

JOURNAL OF ECOLOGICAL SOCIETY

Vol. 4, 1991

Editor
Prakash Gole



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OF
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ECOLOGICAL SOCIETY
PUNE, INDIA

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Published by

Prakash Gole, *Executive Director*

Ecological Society

1 B Abhimanshree Society

off Pashan Road

Pune 411008, India

Telephone : 336408

Printed at

Aksharchhaya

2035 Sadashiv Peth

Tilak Road, Pune 411030

Cover :

Aerial photograph showing
algal bloom in the river.

Transparency by Dr. S. V. Bhawe

Acknowledgement :

The grant of assistance from the Department of Science &
Technology, Govt. of India, towards the publication of this
Journal is gratefully acknowledged.

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Attention Contributors

Contributors of articles are requested to assist the editor by observing the following:

1. Articles which have at the same time been offered for publication to other journals or periodicals, or have already been published elsewhere, should not be submitted.
2. The MS should be typed (double spacing) on one side of a sheet only, and the sheets properly numbered.
3. All scientific names to be printed in italics, should be underlined.
4. Trinomials for subspecies should only be used where identification has been authentically established by comparison of specimens actually collected.
5. Photographs for reproduction must be in black and white, clear and show good contrast. They should be post-card size or larger and on glossy paper.
6. Text-figures, line drawings and maps should be in Indian ink.
7. References to literature should be placed at the end of the paper, alphabetically arranged under author's name, with the abridged titles of journals or periodicals underlined (italics) and titles of books *not* underlined.
8. Reference to literature in the text should be made by quoting the author's name and year of publication.
9. Each scientific paper should be accompanied by a concise clearly written synopsis, normally not exceeding 200 words.
10. Authors are supplied 20 reprints of their articles free of charge. In the case of joint authorship, 40 copies will be given free to be distributed among the two or more authors. Orders for additional reprints should be in multiples of 20 and should be received within two weeks after the author is informed of the acceptance of the manuscript. They will be charged for at cost plus postage and packing.

Editor
Journal of Ecological Society

Foreword

Another year's observation of the ecological scene leads us to the conclusion that habitat is being disturbed in many places, largely due to economic reasons and in some areas to political disturbance. Such disturbance can prove fatal to organisms living there, not so much to the humans as to the plant and animal species who are far more dependent on their surroundings, water and air, than humans who can always make up for certain deficiencies by other means. Development of every kind must inevitably lead to habitat change, whether it is a rail or road project, a housing program, an industrial complex or even a sports stadium. The organisers of all these development schemes cannot foresee the ecological effects, and once any particular species of plant or animal is disturbed, it does not take long for it to disappear from the scene altogether, never to be reproduced again. And what a terrible loss this can mean to our bountiful planet.

One of the contributors to the journal, who belongs to my school of thought if not to my academic college, has rightly drawn attention to the menace of our ever growing megalopolises and the periodic study groups or planning boards who are asked to produce a report of their findings and recommendations. From my own experience, I can say that if we are to overtake problems, and there are plenty, and provide for them

and rectify them, then what we sorely need is an implementing body of dependable people with funds to execute, and not just reports which lie in state until they get out of date. Population growth has to be checked if INDIA is to survive.

L. G. Rajwade
Chairman, Ecological Society

The Future of our Exploding Cities : The Case of Pune Metropolis

P. G. Sardesai

In the post independence era, especially during the last two decades, we are experiencing, phenomenal growth of the metropolitan cities like Bombay, Pune, Delhi, Bangalore, Calcutta, Madras etc. There is an urban explosion due to massive influx of the rural population to urban areas, mostly in search of employment opportunities. Due to concentration of industries in metropolitan and other cities and other contributory factors there is also a peripheral growth overspilling the city limits. Also activities in the tertiary sector has been one of the important factors resulting in such a rise in population.

The effects of such rapid urbanization and industrialization are well known; congestion, environmental degradation, housing shortage, growth of slums, to name a few. All this has put enormous strain on public facilities such as water supply, drainage, electricity, public health etc. Lack of proper planning and limited technical capacities of most of the authorities to grapple with these problems of development have forced the urban settlers to live in unplanned, overcrowded and undesirable environments. So far the efforts made by governmental, semi-governmental and local agencies to contain the various problems are only marginal and as the cities continue to grow, the situation is tending to become anarchic.

Let us examine the enormity of the problem concerning

physical planning and its financial and legal issues with reference to a fast growing city like Pune.

Even though under the provisions of MRTP* Act 1966, Statutory Development Plans for all the 213 Municipal Councils in Maharashtra have been prepared, their implementation is not satisfactory. The failure to implement is due to untrained and inadequate staff, general apathy, pressures from vested economic and political interests etc. The Councils have meagre resources to implement the proposals of the Plans. In Corporation towns lands are scarce and costly; the corporation budget can provide little funds to acquire sites reserved for public purposes and to provide civic services in adequate measure. The speculation in land transactions on the outskirts of the large metropolitan centres has upset the process of balanced development and the unearned increments in the values of such lands ripe for development have been pocketed by the unscrupulous land sharks. The sufferers are the community at large and Public Authorities in general.

This is well illustrated by Pune city whose population rose from 6,05,504 in 1951 to 16,85,300 in 1981 and is now around two million. The rapid expansion of the city in all directions if continued unchecked will give birth to a megalopolis which may have a projected population of around 5 million spreading over an area of about 1500 sq. km. in the next decade or so. In the sanctioned plan of the Pune Metropolitan Region (PMR) large fringe areas around Pune city have been zoned as "Agricultural and No Developmental Zone". Large-scale fragmentation of holdings in this agricultural areas by selling plots for non-agricultural developments and circumventing the provisions of the Urban Land Ceiling act has now become the order of the day. The Revenue Department could exercise little control over the conversion of such lands to non-agricultural purposes. The resulting development is unplanned and devoid of basic facilities such as roads, water supply, drainage and electricity.

Regional Planning

Due to cities overspilling their boundaries, regional planning has acquired special significance. The region surrounding and

*Maharashtra Regional Town Planning Act

supporting the city is also required to be planned simultaneously. The 1966 MRTP act makes a provision for establishment of Regional Planning Boards and preparation of statutory regional plans. More than a dozen such Regional Plans, some of them for the whole district, have so far been prepared. But for want of provisions to create a suitable implementing machinery, these plans have by and large, remained as paper documents only.

A Regional Planning Board has recently been established under the 1966 Act to prepare a perspective Regional Plan for the Pune district as a whole. It would be necessary for such an apex body to ensure that adequate zoning of lands for residential, commercial and industrial purposes to accommodate the projected population over the next 20 years be earmarked and the rest of the area reserved for agricultural and forestry development so that there will be ample greening and adequate space provided for recreational facilities by way of regional parks; sanctuaries, gardens, play grounds, lakes etc. The question of setting up the implementing machinery with adequate powers to execute such a regional plan has of course, not been tackled at all so far.

If proposals of such a Regional Plan are to be translated into practice, it would be immediately necessary to make suitable modifications to the 1966 MRTP act to provide executive and financial powers to such Regional Planning Boards and coordinate their findings and proposals with those of the District Planning and Development Councils.

If this is not done by the Government immediately, the exercise of the establishment of such RP Boards and formulating only recommendatory proposals would prove to be ultimately futile as is the experience of all RP Boards so far formed during the last decade or more. In any case the present trends of centralization of developments in and around large cities and conurbations have got to be reversed on account of the fact that almost 75 to 80 p.c. of our population is still rural-based. The only solution to stabilize them near their habitations appear to be to create sufficient number of counter magnets by establishing New Towns and Dormitory Towns away from metrocities. Government have now adopted the policy of creating industrial areas in rural regions and it is understood that about 60 growth

centres and sites for 120 industrial estates have been identified by the Govt. of Maharashtra. It will be necessary to properly plan new townships around these growth centres and industrial areas already identified. If properly executed these will reverse the immigration of people into urban areas and a balanced development in the rural-urban matrix will become a reality. This will also stop the growth of Metrocentres like Pune, Bombay etc.

The Pune Metropolitan Regional Plan prepared in the 1970s and the first development plan for Pune city prepared around that time, remained mostly on paper except that a new town development authority known as Pimpri-Chinchwad New Town Development Authority was created on the recommendations of the Regional Board. A revised D.P. for Pune city was prepared and sanctioned by the Government in 1987 which, inter alia, have recommended certain measures for regulating the growth of the city and its environment. These measures are :

1. Greening and afforestation of all hill-slopes and tops in the area by Forest Department and their development as regional parks and recreational natural areas.
2. Improvement of the Mula and the Mutha river banks as also the channelization of various nullahs passing through the city and developing the areas around them as walking plazas, cycle tracks, river-side walks etc.
3. Conservation and restoration of buildings of historical and architectural value.
4. Widening of arterial roads and tree plantations along them and also along the Mutha right and left bank canals.
5. Removal and shifting of unhealthy slum areas to be rehabilitated elsewhere and improvement of the conditions of other slums.
6. Diversion of national and state highways outside city limits.
7. Earmarking and reservation of a number of sites for public purposes such as parks, playgrounds, hospitals, markets etc.
8. Traffic improvement by channelizing important arterial roads.

The proposals if implemented in the right spirit in the next 10

years would greatly improve the environment within the city limits. But for their successful implementation a number of departments and agencies will have to function in a coordinated manner. Secondly substantial funds need to be placed at the disposal of the concerned departments. It would indeed be better if a central authority for implementation vested with adequate powers and funds is created. It may be easier for such an authority to approach national and international financial bodies for raising the required funds for executing projects of establishment of a ring of new towns around Pune (and Bombay etc.)

Private Enterprise

Private entrepreneurs can also be involved in a big way in the development of well-planned New Towns & Dormitory towns or colonies. For example, Pune Developers of Ms. Chandras & Kane have planned the "Shivanand Enclave" on a 100-acre site near Baneshwar which is planned on "Neighbourhood Planning" principles.

It needs no overemphasizing to say that by and large Government and Municipal Corporations have failed to control urban development within and outside the metropolitan towns in fringe areas as also unable to provide strong and effective communication lines in the rural hinterlands for want of funds. My feeling is that such capital-intensive projects as multilane highways (Trans-state and Trans-national), ultra-modern shopping centres etc. should necessarily be given to private entrepreneurs who would be able to treat these as commercial ventures by recouping part of the cost of these projects by levying tolls on highways and charging parking fees etc. in commercial areas as is being done in foreign countries. Even the implementation of development plans, partly through private enterprise (in so far as acquisition and development of sites are reserved for public purposes) has also become a necessity, as even larger corporations like BMC and PMC are unable to implement the development plan projects for want of adequate funds in their annual budgets.

New Towns

The New Towns Development Experiment has been success-

ful in countries like UK and USA. On the basis of my experience I have come to believe that it would be the only strategy to decentralize the process of urban concentration in large Metrocities and diffusing the development into which the rural hinterlands need to be properly developed in the interests of preserving their environment and provide employment and civic amenities to the inhabitants of these rural areas.

If the new towns are to become affordable the planning and implementation authorities need to adopt certain concepts that may involve departures from present practices. Virgin rural lands can be economically developed under the Sites and Services Scheme with provision of infrastructural facilities of *murrum road*, water supply, drainage, electricity etc. for different sizes of plots affordable to different groups and permitting both government and private developers to construct houses using local material so that they are within the reach of poorer sections of the community.

Ideally to guide and control large-scale development, unitary ownership of land will be necessary. The Urban Land Ceiling Act of 1976 was enacted to secure this objective but it merely succeeded in taking out of the market large chunks of lands which sent the landprices sky-rocketing with builders and promoters reaping high profits out of the artificial scarcity of land. To me it appears the sooner the act is scrapped or overhauled the better for housing and regional development. If the new town authorities are in a position to acquire sizeable areas of land for development, land values will be frozen and fragmentation of lands will be discouraged.

Town Planning Schemes

An effective way to control development in semi-urban and virgin lands on the outskirts of metropolitan cities, is preparation of Town Planning Schemes under the provisions of MRTTP Act 1966. This would allow lands to be pooled and redeveloped on scientific lines. In such schemes the pooled lands are redistributed to original owners in the shape of Final Plots. Betterment contributions are recovered. But the present procedure needs to be expedited by amending the 1966 MRTTP act. Local authorities and corporations can gain valuable expertise by carrying out such schemes which will also bring in much

needed revenue to these authorities.

Housing and Slums

If housing is planned properly and is affordable, creation of slums can be checked. Slums have become a permanent feature of today's urban areas. Their eradication is thwarted by powerful political and socio-economic forces. Improving the living conditions in existing slums, and resettlement of those sections of slums which are located in especially unhygienic and sensitive areas on alternate sites appear to be the only solutions to the present impasse. Indeed if pragmatic approach is not adopted growth of cities will essentially involve growth of slum areas with more than half the population living there in an acutely degraded environment.

