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Logo Description : It symbolizes an elephant within an ecological frame of peace and harmony moving towards prosperity and posterity. **Cover photo :** (Anticlockwise from top) : 1. *Aeschynomene aspera* L.species of Malkangiri, Orissa, *2.* Use of blow pipe for triquin administration at Nandankanan, 3. Impact of construction on the environment, 4. Projected surface temperature changes for the late 21st century (2090-2099), 5. Specule of Spongilla alba bengalensis at RMNH, Bhubaneswar, **Cover background Photo :** *Hedychium coccineum* in full bloom, Similipal (By Manoj V. Nayyar).

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The entire human race seems to be standing at a strange crossroad. Years of pursuit of selfish human interests and a rather ruthless development strategy have played havoc with the ecosystem and brought the entire living race to a point in time - where we are beset with ever renewing challenges that continue to threaten the onward march of human supremacy.

Emergence of many infectious diseases in recent years has been a reason for world wide concern. The phenomenon can mainly be attributed to factors like climate change, global warming, mutation of pathogens, population explosion, more usage of pesticides, air pollution (relentless release of carbon dioxide, nitrous oxide, methane etc to atmosphere), nuclear wastes and industrial effluents to name a few. Some diseases which have caused widespread disaster and caused the world to sit up and take notice are Japanese B encephalitis, Severe Acute Respiratory Syndrome (SARC), Hanta virus Pulmonary Syndrome (HPS), avian influenza, swine flu, dengue, malaria, lyme etc. What is even more significant is that some of these diseases do have serious zoonotic implications.

History has it that there has always been a silent competition between technology and nature and a quick glance at history would suggest there has been no clear victor. Centuries back small pox and plague resulted in mass scale human casualty followed by influenza, tuberculosis etc which caused large scale devastation. The vaccine for small pox was produced and later the disease was controlled. Later Calmitte and Guerin invented the life saving vaccine BCG for tuberculosis. It saved the lives of millions of children during the 20th century. Necessary therapeutic measures were taken against plague which was also controlled. Soon after these situations were over, revival of influenza surfaced inviting a global crisis (During 1918-19, 40 million died globally due to influenza). Under the scenario, the medical fraternity worked frantically to combat the destructive impact of the disease over mankind and the animal kingdom. In recent years, asthma, polio, cancer and AIDS have posed serious threat to human health due to an ever changing lifestyle. The race goes on.

We may conclude that the trend of constantly emerging problems has kept the scientific community on its toes to carry out systematic research and find effective solutions. The emergence of bird flu and swine flu have posed a fresh and serious challenge before the scientific community. Moreover the severity of outbreak of swine flu in human population has created a flutter among scientists as well as the common man. In view of the development of this pandemic strain which affected humanity all over the world, WHO has declared the present outbreak of swine flu as a pandemic-public health emergency of international concern. Since India is a vulnerable country, the government through its public health officials should sensitize the general public over the basic facts about the virus and its zoonotic importance. It should take appropriate action to reduce the spread of the infection, throw proper surveillance and adopt necessary control and preventive measures.

Besides, mutation of many common pathogens has thrown a potential challenge to the medical fraternity which now has a new task in battling against the effect of modified characters and the infectivity of the organism promoting drug resistance. Recently, there have been reports about an alarming trend in various pathogens which sometimes cross the natural species barrier and create trans-species infections. This might have been occurring due to constant global environmental pressure and drastic changes in lifestyle. The commercial compulsion of establishing different livestock farms in close proximity to human habitations, generally invites such type of infection as cattle, pigs, dogs, poultry, etc are reservoirs of many dreadful pathogens. That apart, there is substantial human animal interface in the national parks, sanctuaries and many other wilderness areas. Migratory birds and aquatic animals also provide an ideal platform for transfer of many serious infections to the human population and vice versa. Hence, the entire living beings of the earth are on the threshold of serious health hazards.

Hence, world community should be conscious about this recent trend which is an indication of some serious crisis through 'changing behavior of different pathogens'. Lest, we might be affected with some serious emerging diseases, which might invite a catastrophe in near future. Hence, it is of utmost importance to educate the masses about possible health hazards and their remedies. Proper awareness is the only immediate key to most of the health concerns that have propped up in recent years.

Here's hoping that the scientific community will play a pivotal role in educating the masses and envisaging an effective strategy to combat modern health hazards.

(Dr. R.K.Samantaray)
Editor-in-Chief

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EFFECTIVE USE OF BLOWPIPE IN SUB-CUTANEOUS INJECTION OF TRIQUIN TO BIG CATS AS PROPHYLAXIS TO TRYPANOSOMIASIS– STUDY AT NANDANKANAN ZOOLOGICAL PARK, ORISSA, INDIA

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ABSTRACT

Different routes of delivering drugs or chemical agents *viz*: intra-muscular (I/M),intra-veinous (I/V) sub-cutaneous (S/C), intra-conjunctival (I/C), intra-peritoneal (I/P)l etc. are in practice in treating wild animals. However, certain routes are preferred considering the rate of absorption in many disease conditions. As a prophylaxis to trypanosomiasis, a blood protozoan parasitic disease that killed 12 number of precious tigers at Nandankanan Zoo, Orissa, India during the debacle of July 2000, a drug triquin (quinopyramine sulphate and chloride) has been in regular use both for prophylactic and curative measure. The only site of sub-cutaneous injection of triquin at requisite dosage preferred earlier was at the base of tail, because the recommended sites were either base of tail or foot paw. In fact after receiving advice from technical committees constituted by Government of India and State Government, a decision was taken at Nandankanan to administer triquin to all big cats sub-cutaneously at 4 months interval as a prophylaxis to trypanosomiasis and accordingly this particular protocol as formulated. Thereafter, routine triquin protocols were followed by putting the tigers and lions into squeeze cage at different enclosures. During September 2000 to May 2006, on an average only 73 % of the big cats could be covered with triquin either luring or by forceful entry into squeeze cage. By this method, a number of animals sustained significant physical injuries including broken teeth and nails and also psychological stress. To overcome these drawbacks, from late 2006 onwards it was preferred to give injection of triquin to big cats by using blow pipe. Further, a decision was taken to change the site of injection from base of tail to inguinal fold (a site where there is compact skin fold) for easy delivery of drug. Under the present study, because of articulate usage of blow pipe, there was 100% coverage and absolutely no injuries incurred due to skin reaction with least physical injury and stress to the animal. Moreover, time taken was significantly less with least man power involvement and rational drug utilization .

Key Words : Blow pipe, sub-cutaneous, trypanosomiasis, squeeze cage, triquin, prophylaxis

INTRODUCTION

Nandankanan Zoological Park, Orissa is famed for its majestic tigers - both white and normal coloured. The state is equally famous for its natural calamities. During 1999, coastal Orissa was devastated due to super cyclone. Nandankanan zoo was also affected significantly due to its impact. One lion died and many big cats were also affected due to cyclonic storms. In the aftermath of super-cyclone, there was outbreak of trypanosomiasis wherein 11 tigers (6 white and 5 normal colored) died within 4 days. Post mortem examination confirmed the cause of death to be due to trypanosomiasis. Trypanosoma is a blood borne parasitic disease. It is a protozoan infection of the blood in humans and other animals caused by trypanosome parasites (Caddis. PAAT 2000). There are many cases of trypanosomiasis infection in big cats. Generally, parasites do not pose any problem as far as the mortality of tigers are concerned (Tilson and Seal, 1987) while many contradicted and diagnosed trypanosomiasis to cause the death. Trypanocidal drugs can be essentially used as a prophylaxis for early treatment in big cats. The parasites successfully manage to escape the host immune system, which happens to be very complex mechanism of antigen switching (Hunt, 2000). Nine tigers, five pumas and one Indian lion affected with trypanosomiasis were successfully treated with Antrycide at 2 mg/1b S/C for five nos. and Berenil at 0.8g/100kg b. wt. (Khan *et al*., 1982). A case of sudden death in a male tiger cub with trypanosomiasis was reported by Rao (1986). However, at Nandankanan all the tigers died due to trypanosomiasis who were injected with Berenil as a curative measure in the face of outbreak. But it was of no use. The drug Berenil may be working well

in cattle, but is not the drug of choice in big cats (Samad 2000). Then as per the recommendations and suggestions from Central Zoo Authority constituted Expert Committee and State Government constituted Health Committee and taking references from many other publications, it was decided that injection triquin (combination of quino-pyramine sulphate and chloride) would be administered with 4 months interval to all the big cats. Then triquin protocol was meticulously carried out to inject triquin s/cly with hand held syringes from September, 2000 onwards. During that period, 81 big cats within 4 months of time were to be covered. But instead, it was taking almost 6 months to complete one protocol coupled with immense post-complicacies. Particularly putting an animal into squeeze cage for administration of triquin was consuming a lot of time and energy. That apart, within a week large number of wounds came up and lot of our efforts were spent on treating the wounds with regular dressing by bringing the said animal into squeeze cage once again. That really hampered our day to day work and even then the protocol was continued for 6 months we could not be able to complete the triquin schedule. Then some other protocols like Fel-o-vax, deworming etc. were mixed up because of their specified time scheme forcing us to stop the triquin protocol. These were the practical difficulties experienced in this method of carrying out triquin programme in the said protocols.

MATERIALS AND METHODS

Treatment of wild animals in captivity as a part of health care has always been a challenge for the zoo veterinarians. As a routine practice, the wild animals are generally secured in squeeze cages for most of the medication in injection form. This is a traditional measure undertaken in most of the zoos of the country. However, it has got a lot of disadvantages such as;

(i) Animal has to be brought to the squeeze cage either luring by means of attractive food or frightening with different objects or producing some loud and fearful sounds. This process itself is a cumbersome process and injury-prone approach.

(ii) It spoils a lot of valuable time and requires more manpower sacrificing other important routine works, which are rather postponed or unnecessarily delayed.

(iii) Animal is likely to undergo severe physical and emotional stress and trauma due to squeezing of the whole body against its will, which may become fatal at times. In most of the cases animals get injured due to severe struggling inside the squeeze cage.

(iv) There is every possibility of handling persons getting injured during such squeezing operation.

Blow pipe

This is the simplest type of dart projector made of PVC or aluminium tube anodized on the outer side for longer life. It is a hollow pipe of 1-2 meter length having one end fitted with a rubber mouth piece . It's a device to give mostly intra-muscular injection from a distance of maximum upto 10 meters. The range can be further increased by using a special mouth piece or joining two pipes together.

Dart

Here in, the dart used is preferably Softy Mini-jet type syringe. The syringe is available in 3 ml. and 5ml. sizes. Before use one has to put the dart holding the drug into the pipe through the broad end. From the broader end a strong and sudden blow is given with an air force from mouth so that it can propel the small plastic dart towards the animal keeping the target. It is mainly used for small, thin skinned animals under captive conditions. Darts work on the principle of compressed air or gas effect. The needle hole is covered with a rubber sleeve before filling the drug and pressurizing the dart. After the drug is loaded in the syringe, it is pressurized, and the tail (woolen feather) is fixed, the dart becomes ready to be blown.

Butane gas

Once the needle pierces the desired location, the drug is automatically released into the animal body under the influence of flammable liquefied butane gas positive pressure over the syringe piston.

