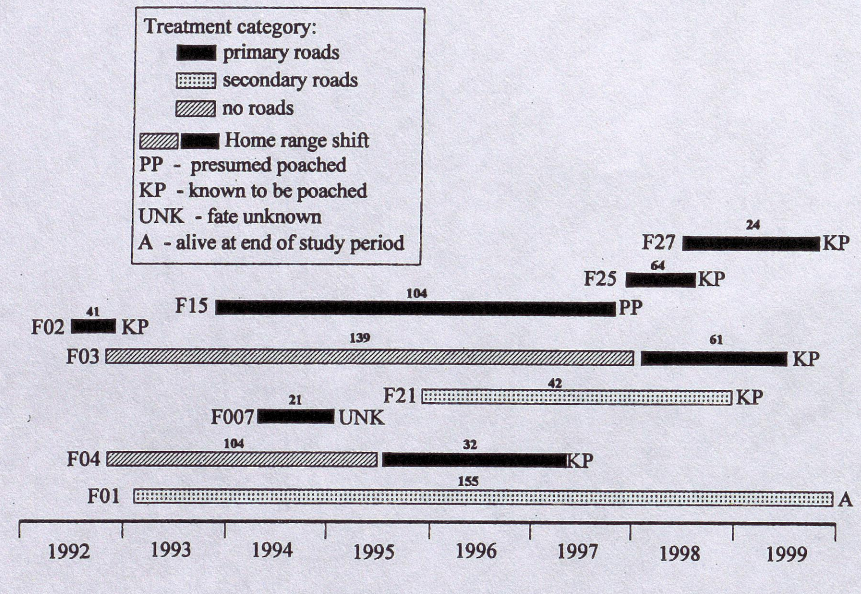

Figure 2. Time span that each of nine adult female tigers was monitored within a home range (Fig. 1) to measure adult survivorship and reproductive success. Monitoring began when a tiger or her cubs (as for F007) were radiocollared and ended with the death or disappearance of that tiger (presumed poached) or the end of the study period. Numbers above bars indicate number of locations used for home-range estimation.

because her second home range was almost completely within the boundaries of her first.

We calculated survival as

$$S = 1 - m\left(\sum_{1}^{i} y_i\right)^{-1}, \tag{1}$$

where y_i is the number of years tiger i was tracked in a given treatment and m is the number of mortalities per treatment at the end of the study period. We constructed this calculation to depict survival as a function of "tiger-years" rather than the annual survival rate used elsewhere (e.g., Heisey & Fuller 1985) because our sample sizes were too small to estimate annual survival. We presumed that F15, who disappeared (Fig. 2), was killed by poachers and her radiocollar destroyed, because we were unable to pick up her signal despite extensive aerial and ground searches and because of tracks in the snow during the first winter following her death. Aerial searches included telemetry flights that covered her entire home range and the home ranges of neighboring tigers (roughly 10,000 km^2 flown every 10 days). Ground searches included daily searches for tracks along a 35-km section of road that bisected the center of her home range and >300 km of foot travel that included at least part of every major drainage in her home range. Intrusions of new tigers (F25 and F03) into her territory provided additional evidence of her death.

Our estimates of adult survivorship within each treatment depended on the time each tiger was monitored, (i.e., probability of a tiger dying increased with time observed). Thus, it was important that the average length of time animals were monitored was similar among treatments or, if not, that they differed in a way that made the test more conservative; in other words, time monitored should be greater in roadless areas. To test this, we compared the mean length of time tigers were monitored in roadless areas to that in areas with roads (primary- and secondary-road treatments combined).

We measured survival rates for cubs from ≥2 months of age, at which time they were able to travel with their mothers and were detectable by tracks, to the age of family breakup (Smith 1984; Smirnov & Miquelle 1999). We considered cubs to have survived if evidence (radio signals or, for uncollared cubs, tracks) indicated they were still in association with their mother at 15 months of age, the minimum age of family break-up (L.L.K. et al., unpublished data). If we knew a female tiger was traveling with at least one cub but we were unable to determine the exact litter size before it perished, we considered it to be a litter of one because of our statistical analysis of cub survival. We defined reproductive success as the number of cubs a female tiger produced that survived to family breakup. We used this definition because most of the cubs were monitored only until family breakup and, in most cases, we did not know if after leaving their mothers they survived to be successfully recruited into the population.

Human Disturbance at Kills

We studied the effects of human disturbance on tiger foraging efficiency and behavior at kill sites from March 1995 to May 1998. We defined foraging efficiency as the amount of meat eaten from each kill made. We considered a tiger disturbed if a person or persons approached the kill close enough to be detected by the tiger (disturbance distance ranged from 5 to 200 m) and a kill abandoned if a tiger left and did not return following disturbance. We monitored kills for at least 2 days to determine whether or not a tiger returned. Radiocollared and unmarked tigers were disturbed by Zapovednik staff, hunters, film crews, capture attempts, and accidental intrusions by our research staff.

We located tiger kills with a variety of methods. Most commonly, we used radiotelemetry (Miquelle et al. 1996) to determine if a tiger had remained in one place for more than 1 day. We investigated the site after the tiger left. We also found kills by following tiger tracks in snow (Yudakov & Nikoleav 1987), by searching areas with congregations of scavengers such as ravens (*Corvus corax*), crows (*C. cornix* and *C. macrorhynchos*), and eagles (*Haliaeetus albicilla* and *H. pelagicus*), through chance encounters, and from reports of forest guards, hunters, or other field workers. At kill sites, we recorded evidence of human disturbance (e.g., footprints), and, because it is not uncommon for people to take meat from tiger kills, we looked for knife or axe marks on kill remains. We determined that a tiger was disturbed while at a kill site by (1) directly observing people and tigers at kills, (2) monitoring radio signals while people approached a kill, and (3) examining a kill site after a person or persons had reported finding a tiger at a kill and determining the timing of abandonment relative to human disturbance from tracks and information provided by the observer. If we were unsure as to whether people approached a kill when the tiger was present or after it had already left the area, we did not use that kill in our analysis.

We visually estimated the percentage of meat eaten by tigers from each carcass by considering that 25% of the meat on a carcass was either (1) a hind leg and half of the body up to but not including the rib cage or (2) a front quarter (a leg, half the neck and head, and half the body including rib cage and internal organs). The percentage of meat not eaten from a carcass was equal to the estimated sum of the meat left on each quarter.

We compared two factors at tiger kill sites disturbed and undisturbed by humans: (1) percentage of meat eaten from each kill and (2) time tigers spent at kills (Wilcoxon matched-pairs test; Ambrose & Ambrose 1981).

To determine whether tigers move less when on kills, we compared average distances between sequential daily locations of four different tigers when they were on kills to those when they were not on kills (Wilcoxon matched-pairs test; Ambrose & Ambrose 1981). Daily locations were those taken approximately 24 hours apart.

Results

Effects of Roads

There was no difference between the mean time tigers were monitored in roadless areas ($\bar{x} \pm$ SD = 4.0 ± 1.8 years, $n = 2$) before they shifted their home ranges and the time tigers were monitored in other treatments ($\bar{x}$ = 2.3 ± 2.1 years, $n = 9$, $t = 2.3$, df = 9, $p = 0.32$) before they died, disappeared, or the study period ended (Fig. 2). Although because of small sample sizes we may have failed to detect a difference, tigers were monitored longer in roadless areas, which should make our test for differences in survivorship more conservative.

Adult female survival per tiger year was greatest (logistical regression, $\chi^2 = 12.2$, df = 2, $p < 0.002$) for radiocollared tigers in roadless areas (Table 1; Fig. 2), but parameter estimates were unstable because our sample size in roadless areas was small. All adult female tigers in roadless areas ($n = 2$) survived their tenure in those locations, whereas all living in an area with primary roads ($n = 6$) were poached (Fig. 2). One tiger (F21) was poached in an area with secondary roads.

The F25 and F27 individuals were not included in the analysis of cub survival because they did not survive long enough in areas with primary roads to reproduce. Cub survival was lower in areas with primary and secondary roads than in roadless areas ($\chi^2 = 10.9$, df = 1, $p = 0.009$; Table 1). Of ≥9 cubs that died in areas with primary roads, 1 was hit by a vehicle, 4 were removed from the wild when their mother (F02) was poached along the road, we presumed ≥1 died of starvation at 3.5 months of age when their mother (F15) was poached, and 3 died of unknown causes (Table 1).

Of the eight cubs that survived to 15 months in areas with primary roads, 1 was killed by a collision with a truck at 20 months; she had not left her natal home range. Another cub (F23), which was captured and radiocollared, survived to adulthood, but her mother (F4) was killed by poachers shortly after family breakup. We also radiocollared three additional survivors from two litters, all of which dispersed from their natal home ranges.

Of 6 cubs that died or were "lost to the population" in areas with secondary roads, 2 died of unknown causes at <1 year, one 6-month-old was shot when it attacked a forest guard, and three 7-month-old cubs were provided with supplemental feeding after their mother was poached. We considered these three cubs lost to the population (mortality) because they would have died without human intervention. Nine of 10 cubs survived to family breakup in roadless areas (Table 1). Only 1 cub died, of unknown causes, at approximately 5 months. Of the 9 survivors, 3 were radiocollared and survived past 20 months, and dispersed from their natal home ranges.