Conservation

The most neglected aspect in the burgeoning cities of today is conservation of our natural, historical and cultural heritage. Natural water bodies such as streams, rivers, lakes and marshes need to be saved from improper use and encroachment by human settlements. Air and noise pollution are to be avoided by streamlining transportation and historical and cultural sites need to be saved from unscrupulous developers. It is this area in which our planning and execution are most deficient as shown by the haphazard growth of Pune city.

Urban Management & Resource Mobilization

Management at the level of local authorities, which are the implementing authorities for Development Plans, is generally poor on account of lack of sufficiently trained and experienced staff to know the implications of large urban development projects in their multifarious facets such as engineering, architectural and environmental. It has been our experience that most of the proposals in Development and Regional Plans remain on paper only due to legal, administrative and financial difficulties. What we need is a well-trained, dynamic and dedicated cadre of city managers uninfluenced by vested interests and by political leaders, if our Development Plans are to be executed scientifically in a phased manner. Participation by enlightened citizenry in the overall execution of the Develop-

ment Plan has also become a prime necessity. For achieving this purpose, suitable modifications to the provisions of MRTP Act 1966 would be necessary.

The execution of urban development projects naturally require enormous funds, for which external financial assistance from bodies such as Life Insurance Corporation of India, HUDCO*, World Bank etc. would be needed. Sufficient resources could also be mobilised by recovery of betterment taxes by preparation of Statutory Town Planning Schemes under the provisions of MRTP Act 1966, improving the property tax structure by scientifically fixing the Rateable Values of properties with the help of trained valuers (at present the properties in most cases, are under-rated or rated on ad hoc basis), leaving open land taxes and taxes on new additions to properties on square meter basis etc.

Conclusion

Considering the complexity and enormity of urban development projects in and around Pune Metropolis (and for that matter all million-plus cities), all of us would agree that unless bold, emphatic and innovative approach is taken to tackle the problems, no desired results could be obtained.

P. G. Sardesai
Ex-Director, Town Planning Dept.
Govt. of Maharashtra

*Housing & Urban Development Corporation

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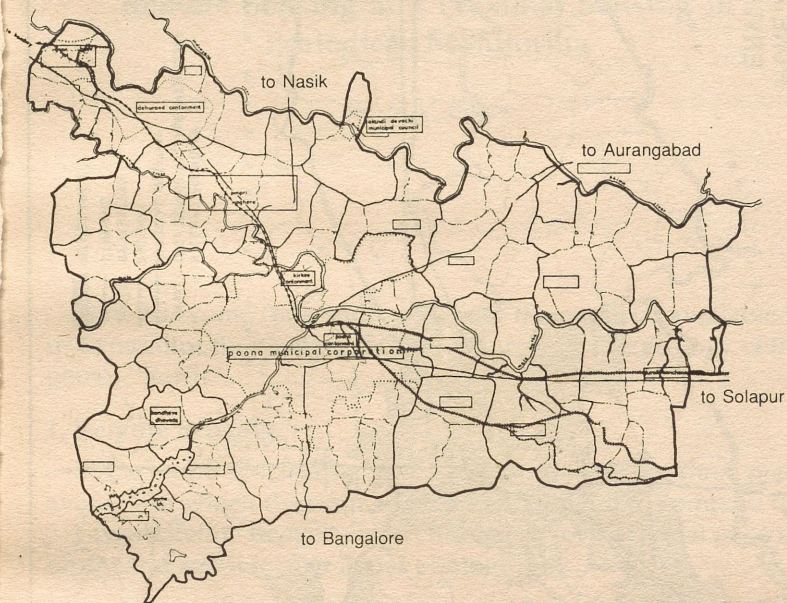
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Poona Metropolitan Region

division of region into micro-regions for
the purpose of planning of community facilities



references

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- - - micro-region boundary
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- corporation boundary
- cantonment boundary
- name of the nucleus village

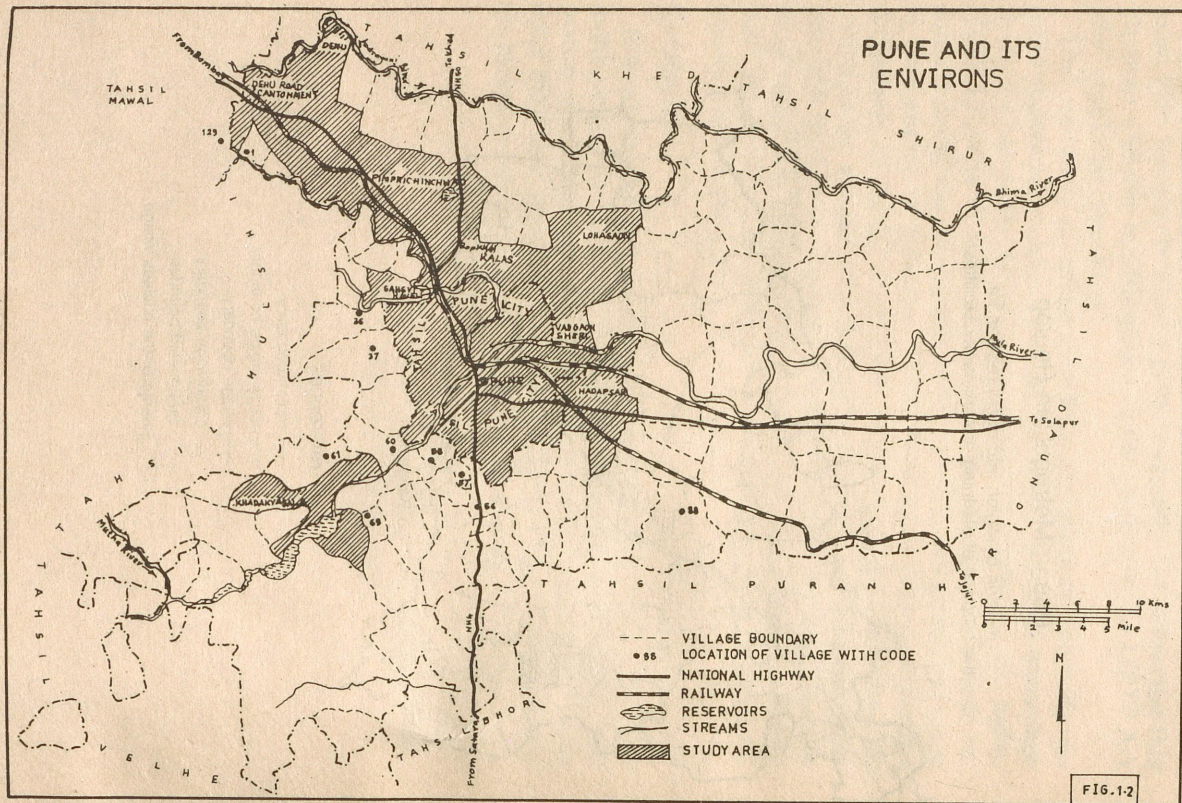


FIG.1-2

Remote Sensing and Proximal Sensing in Ecological Monitoring

Dr. S. V. Bhawe

Time has come for a short review of the methods available to us to monitor the changes that are occurring in the ecology of the planet "Earth".

1. Remote Sensing

In the entire spectrum of remote sensing there are three main avenues in which data can be obtained. I intend to compare the 3 ways : Satellite Imagery, conventional 9" format aerial photography and small format aerial photography.

Satellite imagery- Its advantages are :-

1. The Product is cheap,
2. A frame covers large area 174 x 174 KMS and therefore is ideal for district level planning.
3. Its repetitive cover once every 14 days or 28 days makes it an ideal tool for monitoring changes such as growing urban sprawl or degrading forest or changing river courses.

Its disadvantages are :-

4. No stereo cover, therefore, no contour information.
5. Poor resolution and output in pixel rather than vectors.
6. It requires intensively trained people to read and understand the data so what you gained in obtaining cheaper product may not in the end turn out to be cost-effective.

7. In application of the interpretation of landuse in the scale 1 : 50,000 it starts to flounder, at 1 : 25,000 it loses quite a bit and at still larger scales it is totally inadequate. This is borne out by experiments in interpretation conducted at the Indian Institute Of Remote Sensing, Dehradun.
8. The eye of the satellite is blind to any object smaller than 100' x 100' and no amount of enlargement can bring it out.

Conventional Large Format Aerial Photography with 9" negative material.

Advantages :-

1. There is nothing superior to this technique.
2. The product is easy to interpret even with short-term trained people.
3. The resolution is high.
4. Contact printing avoids errors introduced by enlarging technique.
5. With ground control and rectification you can achieve high photogrammetric standards.
6. 60% overlapping frames provide stereo cover and height information.
7. With stereoplotters like Wild A10 the most accurate extension and contour work can be done.

Disadvantages :-

1. Its very high prohibitive cost.
2. It requires large cameras, larger aircraft, high standard processing equipment and post-processing of photographic product makes the whole operation quite unwieldy.
3. It is practised by Survey Of India, National Remote Sensing Agency and Airforce. Their facility centres are at Bangalore in the south, Hyderabad in the east, Ahmedabad in the west and Dehradun in the north, interdepartmental shunting consumes a lot of time and it is years before you get the desired product in your hand by which time it is out of date and may be you will request fresh photography.

The small format has all the advantages of large format and none of the disadvantages.

Advantages :-

1. When it is executed to high standards its accuracy can be guaranteed to be 97% to 99% of that of conventional aerial

photography. There are several requirements of small format aerial photography. A reasonable high performance four seater aircraft with good endurance and sophisticated instrumentation for precision flying, a rotatable vibration-absorbing camera mount over a R and D cleared hole in the belly of the aircraft to take at least 70mm or larger film camera with large capacity magazine and remote control operation via intervalometer are necessary.

2. The delivery of product is quicker.
3. It is much cheaper than conventional aerial photography.
In the pursuit of making aerial photography cheaper and cheaper, one should not sacrifice principles of photogrammetry and use of 35 mm format and flying club-type aircraft or microlites with limited space and instrumentation cannot be flown with the precision required. Strict adherence to verticality, to navigation paths, to airbases with intervalometer, lane widths, crab angles and rotation of camera and thousand other details makes the results of this small format (70 mm) comparable with the large format. The only vitiating factor is that an enlargement is required and this introduces another optical system and hence the slight loss of accuracy.
4. This format can handle any scale from 1 : 500 to 1 : 100,000.
5. Resolution is far superior than Satellite Imagery.

There are 32 million particles in a 70 mm negative as opposed to 0.6 million in satellite image. The information which photography can give is simply not there in satellite imagery.

In conclusion the small format is cost-effective and judging from the number of papers devoted to this in foreign journals and from the field experience gained by us so far the place of small format in the gamut of remote sensing is certainly reserved in the box office.

2. Proximal Sensing

No matter what people selling satellite imagery or aerial photography will have you believe, there is no substitute to actually going to the area and feeling the jungle or savannas or the wetlands by the proximal senses of naked eyes, the nose, the ears and the skin which makes you appreciate even the caress of a gentle breeze.

3. Acquisition of data : its storage, retrieval and presentation

The data acquired by remote or proximal sense have to be stored in a form which is not only understandable to us but should be in a format by which we can converse with the worldwide programmes like the UNEP and UNDP studies. The details of this will be dealt with in our next issue of the journal.

4. Vihangam Alok

Vihangam Alok is a facility developed by the author for acquisition of knowledge by aerial photography and he uses it in a symbolic way with other facilities towards the lofty aim of defending the planet earth. Vihangam Alok has the equipment—namely an aircraft specially modified and fitted with the most appropriate camera, similar to what was used even by NASA, USA for its mission to the moon. A sophisticated processing laboratory and above all the expertise, skill and dedication required for flying the mission and producing the result. The photos can be digitised and stored, manipulated and retrieved and can be a part of geographical information system. No matter what you need in the end, the base map of today's existing structures is going to be the basis and aerial photography is key to that end. Vihangam Alok can provide you that key. Remote sensing is done by satellite imagery and aerial photography. Satellite covers large areas but gives only broad characteristics. Aerial photography gives detailed photos of high resolution. Therefore, use of satellite imagery for regional (district size areas of several thousand kilometers) planning and use of aerial photos, its products and derivatives for detailed planning of any physical attributes - urban, rural or any other is a must.

For small areas like factories and promoters' and builders' activity you can use very large-scale photography, use of oblique type for perspective and vertical type for mapping. If you want to study a small bird sanctuary or the development plan of the city, village or industrial complex, vis-a-vis the forest areas next to it, large-scale aerial photography only will serve.

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Glossary

- Pixel : Smallest Unit in which an earth station receives information from the Satellite.
- Intervalometer : Timer for camera giving repetitive exposure after set interval.
- Crabangle : Angle between heading and tract.