Animals generally fear to enter into squeeze cage. In earlier procedure, at times the animals do not enter into squeeze cage and we were forced to leave that particular case. This is the reason why some of the animals could not be covered with triquin for years together. These are some of the situations why usage of blow pipe come into picture. In past when animals did not enter into squeeze cage, most of the times pistol type dart gun was used to give injection from a distance leaving usage of blow pipe as the least preferred option. Particularly, for triquin injection, as the recommendation was to give it sub-cutaneously at the base of the tail or foot pad, it was next to impossible to think to give the said injection by blow pipe. Earlier, as per procedure, after giving

triquin one has to give a thorough massage for better absorption. Considering absorption of the chemical as main criteria, the posterior lower abdominal fold was preferred. Later it was thought, if the target to the said broad skin fold can be taken up by blow pipe with smaller size needle, once the sleeve would be pushed due to striking force, certainly the drug would be discharged sub-cutaneously. Moreover, the force of the needle would be reduced in the process and may not punch into either to peritoneal or thigh muscle.

This being the basis and considering the afore-mentioned compelling situations, it was contemplated to carry out this innovative method of using blow pipe to over come these practical difficulties. As the saying goes "Necessity is the mother of invention", so the zoo vets came up with a suitable alternative to overcome above nagging problem in wild animal treatment i.e. introduction of blow pipe for administration of triquin injection sub-cutaneously to big cats of Nandankanan Zoological Park.

Fig.1 : Blow pipe, butane gas, feather and syringes

Fig. 2 : Feather/cap/needle/syringe/adapter

Fig. 3 : A complete dart

Fig. 4 : Final loading into blow pipe

Fig. 5 : Use of blow pipe for triquin administration

Fig. 6 : Triquin contained dart hitting the target

RESULTS

Table 1 : Different protocols of carrying out triquin programme.

Protocol – 1 (07.09.2000 to 10.12.2000)

Sl. No.	Type of animal	Number of animals	Numbers covered	Numbers not covered	No of cases of sloughing	No. of inflicted injuries
1	Tigers	36	23	13	5	2
2	Leopards	7	3	4	-	-
3	Jaguars	2	-	2	-	-
4	Lions	41	34	7	—	-
	TOTAL	86	60	26	5	2

Protocol – 2 (05.01.2001 to 30.04.2001)

Sl. No.	Type of animal	Number of animals	Numbers covered	Numbers not covered	Cases of skin sloughing	Injuries otherwise
1	Tigers	36	28	8	2	6
2	Leopards	7	2	5	-	-
3	Jaguars	2	1	1	-	-
4	Lions	41	40	1	1	1
	TOTAL	86	71	15	3	7

Protocol - 3 (17.05.2001 to 30.10.2001)

Sl. No.	Type of animal	Number of animals	Numbers covered	Numbers not covered	Cases of skin sloughing	Injuries otherwise
1	Tigers	33	29	4	5	2
2	Leopards	7	7	-	1	1
3	Jaguars	2	2	-	-	-
4	Lions	39	38	1	-	1
	TOTAL	81	76	5	6	4

Protocol - 4 (05.01.2002 to 05.03.2002)

Sl. No.	Type of animal	Number of animals	Numbers covered	Numbers not covered	No of cases of sloughing	No. of inflicted injuries
1	Tigers	32	25	7	7	2
2	Leopards	7	5	2	1	-
3	Jaguars	2	2-	-	—	-
4	Lions	38	32	6	-	-
	TOTAL	79	64	15	8	2

Protocol - 5 (05.01.2002 to 05.03.2002)

Sl. No.	Type of animal	Number of animals	Numbers covered	Numbers not covered	Cases of skin sloughing	No. of inflicted injuries
1	Tigers	31	20	11	2	1
2	Leopards	7	4	3	1	-
3	Jaguars	2	2	-	-	-
4	Lions	32	30	2	-	1
	TOTAL	72	56	16	3	2

Protocol - 6 (08.01.2003 to 13.02.2003)

Sl. No.	Type of animal	Number of animals	Numbers covered	Numbers not covered	Cases of skin sloughing	No. of inflicted injuries
1	Tigers	30	13	17	3	1
2	Leopards	7	4	3	-	1
3	Jaguars	2	2	-	-	-
4	Lions	32	13	19	-	-
	TOTAL	71	32	39	3	2

Protocol - 7 (08.01.2003 to 13.02.2003)

Sl. No.	Type of animal	Number of animals	Numbers covered	Numbers not covered	Cases of skin sloughing	No. of inflicted injuries
1	Tigers	28	19	9	4	1
2	Leopards	5	5	-	1	1
3	Jaguars	2	1	1	-	-
4	Lions	32	31	1	-	-
	TOTAL	67	56	11	5	2

Protocol - 8 (05.09.2003 to 28.12.2003)

Sl. No.	Type of animal	Number of animals	Numbers covered	Numbers not covered	Cases of skin sloughing	Injuries otherwise
1	Tigers	26	21	5	4	1
2	Leopards	5	-	5	-	-
3	Jaguars	2	1	1	-	-
4	Lions	28	18	10	-	-
	TOTAL	61	40	21	4	1

Protocol - 9 (05.06.2004 to 10.12.2004)

Sl. No.	Type of animal	Number of animals	Numbers covered	Numbers not covered	Cases of skin sloughing	Injuries otherwise
1	Tigers	25	24	1	5	2
2	Leopards	4	4	-	-	-
3	Jaguars	1	1	-	-	-
4	Lions	28	14	14	-	-
	TOTAL	58	43	15	5	2

Protocol - 10 (09.01.2005 to 22.04.2005)

Sl. No.	Type of animal	Number of animals	Numbers covered	Numbers not covered	Cases of skin sloughing	Injuries otherwise
1	Tigers	28	22	6	2	1
2	Leopards	5	5	-	1	1
3	Jaguars	1	1	-	-	-
4	Lions	28	12	16	-	-
	TOTAL	62	40	22	3	2

Protocol -11 (11.09.2005 to 13.11.2005)

Sl. No.	Type of animal	Number of animals	Numbers covered	Numbers not covered	Cases of skin sloughing	Injuries otherwise
1	Tigers	30	21	9	2	1
2	Leopards	5	5	-	-	1
3	Jaguars	1	1	-	-	-
4	Lions	30	18	12	-	-
	TOTAL	66	45	21	2	2

Protocol -12 (07.04.2006 to 24.05.2006)

Sl. No.	Type of animal	Number of animals	Numbers covered	Numbers not covered	Cases of skin sloughing	Injuries otherwise
1	Tigers	29	20	9	5	2
2	Leopards	5	5	-	1	-
3	Jaguars	1	1	-	-	-
4	Lions	31	26	5	1	1
	TOTAL	66	52	14	7	3

Protocol -13 (08.09.2006 to 24.10.2006)

Sl. No.	Type of animal	Number of animals	Numbers covered	Numbers not covered	Cases of skin sloughing	No. of inflicted injuries
1	Tigers	29	29	-	-	-
2	Leopards	4	4	-	-	-
3	Jaguars	1	1	-	-	-
4	Lions	29	29	-	-	-
	TOTAL	63	63	0	0	0

Protocol -14 (08.09.2007 to 23.03.2007)

Sl. No.	Type of animal	Number of animals	Numbers covered	Numbers not covered	Cases of skin sloughing	No. of inflicted injuries
1	Tigers	30	30	-	1	-
2	Leopards	05	05	-	-	-
3	Jaguars	01	01	-	-	-
4	Lions	27	27	-	-	-
	TOTAL	63	63			

Analysis

- From protocol 1 to 12 triquin was administered manually inside squeeze cage. Both 13th and 14th protocol were carried out by using blow pipe from a distance.
- Protocols 1 to 12 caused large scale wounds i.e. out of 861 cases, sloughing of skin reported was 54 and injuries inflicted otherwise was 31. In tigers only out of 335 cases 46 number of cases showed sloughing of skin and 22 cases showed injuries otherwise. Hence, over all % of both sloughing of skin and injuries otherwise are 6.27 % and 3.6 % and in tigers specifically the figures are 13.73 % and 6.57 %.
- Studied Protocols 13th and 14th showed no injuries as such except only in one case during 14th protocol.
- 14th protocol was finished in record time i.e. from 08.03.2007 to 23.03.2007.
- Cases of sloughing of skin and injuries otherwise were reported to be nil during 13th protocol.
- From protocols 1 to 12 on an average 73 % of animals were covered.
- During 13 th and 14th protocols, 100 % animals were covered under triquin protocol.
- More labour (7 to 10 people) involvement was there from 1st to 12th protocols.
- Maximum 3-4 people were involved in the protocols of 13th and 14th.
- Many a time after giving injections to one or two animals, other cases do not co-operate. Hence, rest of the unused drugs were usually wasted.
- During 13th and 14th protocols, drug usage was hundred percent.

Table 2 : Different protocols and the percentage of coverage

Protocol serial	Period of coverage	Total duration of coverage (in days)	Total big cats to be covered	Big cats covered	Percentage of coverage
1	07.09.00 - 10.12.00	93	86	60	69.8
2	05.01.00 - 30.04.01	145	86	71	82.5
3	17.05.01 - 30.10.01	163	81	76	93.8
4	05.01.02 - 05.03.02	60	79	64	81
5	06.04.02 - 03.10.02	177	72	56	77.8
6	08.01.03 - 13.02.03	35	71	32	45.1
7	05.09.03 - 28.12.03	113	67	56	83.6
8	23.01.04 - 10.06.04	137	61	40	65.6
9	05.06.04 - 10.12.04	185	58	43	74
10	09.01.05 - 22.04.05	103	62	40	64.5
11	11.09.05 - 13.11.05	62	66	45	68.2
12	07.04.06 - 24.05.06	47	66	52	78.8
13	08.09.06 - 24.10.06	46	63	63	100
14	08.03.07 - 23.03.07	15	63	63	100

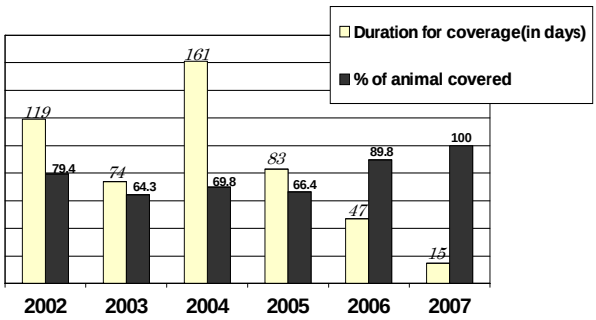

Fig. 7 : The % of Triquin coverage over years

The protocol was initiated as per the recommendations by putting animals into the squeeze cage and after properly securing the animal through squeezing, triquin was administered sub-cutaneously at the base of the tail manually. In the meanwhile, we have had 14 number of total protocols completed as yet at Nandankanan.