Disturbance at Kills

We monitored 15 tigers (11 with radio collars and 4 without) on 86 kills (Table 2) and examined kill sites after tigers departed. In the absence of human disturbance, tigers consumed more meat from each kill ($\bar{x} \pm$ SD = 97 ± 9% meat eaten, $n = 62$ kills) than tigers disturbed at kills ($\bar{x}$ = 64 ± 32% meat eaten, $n = 24$ kills; $Z = 3.71$, $p = 0.0002$). Undisturbed tigers also spent more time at each kill site ($\bar{x}$ = 3.3 ± 1.5 days; $n = 60$) than disturbed tigers ($\bar{x}$ = 2.4 ± 1.6 days, $n = 25$; $Z = 2.3$, $p = 0.02$). Abandonment of kills occurred in 63% of 24 instances when tigers were disturbed by people. Individual tigers varied in their response to human disturbance, however (Table 2). Eight tigers were more tolerant to human disturbance, returning to 9 kills and eating after people left. Six tigers did not return to 15 kills after being disturbed, even though ≥70% of the meat remained on 11 of the 15 kills. One female (F15) with a 1-year-old cub was disturbed at 8 sequential kills and abandoned all of them. Distance between daily locations was significantly smaller for 4 tigers when they were on a kill than when they were not (Table 3).

Table 1. Survival of cubs and radiocollared female tigers in areas with and without roads on and near the Sikhote-Alin State Biosphere Zapovednik, Primorye Krai, Russia, 1991–1998.

Treatment	*Females* n	*Tiger-years*[a]	*Female survivorship per tiger-year*	*Litters* n	*Cubs produced*	*Cubs surviving to age of family breakup*
Primary roads	6/5[b]	10.6	0.33	7	17[c]	8[d]
Secondary roads	2	9.9	0.90	4	10	4
Roadless	2	8.0	1.00	4	10	9

[a] *Tiger-years represent the sum of the number of years that each tiger was tracked in each different area.*
[b] *Six females were used to determine adult mortality rates, and litters from five females were used to determine cub survivorship.*
[c] *There were 17 or more cubs because one litter had an unknown number of cubs (≥1). However, we used* n *= 17 for statistical analysis of cub survival.*
[d] *One of these eight was killed by a truck when she was 20 months old and before she dispersed from her natal home range.*

Table 2. Disturbance level and response by 15 individual tigers at 86 kill sites on and near the Sikhote-Alin State Biosphere Zapovednik, Primorye Krai, Russia, 1995–1998.

			Break down of total kills		
Tiger	*Sex*	*Number of kills*	*undisturbed*	*disturbed*	*abandoned after disturbance (%)*
01	F	16	16	0	
03	F	10	9	1	0
04	F	2	1	1	0
15	F	22	14	8	100
16	M	13	10	3	66
18	M	1	0	1	100
20	M	5	2	3	33
21	F	2	1	1	0
22	M	3	3	0	
23	F	1	0	1	100
25	F	6	5	1	0
unmarked	F	1	1	0	
unmarked	F	2	0	2	100
unmarked	M	1	0	1	0
unmarked	F	1	0	1	0
Totals		86	62	24	

Discussion

Although our sample size was small for adult female tigers in roadless areas ($n = 2$) and both tigers left these areas during the study, we consider this a valid "control" group to compare with "treatment" tigers in areas that contain roads because (1) both tigers lived in both treatment types (Fig. 2) long enough to have reproduced (both produced two litters in roadless areas and one litter in areas with primary roads) and (2) there was no difference between the time tigers were monitored in roadless areas before they shifted and the time tigers were monitored in other treatments before they died or the study ended.

Our data support the hypothesis that the risk of adult female mortality increases and reproductive success decreases for tigers whose territories include primary roads. An area of particular concern was that portion of the Zapovednik bisected by a primary road. Over an 8-year period, all four adult female tigers holding territories in that area were poached or presumed poached, and no cubs born in that area survived to dispersal age, except one radiocollared male cub (15 months old and alive at the time of manuscript preparation) and his sister, whose present status is unknown. Although our sample sizes were small and our study represents only one region within Amur tiger range, the data indicate that tigers living in the vicinity of lightly traveled primary and secondary roads incurred greater mortality and lower reproductive success than those with territories away from roads. Because it is protected, the Zapovednik supports a greater abundance of prey and higher tiger densities than surrounding unprotected areas and acts as a source population for tigers (Smirnov & Miquelle 1999; Miquelle et al. 1999). Our data suggest, however, that construction of the road through the southeast section of the Zapovednik resulted in an otherwise high-quality habitat becoming a population sink for tigers and providing no recruitment of young animals into adjacent areas. It is almost certain that these effects would be greater in areas where road traffic is heavier.

Table 3. Comparison of mean distance between daily locations of radiocollared tigers on kills and those not on kills in and near the Sikhote-Alin State Biosphere Zapovednik, Primorye Krai, Russia, 1995–1998.

	Mean distance moved (km)			
Tiger	*on kill (n)*	*not on kill (n)*	Z	p
F01	0.1 ± 0.2 (8)	3.6 ± 2.4 (8)	2.5	<0.05
F03	0.07 ± 0.2 (22)	4.3 ± 2.1 (19)	3.8	<0.001
F15	0.2 ± 0.2 (25)	5.7 ± 3.4 (25)	4.4	<0.0001
M16	0.7 ± 1.1 (17)	7.9 ± 4.8 (20)	3.6	<0.001

Amur tigers are territorial (Matyushkin et al. 1980; Yudakov & Nikoleav 1987; Salkina 1993; Goodrich et al. 1999; Miquelle et al. 1999), and home-range shifts made by tigers F03 and F04 during our study were likely a result of (1) daughters inheriting their natal home ranges as mothers shifted to other areas, as described by Smith et al. (1987), and (2) territories concurrently becoming vacant in adjacent areas with primary roads. For example, tiger F15 took up residency in an area with a primary road (Fig. 1) after the former resident, F02, was poached and that territory became vacant. Likewise, tigers F25 and F03 took up residency in portions of that area after tiger F15 disappeared and was presumed poached, F03 residing in a territory in the southern half of the area and F25 in the northern half.

Tigers may also be attracted to roads, as evidenced by individuals in our study whose activity centers included roads (Fig. 1). Amur tigers and other large carnivores use roads as travel corridors (Matyushkin 1977; Bragin 1986; LeFranc et al. 1987; Bailey 1993; L.L.K. et al., unpublished data), exposing themselves to poachers and fast-traveling vehicles. After tiger F03 shifted from a roadless area to an area with a primary road, she was observed several times walking on the road during daylight hours, showing no apparent fear of traffic. Khramtsov (1995) reported that over a 10-year period, six Amur tigers were shot and killed by poachers along a road near Lazovsky Zapovednik.

The detrimental effects of roads have been reported for a wide variety of large carnivores (Noss et al. 1996; Table 4). Because large carnivores occur at low densities and have low reproductive rates, the effects of human disturbance are often magnified. Small changes in reproductive success and survivorship can have serious implications for isolated carnivore populations (Knight & Eberhardt 1985). Roads are a serious threat to many large-carnivore populations because they facilitate human access, thereby increasing disturbance, decreasing available habitat, decreasing reproductive success, and increasing mortality rates. Increased human-related mortality (Murphy 1983; Maehr et al. 1991), decreased prey abundance (Caro 1994), habitat degradation (Smith et al. 1998), and avoidance of otherwise suitable habitat (review by Weaver et al. 1996) have all been attributed to road access or high road densities.

The effect of roads can vary among large-carnivore species and among sex and age classes within species (Table 4). For example, female Florida panthers (*Puma concolor coryi*) avoid crossing roads, which thereby become barriers that delineate territorial boundaries and affect spacing patterns. Male panthers readily cross roads, however, resulting in relatively high mortality rates from vehicle collisions (Maehr 1997). Gray wolves (*Canis lupus*) shift territorial boundaries to avoid heavily traveled roads (Thurber et al. 1994), whereas female grizzly bears (*Ursus arctos*) with cubs may be attracted to habitats adjacent to roads because males avoid those areas (Mattson et al. 1987).