Satellite Monitors Cranes Migrating from Siberia

David H. Ellis and Uri Markin

Many people, Russian and American, would not be pleased to receive an invitation to go to Siberia. For us, however, it was a dream come true. When Sasha Sorokin and George Archibald invited us to participate in developing a satellite telemetry capability to learn the migration route of the highly endangered western population of the Siberian Crane (*Bugeranus leucogeranus*), they little knew how important the project would become to each of us. For example, Yuri had studied the ecology of the Eurasian Crane (*Grus grus*: the surrogate species involved in the first year of the project) for 18 years and had long hoped for the means of following the movements of cranes from northern Europe and Asia to and from their wintering grounds. For David, the opportunity was the realization of efforts begun 20 years earlier to learn the Russian language in hopes of one day working in Siberia.

While our interests in the project drew us quickly into a united team, our contributions were divergent. Yuri applied his skills in capturing cranes, adult Eurasian Cranes. Likewise, it quickly became David's responsibility to arrange equipment and support for the project. Fortunately, Charles Vermillion, a division chief with the National Aeronautics and Space Administration, became interested in the project and arranged for full support from Telonics, the manufacturer of the satellite backpacks. In

addition, Phil Effinger of Clairson Enterprises, one of International Crane Foundation's benefactors, also got involved by helping manufacture the feather guard, a plastic shield that keeps the bird's feathers off the solar panel on the backpack. Next, the University of Maryland Department of Industrial Arts volunteered space, equipment and expertise in the design and construction of a four-barrel shotgun used to shoot a net over the cranes intended to wear the backpacks. Finally, the captive crane colonies at the Patuxent Wildlife Research Center were involved testing harness and attachment designs. Almost overnight, the project blossomed from an unexpected invitation to a full blown research effort.

As for any field project, most of the work comes before the team enters the field: literally months of preparation preceded our brief 4 week stay in the marshes along the Kunovat River in northwestern Siberia.

Although Yuri had previously done field work in the area, no one could have anticipated the problems we would encounter. First, although a Siberian Crane nest was within a mile of our camp, the nearest Eurasian Crane nest was about 3 hours away. After short hikes that failed to locate cranes nearby, we made a 3-day hike to locate pairs suitable for study. After hours of sloshing through the ice coated and ice underlain bogs, David plunged neck deep through a hole in the submerged root mat that provided our highway. Yuri immediately produced dry socks, shirt and pants to forestall hypothermia, and after 2 hours by the bonfire most of David's camera was back in working condition. After this visit to the more distant pairs, we decided that we must leave our comrades at base camp and move nearer to the cranes. On 8 June, 15 days into our residency in the marshes, we settled into our new camp and began, in earnest to capture adult cranes. For the next two days, we alternated watches from our perch in a Siberian pine ca 300 m from the first crane nest. We waited trying to pick the propitious moment for placing our anesthetic laced bait on the crane nest to maximize our chances of capturing the male (i.e., the larger bird, normally the male, is probably better able to carry a 150 g backpack). Twice the birds refused to eat our bait, first a generous slice of pike and then a sandpiper egg.

Finally, we decided to try another pair nesting about 2 hours

across the marshes. As we approached the second pair, we chose a view point hidden in the forest and after only 2 hours, decided to proceed. Yuri left with the bait as David watched from a make-shift blind of brush and pine saplings. After the cranes flushed, Yuri quickly placed the bait egg and slogged back to the forest. Almost immediately, a large gull swooped to the nest and, crazy as it may sound, began to incubate the sandpiper egg (i.e., our bait). The male returned and drove the gull away, then swallowed what we suspected was not the bait, but rather contents of his own egg broken by the gull. Yuri, now back at the blind, and I now wrung our hands as we waited wondering. Soon the male left the nest and wandered into the marsh, confirming our fears that the crane egg might be broken. The nest was left unguarded and our spirits fell as we contemplated the scene unfolding before us. Depressed, we remained in the blind watching the male and the empty nest. Finally, Yuri, with the confidence that comes from 20 years of observing this species, spoke, "I assure you, that bird is not well." In that instant, our spirits soared. Yes, the male was definitely beginning to stagger. Cautiously, we began our approach, alternately moving swiftly through the water when the crane slept and posing statue-like with arms and legs akimbo when he, at intervals, looked up. Very soon, Yuri pounced on the groggy bird and with his mate distress calling overhead, we carried him back to the forest to attach the backpack. Our elation at this first success was tempered by the tragedy at the nest. We learned from slogging into the marsh to retrieve the half-sleeping male, that the crane egg was still okay. However, during all of the disturbance associated with placing the bait and retrieving and handling the male, crows slipped in, lured the female away, and destroyed the egg. Had the female been quicker to return to the nest, had she stayed on the nest rather than leaving to pursue one crow while its partner did the damage, the story might have been different. But, at any rate, our first success was tempered by this tragedy. The season was far advanced so it was not likely that Boris (as this male was named by our NASA cooperator, Charlie Hoisington) and his mate would produce more eggs or rear a chick. It became our goal to compare Boris's migration (without chicks) to the migration of other pairs that hopefully would have chicks.

Yuri and I slogged back to our camp encouraged by our partial

success with Boris and determined that on our next attempt we would not cause the pair to fail in their nesting attempt. A few hours later (the next day) we made another attempt with the uncooperative pair near our camp. This time, when Yuri placed the bait, he noticed that one of the crane eggs was beginning to hatch. Once again the pair seemed to ignore the bait. We watched until 9:50 p.m. (still light, of course) and debated moving on to another pair but decided to check for groggy birds again at midnight. At midnight, both birds were seen, but neither was groggy. What to do? What to do? We decided to get some rest and then decide whether to try more with this pair or to move on. When we checked again in the morning, the male (soon to be known as Ivan) stood sleeping on wobbly legs, not far from the nest. When sloshed out to retrieve him, we were in for another surprise: one egg was already hatched and the chick was gone (presumably with the female). The second chick was peeping from a hole in the shell, so now we had a drugged male and a hatching egg needing attention. Not knowing how long Ivan had been drugged, we rushed to get him harnessed and back out into the marsh to take over duties with the hatching chick. Seventy-five minutes later, Ivan, with a brand new cross-your-heart harness and \$3500 backpack, was nudged back into the marsh. The anesthetic was already wearing off and in only 17 minutes, he took his first slightly wobbly flight. Knowing that the survival of the chicks was now out of our hands and that it would be best for Ivan's family if we left the area, we crossed the marshes to check on Boris and his mate. For 7 1/2 hours we searched the area but failed to hear or see the pair. It would not be until David's return to the U.S.A. that the good news came from NASA that Boris was alive and well back in Siberia.

Next day we returned to check on Ivan's family. Ivan was seen sitting attentively (if nervously) on the nest with, incredible as it may seem, absolutely no attention to his new apparatus. But was the chick in the egg beneath still alive? It would be 3 days before we would know with certainty. On the 17 June while searching the marshes for the pair, we from separate vantage points observed Ivan, his mate, and not 1 but 2 chicks scampering about at the marsh edge. Imagine our delight as we watched the family for nearly an hour. During this time, Ivan again showed no attention to either his harness or backpack.

We knew from radio contacts, that the following day a helicopter would come and lift us from our camp in the marshes just south of the Kunovat River and return us to base camp along the Hoolyoogan River. With these successes behind us, we energetically packed our gear, anxious to report our efforts to our comrades.

Right on schedule, we heard the fluttering roar as the Aeroflot troop transport chopper neared our camp. For the next three hours, the big machine wended its way over the marshes searching for an opportunity to capture a crane to wear our third satellite transmitter. Our hope was to find a molting (i.e., flightless) crane or possibly net-gun even a flighted crane from the helicopter door. Nowadays, mammals and even some birds are routinely netted from small two or four-passenger helicopters, however, we feared that the huge Russian chopper would be unable to match a crane's evasive maneuvers. For 3 hours we sought and pursued cranes. It was a beautiful, but nerve wracking experience for David as he sat with legs dangling from the helicopter door as the chopper tried in vain to match the crane's twists and turns. The net gun trajectory required that he shoot from 15 meters (45 feet) or less. Twice he loaded the gun in preparation for a sort, but the birds were never in range and eventually eluded the behemoth chopper. Finally, Sasha and Yuri spotted a flightless female and we closed in for a shot. Unfortunately, the running crane, aware of its vulnerability, kept to the stands of forest where the tree tops kept us just out of range. Twice we had opportunities that were almost good enough, so twice David shot. On the second shot, the net brushed over the crane's shoulders, but she ran from beneath it and escaped. At length she tired, however, and 3 of us jumped from the helicopter and pursued her into the woods where Yuri pounced on her. Now the rush was to harness the bird, dubbed Katya at NASA, before the helicopter ran out of fuel. In this aqueous environment there is literally no place for the chopper to land. In only 45 minutes, we had Katya ready to go. As half of our crew raced to attach the harness, Sasha took the helicopter in search of the 2 nets. No luck! It was the most expensive shooting David had ever done : \$274 in two shots.

When 18 June was over, we had the satisfaction of having deployed all 3 PTT's. It only remained to fight the mosquitoes,

enjoy our few remaining days in the Ob River country, and then hope for the best for Boris, Ivan and Katya as the Tiros satellites monitored their movements through the subarctic autumn and their passage south from their Siberian homeland.

When David returned to Washington, D.C. on 25 June, the news came quickly that all 3 cranes were indeed moving about their native marshes. Fortunately, the distances involved were great enough to safely conclude that these moves were not merely errors in the detection system. Through July, the birds were relatively sedentary, then in mid-August, Boris abandoned his already large home range (i.e., he had no chicks to hamper his movements) and moved ca 80 miles southwest to the marshes immediately adjacent to the Ob River. With Boris' move, we all experienced a surge of excitement believing the migration was underway, but Boris spent the next two weeks without further movement. In mid-August, Ivan and Katya also began to wander more. By the end of August, all 3 had moved southwest to the marshes near the Ob. Ivan moved the least distance, perhaps providing us with a hint that he still had his chicks with him. Slowly the days rolled by as we waited for the NASA computer to reveal further movement. Finally, at the end of the first week of September, Katya took the lead heading straight south. Ivan and Boris lingered along the Ob until mid September, but now both are moving south. At the time of this writing, the winter home of the Eurasian cranes that breed in western Siberia is still unknown, but Katya's trajectory points increasingly toward India. A surprising aspect of the migration is that even after it began, the birds seemed in no hurry. They sometimes flew 50 miles or so and then lingered a few days before moving on.

In reading this we hope you share the excitement with feel as we discover, first of all, the migration route of Eurasian Cranes from Siberia and second, as we learn about the telemetry system in hopes it will prove suitable for work with the even more precious Siberian crane in 1991.

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Welfare of the Tallest Flying Bird in the World

Prakash Gole

In Search of the Tallest Flying Bird

Sarus Crane, the tallest flying bird in the world is not faring well in India. I reached this conclusion after a two-year (1988-90) investigation spanning almost the entire range of the crane. I logged some 20,000 kms travelling by road through north Maharashtra, MP, UP, Bihar, Orissa, Assam, W. Bengal, Rajasthan, Gujerath and Haryana searching for Sarus in some of the remotest areas of these states. I travelled mainly in winter, spring and early summer, the purpose being to observe as far as possible Sarus families and their life and movements. Earlier in 1982 I had studied the nesting of Sarus in the Keoladeo Ghana National Park near Bharatpur in Rajasthan.

In my travels I could observe about 1600 Sarus cranes including 140 families i.e. Sarus pairs accompanied by one or two juveniles and 538 pairs. The rest were either in flocks or singletons. The largest Sarus flock I came across consisted of 38 Sarus. Even in flocks it was possible to separate pairs from those that have yet to form a pair bond.

Sarus crane is a bird of wetlands. In observing the Sarus I could also perceive the conditions of our wetlands of north India. In the course of the journeys I visited about 500 wetlands small and big and of varied types : marshes, river basins, ponds, lakes, reservoirs, canal seepage areas, estuaries and deltas. Be-

sides, I noticed crops and agricultural practices and the status of degraded and wastelands; for I saw Sarus utilizing all these habitats.

Sarus was never found far away from human settlements. Indeed in some parts of its range it is impossible for the Sarus pair to move away from people, so densely populated these regions are! I therefore, made it a point to ask people what they feel about the ubiquitous pair and if they could remember any instances of peaceful or violent interactions with these cranes.

I had also circulated a questionnaire to members of the Crane Working Group of India. Some of the members provided me details of the Sarus residing in their own localities.

The Movements of the Sarus Family

Sarus chicks are precocious, moving in and about the large nest within hours of emerging from egg-shells. In the marsh they are adept at concealing themselves whenever the parents raise an alarm even though their cinnamon-brown colour does not particularly match the blue-green aspect of the marsh. As the days pass parents gradually enlarge the foraging area. Yet my encounters with Sarus families never took place far away from wet areas. Till the juveniles separate and become independent of parents, movements of the Sarus family are restricted to wet areas be they marshes, ponds overgrown with vegetation or flooded agricultural fields. I have seen juveniles as tall as parents moving as a family in such well-watered and wet areas. At that time the juveniles should be 5 to 7 months old. The juveniles get their food mainly from wet habitats and secondarily from agriculture. Proteinous food required by juveniles for their growth should be available in greater quantities in wet areas than in dry ones.