DISCUSSION

In 12 number of earlier protocols not a single protocol could cover all the animals. But however, due to usage of blow pipe during 13th and 14th protocols, we covered 100 % of the animals. In all these 12 number of protocols from out of 861 cases covered, total number of sloughing of skin cases reported were 54 and number of animals wounded otherwise including broken teeth were 31 Hence, over all % of both sloughing of skin and injuries otherwise are 6.27 % and 3.6 %. But surprisingly, not a single case was affected with sloughing of skin or wounded otherwise during the 13th protocol. However, during the 14th protocol, one case i.e. tiger Ashok shown sloughing of skin. In this particular case when from the blow pipe the dart was blown, it hit to the abdominal region instead of inguinal region. That apart, doctor could see that half of the drug flushed out over the skin. Reason of skin affection may be due to leakage of sleeve or less gas pressure or less blowing force. One important thing we observed that during the course of 12 protocols, only in cases of tigers, from out of 335 cases covered, in total 46 number of cases showed sloughing of skin, which is about 13.73%; but in all other animals like lions, leopards and jaguars in total showed only 8 numbers of sloughing of skin i.e. 2.38 % . It was also noticed that the animals inflicted wound otherwise in tigers are in total 22 numbers out of 335 cases covered i.e. 6.57 %. Rest of the animals in total inflicted only 9 number of injuries i.e. 2.69 %. It implies that tigers are more affected to sloughing of skin on usage of this quinopyramine drug. Further studies are required as to why tigers were affected and lions were not affected with sloughing of skin. It might be that the tiger skin differs in thickness from that of lions and that the tiger skin fold is more prone to become intra-dermal in course of giving sub-cutaneous injection. In 13th and 14th protocols total number of injuries was only 1. During protocols 1 to 12 large number of people were engaged for the purpose of carrying out the routine works like feeding the animals, cleansing the area and lifting of left over bones, de-ticking programmes etc. However, routine works were not affected by using blowpipe. Particularly at densely populated zones of tiger and lion safari, only one keeper or sub-keeper was used to guide the doctor to the animal house for carrying out the said job. The other people did their routine works without much fuss. In most of the cases when the animal remains in the feeding cubicle, the said job was carried out. In some cases, inside the kraal when we get animal at close quarter, immediately we blow the dart before the animal could understand anything as dart being projected silently. By usage of blow pipe it was observed that there was less stress (both physical and psychological) caused to the animals. The most important factor among all, was saving of precious time . Initially in 12 different protocols, on an average, it took 4 months to complete a protocol. On 6th and 12th protocols the time taken was one and half month. But then, 6th protocol showed that only 32 big cats were covered out of 71 cases i.e. less than 50 % was covered. In 12th protocol, 52 big cats were covered out of 66 cases and the % of coverage was little better i.e. 78 % and total number of sloughing of skin was 7 and injuries otherwise was 3. Comparing the situation to 13th and 14th protocols, apart from being 100 % coverage and lack of injuries, both the protocols took very less time to be finished i.e. 1 ½ month during 13th protocol and ½ month during 14th protocol. Since Triquin vial is available in 2.5 g which are supposed to be diluted with 15 ml of distilled water and as per the dosage 3 ml s/c can be given to adult large cats. Hence, 5 of the adult animals could have been covered at one go. But say, in earlier procedure after injecting one such case, if rest animals do not co-operate, then the whole of the prepared amount of drug was going to be wasted. But in case of usage of blow pipe, whole of the quantity of drug was used leading to proper utilization of the medicine.

PRECAUTIONARY MEASURES

(i) It is advocated that target at inguinal region should preferably be done, a little tilted towards thigh rather than flank zone.

(ii) Before loading butane gas, one should necessarily put the plastic sleeve over the small hole at the top portion of the needle. Otherwise, chances are there that the whole quantity of the drug may be sprayed into the user's eye.

(iii) Animal should not be disturbed much before administration of triquin.

(iv) If the mother is with the cub (below 2 months), preferably mother should be separated.

(v) Leaked plastic sheeth should be checked and replaced with good ones before the operation.

(vi) Dart should be collected from animal house as quickly as possible without making much disturbance to the animal.

(vii) Before reuse, softy miniject type needle should be sterilized in boiled water.

CONCLUSION

Usage of blow pipe in giving triquin injection sub-cutaneously at inguinal fold resulted in following sailent findings: (i) 100% big cats were covered with triquin administration under the test study of both 13th and 14th protocols as compared to only 73 % coverage in earlier 12 protocols. (ii) There was no possibility of incidence of trypanosomiasis from 13th protocol onwards, since all cases were covered with triquin administration by usage of blow pipe. Instead, there were lapses of partial coverage in all other protocols i.e. protocol 1 to 12. In the meanwhile, one of the tiger 'Roshan" fell seriously ill when 8th protocol was in progress with all symptoms of trypanosomiasis. Further it was established to be a confirmatory case of trypanosomiasis after necessary screening of blood. Hence, the lapses of partial coverage was established to be the reason of recurrence of trypanosomiasis. (iii) This innovative process saved lot of time. The average time taken for earlier 12 protocols was roughly 4 months. However, the studied protocols of 13th and 14th were completed on an average period of one month. Specifically 14th protocol was completed in record 15 days with 100% coverage. (iv) Reporting of sloughing of skin was found to be only a solitary case in both the studied protocols. Earlier, in all 12 protocols, the cases of sloughing of skin were 54 (v) Injury due to struggling including broken teeth was also reported to be nil under the study. But in all those 12 protocols, this figure was 31. (vi) There was rational usage of triquin on the recent study wherein 100% of drug was utilized . But in earlier programmes, most of the time we were forced to waste the remaining quantity of drug as subsequent animals do not co-operate to be squeezed.

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GENETIC DIVERSITY OF *Pseudomonas putida* FIELD POPULATION REVEALED BY RAPD FINGERPRINTING FROM FRESHWATER FISHES

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ABSTRACT

Random amplified polymorphic DNA (RAPD) analysis was used for the molecular characterization and assessment of genetic similarity of 30 isolates of *Pseudomonas putida*. Total genomic DNAs from 30 field isolates and one reference strain (ATCC 49128) was amplified using nine different (OPK 3, OPH 3, OPH 20, OPE 12, OPA 13, OPA 14, OPF 5, OPF 10, OPF 12) 10-mer primers. The different and informative band patterns obtained from RAPD analysis of these strains ranged from 2-6 fragments with a size ranged from 150-2580 bp. A total of 22 diagnostic markers were found in *P. putida* strains with maximum numbers observed by using primer OPF 10 and minimum by OPA 13 and OPA 14. These unique diagnostic markers can be used to characterize unknown isolates of *P. putida*. *P. putida* strains (PP02, PP05 and ATCC 49128) were highly virulent as the LD_{50} value was $10^{5\text{-}5.5}$ CFU ml^{-1}.

Key words : *Pseudomonas putida*, RAPD fingerprinting, genetic diversity

INTRODUCTION

Pseudomonads are widespread in aquatic and terrestrial environments and are renowned for their ability to inhibit other microorganisms (Ellis *et al.,* 2000). Identification of *Pseudomonas putida* strains, especially indigenous isolates, still remains a formidable task although many different techniques have been developed. Conventional methods, including serotyping (Leung *et al.,*1994), intrinsic antibiotic resistance (Mueller *et al.,*1988), separation of total cellular proteins by SDS-PAGE (Sadowsky *et al.,*1987), bacteriophage typing (Schmidt *et al.,* 1986) are often inadequate for rapid and accurate strain differentiation of bacteria.

In the last one and half decade, various techniques that rely on different nucleic acid patterns and therefore discriminate at genetic level, have been developed to gain information about genetic diversity and genetic relationships between different organisms (Judd *et al.,*1993). Randomly amplified polymorphic DNA (RAPD) analysis (Welsh and McClelland,1990; Williams *et al.,*1990) can successfully be applied for identification of various bacterial strains (Stephan *et al.,*1994). Using this fast and sensitive method, reproducible and characteristic fingerprints of complex genomes can be obtained without any previous knowledge about the genomes being studied. Differences between particular strains are revealed as DNA polymorphisms resulting from the amplification of different segments of genomic DNA by using short oligonucleotide primers of arbitrary sequence. Biosecurity (pathogen preventing) programmes that address aquatic animal pathogens and diseases are becoming increasingly important focus of ornamental fish and aquaculture industries (Scarfe *et al.,*2006). Major limitations for the development of serological assays include that the required anti-serum for the detection of a pathogen be accessible and affordable, and that the required degree of sensitivity and specificity is often difficult to reach (Adkison *et al.,*2005). PCR-based techniques have increasingly been developed for fish pathogen diagnosis (Cunningham, 2002). This trend is stimulated by the continuous growing availability of sequence data in databases such as GenBank (Benson *et al.,*2004) and the increasing availability of microbial full genome sequences. Although most of these methods are convenient for the detection of a single pathogen, screening for large numbers of different pathogens relies on a significant number of parallel tests, often using different technologies (Evangelopoulos *et al.,*2001; Lievens *et al.,*2005).

We chose to use RAPD-PCR to complement traditional bio-chemical and serological methods of identification of unknown bacteria. Unlike methods that rely on DNA sequence information for unique primer design, RAPD PCR uses short primers of arbitrary sequence and annealing conditions that favour nonspecific template binding (Welsh and

McClelland, 1990). RAPD primers amplify sequences that are repetitive or unique, and amplification products occur wherever the primers bind in a converging orientation. The aim of the present investigation was to examine the suitability of the RAPD method to distinguish *P. putida* strains and to detect genetic similarity and diversity in field population isolated from various fishes.

MATERIALS AND METHODS

The 30 isolates of *P. putida* collected from diseased fish from in and around Bhubaneswar, India used in this study are listed in Table 1. Ten of these were isolated between 2001-2002 and remaining 20 isolates were collected during August 2002- January 2004. Preliminary identification was made on the basis of their colony characteristics in addition to Grams staining. Dominant isolates were purified and identified using conventional biochemical tests described by Mac Fadden (1976) and West and Colwell (1984), and further five strains of *P. putida* were identified based on Baumann and Schubert (1984) used in the RAPD analysis. One strain from commercial inoculants was also included in this investigation as reference strain (ATCC 49128) obtained from Becton Dickinson Microbiology System, Becton Dickinson and Company, Cockeysville, Maryland, USA.

All the isolates of *P. putida* were tested for virulence against healthy fry of *Labeo rohita* (5 ± 0.7 g) in laboratory infection assay. To test the degree of virulence, bath challenge was done by adjusting the bacterial load as 10^5, 10^6, 10^7 and 10^8 cfu ml^{-1} and LD_{50} value of the respective pathogens was calculated (Reed and Muench, 1938).

Genomic DNA preparation

For isolation of genomic DNA (Williams *et al.,*1990) there was slight modification. The bacteria were grown at 37^{0}C for 24 h in 20 ml of trypton soya broth (Hi Media, India). Cells were pelleted several times by centrifugation at 9,000 g for 10 min and washed in Tris-EDTA (TE) buffer (10 mM 1^{-1} Tris-HCl; 1 mM 1^{-1} EDTA, pH 8.0) and finally suspended in 467 µl of TE buffer, 30 µl of sodium dodecyl sulphate (SDS; BDH) and 5 µl proteinase K (20 mg ml 1^{-1}; Sigma chemical Co.) respectively. After 2 h incubation at 37^{o}C the lysate was extracted with an equal volume of phenol: chloroform: isoamyl alcohol (25:24:1, V/V) and once with chloroform: isoamyl alcohol (24:1, V/V). DNA was ethanol precipitated in the presence of sodium acetate (0.3 mol l^{-1}), washed in 70% ethanol, dried and re-dissolved in 40 µl TE buffer. The concentration and the purity of DNA were estimated spectrophotometrically (Bio Rad, Smartspec 3000) at 260 and 280 nm.