Human-induced mortality can have deleterious effects on a population beyond the loss of a breeding individual

Table 4. Documented deleterious effects of roads on large carnivores.[a]

Species	Behavioral response	Increased human access resulting in: aggressive encounters with humans	overharvest	displacement	vehicle collisions	Habitat alterations: habitat loss	habitat fragmentation
Canidae							
Gray wolf (*Canis lupus*)[b]	+/− +/−		+	+	+	+	+
Ursidae							
Grizzly bear (*Ursus arctos*)[c]	+/+ +/−− −/− /+	+	+	+	+	+	+
American black bear (*U. americanus*)[d]	0/− −	+	+	+	+	+	+
Spectacled bear (*Tremarctos ornatus*)[e]			+			+	+
Asian black bear (*U. thibetanus*)[f]		+	+			+	
Felidae							
Tiger (*Panthera tigris*)[g]	+ +					+	
Lion (*P. leo*)[h]			+				
Cheetah (*Acinonyx jubatus*)[i]			+[j]	+			
Cougar (*Puma concolor*)[k]	+		+		+		
Florida panther (*P. c. coryi*)[l]	0 −		+		+		+
Iberian lynx (*Lynx pardina*)[m]	+ +				+		+

[a]*Where behavioral responses were reported in the literature we scored them as follows: −, avoidance of roads; +, attraction to roads; or 0, no response.*
[b]*Mladenoff et al. (1995); Thiel (1985), Wisconsin; Fuller et al. (1992), Minnesota; Thurber et al. (1994), Alaska.*
[c]*Review by Servheen (1987), widespread; Mattson et al. (1987), Wyoming; McLellan & Shackleton (1988), Rocky Mountains; Mace et al. (1996) and Kasworm & Manley (1990), Montana.*
[d]*Singer & Bratton (1980), Tennessee; Manville (1983), Michigan; Brody (1984), North Carolina; Young & Beecham (1986), Idaho.*
[e]*Peyton (1994), Peru.*
[f]*Hazumi (1994), Japan.*
[g]*Smith et al. (1998), Nepal; Matyushkin (1977), Russia.*
[h]*Schaller (1972), Serengeti, Africa.*
[i]*Caro (1994), Serengeti, Africa.*
[j]*Overharvest of game species.*
[k]*Murphy (1983), Montana; Beier (1995), Southern California.*
[l]*Maehr (1997); Maehr et al. (1991), Florida.*
[m]*Ferreras et al. (1992); Rodriguez & Delibes (1992), Spain.*

and its progeny. The loss of tenured individuals from populations of solitary carnivores, especially in those with territorial systems, may result in social instability, increased aggressive interactions and associated mortality, increased infanticide, decreased reproduction, and increased disease (Smith 1984; Hornocker & Bailey 1986; Smith & McDougal 1991; Goodrich & Buskirk 1995). Also, high survival and longevity of adult females is critical to the continued well-being of most carnivore populations (Smith & McDougal 1991; Weaver et al. 1996).

Using a tiger population simulation model, Kenney et al. (1995) found that when poaching continued over time, the probability of population extinction increased sigmoidally. Other forms of persistent human-induced mortality would presumably have similar effects. Although evidence is biased toward greater detectability of human-related mortality, Matyushkin et al. (1996) reported that most tiger mortality in the Russian Far East is human-related. Our data support these findings and demonstrate that roads increase tiger mortality due to poaching and traffic accidents.

Tiger conservation in Russia must include prevention of road construction wherever possible, closing unnecessary roads, and regulating access to roads through sensitive areas, particularly in areas supporting source populations (Smirnov & Miquelle 1999). Examples of how road closures have protected wildlife habitat and increased wildlife populations could act as models for the Russian Far East (Mattson 1993; Willcox & Ellenberger 2000). A key to halting further decline in tiger numbers throughout their range would be the establishment of a landscape-scale plan that protects existing tiger habitat and provides for the needs of local people (Smith et al. 1998; Miquelle et al. 1999). Regulating road access through tiger habitat should be an important component of any management regime on tiger-management areas.

Our data support the hypothesis that tigers forage less efficiently when they are disturbed by humans at kill sites. Disturbed tigers ate less from each kill because they often abandoned kills, whereas undisturbed tigers rarely left until all meat was consumed. Tigers at kills moved less and hence probably expended less energy than those not on kills, while realizing an energy gain by remaining longer and consuming all available meat on kills. Frequent disturbance of individual tigers may increase energetic demands because tigers are forced to eat less from each kill and spend more time hunting and less time resting. Although we have no direct evidence, this could result in increased risk of injury and death associated with predation attempts (Rabinowitz 1986; Mech & Nelson 1990), reduced reproductive success, and reduced survival of both adults and cubs whose mothers are disturbed frequently.

Reduced feeding activity and increased energy expenditure in response to human recreational activity have been documented for a variety of species, including Bald Eagles (*Haliaeetus leucocephalus*), bighorn sheep (*Ovis canadensis*), and mule deer (*Odocoileus hemionus*) (MacArthur et al. 1979; Stalmaster & Newman 1978; Freddy et al. 1986; Stalmaster & Kaiser 1998). Black bears (*Ursus americanus*) sometimes abandon their dens in response to human approach (LeCount 1983; Hellgren & Vaughan 1989; Goodrich & Berger 1994), resulting in greater overwinter weight loss (Tietje & Ruff 1980), cub abandonment, and cub mortality (Goodrich & Berger 1994). Amur tigers are frequently disturbed at kills in winter because their tracks are easy to follow and crows and eagles around carcasses make kills conspicuous.

Our data are not suitable for examining the relationship between human disturbance at kills and the vicinity of kills to roads because our ability to detect and monitor disturbance and tiger behavior at kills was closely related to distance to roads. Moreover, our data do not reflect disturbance rates.

Because tigers often use roads as travel corridors, tigers displaced from their kills not only lose a valuable food resource, they are at greater risk of being poached or killed in traffic collisions because they may be on the road more often. In addition, tigers may be more at risk of being displaced or being poached while on their kills in areas with roads because tigers can be more easily tracked to kills, as with F21, who was shot 1 km from a secondary road after a poacher tracked and shot her while she and her three cubs were at a kill site.

Although some tigers may become habituated to human disturbance (McDougal 1977), habituation may lead to increased aggressive encounters with people, as with grizzly bears (Mattson et al. 1996) and Asiatic lions (*Panthera leo persica*) (Saberwal et al. 1994). Bait-site feeding of tigers for public viewing was halted in Chitawan National Park, Nepal, after two tiger attacks on humans (McDougal 1977). Public attitudes toward carnivores affect conservation efforts (Kellert et al. 1996), and increased aggressive encounters may weaken public support for tiger conservation in the Russian Far East. News of tigers in close proximity to villages and encounters between tigers and hunters are nearly always reported in local newspapers and journals (e.g., Smirnov 2000).

Our data suggest that, in the absence of human disturbance, Amur tigers usually consume nearly all available meat at kills. The misconception of frequent surplus killing among tigers in the Russian Far East has probably arisen because tigers often abandon kills when disturbed by people (in such cases the observers of surplus killing) and people often usurp meat from kills, making it necessary even for those tigers that return to kills to hunt again. For example, Pikunov (1983) reported snow-tracking a tiger that killed five ungulates in 15 days and never ate more than 20% of any of them. This is likely an artifact of repeated disturbances of sequential kills by the observer and not typical tiger behavior.

Conclusions

The effects of human disturbance on the survival and foraging of tigers can be mitigated through appropriate management actions. Roadless areas with minimal and regulated human access should be maintained throughout the range of the Amur tiger to avoid mortalities from auto collisions and poaching and to minimize human disturbance to tigers. This is particularly important in areas such as national parks and Zapovedniks that are considered source populations. Human activities should also be restricted in sensitive areas and time periods, such as when resident females are traveling with young cubs. Education programs, particularly those directed at visitors to national parks and Zapovedniks, should stress the importance of avoiding tiger kills. Whenever possible, roads through protected tiger habitat should be closed at night and speed limits should be strictly enforced.

The implications of our results may be most important in unprotected areas where human access to tiger habitat is unrestricted and human behavior more difficult to regulate. We encourage the development of programs for closing secondary roads no longer being used for resource extraction and for restricting the construction of new roads through sensitive tiger habitat as important measures to protect Amur tiger populations.

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Annexure G2

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Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities

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Abstract: *Roads are a widespread and increasing feature of most landscapes. We reviewed the scientific literature on the ecological effects of roads and found support for the general conclusion that they are associated with negative effects on biotic integrity in both terrestrial and aquatic ecosystems. Roads of all kinds have seven general effects: mortality from road construction, mortality from collision with vehicles, modification of animal behavior, alteration of the physical environment, alteration of the chemical environment, spread of exotics, and increased use of areas by humans. Road construction kills sessile and slow-moving organisms, injures organisms adjacent to a road, and alters physical conditions beneath a road. Vehicle collisions affect the demography of many species, both vertebrates and invertebrates; mitigation measures to reduce roadkill have been only partly successful. Roads alter animal behavior by causing changes in home ranges, movement, reproductive success, escape response, and physiological state. Roads change soil density, temperature, soil water content, light levels, dust, surface waters, patterns of runoff, and sedimentation, as well as adding heavy metals (especially lead), salts, organic molecules, ozone, and nutrients to roadside environments. Roads promote the dispersal of exotic species by altering habitats, stressing native species, and providing movement corridors. Roads also promote increased hunting, fishing, passive harassment of animals, and landscape modifications. Not all species and ecosystems are equally affected by roads, but overall the presence of roads is highly correlated with changes in species composition, population sizes, and hydrologic and geomorphic processes that shape aquatic and riparian systems. More experimental research is needed to complement post-hoc correlative studies. Our review underscores the importance to conservation of avoiding construction of new roads in roadless or sparsely roaded areas and of removal or restoration of existing roads to benefit both terrestrial and aquatic biota.*