At night the family roosts on a slightly raised portion of the marsh, on a mound or at the base of a tree.

Habitats the Sarus Use

Pairs unencumbered by juveniles, did not have to restrict themselves to wet areas. Indeed their habitat utilisation varied from region to region. Today Sarus numbers are the highest in UP. Almost 75% of the total area of this state is devoted to cultivation of food-grains. No wonder then as many as 70% of

the Sarus observed in UP were in agricultural fields. In Haryana where also agriculture is intensive, pairs were mainly seen in fields. But these were found always to be not far away from water. Wet areas in Haryana are mainly lakes and spots where water seeping from canals, collects. Sarus appeared to be restricted to these areas.

Habitat-utilisation in Gujerath was more or less similar to that in Haryana. Sarus in Gujerath are numerous in Kheda and Vadodara districts. These districts are well-watered as cultivation thrives on irrigation. Sarus pairs, though utilizing agriculture and other dry areas more than families, were indeed never far away from water. They returned to roost in marshy and lakeside areas even if they were utilizing dry areas during the day.

Rajasthan is not a major producer of food-grains in India. Naturally more Sarus in this state were observed near lakes and rivers than in agriculture. Families were invariably located in marshes or by the side of ponds while pairs seen in cultivation were really never far away from water. Canal seepage areas again provided a major habitat for Sarus in Rajasthan. In some of these areas (Kota) Sarus pairs breed in all but the driest months of the year (i.e. May and June).

Sarus, therefore, though collecting a large portion of its food from cultivated areas, was seen to be intimately connected with our wetlands. The welfare of the tallest flying bird appears to be largely conditioned by the health of the wetlands of our country.

The Social Evenings

Next to wetlands and cultivation two other habitats were seen to be significant in the life of Sarus. They are fallow lands and wastelands. These open spaces served as gathering and loafing points and had a peculiar function in the life of Sarus. As juveniles become independent and are separated from parents, they tend to collect often in an open area. Such gatherings of sub-adult Sarus were mainly observed in the afternoon and evenings. A lot of activity was noticed in such flocks—dancing, pirouetting, running with wings spread, mock challenges and sparring, bowing and jumping made these gatherings lively and attractive. They were noisy too as Sarus pairs also seemed to be attracted to participate in such socializing through unison-

calling which probably served to strengthen their pair bond. It is during such social evenings that the sub-adults probably searched for their mates; and this socializing invariably took place in fallow and wastelands. It is on these lands that the legendary pair bond of the Sarus is therefore, formed.

Such social gatherings of Sarus were particularly noticed in UP and to a lesser extent in Gujerath and Rajasthan. In UP due probably to over-use of irrigation and fertilizers, a lot of cultivated land has turned saline. Extensive areas of these "usar" lands are particularly seen in Aligarh, Etah, Etawah, Farukhabad, Hardoi, Mainpuri, Rae Bareli and Unnao districts. Sarus were seen to be numerous in these districts with a large percentage of saline and water-logged land. In Gujerath Sarus collected in fallow lands not far away from water bodies such as lakes, canals and streams. A peculiar case was reported from Khambat where Sarus used beaches along estuaries and river-mouths for loafing. In Rajasthan fallow areas along canals and jheels were used while a number of Sarus gathered in the shallows of the Kali Sindh river where a lot of socializing went on in the evening before the flock roosted in the river-bed.

The Activity Pattern and Habitat Utilization

For Sarus families the day began with feeding in marshy and wet areas, while most of the pairs without chicks went to fields for food. In late morning a few pairs came together in fallow fields and wastelands where bouts of unison-calling, dancing and running about, were noted. The noon hours were either in and around lakes, or in rivers or in agriculture under the shade of a nearby tree. I had seen pairs and families standing under the scant shade of an acacia bush in a cotton field in Gujerath. The water, a ditch filled with rain water was nearby! In the afternoon there was another session of feeding in agriculture or wet areas. In the evening gatherings of 20 or more Sarus were seen again in fallow or wastelands where a lot of activity and socializing were evident.

In May and June when most of the farms lie fallow, when the temperature crosses 40°C. over much of the Sarus range, and when lakes, ponds and marshes dry up, scattered pairs and subadults come together at a few spots which still retain water. Large gatherings of Sarus are then seen, ranging from a few

scores to a couple of hundred cranes.

If we relate the use of various habitats by Sarus to its activity pattern of feeding, resting, loafing, roosting and nesting, marshes and ponds each sustained 16 Sarus activities in the 4 states (Haryana, UP, Rajasthan and Gujerath) in which Sarus is commonly found today. Cultivation, so important for feeding, becomes less important if all the Sarus activities are considered. The ideal habitat-combination for Sarus appears to be marshes, ponds, fallow land and cultivation-- in that order. The spread of cultivation may benefit Sarus in terms of feeding but it will hamper some of its other activities and as a whole he will not be better off.

The Pair Decides to Nest

The nesting is invariably related to shallow pools overgrown with vegetation. The nest may be constructed in clear but shallow patch of water (the surrounding vegetation uprooted to make the nest platform); in dense *typha* stands; on a raised mound in a marsh or even in a pond entirely covered by water hyacinth (*Eichhornia crassipes*). Flooded rice fields is another nesting location; but farmers may not tolerate such nests.

In Haryana and Gujerath the nesting season extends to monsoon and immediate post-monsoon months. In Rajasthan Sarus nests during the short monsoon season but year-round availability of water in the canal seepage areas has extended the nesting season almost throughout the year except May and June, the driest months. I have seen Sarus incubating eggs in mid-April in these areas. In UP also, in well-watered localities Sarus nests from July to April.

Sarus is not a colonial nester, though in favourable locations such as Keoladeo National park, as many or more nests can be found in a 5 sq km area (In recent years however, Sarus is unable to nest due to paucity of water in the Park). Again in well-watered localities almost every pond will hold a Sarus nest. Such regions include pockets in the districts of Rae Bareli, Lakhimpur, Lucknow, Farrukhabad, Etawah, Mainpuri, Bahraich and Gorakhpur in UP; in Kheda, Vadodara and Surat districts in Gujerath and in Kota in Rajasthan.

The above account may convey the impression that Sarus is generally doing well in our country and its future is fairly

secure. I can offer however, several reasons why I think otherwise.

Sarus : How Far and How Many?

Let us consider the present Sarus range (see map). While searching for Sarus in the several states, I was particularly noting the fringe areas beyond which Sarus does not occur today. Such fringe areas include Bhandara and Chandrapur districts of Maharashtra; Rewa, Chhatarpur and Gwalior in MP; regions east of Allahabad in UP; Hissar and Panipat in Haryana; Jodhpur in Rajasthan and Surat and Valsad in Gujerath. Beyond these fringes Sarus occurs sporadically and is not resident. It may be remembered at one time (may be upto the nineteen fifties; we do not have detailed records of its former distribution) Sarus used to range from Sind in the west to the border of Burma in the east and from Kashmir in the north to the Godavari river in the south. Now the Sarus range is substantially narrowed down. Sarus to-day is mainly found only in 4 states of the Indian Union as described above. It is restricted to small pockets in MP and Maharashtra and to a few valleys in Himachal Pradesh. Its occurrence in Bihar and West Bengal is at best sporadic and it has disappeared from Punjab in recent times.

What about its numbers? No earlier estimate exists and since 1987 the annual waterfowl counts showed Sarus numbers of about 300. As pairs and families remain scattered and rarely collect in flocks when the count is carried out in January, the crane numbers might be under-estimated. I have, after carefully examining the distribution in different districts of the 4 states, hazarded a guess that the total population of Sarus in India is around 12000.

But it probably is a declining population. Let us consider the rate of recruitment in our sample population. In the sample of 1587 Sarus 197 were juveniles; i.e. 12% of the total. This can be compared with 43 to 60% in Common cranes (*Grus grus*) nesting in Germany and 20 to 50% in Mississippi Sandhill cranes of USA. Both these species, like Sarus, are not yet endangered. Even the endangered Red-crowned crane (*Grus japonensis*) showed a better recruitment rate (10 to 19% between 1966-79) in Hokkaido, Japan, where it is protected.

A greater percentage of juveniles to adults was observed in Haryana and Gujerath (17 and 16% resp.) than in UP and Rajasthan. But the number of Sarus in the latter two states is far higher than the former two. Indeed in UP where Sarus numbers are the highest, the recruitment rate was less than the average for the whole sample. If Sarus breeding in Kota area are excluded, the percentage of juveniles to adults in Rajasthan will be less than in UP. It therefore, appears that a majority of Sarus are not successful in rearing their offsprings to maturity.

Sarus and the People

If a majority of Sarus are unable to raise their chicks to maturity, the conditions of the wetland habitat on which Sarus depends for nesting and feeding, must have deteriorated. Indeed in UP many a village pond have become cesspools of filth and are covered by weeds. Many jheels are put under the plough as soon as the dry season begins. The canal seepage areas which provide year-round breeding habitat for Sarus in Kota, Rajasthan, are sought to be drained in Haryana and UP for agriculture and human settlements including industry.

To a certain extent the movement of people and cattle does not disturb Sarus if the ethos of the population is favourable to the crane. But popular sentiment does not protect Sarus all through its present range. While the sentiment is fairly strong in Gujerath, Rajasthan and west and central UP, it is less so in east UP, Bihar and MP, especially in the tribal areas. Even in Gujerath Sarus is not protected in tribal areas. In Assam people were surprised when we told them that Sarus is protected through sentiment in some regions of the country!

Where the sentiment is strong, the farmers tended to connive at the loss to their crops inflicted by Sarus. I have seen Sarus attacking standing crops to eat grains from cobs. But scattered pairs might not be able to inflict a substantial loss; I had never seen a flock of Sarus going on rampage. When asked, people in Rajasthan, central UP and Gujerath told that they did not mind the damage as it was never heavy. Very few remembered any interactions with the pair, peaceful or violent. In north Maharashtra I was told that farmers destroyed Sarus nests if those were found in standing paddy. In parts of eastern UP Sarus is hunted for meat. But in the rest of its range the presence of the

pair is just taken for granted. I have seen Sarus pairs foraging within 15 meters of a family working in the field.

The Predators

Neither is Sarus troubled by avian predators. A nesting Sarus is not afraid of eagles and hawks flying overhead or swooping down! Indeed I had seen Sarus attacking a Spotted Eagle (*Aquila clanga*) in Keoladeo National park and compelling it to abandon a fish he was holding in its beak. A mature Sarus has perhaps no enemies other than man. But Sarus chicks may be ambushed by jungle and fishing cats, mongooses and jackals while moving through tall grass and other vegetation. On a riverine roost in the Kali Sindh river Sarus were killed as they collided against overhead electric cables, while coming in to roost in failing light. Similar accidents were reported from certain areas of UP. The BNHS research team in Bharatpur have on record cases of pesticide poisoning of Sarus. This last case is more pertinent than others to the point I am now about to make.

The Threatening Milieu*

Let us have a close look at the areas in which Sarus is found today. If we look at the physical map of India, it will be evident that Sarus is resident in the flood plains of certain major rivers of the country such as the Yamuna, the Ganga and the Ghagra in UP; the Sindh, the Betwa and the Ken on the border of UP and MP; the Banas, the Chambal and the Kali Sindh in Rajasthan and the Mahi and the Sabarmati in Gujerath. It resides in areas at or near the sea level. In Gujerath it occupies areas close to the sea shore.

Yet Sarus is neither a coastal bird nor is it found in all the low-lying areas. We had already seen that Sarus utilizes wet areas and agriculture. Yet Sarus is not found wherever fields and marshes are found. While doing transects in UP in November 1988, it was impossible to avoid the impression that Sarus was associated with paddy. Yet Sarus is not found in all the paddy-growing areas. Sarus is never far away from human beings; yet it is resident only in a handful of states of India. There must be

*Discussion in this section is based on statistics taken from Social & Economic Atlas of India, Oxford University Press.

some reasons why Sarus is found in certain areas and why it does not occur in other areas.

India is a developing country. There are certain indices which signify the pace of development. Urbanisation, industrialization and modernization of agriculture including greater use of fertilizers and machinery, spread of irrigation, are some of the indices of development. Enhanced production in agriculture and industry are the products of development. As Sarus is closely associated with human beings, this "development" is bound to affect it for good or for worse. Let us now examine if this had indeed happened. Let us see how the areas in which Sarus is resident in good numbers, have so far fared in terms of development.

Let us take industrialization first.