Oligonucleotide primers and PCR amplification condition

Each of two hundred oligonucleotide primers, obtained from Operon Technology was chosen arbitrarily. All the primers used in this study were 10 nucleotides in length and had a GC content of 70%. Those primers which produced clear and reproducible bands (at least two and above identical tests) were selected for genomic study. A total of nine primers amplified and produced distinct and reproducible band having sequence (5' to 3') are shown in Table 3. Amplification reactions were performed in a 25 µl volume containing 2.5 µl 10X PCR buffer (pH 8.4), 2.5 mM each dNTPs (dATP, dGTP, dCTP, dTTP), 5 pmol primer, 2.5 mM $MgCl_{2,}$ 50 ng of genomic DNA and 1 unit *Taq* DNA polymerase (GENE I, India) made up to 25 µl with sterile double distilled water. The amplification were performed for 4 min at 94^{o}C for initial denaturation and then amplified in a thermocycler (MJ- Research) for 37 cycles consisting of 45 s at 94^{o}C, 45 s at 36^{o}C and 1min 30 s at 72^{o}C followed by 7 min incubation at 72^{o}C.

Amplification products were separated by submerged gel electrophoresis on precast 1.2 % agarose gel run in 1X Tris boric acid (TBE) buffer (98 mM Tris, pH 7.6, 89 mM Boric acid, 2 mM EDTA) in apparatus (BioRad sub-cell Model 192) for 2.5 h at 80 V cm^{-1} and 20^{o}C. DNA bands were visualized by staining with ethidium bromide and photographed under U.V. Gel Doc system (UVI Soft, Inc.). One kb DNA ladder (MBI, Fermentas) was used as molecular mass marker.

The molecular weights of amplified fragments were determined using software (Alpha Inotec). For data analysis, the bands were only scored if they were amplified from DNA preparation. Each reproducible band was considered to be an independent character and was scored as either present or absent to give a binary matrix i.e. 1= presence of band and 0= absence of band. The index of similarity (S_{AB}) between individuals was calculated using the equation of Nei and Li (1979):

$$S_{AB}=2N_{AB}/(N_A+ N_B)$$

Table 1: The different isolates of *Pseudomonas putida* along with their LD_{50} value.

Strains	Isolates	Fish	Organ of isolation	Date of isolation	Isolation site	LD_{50} in CFU ml^{-1}
PP01	PP011	*Catla catla*	Kidney	August- 2003	CIFA farm, Bhubaneswar	10^6
	PP012	*Labeo rohita*	Liver	August- 2003	CIFA farm, Bhubaneswar	10^7
	PP013	*Anabas testudineus*	Gill	August- 2003	CIFA farm, Bhubaneswar	10^7
	PP014	*Catla catla*	Kidney	August- 2003	CIFA farm, Bhubaneswar	10^6
	PP015	*Labeo rohita*	Skin surface	September-2003	Private farm, Puri	10^7
	PP016	*Labeo rohita*	Gill	Octopber-2003	Private farm, Puri	$10^{6.5}$
PP02	PP021	*Clarius batracus*	Kidney	Octopber-2003	Private farm, Puri	10^5
	PP022	*Cirrhanus mrigala*	Skin surface	Octopber-2003	Commercial farm, Khurda	$10^{5.5}$
	PP023	*Carassius auratus*	Gill	Octopber-2003	Ornamental Fish Farm, Bhubaneswar	10^6
	PP024	*Catla catla*	Liver	Octopber-2003	Commercial farm, Khurda	$10^{6.5}$
	PP025	*Labeo rohita*	Gill	November-2003	Commercial farm, Puri	10^6
PP03	PP031	*Anabas testudineus*	Skin surface	November-2003	Commercial farm, Puri	10^7
	PP032	*Catla catla*	Liver	November-2003	Commercial farm, Khurda	10^6
	PP032	*Cirrhanus mrigala*	Skin surface	November-2003	CIFA research pond, Bhubaneswar	10^7
	PP034	*Clarius batracus*	Kidney	December-2003	CIFA research pond, Bhubaneswar	10^6
	PP035	*Labeo rohita*	Liver	December-2003	CIFA research pond, Bhubaneswar	10^7
	PP036	*Carassius auratus*	Kidney	January-2003	CIFA research pond, Bhubaneswar	$10^{6.5}$
	PP037	*Cirrhanus mrigala*	Gill	January-2003	Private farm, Puri	10^6
	PP038	*Anabas testudineus*	Skin surface	January-2003	CIFA farm pond, BBSR	$10^{6.5}$
PP04	PP041	*Carassius auratus*	Kidney	January-2003	Ornamental Fish Farm, Bhubaneswar	10^6
	PP042	*Catla catla*	Skin surface	March-2002	Pvt. farmer's pond Balasore	$10^{6.5}$
	PP043	*Clarius batracus*	Gill	March-2002	Private Farmer's pond, Bhubaneswar	10^7
	PP044	*Catla catla*	Liver	July-2002	CIFA research pond, Bhubaneswar	10^7
	PP045	*Carassius auratus*	Kidney	July-2002	Ornamental Fish Farm, Bhubaneswar	10^6
	PP046	*Anabas testudineus*	Kidney	February-2001	Private farm, Puri	$10^{6.5}$
PP05	PP051	*Cirrhanus mrigala*	Skin surface	February-2001	CIFA research pond, Bhubaneswar	10^6
	PP052	*Catla catla*	Liver	April-2001	Private farm, Puri	10^6
	PP053	*Labeo rohita*	Gill	April-2001	CIFA research pond, Bhubaneswar	$10^{6.5}$
	PP054	*Clarius batracus*	Skin surface	June-2001	CIFA research pond, Bhubaneswar	10^6
	PP055	*Labeo rohita*	Liver	June-2001	CIFA research pond, Bhubaneswar	$10^{5.5}$
ATCC 49128						$10^{5.5}$

where N_{AB} is number of fragments shared by individuals A and B, and N_A and N_B are the numbers of fragments scored for each individual. This method was chosen because of the greater emphasis placed on fragment matches versus that of non-matches. The scored data were used to calculate the genetic distance values and to construct the unweighted pair group method of arithmetic (UPGMA) dendrogram using statistical Analysis System (SAS) software version 6.

RESULTS AND DISCUSSION

The different isolates *of P. putida* differ from each other in the utilization of different sugars, PP11-PP16 showed positive meso-inositol and valine; PP21-PP25, dextrose and mannitol; PP31-PP38, sorbitol and adonitol; PP41-PP46, melibiose, inulin and dulcitol; PP51-PP55, cellobiose, ribose and xylose respectively. The LD_{50} of *P. putida* isolates ranged from 10^5 to 10^7 CFU ml^{-1} (Table 1). The maximum virulence was seen in *P. putida* strain (PP02, and PP05, 10^5, ATCC 49128, $10^{5.5}$) whereas the minimum in (PP01, PP03 and PP04, 10^7; Table 1).

In this study, we assessed the suitability of RAPD technique for rapid molecular characterization of fish pathogenic bacteria, especially at the strain level. For DNA fingerprinting study, six isolates representating one strain of *P. putida* PP01, five isolates as PP02, eight isolates as PP03, six isolates as PP04 and five isolates as PP05 were selected to carry out the RAPD analysis. Total genomic DNA from all the isolates of *P. putida* as well as one reference strain ATCC 49128 from commercial inoculants was used as template for RAPD fingerprinting. Two hundred primers were tested in an initial screening on selected individuals. The RAPD banding patterns (Fig 1-3) was examined for the presence or absence of bands that occur using certain primers. Nine (OPK3, OPA 13, OPA 14, OPH 3, OPH 20, OPF 5, OPF 10, OPF 12 OPE 12) of these primers were chosen for their ability to provide consistent amplification, clarity and polymorphic fragment patterns. The nine RAPD primers produced 163 bands in total, of which 12, 25, 26, 26, 32, 32 bands were generated by *P. putida* strains PP01, PP02, PP03, PP04, PP05 and ATCC 49128 respectively. The number and size of scorable fragments amplified by different primers varied from 2-6 with a size range of 0.15-2.58 kb (Table 2). The highest number of amplified fragments was seen with primer OPE 12 (6 bands) followed by OPF 12, OPF 10 and OPH 20. Although differences were observed in the number and sizes of fragments amplified from different strains within a species, many fragments were also shared between all strains. Amplification with each of the nine primers reveals at least one specific RAPD fragment. RAPD fragments showed a high degree of polymorphism between the strains.

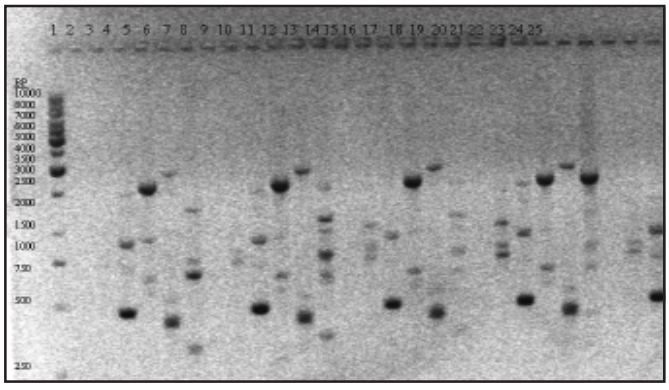

Fig 1. : RAPD profile generated by PCR using *P. putida* (PP01-PP05) and reference strain (ATCC 49128) with OPK 3, OPE 12, OPF 5 and OPF 10 primers. (L-R) 1-1kb ladder, 2-6- PP01-PP05, 7- ATCC 49128, 8-12-PP01-PP05, 13-ATCC 49128, 14-18- PP01-PP05, 19-ATCC 49128, 20-24-PP01-PP05, 25-ATCC 49128.

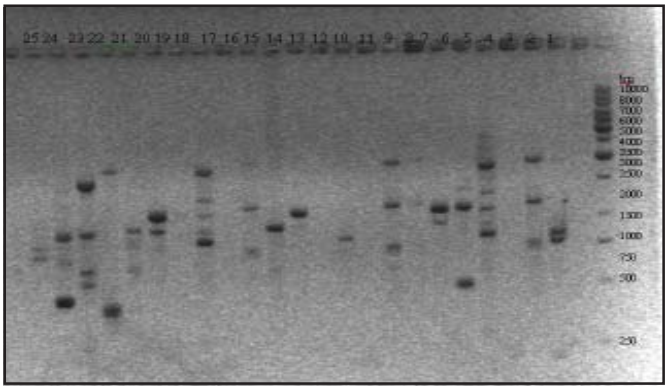

Fig 2. RAPD profile generated by PCR using *P. putida* (PP01-PP05) and reference strain (ATCC 49128) with OPF 12, OPA 13, OPA 14 and OPH 3 primers. (R-L) 1-1kb ladder, 2-6-PP01-PP05, 7- ATCC 49128, 8-12-PP01-PP05, 13-ATCC 49128, 14-18- PP01-PP05, 19-ATCC 49128, 20-24-PP01-PP05, 25-ATCC 49128.

The diagnostic markers and their estimated molecular weights for *P. putida* are shown in Table 3. The total of 22 diagnostic and reproducible markers were found in *P. putida*; the maximum number was observed in OPF 10 (480-2400 bp) and minimum in OPA 13 (1250 bp) and OPA 14 (1100 bp) respectively. RAPD markers have successfully identified interspecies variation in tilapia using 10

Table 2: Number and size of *P. putida* fragments amplified by different RAPD primers.