Revisión de los Efectos de Carreteras en Comunidades Terrestres y Acuáticas

Resumen: *Las carreteras son una característica predominante y en incremento de la mayoría de los paisajes. Revisamos la literatura científica sobre los efectos ecológicos de las carreteras y encontramos sustento para la conclusión general de que las carreteras están asociadas con efectos negativos en la integridad biótica tanto de ecosistemas terrestres como acuáticos. Las carreteras de cualquier tipo ocasionan siete efectos generales: mortalidad ocasionada por la construcción de la carretera; mortalidad debida a la colisión con vehículos; modificaciones en la conducta animal; alteración del ambiente físico; alteración del ambiente químico; dispersión de especies exóticas e incremento en el uso de áreas por humanos. La construcción de carreteras elimina a organismos sésiles y a organismos de lento movimiento, lesiona a organismos adyacentes a la carretera y altera las condiciones físicas debajo ella misma. Las colisiones con vehículos afectan la demografía de muchas especies tanto de vertebrados como invertebrados; las medidas de mitigación para reducir la pérdida de animales por colisiones con vehículos han sido exitosas solo de manera parcial. Las carreteras alteran la conducta animal al ocasionar cambios en el rango de hogar, movimientos, éxito reproductivo, respuesta de escape y estado fisiológico. Las carreteras cambian la densidad del suelo, temperatura, contenido de agua en el suelo, niveles de luz, polvo, aguas superficiales, patrones de escurrimiento y sedimentación, además de agregar metales pesados (especialmente plomo), sales, moléculas orgánicas, ozono y nutrientes a los ambientes que atraviesan. Las carreteras promueven la dispersión de especies exóticas al alterar los hábi-*

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tats, al estresar a las especies nativas y proveer corredores para movimiento. Las carreteras también promueven el incremento de la caza y la pesca, el hostigamiento pasivo de animales y modificaciones del paisaje. No todas las especies ni todos los ecosistemas son afectados por las carreteras de igual forma, pero en general la presencia de carreteras está altamente correlacionada con cambios en la composición de especies, los tamaños poblacionales y los procesos hidrológicos y geomorfológicos que afectan a la estructura de sistemas acuáticos y reparios. Se necesita más investigación experimental para complementar estudios correlativos post-hoc. Nuestra revisión hace énfasis en que en trabajos de conservación es importante evitar la construcción de nuevas carreteras en áreas carentes de ellas o en áreas con pocas carreteras, además de remover o restaurar carreteras existentes con la finalidad de beneficiar tanto a la biota acuática como la terrestre.

Introduction

Among the most widespread forms of modification of the natural landscape during the past century has been the construction and maintenance of roads (Diamondback 1990; Bennett 1991; Noss & Cooperrider 1994). As conservation biologists seek to understand the forces that influence the viability of populations and the overall health of ecosystems, it is important that we understand the scope of the ecological effects of roads of all types, especially important as conservation biologists are asked to participate in the development and implementation of strategies to protect or restore elements of biological diversity and integrity.

Roads of all kinds affect terrestrial and aquatic ecosystems in seven general ways: (1) increased mortality from road construction, (2) increased mortality from collision with vehicles, (3) modification of animal behavior, (4) alteration of the physical environment, (5) alteration of the chemical environment, (6) spread of exotic species, and (7) increased alteration and use of habitats by humans. These general effects overlap somewhat. In some cases animals modify their behavior and avoid roads because of concentrated human activity along roads. Roads may facilitate the spread of invasive species by disrupting native communities and changing physical habitats. Roads may fragment populations through roadkill and road avoidance. Despite the difficulty of categorizing discretely the causal basis in every example, these seven categories provide a useful framework for assessing what is known and unknown about the ecological effects of roads.

Selective road removal, relocation, or remediation may provide ecological benefits in certain situations. Yet, although roads are commonly identified as important correlates or indicators of loss of ecological health (e.g., Noss & Cooperrider 1994), the specific mechanisms by which biota are affected are often complicated or uncertain. Therefore, mitigation or treatment of specific effects, whether during road design or in post-construction remediation, can be costly and fraught with uncertainty.

Mortality from Road Construction

Road construction kills any sessile or slow-moving organism in the path of the road. The extent to which road construction contributes to direct mortality has not been estimated as has direct mortality from other forms of habitat destruction (e.g., Petranka et al. 1993). The fact that road construction kills individual organisms is obvious, however. The magnitude of such construction is not trivial; the 13,107,812 km of road lanes of all types in the conterminous United States, with an average width of 3.65 m per lane, have destroyed at least 4,784,351 ha of land and water bodies that formerly supported plants, animals, and other organisms (U.S. Department of Transportation 1996). The actual number is likely much higher because this estimate does not include shoulder pavement and land peripheral to the roadbed that is cleared during construction.

Construction may physically injure organisms adjacent to the path of construction. Roads built for extraction of white fir result in damage to trees that is visible up to 30 m from the road (Trafela 1987). Such damage contributes to a decline of up to 30% in forest productivity per rotation, due in part to a decline in growth of damaged trees. Construction also alters the physical conditions of the soil underneath and adjacent to the road. Riley (1984) showed that road construction increases soil compaction up to 200 times relative to undisturbed sites. These changes likely decrease the survival of soil biota that are not killed directly. Direct transfer of sediment and other material to streams and other water bodies at road crossings is an inevitable consequence of road construction (Richardson et al. 1975; Seyedbagheri 1996). High concentrations of suspended sediment may directly kill aquatic organisms and impair aquatic productivity (Newcombe & Jensen 1996).

Mortality from Collision with Vehicles

Mortality of animals from collision with vehicles is well documented. Many reviews of the taxonomic breadth of the victims of vehicle collision have been published (e.g., Groot Bruinderink & Hazebroek 1996). Few if any terrestrial species of animal are immune. Large mammals ranging in size from moose (*Alces alces*) to armadillos (*Dasypus novemcinctus*) are the best-documented roadkills, probably due to interest in their demography and to their size (Bellis & Graves 1971; Puglisi et al. 1974;

Reilly & Green 1974; Holroyd 1979; Wilkins & Schmidly 1980; Bashore et al. 1985; Davies et al. 1987; Bangs et al. 1989; Palomares & Delibes 1992).

Roadkill among many other species includes American Kestrels (*Falco sparverius*; Varland et al. 1993), Barn Owls (*Tyto alba*; Newton et al. 1991), Northern Saw-whet Owls and Eastern Screech Owls (*Aegolius acadicus and Otis asio*; Loos & Kerlinger 1993), tropical forest birds (Novelli et al. 1988), garter snakes (Dalrymple & Reichenbach 1984), granivorous birds (Dhindsa et al. 1988), American crocodile (*Crocodylus acutus*; Kushlan 1988), green iguanas (*Iguana iguana*; Rodda 1990), desert snakes (Rosen & Lowe 1994), toads (van Gelder 1973), plus a wide range of invertebrates, especially insects (H. C. Seibert & Conover 1991).

This form of mortality can have substantial effects on a population's demography. Vehicle collision is the primary cause of death for moose in the Kenai National Wildlife Refuge in Alaska (Bangs et al. 1989) and for Barn Owls in the United Kingdom (Newton et al. 1991), the second highest form of mortality for Iberian lynx (*Felis pardina*) in southwestern Spain (after hunting; Ferreras et al. 1992), and the third highest form for white-tailed deer (*Odocoileus virginianus*) in New York (Sarbello & Jackson 1985) and wolves (*Canis lupus*) in Minnesota (Fuller 1989). Roadkill is a limiting factor in the recovery of the endangered American crocodile in southern Florida (Kushlan 1988) and is contributing to the endangerment of the prairie garter snake (*Thamnophis radix radix*; Dalrymple & Reichenbach 1984). Roadkill is often nonspecific with respect to age, sex, and condition of the individual animal (e.g., Bangs et al. 1989).

Amphibians may be especially vulnerable to roadkill because their life histories often involve migration between wetland and upland habitats, and individuals are inconspicuous and sometimes slow-moving. Roads can be demographic barriers that cause habitat and population fragmentation (Joly & Morand 1997). In the Netherlands, for example, roads with high traffic volume negatively affect occupancy of ponds by moor frogs (*Rana arvilis*; Vos & Chardon 1998). In Ontario, the local abundance of toads and frogs is inversely related to traffic density on adjacent roads, but the incidence of roadkill relative to abundance is higher on highly trafficked roads (Fahrig et al. 1995). Thus, even though populations in high-traffic areas have apparently already been depressed from cumulative road mortality, they continue to suffer higher proportionate rates of roadkill.