In Haryana Sarus is mainly found in Gurgaon, Sonipat and Rohtak districts. While the former two are industrially advanced, Rohtak comes under the category of 'backward district' in terms of development. In Gurgaon and Sonipat, inspite of the industry, the maintenance of large wetlands appears to have benefited Sarus. Similarly Kota in Rajasthan and Kheda and Vadodara districts in Gujerath are industrially advanced. But maintenance of large ponds, lakes and wetlands including the canal seepage areas and irrigated agriculture have contributed to the well-being of Sarus. If these special factors change, and there are indications in Haryana and Rajasthan of increasing human pressures on the wetlands, the future of Sarus will not be secure in these states.

In UP however, the districts of Bahraich, Kheri, Etawah and Mainpuri, where Sarus is numerous, all fall under the backward district category.

Nor is the rate of urbanisation very high in the districts in which Sarus is numerous, except in Haryana. During 1971-81 Kota, Kheda and Vadodara recorded no increase in urbanisation while in the above UP districts urbanisation increased only gradually.

In terms of density of human population again, districts in Haryana have recorded a rapid increase during the above period but Kota and Vadodara and Kheri and Bahraich have recorded only a gradual increase in population density. Kheda, Etawah and Mainpuri have not recorded any increase in popu-

lation density at all.

Now consider agriculture with which Sarus is so intimately concerned. Is the agriculture in Sarus districts 'modern' in terms of mechanisation, use of fertilizers etc? The number of tractors per 1000 human population is as low as 1 to 3 in all states (except Haryana) in which Sarus is resident. Only in Haryana it is 7.47 per 1000 human beings. In all 'Sarus' states the consumption of plant nutrients is also low, between 8 kg. (Rajasthan) and 45 kg. (UP) per hectare compared to 93 kg. in Punjab. The consumption of fertilizers is 50-75000 tonnes for the whole district in Kheda, 25-50000 tonnes in Vadodara, Pilibhit, Kheri, Bahraich and Etawah districts, 15-20000 tonnes in the districts of Mainpuri, Rohtak and Sonipat and still lower in the other Sarus districts such as Kota, Bharatpur and Gurgaon. In all the Sarus districts the production of rice and wheat is only 1 to 3 tonnes per hectare far lower than in Punjab. One reason for the low production, especially in the districts of UP, is the high percentage of salt-affected and water-logged land in many of the districts in which Sarus occur.

On the whole Sarus appears to reside in areas where industrialization is localised and has not led to a great increase in urbanisation and population density; where agriculture is of low intensity and not sufficiently modernised; where yields are low due probably to low consumption of fertilizers and where due to salt-affected and water-logged conditions, no large-scale investment in agriculture is made and where agriculture may be more or less practised as subsistence farming.

If the above reasoning is correct, i.e. Sarus seems to be numerous in the so-called backward areas of the country, the threats to its future become self-evident. They are : a great increase in industrialization leading to destruction of Sarus habitat; rapid increase in urbanisation and population density; rapid modernisation of agriculture leading to uniformity of habitat, reclamation of wetlands, greater use of machinery, fertilizers and insecticides; in effect intensification of all the indices of economic development. It appears that all these factors or indices are operating with greater intensity in Haryana than in the other Sarus states. Unless special efforts are taken to protect the habitat of Sarus, its future in Haryana will not be secure. Indeed it may already be on the retreat from that

state as was the case in Punjab a score of years ago. In UP the destruction of wetlands appears to be affecting Sarus in its reproduction and may in the long run threaten the crane. In Rajasthan and Gujerath the wetlands do not appear to be threatened immediately. Greater spread of industry and intensification of agricultural development may pose a threat to the future of Sarus in these states if proper care is not taken.

Ensuring the Sarus Welfare

It is interesting to note that where shallow, freshwater wetlands are available all the year, Sarus breeds almost throughout the year. Availability of water in the nesting habitat appears to be the critical factor inducing Sarus pairs to nest. The pairs breed in a scattered fashion and even if a large area is available (such as K. G. National Park), pairs maintain a nesting territory and remain spaced out. Creation and maintenance of large nesting areas do not seem to be the prime need for ensuring the successful nesting of Sarus. Even small wetlands such as village ponds, if maintained in good condition as freshwater reservoirs, can support one or two nesting pairs. Such ponds can be used by human beings as well as Sarus and will be far cheaper to maintain than a large reserve. Villagers can be encouraged to maintain freshwater ponds and regulate their use so that while benefiting themselves they will also offer shelter to wild birds and animals.

Sarus is a part of the Indian village scene and should be allowed to remain so. A little care and restraint by man appear to be sufficient to ensure its survival and welfare.

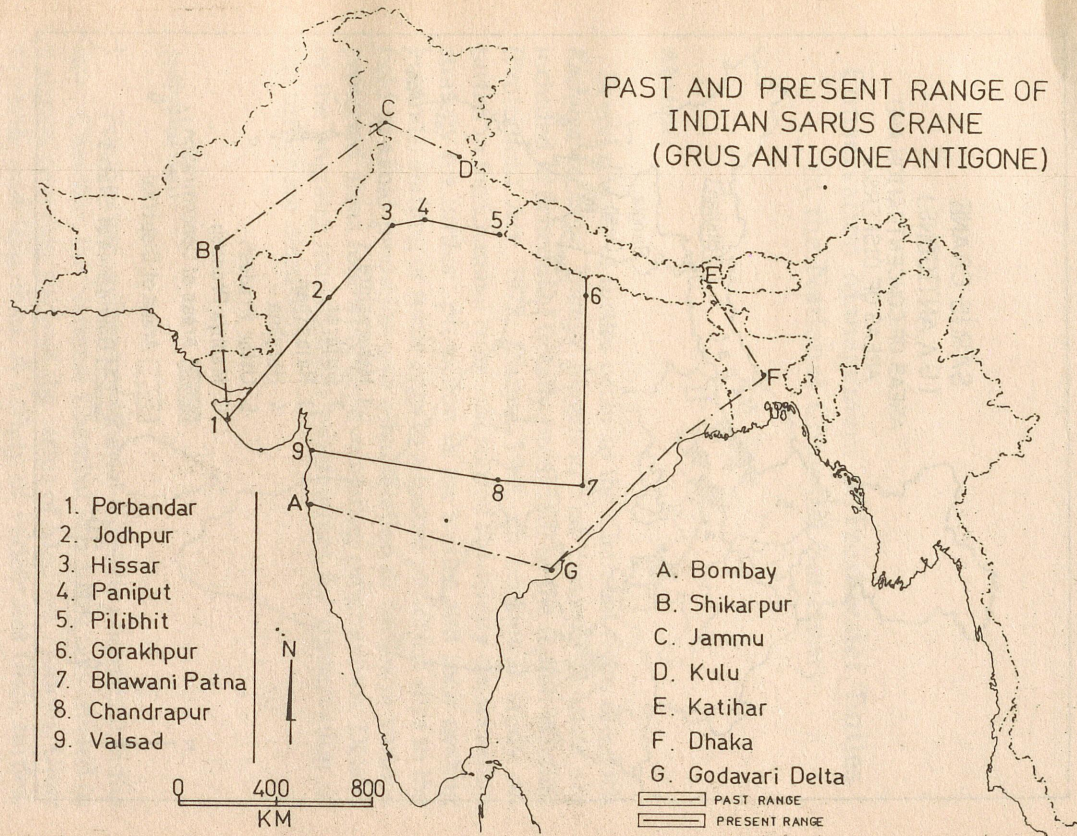
Maintenance of wetlands and well-watered areas and the positive sentiment of human population towards this ancient, epical and the tallest flying bird, are the prime factors that will decide the future of this magnificent avian.

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Acknowledgement

The author is grateful to the Chief Wildlife Wardens of Maharashtra, MP, Orissa, Bihar, Assam, UP, Rajasthan & Gujerath and their staff for their help. He is grateful to many members of the Crane Working Group of India for their help in field-work. The Sarus Crane Study was funded by the Ministry of Environment & Forests, Government of India.

PAST AND PRESENT RANGE OF
INDIAN SARUS CRANE
(GRUS ANTIGONE ANTIGONE)

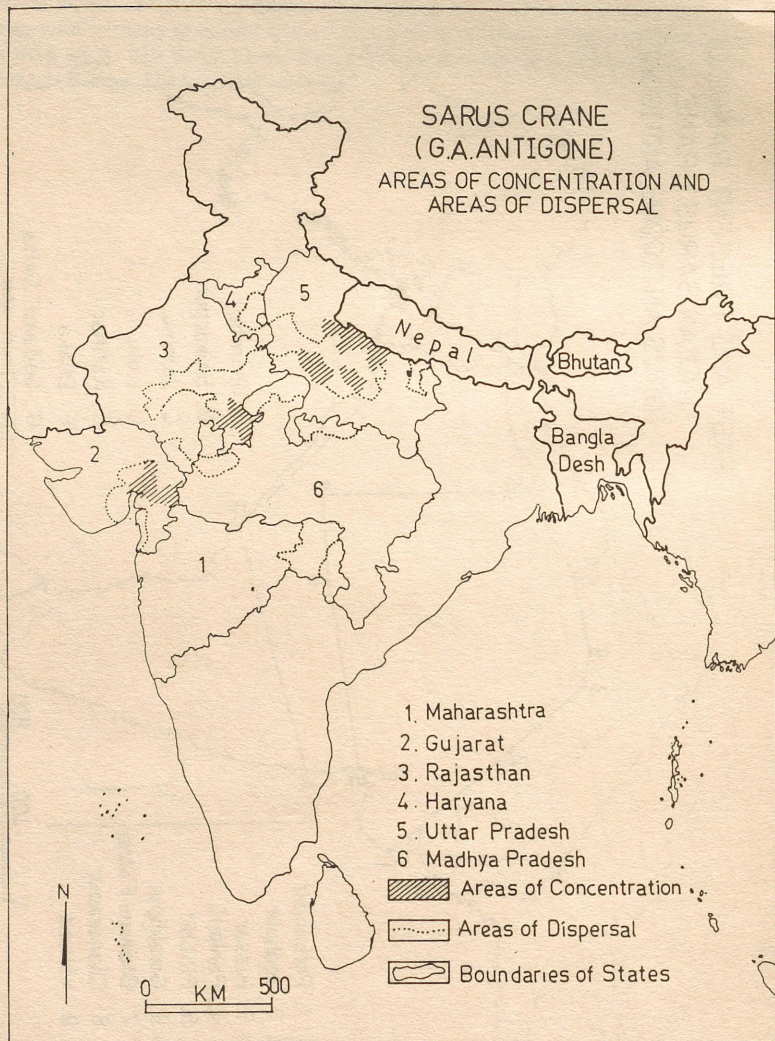


1. Porbandar
2. Jodhpur
3. Hissar
4. Paniput
5. Pilibhit
6. Gorakhpur
7. Bhawani Patna
8. Chandrapur
9. Valsad

- A. Bombay
- B. Shikarpur
- C. Jammu
- D. Kulu
- E. Katihar
- F. Dhaka
- G. Godavari Delta

--- PAST RANGE
— PRESENT RANGE

SARUS CRANE
(G.A. ANTIGONE)
AREAS OF CONCENTRATION AND
AREAS OF DISPERSAL



Conservation Management of Freshwater Turtles in the National Chambal Sanctuary

R. J. Rao

Abstract

Seven species of turtles occur in the Chambal river, of which *Kachuga kachuga*, *Trionyx gangeticus* and *Lissemys punctata* are included in Schedule I (totally protected) of the Indian Wildlife (Protection) Act, 1972. During 1983, an ecological study on turtles in the Chambal river was started to identify conservation strategy for turtles : protection to the turtles and their nesting grounds, shifting of turtle eggs to adjacent protected sites in the field to avoid predation and rehabilitation of turtles in various protected areas following captive rearing programmes. Details of the ongoing management programmes for conservation of the turtles are discussed.

Introduction

For the management of Gharial (*Gavialis gangeticus*) in the river Chambal, the National Chambal Sanctuary was created in a region covering parts of the states of Madhya Pradesh, Uttar Pradesh, and Rajasthan. A variety of vertebrates (fish, turtles, crocodiles, wetland birds and mammals) continue to occur here in a habitat which is very little altered over the years because of human activities. The Sanctuary offers a unique opportunity to study aquatic fauna.

Recent concern over the steady decline in populations of different species of freshwater turtles in different river systems in India has prompted research and conservation programmes on freshwater turtles in different parts of India (Moll 1984; Rao 1986). As relatively little is known about the biology and ecology of freshwater turtles in India (Moll 1986), their populations in the National Chambal Sanctuary are of great scientific interest. Ecological studies on freshwater turtles in the National Chambal Sanctuary were initiated by the Wildlife Institute of India in October 1983 (Rao and Singh 1984). This paper discusses the state of current knowledge on the ecology and conservation management of freshwater turtles in the National Chambal Sanctuary.