Primer	Sequence(5'to 3')	Number of amplified fragments						Size of fragments (Kb)					
		A	B	C	D	E	F	A	B	C	D	E	F
OPK3	CCAGCTTAGG	2	2	3	4	3	4	0.56 -1.23	0.84 -1.31	0.41 -1.81	0.53 -1.92	0.37 -2.36	0.26 -1.50
OPE 12	TTATCGCCCC	2	3	3	4	4	6	0.84 -1.12	0.78 -0.87	0.44 -1.90	0.55 -1.92	0.41 -2.40	0.32 -2.01
OPF 5	CCGAATTCCC	2	3	2	3	4	5	0.48 -1.01	0.82 -1.22	0.46 -1.09	0.61 -2.04	0.44 -2.50	0.56 -2.04
OPF 10	GGAAGCTTGG	2	5	4	2	3	5	0.63 -2.01	0.46 -1.90	0.48 -2.10	0.73 -2.10	0.42 -2.58	0.42 -2.19
OPF 12	ACGGTACCAG	2	2	2	2	4	3	0.37 -0.87	0.78 -0.87	0.48 -2.31	0.74 -1.33	0.86 -2.13	0.42 -1.15
OPA 13	CAGCACCCAC	3	2	4	2	2	2	0.97 -1.17	0.52 -1.27	0.53 -2.20	0.64 -1.20	0.24 -0.78	0.63 -1.10
OPA 14	TCTGTGCTGG	2	2	3	2	4	3	0.83 -1.10	0.52 -0.90	0.66 -1.19	0.36 -0.97	0.90 -1.94	0.74 -0.87
OPH 3	AGACGTCCAC	2	2	3	4	3	2	0.87 -1.03	0.50 -0.87	0.30 -1.97	0.41 -1.58	0.33 -0.78	0.59 -0.68
OPH 20	GGGAGACATC	5	4	2	3	5	2	0.36 -2.10	0.39 -1.42	0.15 -1.45	0.66 -1.05	0.40 -2.27	0.56 -1.27

NB: A- E: PP01 -PP05, F: ATCC 49128

Table 3 : Molecular weight of diagnostic markers for *P. putida* for each primer.

OPK 3	OPE 12	OPF 5	OPF 10	OPF 12	OPA 13	OPA 14	OPH 3	OPH 20
-	-	-	2400	2130	-	-	-	-
-	1040	1090	-	1170	1250	1100	-	1490
970	780	920	985	860	-	-	870	810
630	-	610	730	-	-	-		600
-	350	-	480	-	-	-	500	-

(Dinesh *et al.,*1996) and four individuals (Bardakci and Skibinski, 1994) per species respectively. A protocol for the application of RAPD technique for *P. putida* systematic has been successfully developed

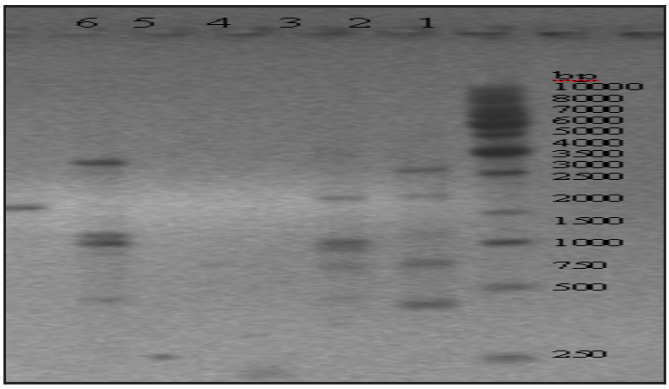

Fig 3. : RAPD profile generated by PCR using *P. putida* (PP01-PP05) and reference strain (ATCC 49128) with OPH 20 primer. (R-L) 1-1kb ladder, 2-6- PP01-PP05, 7- ATCC 49128.

in this study. Ideally, identification of one or a few diagnostic RAPD fragments can be applied to the differentiation of strains or population without the need for extensive statistical analysis. This was demonstrated by the availability of several diagnostic markers.

The dendrogram in Fig 4 shows that *P. putida* stains studied could be divided into two major clusters based on their RAPD profile. Within the major cluster which includes five strains of local isolates are closely related to each other whereas, the commercial inoculants (ATCC 49128) were found distantly related to above five stains. *P. putida* strains PP03 and PP05 (genetic similarity 0.035) and PP02 and PP04 (genetic similarity 0.027) were closely related to each other. The strain ATCC 49128 was found closely related to PP02 and PP04 than PP01, PP03 and PP05 respectively.

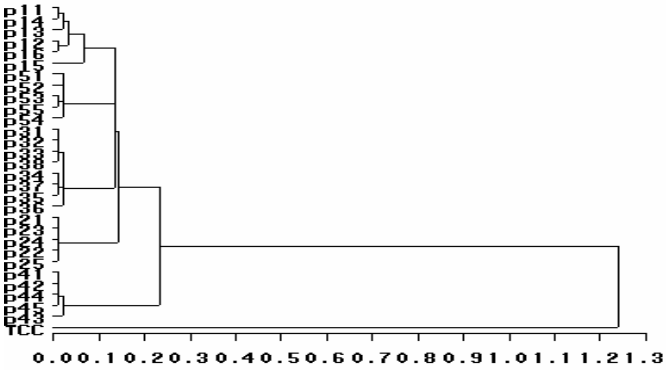

Fig 4. Dendrogram of *P. putida* strains based on genetic similarity coefficients derived from RAPD fingerprints generated by using nine different 10-mer primers

The ribosomal sequences are widely used targets for diagnostic development due to their universal abundance, and evolutionary and phylogenetic properties, reflected by the presence of both variable and highly conserved sequence domains. Nevertheless, ribosomal DNA sequences do not always reflect sufficient variation to discern particular species (Thompson *et al.,* 2004; Kupfer *et al.,* 2006). The housekeeping genes showing intertaxa sequence variation are becoming more intensively studied, including the DNA gyrase subunit B gene and genes encoding the RNA polymerase subunits A and B ; *rpoA* and *rpoB* (Thompson *et al.,* 2005; Tarr *et al.,* 2007). The detection limit of LAMP technique is similar or better to that of PCR. As a result, LAMP is a rapid, highly specific, sensitive and cost-effective alternative for PCR, which can be used for detection, even on-site detection, of specific fish pathogens (Shivappa *et al.* 2008; Wei *et al.,* 2008).

The results of this study indicated that RAPD technique allowed very fine discrimination close to the strain level, clearly and reliably differentiating bacterial isolates. RAPD profiles were reproducibly obtained for all *P. putida* isolates. By the RAPD analysis clear differences were observed between *P. putida* field isolates and reference strains (ATCC 49128). The result presented here showed that RAPD analysis could effectively distinguish different *P. putida* strains. RAPD is considered to be a fast and simple method once the primers revealing the polymorphism are identified and PCR conditions optimized. Slight differences in primer sequences can cause significantly different RAPD patterns that enable an easy visual discrimination among strains. In comparison with other molecular typing methods, RAPD is faster and less labour intensive, eliminates the need for pure DNA, only a small amount of template is required for the amplification reaction and in some cases the method gives better discrimination among bacterial strains (Bostock *et al.,*1993; Wang *et al.,*1993). Our study also demonstrates that *P. putida* strains could be easily differentiated by RAPD fingerprinting, thus supporting the validity of this fast and accurate technique in studying diversity of *P. putida* field population. Further investigations are needed for the assessment of the effects of releasing *P. putida* strains in the environment and for a better understanding of the relationships among field population.

In conclusion, RAPD analysis generated specific genomic patterns, which differentiated closely related strains as observed in present study. Unique fingerprinting profiles generated by the RAPD techniques can be exploited for strain identification purposes and they can be useful in epidemiological studies to determine the origin of a bacterial population responsible for a given outbreak. These findings indicate the RAPD derived markers can be used to differentiate and identify isolates within the specialized group of pathogens and thus provide a relatively rapid method for tracking new introductions in the environment.

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MANAGEMENT OF MUNCIPAL SOLID WASTES IN NATIONAL CAPITAL TERRITORY OF DELHI WITH ESTIMATION OF ENERGY CONTENT

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ABSTRACT

As a result of anthropogenic activities wastes are generated and accumulated. Unless properly managed, these accumulated wastes lead to serious environmental problems. The most common practice for disposal of muncipal solid wastes (MSW) is through landfilling. Many improvements have taken place in making proper landfills. Slowly most of the non-engineered landfills have been abandoned. Some recent study has been undertaken with respect to the disposal of wastes in the National Capital Territory(NCT) of Delhi, which is spread over an area of 1484.5 Km^2. The Municipal Corporation of Delhi (MCD) is responsible for a total territory of 1399 Km^2 and bears the responsibility of garbage collection. In the NCT of Delhi, MSW is disposed off in three different landfills with ~ 2000- 2100 tons of garbage disposed off in each per day; Gazipur (East Delhi) with 2100 tons in an area of 70 acres, Okhla (Central Delhi) with 1200 tons in an area of 32 acres, and Bhalsawa (North Delhi) with 3200 tons in an area of 40 acres. These disposed wastes contain various materials like food waste, paper, card board, plastic, textile, rubber, leather, yard waste, wood, glass, metal, inert (dirt, ashes etc.) in different percentages. There is a lot of energy contained in these MSW disposed of in the landfills. An attempt has been made to calculate the energy content (CV) of these wastes using experimental and empirical models. The models for the predictions used the following analyses: (i) Physical Composition, (ii) Ultimate Analysis, (iii) Proximate Analysis. Most of the garbage in the landfills undergoes anaerobic decomposition which is a biological degradation producing landfill gases with methane and carbon dioxide as the major components through various phases of reaction. Different methodologies have been tried to calculate the amount of landfill gases (LFG). Though, many models have been tried, but according to IPCC (1996) two methods, i.e. Default method (DM) and first order decay (FOD) method have been recommended for estimating LFG. Methane trapped was calculated for its LPG equivalent. This methane, if put to use, could save a huge consumption of LPG which has been detailed in this paper.

Key Words : MSW, landfill, energy content, empirical models, methane emission, LPG equivalent

INTRODUCTION

Municipal solid waste (MSW) management in India continues to remain as one of the most neglected areas of urban development (Jha, 2001). It has often accounted for severe urban health problems in the past. The National Capital Territory of Delhi is spread over an area of 1484.5 Km^2. The Municipal Corporation of Delhi (MCD) is responsible for a total territory of 1399 Km^2 and bears the responsibility of garbage collection. In the NCR of Delhi MSW is disposed off in three different landfills with more than 2000 tons of garbage disposed in each per day as shown in Table 1.

Table 1 : Landfill sites of Delhi

Sl. No.	Landfill	Starting year	MSW received (tons/day)	Area (acres)
1	Ghazipur (East Delhi)	1984	2100	70
2	Okhla (Central Delhi)	1996	1200	32
3	Bhalsawa (North Delhi)	1992	3200	40

Source : COWI, 2004

These disposed of wastes contain various materials like food waste, paper, card board, plastic, textile, rubber, leather, yard waste, wood, glass, metal, inert (dirt, ashes etc.) in different percentages as given in Table 2.