Mitigation measures have been employed in different locations with varying degrees of success (e.g., Yanes et al. 1995). For example, underpasses on Interstate 75 have been only partially successful in reducing roadkill of Florida panthers (*Felis concolor coryi*; Foster & Humphrey 1991). Despite mitigation efforts, roads are likely to be a persistent source of mortality for many species. In general, mortality increases with traffic volume (e.g., Rosen & Lowe 1994; Fahrig et al. 1995). Some species are less likely to be killed on high-speed roads than on medium-speed roads because the former usually have vegetation cleared back further from the road's shoulder, creating less attractive habitat and greater visibility for both animals and drivers. Other species, however, are attracted to the modified habitat alongside and in the meridians of high-speed roads (Cowardin et al. 1985), making them population sinks.

Modification of Animal Behavior

The presence of a road may modify an animal's behavior either positively or negatively. This can occur through five mechanisms: home range shifts, altered movement patterns, altered reproductive success, altered escape response, and altered physiological state.

Black bears (*Ursus americanus*) in North Carolina shift their home ranges away from areas with high road densities (Brody & Pelton 1989), as do grizzly bears in the Rocky Mountains (*Ursus horribilis*; McLellan & Shackleton 1988). Elk (*Cervus elaphus*) in Montana prefer spring feeding sites away from visible roads (Grover & Thompson 1986), and both elk and mule deer (*Odocoileus hemionus*) in Colorado in winter prefer areas >200 m from roads (Rost & Bailey 1979). Wolves will not establish themselves in areas with road densities greater than a region-specific critical threshold (Jensen et al. 1986; Thurber et al. 1994), probably as a result of a relationship between road density and hunting pressure. Mountain lion (*Felis concolor*) home ranges are situated in areas with lower densities of improved dirt roads and hard-surface roads (Van Dyke et al. 1986), suggesting that either mountain lions avoid these areas or road construction tends to avoid their prime habitat. Elephants (*Loxodonta africana*) in northeastern Gabon preferentially locate in forests away from both roads and villages (Barnes et al. 1991). Both Black Vultures (*Coragyps atratus*) and Turkey Vultures (*Cathartes aura*), on the other hand, preferentially establish home ranges in areas with greater road densities (Coleman & Fraser 1989), probably because of the increase in carrion.

Roads may also alter patterns of animal movement. Caribou (*Rangifer tarandus*) in Alaska preferentially travel along cleared winter roads that lead in the direction of their migration (Banfield 1974). Although the road may enhance caribou movement, it results in increased mortality from vehicle collisions and predation by wolves. After calving, female caribou with calves avoid roads (Klein 1991). The land snail *Arianta arbustorum* avoids crossing roads, even those that are unpaved and as narrow as 3 m (Baur & Baur 1990), and extend their movements along road verges. Reluctance to cross roads is also seen in white-footed mice (*Peromyscus*

(50)

leucopus; Merriam et al. 1989) and many other rodent species (Oxley et al. 1974), even when the road is narrow and covered only with gravel. Cotton rats (*Sigmodon hispidus*) and prairie voles (*Microtus ochrogaster*) avoid roads as narrow as 3 m (Swihart & Slade 1984). Black bear almost never cross interstate highways in North Carolina (Brody & Pelton 1989) but will cross roads with less traffic volume. Roads act as barriers to gene flow in the common frog (*Rana temporaria*) in Germany, leading to significant genetic differentiation among populations (Reh & Seitz 1990). Other animals that show a reluctance to cross roads include pronghorn antelope (*Antilocapra americana*; Bruns 1977) and mountain lions (Van Dyke et al. 1986).

Some animals seem unaffected by the presence of roads, at least at some spatial scales. Based on a study of 20 wolverines, Hornocker and Hash (1981) concluded that the sizes and shapes of home ranges of wolverines where they are still found in northwestern Montana are independent of the presence of highways. Similarly, the presence of highways explained none of the allelic differentiation among populations of brown hares (*Lepus europaeus*) in Austria (Hartl et al. 1989).

Roads may affect an animal's reproductive success. Productivity of Bald Eagles (*Haliaeetus leucocephalus*) in Oregon (Anthony & Isaacs 1989) and Illinois (Paruk 1987) declines with proximity to roads, and they preferentially nest away from roads. Golden Eagles (*Aquila chrysaetos*) also prefer to nest away from human disturbances, including roads (Fernandez 1993). The reduced nesting success of eagles in proximity to roads may be more a function of the presence of humans than of the road itself; nesting failure by Golden Eagles in Scotland correlates with how easy it is for people to approach but not with proximity to roads themselves (Watson and Dennis 1992). Relative to habitat availability, Sandhill Cranes (*Grus canadensis*) avoid nesting near paved and gravel public roads (Norling et al. 1992); they do not avoid private roads with low-traffic volume (Norling et al. 1992) and can habituate to roads over time (Dwyer & Tanner 1992). Mallards (*Anas platyrhynchos*) in North Dakota, on the other hand, prefer road rights-of-way for nesting (Cowardin et al. 1985), perhaps because of a lower level of predation there.

Roads can also alter escape responses. Pink-footed Geese (*Anser brachyrhynchus*) in Denmark are more easily disturbed when feeding near roads, flying away when humans approach within 500 m, a greater distance than when feeding in areas without roads (Madsen 1985). Both the Lapwing (*Vanellus vanellus*) and Black-tailed Godwit (*Limosa limosa*) are more easily disturbed near roads and have disturbance distances of 480–2000 m depending on traffic volume (Van der Zande et al. 1980). Less well known is the effect of roads and vehicles on an animal's physiological state. MacArthur et al. (1979) showed that heart rate and therefore metabolic rate and energy expenditure of female bighorn sheep (*Ovis canadensis*) increase near a road independent of any use of the road. Roads contribute to fragmentation of populations through both increased mortality and modification of behavior that makes animals less likely to cross roads. Fragmentation may be accelerated by roads when spatially critical habitat patches (e.g., "stepping stones") become unoccupied as a result of increased local mortality or reduced recolonization.

Disruption of the Physical Environment

A road transforms the physical conditions on and adjacent to it, creating edge effects with consequences that extend beyond the time of the road's construction. At least eight physical characteristics of the environment are altered by roads: soil density, temperature, soil water content, light, dust, surface-water flow, pattern of runoff, and sedimentation.

Long-term use of roads leads to soil compaction that persists even after use is discontinued. Soil density on closed forest roads continues to increase, particularly during winter months (Helvey & Kochenderfer 1990). Increased soil density can persist for decades: logging skid trails in northeastern California over 40 years old have soil that is 20% more compacted than soil in nearby areas that have not been used as trails (Vora 1988).

The reduction of water vapor transport on a road with a hard surface increases the surface temperature of a road compared to bare soil, an effect that increases with thickness of the road surface (Asaeda & Ca 1993). The heat stored on the road surface is released into the atmosphere at night, creating heat islands around roads. Animals respond to these heat islands: small birds (Whitford 1985) and snakes, for example, preferentially aggregate on or near warm roads, increasing their risk of being hit by cars and, at their northern range limits, reducing energetic demands for breeding.

During the dry season, the moisture content of soils under roads declines even if the roads are not in use (Helvey & Kochenderfer 1990), probably in response to changes in soil porosity. Roads through forests also increase the amount of light incident on the forest floor. The amount of increase depends on how much of the original canopy and lower strata remain, which depends in turn on the width of the road and roadside verge. The increase in light increases the density of species that preferentially grow where light levels are high, such as early-successional, disturbance-adapted species such as the North American orchid *Isotria medeoloides* (Mehrhoff 1989).

Road traffic mobilizes and spreads dust, which when settled on plants can block photosynthesis, respiration, and transpiration and can cause physical injuries to plants (Farmer 1993). These effects are sufficient to alter plant community structure, especially in communities dominated by lichens and mosses (Auerbach et al. 1997). Although most sediment enters water bodies through overland flow or mass failure, dust from highly trafficked roads can serve as a source of fine sediments, nutrients, and contaminants to aquatic ecosystems (Gjessing et al. 1984).

Roads and bridges can alter the development of shorelines, stream channels, floodplains, and wetlands. Because of the energy associated with moving water, physical effects often propagate long distances from the site of a direct road incursion (Richardson et al. 1975). Alteration of hydrodynamics and sediment deposition can result in changes in channels or shorelines many kilometers away, both down- and up-gradient of the road crossing. The nature of such responses to channel and shoreline alteration is not always predictable; it may depend on the sequence of flood and sedimentation events after the alteration is made. Roads on floodplains can redirect water, sediment, and nutrients between streams and wetlands and their riparian ecosystems, to the detriment of water quality and ecosystem health. Roads are among the many human endeavors that impair natural habitat development and woody debris dynamics in forested floodplain rivers (Piégay & Landon 1997).

Road crossings commonly act as barriers to the movement of fishes and other aquatic animals (Furniss et al. 1991). Although many headwater populations of salmonid fishes are naturally migratory, they often persist today as fragmented headwater isolates, largely because of migration barriers created by road crossings and other human developments that fail to provide for fish passage (Kershner et al. 1997; Rieman et al. 1997). Salmonids and other riverine fishes actively move into seasonal floodplain wetlands and small valley-floor tributaries to escape the stresses of main-channel flood flows (Copp 1989), but valley-bottom roads can destroy or block access to these seasonally important habitats (Brown & Hartman 1988). Persistent barriers may encourage local selection for behaviors that do not include natural migration patterns, potentially reducing both the distribution and productivity of a population.