Study Area

The study was conducted in a stretch of 400 km of the Chambal river, which is under the management of the National Chambal Sanctuary. The Chambal river is perennial, having its origin in the Vindhyan Range near Mhow district of Madhya Pradesh. It flows in a North-eastern direction, passing through Rajasthan up to the point where its major tributary, Parbati, joins it near Pali. Thereafter, it flows in an easterly direction, forming the boundary of M.P., Rajasthan and M.P. and Uttar Pradesh. It joins the Yamuna River near Bareilly of Etawah district of U.P. The Yamuna, in turn, flows in south-east direction till it meets the Ganges at Allahabad in U.P.

The deep and fast flowing Chambal river varies considerably in physiography. At places the river is shallow and fast and there are many shallow riffle areas. The substrate ranges from mud and silt to sand and rock. When the water-level is low (April-June) the river is 150-250 m wide and has a maximum depth of 20 m. During wet season (July-September) the river floods naturally and the extent of erosion and deposition of soil is considerable. During this period the maximum depth of the river is around 50 m. The water temperature ranges from 15°C during winter to 33°C during summer. A series of multipurpose dams at Gandhi Sagar (M.P.), Rana Pratap Sagar (Raj.), Jawahar Sagar (Raj.) and Kota barrage (Raj.) have been erected in the upper reaches of the Chambal river (Fig. 1), which greatly influence the waterflow in the study area. General information

on climate, vegetation characteristics and fauna of the study area was described earlier (See Rao and Singh 1984).

Turtle Species In the Chambal River

Based on collections of shells and live specimens, four species belonging to two genera and one family of hardshell turtles, and 3 species belonging to three genera and one family of softshell turtles were identified in the Chambal river (Table 1). They are : *Kachuga kachuga*, *K. dhongoka*, *K. tentoria circumdata*, *Hardella thurgii*, *Chitra indica*, *Lissemys punctata* and *Trionyx gangeticus*. Among them *Hardella thurgii* appears to be the rarest turtle in the Chambal river as only one shell was collected on 13.4.1985. No live specimen has been found since 1983. The other hard-shell turtle species are found all along the Chambal river, which use rock out-crops, sand bars and hardsoil for basking and large sand bars and other protected and isolated areas for nesting. Soft shell turtles occur throughout the study area and prefer slopey edges (at least 30 cm) of otherwise flat sand banks bordering a flowing strip of water over 50 cm deep for basking. *Trionyx gangeticus* and *Lissemys punctata* lay eggs on muddy banks, preferably inside gullies. Details on the habitat requirements, basking and nesting behaviour of turtles are reported elsewhere (Rao and Singh 1985 a,b,c).

Threats

Human activities

Multifarious human activities in recent years have increased the adverse impact upon turtle populations in the National Chambal Sanctuary. These activities include illegal fishing, sand-mining, agricultural practices on the river banks and wood-collection from riverside vegetation (Rao 1987b). Because of sand mining and agricultural practices eggs of hard shell turtles (10%) and soft shell turtles (*Trionyx gangeticus*) (50%) were destroyed at Rajghat in a stretch of 8 km during the 1987-1988 nesting season. Due to construction of dams and barrages in the upper reaches of the Chambal river, water level has decreased and fords have appeared dividing the river course into smaller segments (Singh and Sharma 1985). The irregular water release caused inundation of turtle nests. All the hardshell turtle nests

(*Kachuga sp.*) monitored during 1985 were flooded (100%) due to release of water from the dams (Rao and Singh 1987b).

Data on the exact number of turtles that died in the illegal fishing activities are difficult to obtain. It was evident however, that the fishing operations have increased in the Chambal river and fishermen killed turtles also. During 1970s a large number of turtles were caught from the Chambal river and exported to Howrah market. *Trionyx gangeticus* is the most utilised turtle of the Chambal. In spite of the protection provided under the law, accidental as well as intentional captures do take place regularly. The usual mode of capture seems to be through hooks with baits of meat and animal intestine (Rao and Singh 1984).

According to Rao and Singh (1985) the numbers of the larger turtle species (*Kachuga kachuga*, *Trionyx gangeticus* and *Chitra indica*) are small in the Chambal river. Due to exploitation of the larger species over the years and habitat destruction recovery of their populations has become difficult. The heavy loss in the eggs of these turtles also contributes to the small population size of large turtle species.

Predation

Predation is probably the most important factor that limits turtle populations in the Chambal river. Turtle eggs were heavily predated by jackals, birds etc. (Rao and Singh 1989c). Predation on the small-sized juveniles is expected to be high and adult nesting females are also usually attacked by predators. Jackals also predate on the newly emerged hatchlings before the hatchlings enter the river (unpublished data). Overturned turtles were found at different nesting sites (Rao and Singh 1987c). This probably resulted due to attacks by predators. These overturned turtles if remained in direct sunlight for a considerable time, suffer thermal stress and may die if not quickly removed to a cooler environment. Carcasses of *gravid Kachuga* species were located at different nesting sites (Rao and Singh 1987a). Reasons for such mortalities are difficult to explain.

Conservation

The most acute problems faced by turtle populations in India in general and in the Chambal in particular, are associated with

habitat destruction and other human activities, particularly commercial exploitation. To save the turtles from exploitation the Union Government provided total protection to a number of endangered *chelonians* under the Wildlife (Protection) Act, 1972 (Rao 1985). Of the seven species of turtles present in the Chambal river, three species, *Kachuga kachuga*, *Trionyx gangeticus* and *Lissemys punctata* are included in Schedule I of the Wildlife (Protection) Act. *Trionyx gangeticus* and *Lissemys punctata* are also included in Appendix I of the Convention of International Trade in Endangered Species of wild fauna and flora (CITES), which prohibits trade in live turtles and their products by the signatory countries to which India joined in 1979. Turtles receive incidental protection in different Sanctuaries specially created for crocodile conservation in India since 1975. Expansion of the research and management programmes meant for other aquatic fauna and flora under the Crocodile project is an excellent example to demonstrate multidisciplinary approach in wildlife management.

Management

Since 1978, management programmes for the conservation of gharial have been initiated in the National Chambal Sanctuary. Forest Departments of three States namely Madhya Pradesh, Rajasthan and Uttar Pradesh are involved in the management programmes. In the Sanctuary fishing was banned to avoid accidental death of gharial by drowning in the nylon gill nets. Rehabilitation of gharial under 'grow and release programme' (FAO, 1974) is being carried out in the Sanctuary. Protection afforded to crocodilians have helped the turtle species in the Chambal. Research on the ecology of turtles, has enabled scientists recognise and appreciate the magnitude of various problems in the Conservation of turtles in the National Chambal Sanctuary. Based on the results of these studies conservation measures which have been suggested include habitat management, species protection and public awareness and education as detailed below.

Habitat preservation

In the light of problems recognised, control of disturbances due to sand mining, agriculture practices and wood cutting at the nesting sites and checks on irregular water releases from

dams and barrages to avoid inundation of turtle nests have been suggested. Other suggested conservation measures include declaration of core zones in the Sanctuary where measures will be taken to preserve the basking and nesting habitats of turtles.

Species preservation

Although laws exist, the habitats of turtles are sometimes so remote that it has not been possible to ensure that these are implemented effectively. Measures have been taken in the Sanctuary to protect the turtles. Protection staff posted all along the river keep regular vigil to stop illegal capturing of turtles. Experiments carried out during the study period suggest that shifting of freshly laid turtle eggs to a protected area in the field is a feasible way to protect the eggs from predators. A few central hatcheries in the river bank near important nesting sites were constructed and the field staff collect turtle eggs carefully for incubation in those hatcheries. Most of the turtle nests are also protected *in situ* by placing iron wire mesh over them. The same practice protects gharial eggs in the Sanctuary (Rao 1988).

Turtle Rehabilitation Programme

"Grow and release" programme initiated for crocodylians may also be instituted for the turtles to ensure their survival (Choudhury and Choudhury 1986) on an experimental basis. Captive-rearing of freshwater turtles was initiated at Deori Gharial Rearing Centre (DGRC), National Chambal Sanctuary, M.P., by the author in collaboration with Madhya Pradesh Forest Department in 1984. Although results were not encouraging in the first year of the programme due to lack of experience, hatching success for eggs of *Kachuga* species was 60% during 1985 (Rao 1985). Since 1985, turtle eggs are being collected from the Chambal river for captive rearing programme. During 1987, the captive rearing programme was also extended to *Trionyx gangeticus* by collecting eggs for incubation at DGRC (Table 2). All the newly hatched turtles are reared along with gharial, according to size groups. Turtles are also reared in separate rearing pools. All turtle species that occur in the Chambal river (except *Hardella thurgii*) are being reared at DGRC. Suitable areas in the sanctuary, where disturbance is minimal are identified for releasing the captive reared turtles.

Since 1986, eggs of *Trionyx gangeticus*, *Lissemys punctata* and *Chitra indica* are being collected from the National Chambal Sanctuary under a Project on rehabilitation of freshwater necrophagous turtles for the biological control of partly cremated corpses that pollute the Ganga river. The Project ensures protected nesting, breeding and rearing of the young turtles and their eventual release into the River Ganga (Basu 1987). Under the Project, measures have been taken to stop poaching by declaring certain areas as closed to ensure rehabilitation of the captive reared turtles. The author is also involved in the surveys conducted from August-October during 1986-1988 in the Chambal river to collect turtle eggs.

Captive Breeding Programme

A project on captive breeding of endangered turtles and tortoises is under consideration by the Department of Environment and Forest, Govt. of India, under an Indo-US Agreement involving the Wildlife Institute of India. In the project, captive breeding of *Kachuga kachuga* is also proposed. Since 1987, *Lissemys punctata* is regularly breeding in captivity at DGRC. Measures are taken to acquire breeding groups of *Kachuga dhongoka*, *K. tentoria*, *K. kachuga* and *Trionyx gangeticus* for captive breeding at DGRC.

Conclusion

The results of the research studies at the National Chambal Sanctuary suggest that the information obtained may help to define more precisely the management programmes required for turtle conservation, and thus facilitate promotion of suitable measures for the conservation of turtles in other river systems in India. With the implementation of the turtle conservation project in India we expect to have fairly good populations of turtles in different water bodies in India.

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Acknowledgements

I am highly thankful to the Director, Wildlife Institute of India, for providing the necessary facilities for conducting ecological studies in the National Chambal Sanctuary. The Chief Conservator of Forests (Wildlife), M.P. kindly gave permission to work in the Sanctuary. I am also thankful to Dr. K. K. Tiwari, Vice Chancellor, Jiwaji University, Gwalior and Prof. J. Bahadur for encouragement. Thanks are due to Dr. L. A. K. Singh and B. C. Choudhury for help and useful suggestions.

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Table 1

Freshwater Turtles in the
National Chambal Sanctuary

Family	Genus	Species
Emydidae	Kachuga	tentoria
		dhongoka
		kachuga
Trionychidae	Hardella	thurgii
	Trionyx	gangeticus
	Chitra	indica
	Lissemys	punctata

Table 2

Turtle Captive Rearing Programme at
Deori Gharial Rearing Centre

Year	Species	Eggs	Eggs	No. of turtles*
1985	<i>Kachuga kachuga</i>	10*	3	6**
	<i>Kachuga dhongoka</i>	34	26	---
	<i>Kachuga tentoria</i>	23	11	---
1986	<i>Kachuga kachuga</i>	---	---	---
	<i>Kachuga dhongoka</i>	165	72	4
	<i>Kachuga tentoria</i>	92	62	0
1987	<i>Kachuga kachuga</i>	---	---	---
	<i>Kachuga dhongoka</i>	120	72	51
	<i>Kachuga tentoria</i>	15	10	---
1988	<i>Kachuga kachuga</i>	21	14	12
	<i>Kachuga dhongoka</i>	24	8	5
	<i>Kachuga tentoria</i>	11	9	7
	<i>Trionyx gangeticus</i>	72	34	9
	<i>Lissemys punctata</i> **	5	4	2
1989	<i>Kachuga kachuga</i>	60	33	33
	<i>Kachuga dhongoka</i>	---	---	---
	<i>Kachuga tentoria</i>	89	78	71
	<i>Trionyx gangeticus</i>	142	68	62
	<i>Lissemys punctata</i>	6	4	3