Table 2 : MSW in percentage contributions in 2000, Delhi

S.No.	Component	% Fraction
1	Food waste	20-30
2	Paper	3-5
3	Cardboard	3-4
4	Plastics	4-6
5	Textiles	0.2-0.5
6	Rubber	1-2
7	Leather	0.2-0.5
8	Yard wastes	20-30
9	Wood	1-2
10	Glass	0.2-0.7
11	Metals	0.2-0.5
12	Inert (dirt, ashes etc.)	30 – 40

Source : ISEM, 2000

There is lot of energy contained in these solid wastes disposed of in the landfills. In order to evaluate the feasibility of energy recovery as an integral part of solid waste management system it is required that the energy content of the solid waste should be determined (Qudais *et al.*, 2000; Reddy, 2005). Energy content is defined as the number of heat units evolved when unit mass of material is completely burned and is measured in joules per gram (J/g) or British thermal units per pound (Btu/lb) or calories per gm (cal/g).

There are several experimental and empirical approaches available for determining the calorific value (CV) materials such as MSW. Calorimetric measurement is the common method for determining the energy content of MSW (Harker and Backhurst, 1981). Regarding the empirical approaches, there are three types of models that are used to predict CV values based on the following analyses (Liu *et al.*, 1996, Reddy, 2005).

(i) Physical composition
(ii) Ultimate analysis
(iii) Proximate analysis

MATERIALS AND METHODS

The physical composition analysis is based on the levels of different components of the solid waste matrix, such as plastics, paper and garbage. The ultimate analysis of waste typically involves determination of the carbon, oxygen, nitrogen and sulfur contents, while the proximate analysis includes an assessment of the levels of moisture, volatile combustible matter, fixed carbon and ash. Table 3 presents a summary of the models commonly used to predict the energy content of MSW.

Table 3 : Summary of empirical models used for predicting the energy content of municipal solid waste

Physical composition analysis	Ultimate analysis	Proximate analysis
Conventional model	Dulong Model	Traditional Model
H = 88.2 R + 40.5 (G+P) – 6 W	H = 81 C + 342.5 (H-O/8) + 22.5 S – 6 (9H+W)	H= 45 B – 6 W
Where	Where	Where
H = net calorific value (Kcal/kg)	H = net calorific value (Kcal/kg)	H = net calorific value (Kcal/kg)
R = plastic, percent weight on dry basis	C = Carbon (% wt)	B = combustible volatile matter
G = garbage, percent weight on dry basis	H = Hydrogen (% wt)	W = water (% dry basis)
P= paper, percent weight on dry basis	O = Oxygen (%wt)	
W = water, percent on dry basis	S = Sulphur (% wt)	
	Steuer's Model	
	H = 81 (C-30/8) + 57 (3O/8) + 345 (H-O/16)+ 25 S – 6(9H +W)	
	Scheurer – Kestner's Model	Bento Model
	H = 81(C-3O/4) +342.5H +22.5 S+57 (3O/4) – 6 (9H +W)	H = 44.75 B = 5.85 W + 21.2

Because MSW is a heterogeneous material and its production rate and physical composition vary from place to place, It is a function of socio-economic level and climatic conditions (Qdais *et al.*, 2000), the energy content of MSW in one country will be different from that of another.

Ultimate analysis of different components is given in Table 4.

Table 4: Analysis of the combustible components in residential MSW

Component	Carbon	Hydrogen	Oxygen	Nitrogen	Sulphur	Ash
Organic :						
Food waste	48.0	6.4	37.6	2.6	0.4	5.0
Paper	43.5	6.0	44.0	0.3	0.2	6.0
Cardboard	44.0	5.9	44.6	0.3	0.2	5.0
Plastics	60.0	7.2	22.8			10.0
Textiles	55.0	6.6	31.2	4.6	0.15	2.5
Rubber	78.0	10.0		2.0		10.0
Leather	60.0	8.0	11.6	10.0	0.4	10.0
Yard waste	47.8	6.0	38.0	3.4	0.3	4.5
Wood	49.5	6.0	42.7	0.2	0.1	1.5
Inorganic :						
Glass	0.5	0.1	0.4	<0.1		98.9
Metals	4.5	0.6	4.3	<0.1		90.5
Dirt, ash, etc	26.3	3.0	2.0	0.5	0.2	68.0

Model Development

To find the fitness of the models, regression analysis was attempted. This has been done on MSW of Delhi using SPSS 13.0 statistical software (Agarwal *et al.*, 2004). The model is based on physical composition of MSW. The resulting regression equation can be expressed as :

$$Y = B_0 + B_1X_1 + B_2X_2 + \ldots\ldots\ldots + B_kX_k$$

Where Y is dependent variable, X_1, X_2, $\ldots\ldots X_k$ are independent variables; B_0 is intercept of straight line, B_1, B_2, $\ldots\ldots B_k$ are unstandarized regression coefficients. Energy content (KJ/ Kg) is the dependent variable. Independent variables tested in the model are the physical composition of the waste, such as organic fraction (biodegradable), paper and cardboard, plastics and non-biodegradables.

Criteria of model selection

SPSS software uses various criteria for deciding the goodness of fit. The coefficient of determination (R^2) and statistic adjusted R^2 is to reflect the goodness of fit of the model. F- Significance level (value less than 0.05) indicate that the model is fitting well to the data set. t – Statistics (more than 2) and t – significance level (below 0.05) indicates a linear relationship between dependent and independent variables. The Durbin–Watson statistics,'d', (possible range 0-4) is used for testing purpose in the analysis. Scatter plot and normal P–P plot have been used for judging fitness of regression line with the data. Normal scatter plot and P – P plots have been shown for all the models used.

Energy Content model for Delhi

For the present study, stepwise method of variable selection has been used to select the best fitting regression model. Four models were approached for the same, which have been detailed in Table 4. The proposed regression model, which uses the percentage by weight of MSW components, is as follow:

Equation derived from Regression using Conventional Model

E = 154.432 (bio) + 183.841 (paper) + 391.762 (plastic) + 11.983 (NB) – 1819.78

Equation derived from Regression using Dulong Model

E = 21.171 (bio) + 82.901 (paper) + 220.001 (plastic) +144.392(NB) + 807.538

Equation derived from Regression using Steurer Model

E= 67.803 (bio) + 109.906 (paper) + 244.409 (plastic) + 160.739(NB) + 687.962

Equation derived from Regression using S- Kestner Model

E = 111.004 (bio) + 122.967 (paper) + 251.429 (plastic) + 176.347 (NB) + 839.20

Where, bio:biodegradable waste, NB: non-biodegradable waste

The value of R^2 is 0.999 for conventional model, 0.925 for Dulong model, 0.926 for Steurer Model and 0.932 for S–Kestner Model. The high value of coefficient of determination indicates that observed data are fitting linearly on the proposed regression line. Standardized coefficient, ß, for plastic and non biodegradable is high compared to other waste components, which shows that plastic and rubber generate maximum energy from waste compared to other components in MSW. As an example two plots are given below (Fig 1 and Fig 2).

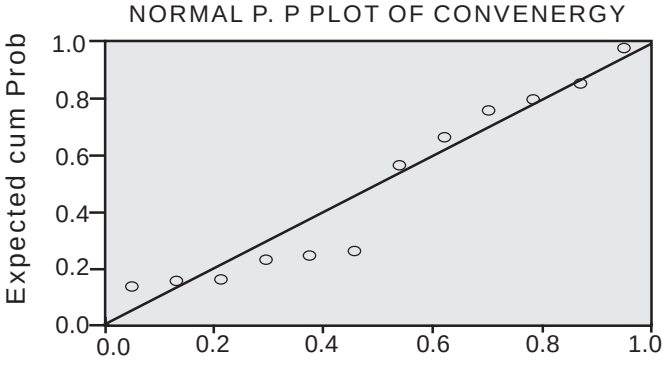

Fig.1: Normal P–P plot for Conventional Model

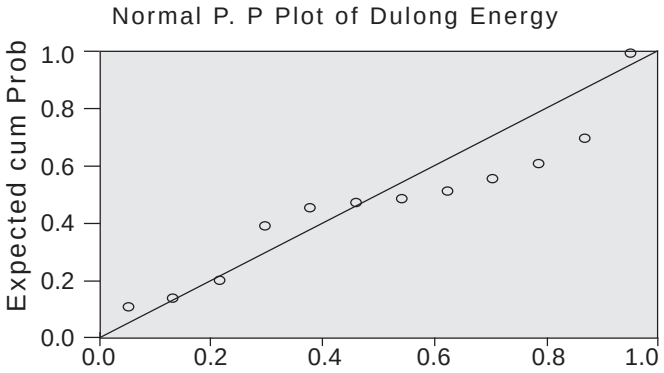

Fig. 2 : Normal P – P plot for Dulong Model

RESULTS AND DISCUSSION

Disposal of MSW in sanitary landfill has proved to be the most economical and acceptable method. Landfills are considered to be one of the major sources of methane generation. Globally, efforts are being made to use the energy potential of emitted methane from these sites. IPCC has deeply focused attention towards methods (empirical, stochiometric, statistical) which can be used for estimation of the generated methane from the landfill sites.

IPCC has suggested two methods of calculating methane emissions namely; default method (DM) and first order decay (FOD) method. Calculations were also done using Triangular method (TM) for estimation of methane from the landfills sites.

Among the available methods, the simplest one for estimating methane emissions from landfills is based on mass balance approach. This method was developed by Bingemer and Crutzen in 1987 and is being used in the revised IPCC Guidelines (1996) as the default methodology for estimating methane emissions from the solid waste disposal sites.

CH_4 emissions (Gg/yr) = MSW_T x MSW_f x MCF x DOC x DOC_f x F x (16/12 – R) x (1-OX)

FOD method provides a time dependent emission profile that reflects the true pattern of the degradation process over a time period. The FOD method requires data on current as well as historic waste quantities, composition and disposal practices for decades (IPCC, 1996). At present, due to lack of systematic data, this method cannot be used for estimation of methane emission. Therefore, a modified approach is proposed wherein the landfill gas is considered to be released in a triangular form, based on time dependent profile like that of FOD.

In this method time dependent release of green house gases (GHG) is based on FOD. Practically, the degradation process of solid wastes in the landfills happens to be a long and continuous process. Therefore, a modified default method or triangular method has been approached. In this method, it is assumed that volume of methane emission is same as that of default method. Also, it is assumed that degradation takes place in two phases. First phase starts after one year of deposition and rate of generation reaches peak in 6th year and thereafter, generation reaches zero in 16th year in second phase.

Methane trapped was calculated for its LPG equivalent which is shown in Table 3. Trapped methane is the methane which can be extracted from landfills and utilized for beneficial purposes. For present calculations it has been taken - 60% i.e., from the total methane generated from landfills, - 60% can be used.

Table 5: Comparison of methane equivalent with the LPG

Year	CH4 estimated from Default Method (Gg)	Extractable methane from landfills (~ 60%)	Mass (Kg)	LPG equivalent of CH4 (Kg)
1992	23.48	14.08	9856	6750.68
1993	26.73	16.03	11221	7685.61
1994	29.00	17.4	12180	8342.46
1995	28.20	16.92	11844	8112.32
1996	33.93	20.35	14245	9756.84
1997	41.79	25.07	17549	12019.86
1998	39.33	23.59	16513	11310.27
1999	44.47	26.68	18676	12791.78
2000	29.58	17.74	12418	8505.47
2001	23.88	14.32	10024	6865.75
2002	29.64	17.78	12446	8542.65
2003	32.98	19.78	13846	9483.56
2004	34.71	20.82	14574	9982.19

If methane can be extracted from landfill and used, this could save huge consumption of LPG as has been indicated in Table 5.