Roads directly change the hydrology of slopes and stream channels, resulting in alteration of surface-water habitats that are often detrimental to native biota. Roads intercept shallow groundwater flow paths, diverting the water along the roadway and routing it efficiently to surface-water systems at stream crossings (Megahan 1972; Wemple et al. 1996). This can cause or contribute to changes in the timing and routing of runoff (King & Tennyson 1984; Jones & Grant 1996; Ziemer & Lisle 1998), the effects of which may be more evident in smaller streams than in larger rivers (Jones & Grant 1996). Hydrologic effects are likely to persist for as long as the road remains a physical feature altering flow routing—often long after abandonment and revegetation of the road surface. By altering surface or subsurface flow, roads can destroy and create wetland habitats.

Changes in the routing of shallow groundwater and surface flow may cause unusually high concentrations of runoff on hillslopes that can trigger erosion through channel downcutting, new gully or channel head initiation, or slumping and debris flows (Megahan 1972; Richardson et al. 1975; Wemple et al. 1996; Seyedbagheri 1996). Once such processes occur, they can adversely affect fishes and other biota far downstream for long periods of time (Hagans et al. 1986; Hicks et al. 1991). Roads have been responsible for the majority of hillslope failures and gully erosion in most steep, forested landscapes subject to logging activity (Furniss et al. 1991; Hagans et al. 1986). Because most of these more catastrophic responses are triggered by the response of roads during infrequent, intense storm events, lag times of many years or decades pass before the full effects of road construction are realized.

Chronic effects also occur, however. The surfaces of unpaved roads can route fine sediments to streams, lakes, and wetlands, increasing the turbidity of the waters (Reid & Dunne 1984), reducing productivity and survival or growth of fishes (Newcombe & Jensen 1996), and otherwise impairing fishing (Buck 1956). Existing problem roads can be remediated to reduce future erosion potential (e.g., Weaver et al. 1987; Harr & Nichols 1993). The consequences of past sediment delivery are long-lasting and cumulative, however, and cannot be effectively mitigated (Hagans et al. 1986).

Alteration of the Chemical Environment

More has been written about the effects of roads on the chemical environment than on all other effects combined. Maintenance and use of roads contribute at least five different general classes of chemicals to the environment: heavy metals, salt, organic molecules, ozone, and nutrients.

A variety of heavy metals derived from gasoline additives and road deicing salts are put into the roadside environment. The most widely documented is lead, but others include aluminum, iron, cadmium, copper, manganese, titanium, nickel, zinc, and boron (Garcia-Miragaya et al. 1981; Clift et al. 1983; Gjessing et al. 1984; Oberts 1986; Araratyan & Zakharyan 1988).

Heavy metal contamination exhibits five patterns. First, the amount of contamination is related to vehicular traffic (Goldsmith et al. 1976; Dale & Freedman 1982; Leharne et al. 1992). Second, contamination of soils, plants, and animals decreases exponentially away from the road (Quarles et al. 1974; Dale & Freedman 1982). Most studies indicate that contamination declines within 20 m but that elevated levels of heavy metals often occur 200 m or more from the road. The pattern of decline is influenced by prevailing wind patterns (Haqus & Hameed 1986). Once metals reach aquatic environments, transport rates and distances increase substantially (Gjessing et al. 1984).

Third, heavy metals can be localized in the soil, either close to the surface if downward transport has not occurred (Indu & Choudhri 1991) or deep below the surface if pollution levels in the past exceeded those in the present (Byrd et al. 1983). Transportation and localization is largely affected by the physical properties of the soil (Yassoglou et al. 1987). Metals and other persistent chemicals fixed to soils may become remobilized once they are inundated or transported to freshwater environments by wind, water, or gravity.

Fourth, heavy metals accumulate in the tissues of plants (Datta & Ghosh 1985; Beslaneev & Kuchmazokova 1991) and animals (Collins 1984; Birdsall et al. 1986; Grue et al. 1986). As with soil, contamination of plant tissue occurs up to at least 200 m from a road and is greatest for individuals along roads with high traffic volume.

Fifth, heavy metal concentrations in soil decline over time where use of leaded gasoline has been stopped and surface-water flow carries the metal ions away (Byrd et al. 1983; Tong 1990). After they leave the terrestrial environment, however, the mobilized metals may cause additional harm to aquatic biota. Also, some of the processes of metal demobilization may be reversed rapidly if environmental conditions, such as acidity of the soils, sediments, or water, change (Nelson et al. 1991).

Deicing salts, particularly NaCl but also $CaCl_2$, KCl, and $MgCl_2$, contribute ions to the soil, altering pH and the soil's chemical composition (Bogemans et al. 1989). As with lead, discontinuation of the use of deicing salts allows plants damaged by salt stress to recover (Leh 1990). The effects on aquatic biota of temporary surges of salt that often accompany runoff from roads to surface and groundwaters have received little study. Deicing salts on roadways elevate chloride and sodium concentrations in streams (Molles & Gosz 1980; Hoffman et al. 1981; Peters & Turk 1981; Mattson & Godfrey 1994) and in bogs, where road salts can alter patterns of succession in aquatic vegetation (Wilcox 1986). Accumulation of salts from chemicals used for road deicing or dust control can disrupt natural stratification patterns and thus potentially upset the ecological dynamics of meromictic lakes (Hoffman et al. 1981; Kjensmo 1997).

Organic pollutants such as dioxins and polychlorinated biphenyls are present in higher concentrations along roads (Benfenati et al. 1992). Hydrocarbons may accumulate in aquatic ecosystems near roads (Gjessing et al. 1984). In one stream along a British highway, numerous contaminants were present at elevated levels in the water column and sediments, including copper, zinc, and various hydrocarbons, but polycyclic aromatic hydrocarbons associated with stream sediments accounted for most of the observed toxicity to aquatic amphipods (Maltby et al. 1995). Comparatively little research has focused on the questions of the fate and effects of the organic chemicals associated with roads.

Vehicles produce ozone, which increases the concentration of this harmful molecule in the air, especially in areas where vehicle exhaust accumulates (Flueckiger et al. 1984). Roads are also especially important vectors of nutrients and other materials to aquatic ecosystems, because the buffering role normally played by riparian vegetation (Correll et al. 1992) is circumvented through direct runoff of materials in water and sediment where roads abut or cross water bodies. Water moving on and alongside roadways can be charged with high levels of dissolved nitrogen in various forms, and sediment brings a phosphorus subsidy when it reaches surface waters. Road deicing salts are an additional source of phosphorus (Oberts 1986). The degree to which roads directly contribute to eutrophication problems in aquatic ecosystems has been little investigated. Because roads deliver nutrients that originate in the contributing slope area, the nutrient burden is probably largely controlled by surrounding vegetation and land use. An increased density of road crossings of water bodies can be expected to increase delivery of nutrients.

The alteration of the chemical environment by roads results in a number of consequences for living organisms. First, in the terrestrial environment the chemical composition of some woody plants changes in response to pollution. These changes include increased concentrations of chemicals produced by plants, such as terpenoids, which help them resist the toxic effects of pollution (Akimov et al. 1989) and salts (Bogemans et al. 1989), and decreased production of other chemicals, such as soluble protein and chlorophyll *a*, which are necessary for plant function (Banerjee et al. 1983).

Second, organisms may be killed or otherwise displaced as a result of chemical exposure. Virtually all measures of soil biotic diversity and function decline in contaminated soil, including abundance, number of species, species composition, index of species diversity, index of equability, and bulk soil respiration (Muskett & Jones 1981; Guntner & Wilke 1983; Krzysztofiak 1991).

Third, the growth (Petersen et al. 1982) and overall physical health (Flueckiger et al. 1984; Moritz & Breitenstein 1985) of many plants is depressed, even to the point of death (Fleck et al. 1988). The sensitivity of plants to pollutants may change during development; for example, seedlings are more sensitive to salt than are adults (Liem et al. 1984), which influences juvenile recruitment. Pollutants may affect plant health by damaging fine roots, mycorrhizae (Majdi & Persson 1989), and leaves (Simini & Leone 1986) and by changing salt concentrations in plant tissues (Northover 1987). Secondary effects on plant health include decreased resistance to pathogens (Northover 1987), causing further declines. In aquatic environments, plant (and animal) assemblages

S3

may change due to direct and indirect responses to nutrient increases and due to growth suppression or mortality caused by other chemicals introduced by roads.

Fourth, plants (Graham & Kalman 1974; Nasralla & Ali 1985; Dickinson et al. 1987; Guttormsen 1993) and animals (Robel et al. 1981; Collins 1984; Harrison & Dyer 1984; Krzysztofiak 1991; Marino et al. 1992), including those cultivated or raised for agriculture, may accumulate toxins at levels that pose health hazards, including those for humans that consume exposed organisms (Jarosz 1994).