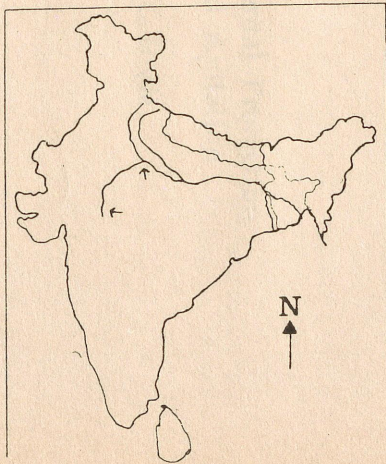
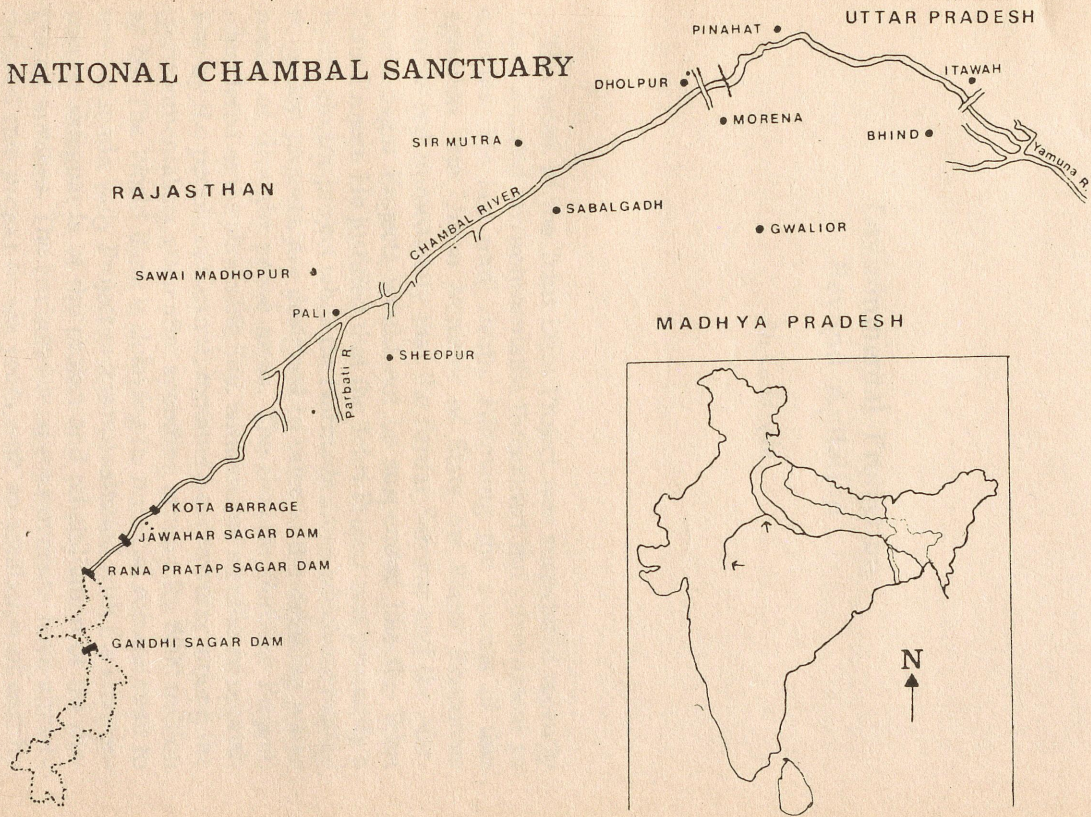
* As on 30.8.1988

** Hatchlings were also collected from the field.

+ Eggs laid by wild caught female

** Captive bred animal.

NATIONAL CHAMBAL SANCTUARY



Environmental Protection Beyond Agitation

N. G. Hegde

The work of the Tehri Dam Project was suspended recently when a noted environmentalist threatened the government to continue his fast until death. Following the success of this agitation, the Union Minister of State for Water Resources announced immediately that the Sardar Sarovar and the Narmada Sagar Projects would not be suspended like the Tehri Dam Project. He justified that the Tehri Project was primarily a hydro-electric project while the Narmada dams which are mainly irrigation projects, are designed to cater to the drinking water needs of drought prone areas. The Saradar Sarovar Project, considered as the state's life line, without any significant opposition by the people of Gujarat, remains a controversy among the environmentalists, even after spending around Rs. 8000 million so far. The World Bank is delaying its financial commitment to the Narmada Vally Project as it is not satisfied with the environmental safeguards of the project and rehabilitation of the displaced families. The environmental controversies have already delayed this project by six years with an escalation of cost by about 50 per cent, over the original cost of about Rs. 65,000 million. The project is expected to generate additional agricultural products worth Rs. 120,000 million every year. So we have lost the opportunity to generate GNP worth Rs. 6000,000 mil-

lion, ten times more than the total investment, in Gujarat state alone.

It is heartening however, to note that a lot of environmental activists are trying to create awareness among the common public about the need for protecting our environment. Certainly this is the only approach how the common public can be involved in conservation of our resources in the long run. However, most of the environmentalists are oriented to agitate against government action and tackle environmental problems in isolation, without taking other interrelated issues into consideration. While most of the environmental issues leading to agitation relate to deforestation, building up of irrigation projects, setting up of industrial projects, letting out of industrial effluent in rivers, there are several other issues which are opposed by the environmentalists. Some of these, issues affecting the common public, are the introduction of high-yielding crop varieties and exotic tree species, upgrading of non-descript cattle using exotic breeds, use of chemical fertilizers and pesticides and so on.

Improved Seeds

Introduction of Mexican wheat varieties and Taichung rice varieties were heavily criticized in the past. However, the environmentalists did not put forward any alternative proposals necessary to increase the food production from a meagre 65-70 million tonnes to 170 million tonnes, to meet the demands of the growing population. Without the introduction of these varieties, use of higher doses of chemical fertilizers and irrigation, the food production would have remained stagnant and a time would have come to go with a begging bowl for food assistance. If any one is asked to choose between the Bengal famine of 1942 which starved millions of people to death and the post-war era of the green revolution in Punjab, which created the so called disparity between the poor and the rich, one would certainly select the latter. A hungry man cannot understand the philosophy of conservation or environmental protection, until his basic needs are fulfilled.

Recently, the Chief Minister of Karnataka, while addressing a scientific gathering, correctly remarked that the concept of environmental protection was degenerating into an unwanted and

unnecessary interference in the implementation of genuine and needed development schemes. The undue and meaningless opposition to development schemes by professional environmentalists might defeat the very purpose of environmental protection.

Quick-growing Exotic Trees

While promoting afforestation, selection of suitable tree species is also a matter of controversy. If the foresters are keen to introduce exotic tree species to improve the profitability, environmentalists insist that the indigenous species must be conserved. In this process, the most important participants of the programme, the farmers, keep themselves aloof watching the controversy between two intellectual groups. There is no dispute about the conservation of our native flora which have survived the vagaries of nature through centuries. These species have an important role to play in conserving the ecology, although we do not have a clear idea as to when and how. The most appropriate place to preserve these species is the natural forest, which is expected to cover 23% of our land area. But when we plan for afforestation on degraded wastelands, barren pastures and unproductive private lands involving rural people, we cannot force upon them the novel concept of preservation. For farmers, sustainable production becomes the primary objective to generate employment, additional revenue and to increase the profit margins. They will not expand their afforestation activity, by planting Banyan and Peepal (*Ficus* species), only because our environmentalists like them.

It is not correct to think that only exotic species yield more biomass and increase profits. The real fact is that we know very little about our indigenous species. We do not have the exact data about their rate of growth, agroclimatic requirements and the uses of the produce. On the other hand, most of the exotic species which have become popular all over the world have an extensive research history and many scientists all over the world have worked on these species for decades, to explore the outstanding germplasm, develop ideal silvicultural practices for optimising the production and process the wood into a variety of value-added products. As a result, the data presented on these species are very attractive and in the absence of any

comparative data on the indigenous species, even a layman is tempted to choose an exotic tree species hoping to earn more.

Take for example, a popular native species Neem (*Azadirachta indica*), which grows very well in dry areas. The products too have a variety of uses. Although, the seeds have been mostly used for soap production; the price paid for the seeds was not attractive enough for the farmers to collect the seeds. Fortunately, in the recent past, scientists in developing countries have explored the possibility of using neem seeds, oil and cake for controlling the pests and diseases on important agricultural and plantation crops. With the growing concern for health hazards due to excessive use of plant protection chemicals, neem products will have good demand in the future. However, we do not have adequate information about the rate of tree growth, biomass yield, seed production and profitability, which can motivate the farmers to plant more neem trees and generate additional income.

Very often, while reforesting the barren hills, the selection of species becomes a controversy. The forester might start with a fast growing tree species, which can establish well and grow fast, but the environmentalist might list the native species which existed long back, on that land. In such a situation the important procedure for selection of suitable species is to study the present micro-climatic conditions, including the moisture availability and fertility of the soil and select such species which can adapt to those conditions. The best thing will be to start with a few hardier species which can adapt to harsh conditions and improve the micro-climate gradually to facilitate the introduction of other valuable species, which were once native to that location.

Today, the most important exotic tree species which are augmenting the supply of fuelwood and minor timber in India are *Prosopis juliflora*, *Casuarina*, and *Eucalyptus*. Other species like Subabul (*Leucaena leucocephala*), *Acacia tortilis*, *Gliricidia sapium* are also making an important contribution to the fodder and fuelwood supply. These are fast growing and adapted to a variety of adverse soil and climatic conditions. In the absence of these species, we would not have met the fuelwood demand in the country today, and probably the poor people who cannot afford to buy wood, would have openly encroached upon the

forest to procure fuelwood free of cost.

Improving Cattle-breeding

Artificial insemination and cross-breeding of our native cattle is another topic of agitation. As a result of neglect and unscientific breeding, our precious indigenous cattle breeds have drastically deteriorated over a period of time. As a result today hardly 5% of the cattle population represent the recognised Indian breeds and the remaining 95% of the cattle are non-descript and uneconomical. The local cows produce 100-200 litres of milk over a long lactation of 15 to 18 months. Maintaining these cattle under stall-feeding will not be economical, but by allowing them to graze on common properties at no cost, farmers can continue to maintain them, without any financial burden, disproportionate to their land holdings and fodder resources. The male calves born to these cows need atleast 5 years before they are put to work. However, there is a strong movement to ban the slaughter of all the categories of cattle, as the present legislation protects the cows only. In this situation, upgrading of these cattle by cross-breeding with exotic breeds is the most appropriate alternative. The cross-breeds come into milk production within a period of 2.5-3 years and produce 8-10 times more milk than their mothers. The cross-breed bullocks can be put to work early at 2.5-3 years of age, and work at par with indigenous bullocks.

No doubt with the introduction of high milking genes, there is also a risk of inducing susceptibility to heat and diseases. Here it is important to think rationally about the pros and cons of various alternatives and identify the best, not only from the point of environmental protection and ecology, but also with a view to improving the income of the farmers and meet the growing demands for milk. Protection against the diseases can be taken care of by spending a few rupees on vaccinations and a programme to preserve the indigenous germplasm can be undertaken by the government in selected areas. Unfortunately the environmentalists do not want to look into the shortage of fodder, degrading pasture and forest resources.

Livestock management is in a sad state in India. Our livestock population is going to cross 500 million by the turn of the century and we will be able to produce only 50 per cent of the

feeds and fodder required to feed these animals. Under such conditions, livestock, a natural resource, which can support the livelihood of rural families will turn into a liability. These animals will consume whatever is available but will not contribute to the income of the farmers. What is needed is to control the cattle population, not necessarily by culling, but by adopting sound management practices, stall-feeding and sterilization measures so that people can maintain a limited number of animals and earn more than what they are getting today. This is a matter of education and motivation and the government is unable to introduce any legislation to control stray animals. If our environmentalists work at the grassroot level to discipline our livestock owners, and to confine the cattle to the sheds, our barren lands can gradually regenerate with native flora without heavy investment on reforestation and protection.

Half-way Agitations

Creating environmental awareness among the people is extremely important. It is not adequate only to agitate against government programmes & stop once the programme is halted. There are instances where environmentalists prevented the construction of dams with a view to restoring the forest area, but no one was on the scene, after the project was dropped by the government. People agitated when a marshy pond was allotted to a school for being converted into a play-ground. The environmentalists won the case, only to promote mosquito breeding. The chapter ends there and the focus shifts elsewhere. If agitation alone is the answer to protect the environment, it would mean treating the symptoms of a sick person than to cure the disease.

While preventing the government to implement certain programmes which may cause environmental deterioration, it is also necessary to motivate the people to protect the environment and rebuild the disturbed eco-system. Active participation of the people at the grass-root level can be a force to reckon with, not only to protect the environment, but also to encounter the culprits who are involved in polluting our environment. This can be done even without government support, provided we create an awareness among the people.