CONCLUSION

Solid waste generation cannot be stopped at one go. It requires innovative approaches for their proper management. Through the present research work, an attempt was made with various types of solid wastes for their proper management and recovery of energy. It was observed that solid waste generated from any source has some energy hidden in them. This energy could be extracted or utilized *in situ* using different technologies. Also, role and collective

responsibility of urban planners, designers, government bodies and above all general public play a significant role in effective ecological and economic solid waste management.

To conclude, in words of Dr. M.S. Swaminathan, "In building a paradigm of sustainable development, it is necessary to link concepts and procedures at the micro level with field level practices to arrive at a way of translating a conceptual response into a reality".

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EFFECT OF NALCO FLY-ASH ON THE GROWTH AND REPRODUCTION OF EARTHWORM *Pheretima posthuma*

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ABSTRACT

Fly-ash is amorphous ferroalumino silicate, an important solid waste around Nalco Power Plants. It creates problems leading to environmental degradation due to improper utilization. However, fly-ash is a useful ameliorant that may improve the physical, chemical and biological properties of soils and is a source of readily available plant macro and micronutrients when it is used with biosolids. Supply of nutrients from fly-ash with biosolids may enhance their agricultural use. The growth and reproduction of *Pheretima posthuma* was studied during vermicomposting of fly-ash in four different proportions (T_1, T_2, T_3, T_4) and one control i.e with cow dung and press mud alone. The growth of cocoon and hatchings production were observed at the interval of 15 days over period of 60 days. The maximum worm growth and reproduction was observed in bedding material alone. Besides, T_1 was also found to be a good mixture for vermiculture.

Key Words : Earth worm, growth, reproduction, fly-ash and press mud, ameliorant

INTRODUCTION

Fly-ash a resultant of combustion of coal at high temperature, has been regarded as a problematic solid waste all over the world. The conventional disposal method for Fly-ash leads to degradation of arable land and contamination of ground water. The repeated exposure of fly-ash causes irritation in eyes, skin, nose and results in arsenic poisoning. (16 lakh tons / year in 14,000 tons /day).Coal combustion product generated each year in India is more than 100 Metric Ton. Per annum of which 4 tm. is released into the atmosphere (Menon 1993)**.** Coal combustion by products were largely treated as waste material. In fact, fly-ash consists of practically all the elements present in soil except organic carbon and nitrogen. It was found that this material could be used as an amendment material in agricultural application (Jala 2004). A careful assessment of soil and fly-ash is required before its application as soil-ameliorating agent. The present outlets of fly-ash disposal are using cement, concrete and grout industries but such use only accounted for 40% of fly-ash produced by thermal power stations. The major problem faced by the coal thermal power stations all over the world is the handling and disposal of fly-ash. In the NALCO CPP (Captive Power Plant) of Angul, Orissa, India, ash pond spreads over an area 700 acres and occupying fertile, cultivable land. Menon studied the effect of mixed application fly-ash and organic compost on soil and availability and uptake of elements by various plant species very little is known regarding the effect of fly-ash amendment on soil biological properties(Menon 1993). Use of fly-ash as a soil-amending agent has been investigated for a variety of crops *viz.* Rice, wheat, vegetable crops **.** Fly-ash acts as a potential dust insecticide against various pests infecting rice, vegetable etc. Moreover fly-ash as a carrier in pesticide formulation and the role of fly-ash in soil properties have been studied by several workers. The beneficial effect of earthworm on soil has been attributed to increase microbial populations and biologically active metabolites such as plant growth regulators(Jala, 2004). Recycling of wastes through vermitechnology reduces the problem of non-utilisation of agrowastes. The earthworms that are employed in organic wastes mixed with soil, to a certain extent accumulate toxic metals and after vermicomposting they can be re-employed for the same purpose.Earthworm growth, maturation, cocoon production reproductive potential are not only influenced by environmental condition but strongly affected by the quality and availability of food. Growth and reproduction of different species of earthworms using different materials flax seeds, cattle manure and goat manure, presumed leguminous leaf litter have been studied. However,

studies are scanty on the reproductive potential of earthworm *Pheretima posthuma* influenced by Nalco fly-ash.The present study was aimed to evaluate the effect of Nalco fly-ash on the growth and reproductive potential of *Pheretima posthuma*. During the period of 60 days the growth and reproduction were observed in Nalco fly-ash (FA) with bedding material (cow dung and press mud) in various combinations where the press mud is solid waste produced by Sakti Sugar Mill, Dhenkanal, Orissa. India.

The main raw material, coal fly-ash samples were collected from electrostatic precipitators of Captive Power Plant, Nalco, Angul, Oirssa, India. The samples contained both amorphous mainly (SiO_2, Al_2O_3) and crystalline components mainly quartz and mullite). Physico-Chemical properties of fly-ash sample collected from Captive Power Plant of NALCO, Angul, Orissa, India have been documented as follows.

Table 1 : Physico-chemical properties of the fly-ash sample as documented by NALCO.

Sl. No.	Components	Composition with % of fly-ash obtained from Nalco)
1	Na_2O	0.10
2	Al_2O_3	29.19
3	SiO_2	55.60
4	K_2O	1.09
5	CaO	3.69
6	TiO_2	2.03
7	Fe_2O_3	4.95
8	BaO	0.00
9	MgO	2.75
10	Surface area (m^2/g)	3.5
11	Mean Particle Size (mm)	13.94

Source : NALCO monthly bulletin "Parichay"; December- 2004

MATERIALS AND METHODS

The following items were collected for the study.

(i) *Pheretima posthuma* was obtained from the stock culture maintained in the Department of Zoology, S. C. S. College, Bantala, Angul, Orissa, India.

(ii) Fly-ash was collected from the Captive Power Plant;Nalco,Angul,Orissa, India. :

(iii) The urea free cowdung was obtained from Angul Dairy Farm. The collected dung was sun dried and powered, used as the substance for the culture of earthworm *Pheretima posthuma*).

(iv) One month old and cured pressmud (PM) was obtained from Sakti Sugar Mill at Dhenkanal, Orissa, India.

Experiments and inoculation of earthworm

The cow dung and press mud were mixed in the ratio of 1:1(W/W) and used as bedding material (BM). Approximately 45 days old clittallate earthworm *Pheretima posthuma* (15g./1kg.) were inoculated in different experimental media as mentioned below. The plastic troughs were covered with nylon mesh and maintained at the room temp. 27 ± 2^0C with 60-70% of moisture, the medium without fly-ash were treated as control. In each combination six replicates were maintained.

The experimental combinations were

T_1	-	FA + BM	(1 : 9)
T_2	-	FA + BM	(2 : 8)
T_3	-	FA + BM	(3 : 7)
T_4	-	FA + BM	(4 : 6)
T_5	-	BM alone	

The biomass (wet weight) of earthworms was weighed in an electronic balance and the number of cocoons and hatchlings were counted by hand sorting method. The biomass (growth), cocoon and hatchling numbers were observed at the interval of 15 days, over a period of 60 days.

RESULTS AND DISCUSSION

The different levels of growth and reproduction of *Pheretima posthuma* were observed in the fly-ash + bedding material mixtures. Table 2 – 4 shows the values obtained for different parameters of growth and reproduction of *Pheretima posthuma* over the experimental period.

The changes in earth worm biomass over the period of 60 days with varies combinations of substrate are present in Table – 2 . The percent changes in the biomass over the initial days are given in brackets. Among the various experimental conditions such as T_1, T_2, T_3, T_4, & T_5 the maximum earthworm biomass

was observed in 100% bedding material, i.e in (T_5: 25.6 + 0.65 gm), the least growth was observed in T_4 (18.3 ± 0.37g) on 60th day. In all the experimental media the biomass have increased steadily but the biomass of *Pheretima posthuma* declined in T_4 on 15th day and in T_4 on 15th to 45th day after inoculation of worms due to mortality. After 45th day there was no mortality of worms and the biomass started to increase up to 60th day. 22% increased over the initial due to decomposition of fly-ash. The results obtained from all the treatments (T_1, T_2, T_3, T_4, & T_5) clearly indicate that fly-ash in combination with bedding material has positive effect on the growth of *Pheretima posthuma*. The efficiency of all the treatments supported the growth of *Pheretima posthuma* and it could be ranked in the following order. T_5 alone > T_1 > T_2 > T_3 > T_4 .

Table 2 : Effect of fly-ash – bedding material on the biomass of *Pheretima posthuma* (P < 0.05).

Substrate Proportion	Initial (O)	Vermicomposting days			
		15	30	45	60
T_1FA + BM 1:9	15 ± 0.75	16.0 ± 0.64 +6.67	19.2 ± 0.73 + 28.0	21.9 ± 0.94 + 40.0	23.1 ± 0.70 + 54.0
T_2FA + BM 2:8	15 ± 0.75	15.4 ± 0.76 + 2.67	16.1 ± 0.65 + 7.33	18.2 ± 0.72 +21.33	19.8 ± 0.93 + 32.0
T_3FA + BM 3:7	15 ± 0.75	14.5 ± 0.64 – 4.0	16.3 ± 0.58 + 8.67	18.7 ± 0.63 + 24.67	20.01 ± 0.55 + 34.0
T_4FA + BM 4:6	15 ± 0.75	13.8 ± 0.75 – 8.0	14.8 ± 0.69 – 7.33	13.8 ± 0.75 – 7.33	18.3 ± 0.75 + 22.0
T_5BM alone	15 ± 0.75	16.3 ± 0.58 + 8.67	20.7 ± 0.69 +38.0	23.1 ± 0.70 + 54.0	25.6 ± 0.65 + 70.67

The inoculation earthworms started to produce cocoons and they were observed on 15th day. On 60th day among all the treatments the T_5 (68.5 ± 1.04) shows best result when compared to the other treatments, it was followed by T_1, T_2, T_3, T_4 respectively. The variation in the cocoon production is depicted in Table – 3.

Table 3 : Effect of fly-ash – bedding material on the cocoons production (number of earthworm *Pheretima posthuma* P < 0.05.

Sl. No.	Subtrate Proportion	Initial (O)	Vermicomposting days			
			15	30	45	60
1	T_1 FA + BM 1:9		9.2 ± 0.77	11.1 ± 0.72	19.01 ± 0.72	59.5 ± 0.82
2	T_2 FA + BM 2:8		8.8 ± 0.70	10.6 ± 0.63	18.4 ± 0.56	57.6 ± 0.93
3	T_3 FA + BM 3:7		8.4 ± 0.51	9.2 ± 0.77	16.2 ± 0.70	52.5 ± 0.85
4	T_4 FA + BM 4:6		8.4 ± 0.68	8.1 ± 0.69	14.3 ± 0.64	46.6 ± 0.91
5	T_5 BM alone		11.1 ± 0.71	13.0 ± 0.71	21.8 ± 0.69	68.5 ± 1.04

The hatchlings production was observed in all the treatments only on 30th day. The greatest mean number of hatchlings per cocoons was observed in the 100% bedding material (T_5) followed by T_1, T_2, T_3 and T_4 (Table – 4). The highest growth (biomass) and reproduction (Cocoon and hatchlings) were observed in T_5 (BM alone) when compared to other treatments. The growth (biomass) and production hatchlings of *Pheretima posthuma* were tested in the fly-ash with bedding materials.

Table 4 : Effect of fly-ash – bedding material on hatchibility of *Pheretima posthuma* p ($P < 0.05$).