Fifth, increased concentrations near roadsides of some pollutants, particularly salt, attract large mammals, putting them more at risk of being killed by vehicles (Fraser & Thomas 1982). Spills of edible products from trucks and trains also attract wildlife to roadsides. Finally, evolutionary processes may be affected through altered selection pressures that result in local differentiation of populations of both plants (Kiang 1982) and animals (Minoranskii & Kuzina 1984).

Spread of Exotic Species

Roads provide dispersal of exotic species via three mechanisms: providing habitat by altering conditions, making invasion more likely by stressing or removing native species, and allowing easier movement by wild or human vectors. It is often difficult to distinguish among these factors. Soils modified during road construction can facilitate the spread of exotic plants along roadsides (Greenberg et al. 1997). Some exotic plants establish themselves preferentially along roadsides and in other disturbed habitats (Wester & Juvik 1983; Henderson & Wells 1986; Tyser & Worley 1992; Wein et al. 1992). The spread of exotic diseases (Dawson & Weste 1985; Gad et al. 1986) and insects (Pantaleoni 1989; Schedl 1991) is facilitated by increased density of roads and traffic volume. Road construction that alters the canopy structure of forests promotes invasion by exotic understory plants, which affects animal communities (Gaddy & Kohlsaat 1987). Some roadside verges have been invaded by maritime plants because of their ability to tolerate saline soil (Scott & Davison 1982). Feral fruit trees are found preferentially along roadsides, and some populations are maintained solely by seeds in fruit waste thrown from vehicles (Smith 1986).

Exotic species are sometimes introduced along roadsides for the purpose of erosion control (Niordson 1989). Native species are now more widely preferred for this purpose, but Dunlap (1987) argues that in some cases the need for rapid establishment of plant cover requires the use of exotic species.

In another form of deliberate introduction, roads provide easy access to streams and lakes for fishery managers to stock nonnative hatchery fish (Lee et al. 1997), which adversely affect native biota and disrupt aquatic ecosystems in many ways (Allan & Flecker 1993). Unsanctioned, illegal, and unintentional introductions of fishes, mollusks, plants, and other aquatic organisms also occur frequently (Allan & Flecker 1993), and they are facilitated by public road access to water bodies.

The dispersal of a biological agent such as a pathogen along a roadway can affect both terrestrial and aquatic ecosystems far from the road. In northern California and southwest Oregon, for example, vehicle traffic and roadway drainage along logging and mining roads during the wet season disperse spores of an exotic root disease (*Phythoptera lateralis*) that infects the endemic Port Orford cedar (*Chamaecyparis lawsoniana*; Zobel et al. 1985). Transfer of the water-borne spores from forest roads into headwater stream crossings can result in the infection and nearly complete mortality of Port Orford cedars along a much larger network of downstream channel margins and floodplains, even deep inside otherwise roadless areas. The progressive loss of this important conifer species from riparian ecosystems may engender substantial long-term consequences for the integrity of stream biota, including endangered salmon species, for which the Port Orford cedar provides shade, large and long-lasting coarse woody debris, and stabilization of channels and floodplains.

Changes in Human Use of Land and Water

Roads facilitate increased use of an area by humans, who themselves often cause diverse and persistent ecological effects. New roads increase ease of access by humans into formerly remote areas. Perhaps more important, roads often increase the efficiency with which natural resources can be exported. At least three different kinds of human use of the landscape, made increasingly possible by roads, can have major ecological effects: hunting and fishing, recreation, and changes in use of land and water.

Roads open up areas to increased poaching and legal hunting. Hunting reduces population sizes of many game species, including brown bear (*Ursus arctos*; Camarra & Parde 1990), Iberian lynx (Ferreras et al. 1992), wolves (Fuller 1989), black bear (Manville 1983), and Egyptian mongooses (*Herpestes ichneumon*; Palomares & Delibes 1992). Roads also increase both legal and illegal fishing in streams and lakes. Native fish populations in previously inaccessible areas are often vulnerable to even small increases in fishing effort. Increased fishing then often gives rise to public demand for fish stocking as an attempt to artificially compensate for the effects of unsustainable harvest, at the further expense of native fishes and other species (e.g., Gresswell & Varley 1988).

Visitors increase when roads make areas more accessible, leading to increased passive harassment of animals—such as elk on Mount St. Helens in Washington State (Czech 1991) and the Oregon Coast Range (Witmer & DeCalesta 1985), brown bear in Europe (Del Campo et al. 1990), and mountain goats (*Oreamnos americanus*) in Montana (Pedevillano & Wright 1987)—and damage to plant communities (Matlack 1993).

Roads are often built into areas to promote logging, agriculture, mining, and development of homes or industrial or commercial projects. Such changes in land cover and land and water use result in major and persistent adverse effects on the native flora and fauna of terrestrial (Van Dyke et al. 1986; Karnefelt & Mattsson 1989; P. Seibert 1993) and freshwater ecosystems (Schlosser 1991; Allan & Flecker 1993; Roth et al. 1996).

Numerous studies have demonstrated declines in stream health associated with roads. Because the nature and extent of land use within a region tend to be highly correlated with road networks, however, it is often difficult or impossible to separate the direct ecological effects of roads from those of the accompanying land-use activities. For example, Eaglin and Hubert (1993) reported that trout biomass and streambed habitat quality in Wyoming streams declined in relation to the number of road crossings and to the proportion of area logged in the contributing catchment. Findlay and Houlahan (1997) found that herptile species diversity in wetlands declined in relation to the density of roads within 2 km of the perimeter. Among streams in the Pacific Northwest, the status or abundance of bull trout populations has been inversely correlated to road density (Rieman et al. 1997; Baxter et al. 1999); these studies used roads as the best available general proxy of cumulative effects associated with land use and human access. On the other hand, some studies (e.g., Roth et al. 1996) have demonstrated correlations of stream biotic integrity with land-use patterns across large catchments but did not investigate the specific roles that roads might play in mediating the causes and effects.

It appears that roads can serve as useful indicators of the magnitude of land-use changes, but it remains unclear to what degree the associated ecological responses result directly from roads themselves. If roads are largely responsible, effects could be ameliorated through altered road design, placement, remediation, or road removal. Strong interactions between roads and land use are likely, however. Forest roads in Idaho, for example, are less prone to erosion when the surrounding landscape remains in natural forest cover (Seyedbagheri 1996).

Discussion and Conclusions

Roads have diverse and systemic effects on many aspects of terrestrial and aquatic ecosystems. The ecological effects of roads can resonate substantial distances from the road in terrestrial ecosystems, creating habitat fragmentation and facilitating ensuing fragmentation through support of human exploitative activities (Fig. 1a). Habitat deterioration is not widely appreciated as an aspect of ecological fragmentation in aquatic ecosystems. At the scale of an extensive landscape or stream network, however, roads produce a pattern of aquatic habitat loss that differs from the terrestrial pattern yet nevertheless results in the ecological fragmentation of aquatic ecosystems (Fig. 1b). We coin the term *hyperfragmentation* to describe the multidimensional view of ecological fragmentation and habitat loss that emerges when the consequences of roads or any habitat alteration for terrestrial and aquatic ecosystems are considered simultaneously (Fig. 1c). Hyperfragmentation is the result of a spatial footprint of ecological effect that propagates across the landscape differently in freshwater and

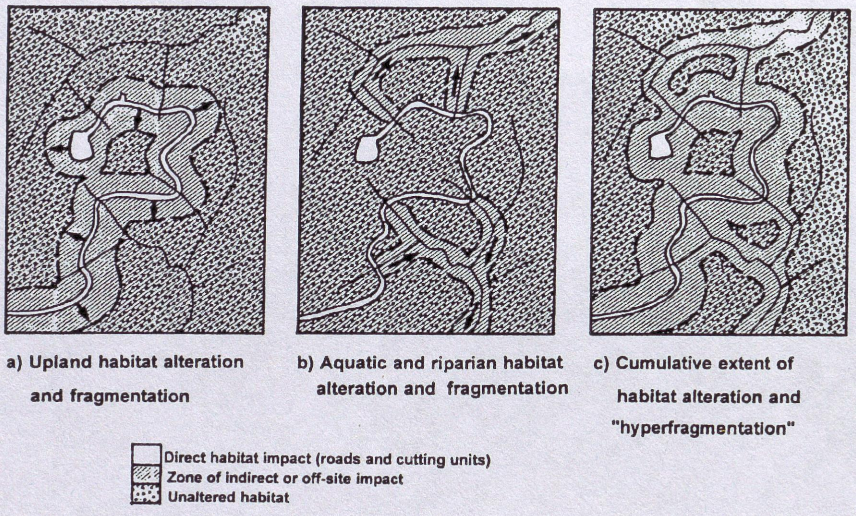

Figure 1. Spatial pattern of direct and indirect habitat alteration caused by human disturbance in a forested watershed: (a) classical forest edge effects contributing to terrestrial habitat fragmentation, (b) downstream-propagating hydrologic and biotic effects leading to large-scale fragmentation of freshwater habitats and populations, (c) combined terrestrial-aquatic view of landscape alteration that we term hyperfragmentation *because it considers multiple ecosystem dimensions on the same landscape. Arrows indicate predominant spatial vector of effects.*

aquatic ecosystems than in terrestrial systems. Even where only a small percentage of the land's surface is directly occupied by roads, few corners of the landscape remain untouched by their off-site ecological effects. The breadth of these effects cannot be appreciated unless one takes a broadly transdisciplinary view of ecosystems and biological communities.