The definition of ecosystem is inter-reactions of plants and

animals and their reaction to the environment. Therefore, we cannot isolate the environment from the human and livestock populations. It is estimated that by the turn of the century, our population will cross 1.2 billion and we need to produce about 240 million tonnes of foodgrain to feed this population. It means that we need to increase our food production by 40 per cent without any additional land. When the land is limited, the other methods to increase food production are through irrigation, high-yielding varieties, higher dose of fertilizers, good plant protection practices and better tillage management. Although we have only around 27% of the area under irrigation, the efficiency of the irrigation system is extremely poor. Farmers in rural areas still believe that more water means higher yields and as a result irrigation efficiency has come down and more than 7 million hectares of fertile fields have turned into saline soils, unfit for crop production. It is this area where we need our environmentalists to help the farmers to adopt ideal irrigation practices, so that more area can be brought under irrigation, by judicious use of water, save a large quantity of fertilizers and protect our productive areas from turning into barren fields. Our average food grain yield is 1590 kg as compared to 3891 kg per hectare in China. Certainly, there is potential to increase our food production, provided we educate our farmers to adopt sound agricultural practices on sustainable basis.

Alternative Strategy

If we are not able to produce more food, fodder and fuel, then we should control our population. We have the same area that we had 50 years ago, but our population has now increased fourfold. In 1951, the per capita availability of agricultural land stood at 0.48 ha while this will be reduced to 0.14 ha in 2000 AD. Land's carrying capacity is limited and further exploitation might upset the entire production system, thereby imbalancing the ecology and polluting the environment. It is therefore, the responsibility of all environmentalists, to make a modest attempt in educating our people to practise family planning, stall-feeding of livestock, judicious use of agricultural inputs, etc. in addition to the protection of forest and prevention of industrial pollution.

Our farmers are scared of losing their crops due to pests and

diseases, and use excessive doses of plant protection chemicals. Neither the producers nor the consumers are aware of the residual effects of the plant protection chemicals on the fruits and vegetables which are sold today in our markets. The death of 4000 people in Bhopal due to poisonous gas leakage is quite insignificant, if we correctly record the health hazards caused due to these chemicals in the field and their effects on the consumers. Use of safer pesticides and botanicals, and proper handling of chemicals is the need of the day. We need to educate our farmers and create consumer resistance, so that such chemicals are avoided whenever it is not necessary. We need to set our aim to educate the masses, by organising training and demonstration, so that sound ecological management and environment protection measures can be incorporated in agriculture and animal husbandry. This can be done only by voluntary effort. The task is challenging and the scope is unlimited. We only need to find some practical environmentalists to set it in motion.

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Why Environmentalists Agitate

The above article illustrates the thinking or rather the dilemma in which a well-meaning scientist working for the welfare of the people, finds himself. He wants the environmentalists to abandon their opposition to development projects and instead educate people to undertake social reform; because according to him, environmentalists do not put forth an alternative development model which will justify their agitations.

Let us see if an alternative development model can be built up. Let us go back to 1947 when the country became independent and the planning process began. If we had begun at the grass-roots level, every village would have been asked to plan for their own drinking water and irrigation water supply, their own artisan and craft requirements, their own health and fuel and wood requirements. It would have meant building small dams and tanks, providing skill-oriented education and sanita-

tion and providing what is today called social forestry. This would have made the development village-oriented and not city-oriented. In the first five-year plan the nation appeared to lean towards this sort of planning but the Second Plan adopted the western growth model with a vengeance and went in for gigantic projects : heavy industry, large dams etc. without caring for the building of infra-structure : social, cultural and environmental. In successive plans the strategy was the same. While gross production increased, the natural base which supported it came to be eroded. The problems like unemployment, perpetuation of inequity remained where they were. While market for ostentatious goods expanded and production of energy-intensive commodities increased, necessities could not be satisfied.

The nation is now searching for palliatives which may reverse the inequitous processes unleashed by the present growth model. These include introduction of exotic species be they plants, animals or products. Little is being realised that they bring in additional problems without adequately solving the ones for which their introduction is justified.

It is wrong to expect environmentalists to support these palliatives while they oppose the very process of development.

Why are we going in for such palliatives? One thing seems to be clear and of basic importance. Our educational system reflects our extrovert thinking. Instead of making it responsive to Indian realities, the system is structured to imitate the west. This is because of the failure of our intelligentsia to correctly gauge our natural and social-cultural environment : the Indian psyche. This again is because the intelligentsia is the product of the educational system foisted on us by the British.

The environmentalists are agitating because they do not agree with the Western growth model and the palliatives propounded by those whom the author perhaps represents.

Let us take the palliative of improved varieties of rice and wheat. If we had not gone in for the massive investment in irrigation, fertilizers and insecticides projects, it would have become difficult for us to adopt these. But if so much investment had gone into proper education, health and family planning and better management and utilization of available natural resources, increased production would have been achieved with-

out these energy-intensive varieties. Indeed increased production would have been achieved at far less cost: environmental and social. It is only a truism to say that a hungry man cannot understand the philosophy of conservation or environmental protection. If this philosophy becomes the basis of life, there need not be any hungry men.

Take the palliative of social forestry based on planting of exotic tree species. These tree-species are again energy-intensive. We adopt these because our education denies the student any familiarity with our own flora and fauna. If during the last 40 years we had built up a research tradition of investigating our own flora and fauna, we could have found our own solutions. The so-called wastelands, barren pastures and unproductive private lands are the result of our unsound management practices which are the result of wrong education. The case of Neem proves this point beyond expectations.

Introduction and spread of *Prosopis juliflora* and Eucalyptus to increase fuel-wood supply has only partially solved our energy problem. Eucalyptus benefits more the pulpwood and paper-making industry than our poor. *P. juliflora* is an extremely aggressive species which tends to eliminate local species. As said earlier, it is likely to create more problems than solutions.

The introduction of exotic breeds of cattle again illustrates our failure to understand our own cattle, our failure to be innovative enough to undertake selective breeding and our failure to build up cattle management in our environment. If we had introduced environmental planning at the grass-roots level, we could have managed better the fodder and timber needs of our own population. Unfortunately economists and financiers rather than environmental experts dominate our natural resource planning. It is wrong to expect only the environmentalists to work at the grass-roots level (which many of them are already doing) when the whole planning approach depends on central direction and centralisation of resources.

Environmentalists need not be urged or taught to create public awareness. It is this awareness so far created which is helping them agitate successfully against indiscriminate adoption and perpetuation of the western development model.

It is wrong to increase production at the cost of our environment. Providing irrigation through surface channels, using inor-

ganic fertilizers and pesticides is a mechanical way of improving yields. Moreover, the whole agricultural development today is directed to mass production of a few select varieties. What we really need is greater biological diversity and diversification of agriculture. If our thrust is in this direction, the farmers would not destroy their lands by using excess of water and fertilizers to produce only sugarcane. If the whole economy is not geared to produce items which only the urban elite and conspicuous consumers demand, the farmers would be less inclined to produce the energy-intensive cash crops.

The problem of increasing population is also attempted to be solved in a mechanical fashion. The incentive to limit the number of children should come from the grass-roots and they will be induced to limit their issues if they think that limiting the number will enhance their standard of living. The city-oriented culture induces them to multiply so that more hands bring in more income to cope with the inflation which is the bane of our planning based on squandering of our natural resources.

I do not think environmentalists can be faulted on grounds which the author of the above article thinks appropriate. I would argue somewhat differently.

Most of our environmentalists are in reality radical humanists. When they talk and think of environment, it is primarily man's environment they are talking about. It is the improvement in man's environment that they are concerned with. According to them if this environment is managed and manipulated well, resulting in the greatest amount of biomass for the largest number of people, the environment of the planet earth should become ideal. This is the new mould in which social justice is to be cast: something like the greatest environmental happiness for the largest number of people.

The proper environmental view would be a concern for the welfare of both human and non-human creatures that inhabit this planet. Man as a being of superior intelligence possesses knowledge and technology to control, regulate and manipulate his environment. If he sheds his moral, social and religious inhibitions including adherence to dogmas and isms, man is in a position to evolve an environmental management plan which will confer greatest benefits to the largest number of people. The

important question that an environmentalist would then ask is how far man would like to allow the non-human creatures to enjoy undisturbed the environment that is necessary to sustain them.

This boils down to a decision by the mankind about the number and variety of animals, birds, insects, marine creatures and plants that will be allowed to live on this planet. Nobody has raised and answered this question in this naked form. The nature conservationist would like to see all non-human creatures that exist at present to be protected and conserved. The radical humanists would as well sacrifice some of them if protection of their environment conflicts with their goal of achieving the highest biomass for the largest number of people.

The nature conservationists would like to conserve all existing non-human creatures as this policy, they believe, in the long run, will benefit humanity at large. The radical humanists are more concerned with achieving the highest biomass now; they are not prepared to believe that long-term interests of mankind are guaranteed if even the most insignificant creature is protected.

The so-called environmentalists alias radical humanists can be faulted on the ground that they do not adequately consider the welfare of the non-human creatures that inhabit this planet.

Dispersal of the Wildboar, *Sus scrofa cristatus* (Wagner) in the Western Ghats region of South Maharashtra.

Behzad Ahmed and Jay Samant

The occurrence and spread of the Wildboar (*Sus cristatus*) in the sugarcane belt of the Kolhapur region was studied by interviewing the hunters, who hunt in crops, often on the invitation of the farmers, and by field observations. Occurrences and instances of wildboar hunting in crops were cross-checked by consulting two independent sources. Records pertaining to the crop infestation by the wildboar at the District Forest Office (DFO), Kolhapur circle, were consulted to analogue and collate the information. The data were telescoped to elicit the patterns of dispersal and to project them on the co-ordinates of time and distance.

The first occurrence of Wildboar was reported beyond the village Tarale in Radhanagari tahsil, in 1970. Between 1970 and now (1990) the Wildboar has peregrinated from beyond Radhanagari dam to far off eastern tahsils viz. Karveer, Hatkanangale and Shirol in the sugarcane cultivation belt which stretches along the rivers Bhogawati and Panchganga (Fig.1). In a period of about two decades, the Wildboar has travelled about 136.6 km in the sugarcane belt. The data (Table 1) reveal that initially the rate of dispersal was slow as compared to its recent speed of peregrination. Between 1982-1983, the Wildboar appears to have covered a distance of 25.6 km.

Wildboars are nomadic and scatter to far off places due to

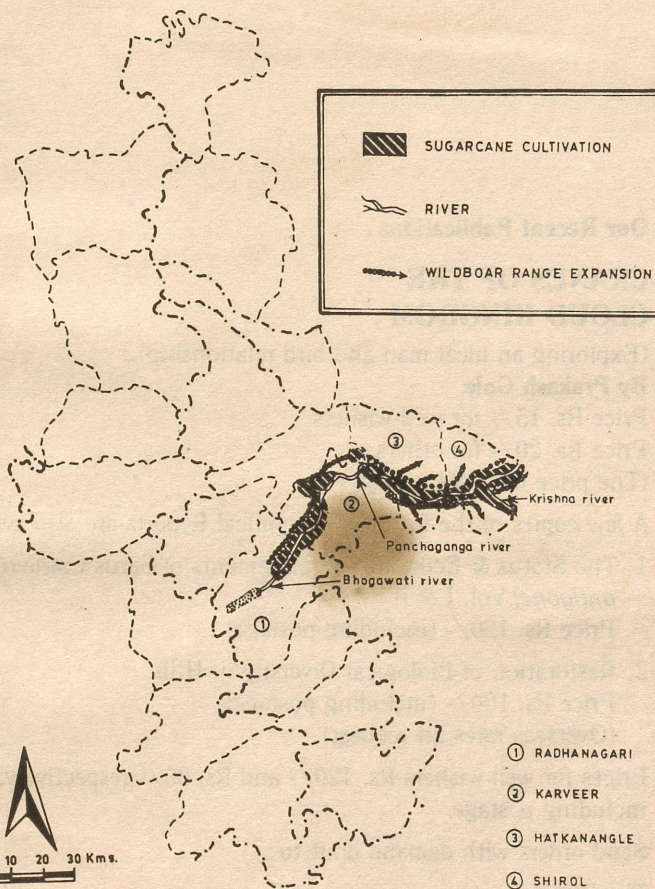
predation pressures (Morris 1929; Dardaillon 1986). In the region under reference hunting is common and the hunting method commonly employed by the local hunters is 'drive'. The recurring hunting activity invariably scatters the Wildboar. The scattered population moved in the sugarcane cultivation, as the sugarcane offered a secure habitat. Hunting Wildboar in a large sugarcane enclave is difficult due to compactness of the plantations (Ahmed and Samant, 1989). The sugarcane belt has lift-irrigation facilities and both Kharif (monsoon) and Rabi (winter) crops are cultivated in the basins of the rivers Bhogawati and Panchganga. The Wildboar discovered this region as the most suitable and secure habitat. The population growth and movements of groups and individual animals invigorated the dispersal. Hunting in the crops and occasional use of 'pig bombs' (crude indigenous explosives) as crop protection measures triggered rapid dispersal to more secure areas within the sugarcane cultivation. The present study indicates that despite hunting and pig bomb operations, the Wildboar is well entrenched in the sugarcane belt of the Kolhapur region. It would be interesting to see if the Wildboars disperse over the other sugarcane cultivation areas of the region.

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