Road design, management, and restoration need to be more carefully tailored to address the full range of ecological processes and terrestrial and aquatic species that may be affected. Deliberate monitoring is necessary to ensure that projects have robust ecological benefits and minimal adverse effects and that they are cost-efficient relative to their actual benefits (e.g., Weaver et al. 1987). Of course, such assessments require time and money that are usually unavailable. Most funds used to remediate problem roads are earmarked for actual field operations and are not available to support such assessment and monitoring. Few of the experts building roads or "restoring" them are trained to recognize and address the full spectrum of ecological issues that we have identified. Moreover, by their nature roads have systemic ecological effects that, even if recognized, cannot be overcome.

If a broad view of the ecological effects of roads reveals a multiplicity of effects, it also suggests that it is unlikely that the consequences of roads will ever be completely mitigated or remediated. Thus, it is critical to retain remaining roadless or near-roadless portions of the landscape in their natural state. Because of the increasing rarity of roadless areas, especially roadless watersheds, conservation efforts cannot rely entirely on protection of existing natural areas. But neither can conservation efforts depend entirely on tenuous and unexamined assumptions about the capability of site- and species-specific mitigation and remediation measures to reduce the ecological consequences of existing and proposed roads.

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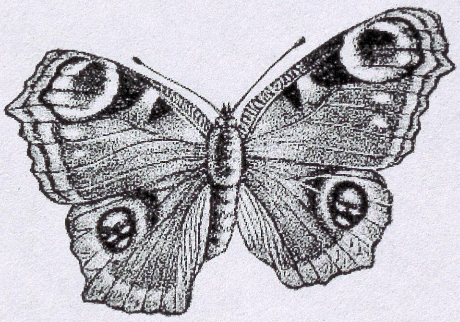

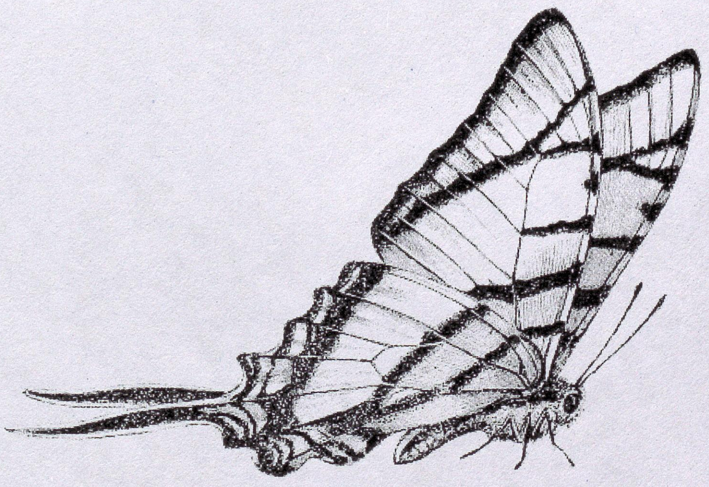

Annexure - H

National Wildlife Action Plan

(2002-2016)

THE SURVIVAL OF MAN IS DEPENDENT ON THE SURVIVAL OF ANIMAL AND PLANT LIFE

Ministry of Environment and Forests, Government of India

XIII. INTEGRATION OF NATIONAL WILDLIFE ACTION PLAN WITH OTHER SECTORAL PROGRAMMES

Overview and objectives

There should be total harmony between the National Conservation Strategy and the National Wildlife Action Plan. Both, along with other related Action Plans, must be recognised as vital national developmental priorities. The central rationale is the fact that biodiversity protection has a bearing on India's water and food security and is the foundation upon which the Indian economy is based.

National planning has not thus far adequately taken into account the ecological and economic consequences of extracting short-term commercial gains from wildlife habitats. It becomes necessary therefore to engage national decision-making bodies, including the Parliament, Prime Minister's Office, Planning Commission, National Development Council and Committee of Secretaries in direct discussions on the need to protect our natural treasury, which comprises rivers, aquifers, forests, grasslands, mountains, wetlands, coastlines marine habitats and even deserts, and the various species that inhabit them. Decision-makers need to recognise that these natural ecosystems are the best way to reduce the frequency and intensity of "natural" disasters including floods, droughts, cyclones and landslides, and are the lifeline for the livelihood requirements of hundreds of millions of rural people. The emphasis in these discussions should be that protecting the environment is in the nation's economic, health and human interests, apart from being a moral imperative.

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The development and planning process has not been able to address the problems pertaining to poverty of dwellers living around national parks and sanctuaries. Whatever programmes have been implemented are also not sustainable on a long-term basis. Poverty has increased, water levels have been going down and landless labourers do not have opportunities for sustaining their life, many communities of local people still depend upon forest usufructs.

It is therefore necessary that the Ministry of Environment and Forests should approach various ministries to integrate their activities in such a manner that the poverty in these areas can be evaluated without affecting the wildlife resources.

Action required

1. Planning Commission to recognise areas within the radius of 5 km. from the boundary of national parks and sanctuaries as special development areas and earmark separate funds for this purpose under the State plans.

Various Union Ministries to work out the following details:

- Ministry of Agriculture and Rural Development should be approached to give priority to soil conservation, partial development, organic farming, evolving appropriate cropping pattern to minimise crop damage from wild animals and adopt crop insurance scheme.
- Ministry of Agriculture should also concentrate on cattle breed improvement, stall feeding and developing appropriate methodology for marketing milk.
- Ministry of Water Resources to be convinced not to pursue big projects for irrigation in the area and to opt for minor irrigation relying on check dams, ponds, wells and other appropriate water harvesting units.
- Transfer of technology and grant of loan for development of sericulture, pisciculture, apiculture for piggery and poultry.
- Department of Small Scale Industries should develop all industries based on traditional crafts and development of information technology.

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Decision-makers need to recognise that natural ecosystems reduce the frequency and intensity of "natural" disasters including floods, droughts, cyclones and landslides, and are the lifeline for hundreds of millions of rural people. Protecting the environment is in the nation's economic, health and human interests, apart from being a moral imperative.

- Ministry of Non Conventional Energy Sources should popularise biogas, solar energy on solar pump sets, biogas plants, solar cookers and other new technologies as an alternative to fuelwood.
- Ministry of Surface Transport and Ministry of Railways to plan roads in such a manner that all national parks and sanctuaries are by-passed and integrity of the PA is maintained. Wildlife corridors also need to be avoided, or mitigative measures (such as restricting night traffic) need to be employed.
- Ministry of Human Resource Development to introduce the subject of conservation as part of the curriculum at all levels and provide training in vocations that do not involve consumptive use of wood at ITI and other institutions.
- Ministry of Information and Broadcasting should launch special programmes on conservation and the need for harmony.
- Ministry of Tourism to adopt a model of tourism that would help flow of direct benefits from protected areas to local people.
- Ministry of Home Affairs to sensitise all the forces to help in protection of wildlife and their habitats.
- Ministry of Defence to provide help to armed forces in the census and survey of endangered species in far-flung and remote areas of the country, and to help apprehend criminals indulging in smuggling.
- Ministry of Finance to issue directions to state governments that like the police and other law enforcing agencies, the field formations of forest departments are exempt from all financial and other cuts. Adequate funds should be made available for protection, prevention of poaching and protecting wildlife habitats through eco-development and other activities. Wildlife should be declared as a 'priority sector'.
- Ministry of Steel and Mines to exclude wildlife protected areas/corridors from their mining plans. Proper rehabilitation of degraded and abandoned mining areas should also be done. A programme to phase out all existing operations in wildlife areas should be prepared.

Priority projects

1.1 Initiate briefing sessions/discussions with Members of Parliament, various Ministries, the Prime Minister and his Office, the Planning Commission, the National Development Council and the Committee of Secretaries, either individually or collectively, on the economic importance of protecting and sustainably using, not over-exploiting, our natural treasury. Similarly, briefing sessions should be held with Chief Ministers, Finance Ministers, Home Ministers and Agriculture Ministers of States/UTs.

Timing: To start in 2002 and ongoing.

Responsibility: MoEF.

1.2 State Wildlife Wings will carry out similar briefing discussions with Panchayat Raj Institutions and other grassroot level institutions involved in the field of rural development.

Timing: To start in 2002 and ongoing.

Responsibility: States and UTs.

1.3 Preparation of a report accessing policies and action plans of other related Ministries to provide guidelines for the Planning Commission, which would help to harmonise other sectoral activities outside PAs.

Timing: To start in 2002 and ongoing.

Responsibility: MoEF, Planning Commission, State Governments and Scientific Institutions.