Substrate Proportion	Initial (O)	Vermicomposting days				
		15	30	45	60	Total
T_1FA + BM 1:9			18.9 ± 0.75	23.7 ± 0.68	34.1 ± 0.55	76.7 ± 0.91
T_2FA + BM 2:8			16.3 ± 0.75	22.4 ± 0.89	26.3 ± 0.95	65.0 ± 0.63
T_3FA + BM 3:7			13.2 ± 0.74	18.0 ± 0.71	24.07 ± 0.94	55.9 ± 1.03
T_4FA + BM 4:6			10.2 ± 0.73	18.5 ± 0.86	23.2 ± 0.74	51.9 ± 1.8
T_5BM alone			20.6 ± 0.88	35.0 ± 0.76	42.7 ± 0.93 7	98.3 ± 0.68

Results showed the maximum biomass, cocoons production and hatchlings were observed in bedding material alone (i.e.T_5) and it was followed by T_1, T_2 and they were followed by T_3 & T_4.

The potential of earthworms as waste processors has been well documented by various authors. Nutrition is an essential factor to determine the maximum growth of an organism. The optimal growth, maturation, cocoon production and reproductive potential of earthworms have been reported to depend on the quality and quantity of the available feed and various physico-chemical parameters. The best results regarding nutritional quality of the vermicompost and the growth and reproduction of *Pheretima posthuma* were obtained when worms were allowed to feed on cow dung show precocious maturation of gonads.

In observation, the maximum worm biomass was observed in T_5 100% bedding material compared to other treatments and the least growth was observed in T_4. The efficiency of all the treatments to support the growth of *Pheretima posthuma* could be ranked in the following order $T_5 > T_1 > T_2 > T_3 > T_4$. The T_5 showed super growth of earthworms because the bedding materials was having higher amount of nutrients. Compared to T_3 and T_4, the combination of T_1 and T_2 showed better growth, it might be due to the higher percentage of bedding material which may provide higher nutrients for the growth of earthworms.

CONCLUSION

The outcome of the present investigation provides an alternative way for the utilization of fly-ash apart from the conventional brick making, land filling etc. The biomass increases and cocoon production of earthworm *Pheretima posthuma* were high in 100% bedding material (cow dung and press mud). The biomass and cocoon production were observed to have an inverse relationship with the percentage of fly-ash mixed with bedding material, results supports the finding of Ramalingam, Kale, Kaushik, and Garg. Garg and Kaushik where they have mentioned the availability of food material influences the production and growth of earthworm. The reduction in the biomass of earthworm up to 60 days in T_4 and up to 30 days in T_3 indicated that the increase percentage of fly-ash reduced the growth of earthworms.

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VERTEBRATE FAUNAL DIVERSITY AT KANJIA LAKE, NANDANKANAN

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ABSTRACT

Kanjia Lake at Nandankanan Sanctuary provides important ecological and economic services such as supporting biotic diversity, nutrient retention and flood protection to the Zoological and Botanical Parks. As a part of the complete biodiversity assessment of this ecosystem, data on vertebrate faunal composition was collected in the form of photo documentation and inventory preparation. The checklists prepared during this study included addition of a number of species that were previously not recorded, while the list of amphibians was introduced for the first time. To conduct a preliminary study on the impact of anthropogenic pressures on species distribution along the lake, two groups: birds and amphibians were considered as indicators. Effective conservation of the wetland would require assessment of multiple organism groups and different types of disturbance at different spatial scales.

Key words : Kanjia lake, biodiversity assessment, vertebrate fauna, species distribution, indicators

INTRODUCTION

Tropical and subtropical regions of the world boast of the largest number of wetlands and the case in India is not very different. Orissa, a sub-tropical state of India, takes pride of having the largest wetland in Asia – Chilika. Besides Chilika, a large number of smaller wetlands are dotted across the state, the Kanjia Lake at the Nandankanan Zoological Park being one of them. Popularly known as the Nandankanan Lake, it is situated between $85^0$48' to $85^0$50' East longitudes and between $20^0$23' to $20^0$25' North latitudes. The lake lies within the boundary of Nandankanan Sanctuary, with the Zoological Park to the south and the Botanical Garden to the north of it. The Ministry of Environment and Forest, Government of India, which came into effect from December 2006, have designated Kanjia Lake as a Wetland of National Importance. The lake is an integral part of the Nandankanan Zoological Park and Sanctuary, and like other wetland ecosystems, it provides all the indirect benefits derived from its ecosystems functions. It is a natural ecosystem that is seasonally connected to the Mahanadi riverine system, and therefore, natural enrichment of its chemical and biological components take place leaving no requirement of human intervention. It is also a source of water for both the Zoological Park and the Botanical Garden for its everyday functions, The Lake is also significant to the Zoo in its conservation message as it plays home to many local migratory bird species that arrive here seasonally, making its avifaunal diversity even stronger. Faunal diversity is directly related to the complexity and stability of an ecosystem. In case of the Kanjia Lake, it is further accentuated by the presence of the Nandankanan Sanctuary and the Chandka Reserve Forest, and is therefore an important site of *in-situ* conservation.

MATERIALS AND METHODS

Fish

Samples were collected at three different points for 10 days. This was achieved with the aid of local fisherman who fish during early hours of morning (between 7 – 9 am), using traditional cast nets of mesh size 7×7 mm. In addition to this, sweep nets of mesh size 5×5 mm were used for surface feeders and those occurring at the edge of the lake. Photographs of collected samples were taken and the samples were identified either from photo identification or from live specimens. All samples were identified according to Day (1922, 1933), and Talwar and Jhingran (1991 a, b) with the help of the photo illustrations and the descriptions provided. Scientific names and authorities follow those of Talwar and Jhingran (1991 a, b).

Amphibians

The survey was conducted for 7 days and the time of survey was chosen late in the evening between 7 to 9 pm when the individuals are most active. We used three survey methods: (a) time-constrained searches along 500 m ×5 m transect belts along the riparian vegetation, (b) identification of call sounds, (c) non-strategic encounter method. Time

constrained search was conducted for 2 hours along a 500m×5 m transect belt in search of amphibian species occurring in the riparian vegetation as well as in small puddles and pools formed due to rains. This method of surveying is most useful for determining presence/ presence not detected and for providing initial data about the species present, Identification was done either from field photographs or specimen sample. The identification was based on Daniel (2002) and Smith (1935) and the scientific names and authorities followed Daniel (2002).

Reptiles :Time constrained searches, litter shifting and non-strategic encounters were undertaken and accounted for the survey of reptiles for 7 days between 8 am to 10 am and 3.30-5.00 pm. Litter shifting was done to document species that were inactive during these times. The maximum documentation however occurred by chance encounters, and the specimens were either collected or photo-documented. Identification was based on Daniel (2002) and Smith (1935), and the scientific names and authorities follow those of Daniel (2002).

Birds : Bird survey of the wetland was based on area search method as there was an unobstructed view of the lake, and the search was conducted during the first 4 hours of sunrise for 10 days. Two line-transects of 500 m each was undertaken, one each on the Zoological Park and the Botanical Garden side. Additionally, time constrained searches were conducted for 90 minutes on each side and the starting point of a transect was alternated (east or west) for subsequent surveys. Bird surveys were avoided on rainy and windy days because of their adverse impact on bird activity (Isaach et al. 2005). Identification was done from the photo documentation, based on photo illustrations of Ali and Ripley (1978) available as a series of books on the birds of India and Pakistan, and scientific names and authorities were based on Ali (1996).

Mammals : The survey of mammals was limited to only direct encounters or sightings, as the use of traps was not possible. The identification, scientific names and authorities followed Pocock (1939, 1941).

RESULTS AND DISCUSSION

An additional 6 species of fish was recorded, bringing the total number of species on the checklist to 47, against the last list of 41. Amphibians: The first baseline checklist of amphibian prepared recorded 10 species in total. Reptiles: 7 more species of reptiles was recorded, bringing the total to 20, against the previous list of 13. Birds: The total number of bird species recorded was 53 as compared to the last record of 37 species due to the addition of 16 more species to the list mentioned. Of the total species recorded, majority were Passeriformes, the largest order in the avifauna group. Mammals: The first list of mammal records 7 species, which occur in the riparian vegetation. The total number of species of vertebrate fauna recorded in and around the Kanjia Lake was 137, with the highest species composition share belonging to birds, followed closely by fish.

Although the study undertaken was only a rapid survey of vertebrate faunal diversity of Kanjia Lake, the results are indicative of high species diversity in this area. The wetland sustains many species that occur here naturally, and is therefore an important site of *in-situ* conservation. A good riparian bird community also reflects a healthy forest cover surrounding the wetland. The area is also considerably rich in amphibian diversity, which adds further to the ecological significance of the lake as the decline in population of this group of vertebrate is of global concern. Since it is a natural ecosystem that connects to a larger river system, enrichment of aquatic species in terms of number can be expected. Although the Zoological Park at the Nandankanan Sanctuary aims at *ex-situ* conservation for spreading awareness and education, the Kanjia Lake is a site of in-situ conservation and its conservation and management plays an important role in maintaining the species diversity of the Sanctuary. Although this survey helped in having a better estimation of the species composition of the lake, it must be borne in mind that the study was a rapid survey and the checklist prepared must be not considered to be conclusive. Instead, a more detailed assessment of the lake‘s species diversity should be conducted. Regular monitoring of a wetland‘s health is also an integral part of its management. To make it more time and cost effective, any environment-sensitive biological indicator such as the ones considered for this study can be used. Also, the checklist of amphibian species

recorded during the survey can be taken as a baseline data to initiate any conservation or management action, as planned by the zoo authorities. Finally, the Management Plan for the lake should accommodate for special strategies to manage the areas with higher human intervention. Any management activity, like the proposed de-siltation of the lake should be undertaken only after considering the impacts on the various biological components, as any change in the aquatic vegetation would bring in cascade changes in the invertebrate and vertebrate fauna that is directly or indirectly dependent on the vegetation.

The study was primarily handicapped by time constraint. The shorter time period allowed only rapid assessment, which leaves the probability of many species still gone unrecorded. The assessment of fish diversity was restricted to only those samples that could be collected from the local fishermen, or those that could be caught near the edge or the surface of the lake. Hence, there was a need for a thorough and strategic sampling method for fish. Similarly the inventory of mammals required more time and better sampling equipments like traps to ensure a more detailed list. Therefore, this study should be considered only as a baseline data for more detailed research on the biodiversity of the lake. The study on species distribution was more of a qualitative study and it must be borne in mind that occurrence of species depends on many physical, chemical and biological factors and a precise conclusion can be derived only by monitoring all three parameters. Kanjia Lake provides ecosystem services to the Sanctuary that are often difficult to value or assess. To maintain the species richness and diversity of the lake, management should take a precautionary approach and instigate conservation measures that would benefit both the Sanctuary and the lake in maintaining an ecosystem that is as healthy in the future as it is now.

Table 1 : Checklist of the fish fauna of Kanjia lake

SL NO.	COMMON NAME	SCIENTIFIC NAME
1	Rohu	*Labeo rohita* (Hamilton – Buchanan)
2	Black Rohu	*Labeo calbasu* (Hamilton – Buchanan)
3	Kuria Rohu	*Labeo gonius* (Hamilton – Buchanan)
4	Bata Labeo	*Labeo bata* (Hamilton-Buchanan)
5	Striped Snakehead	*Channa striatus* (Bloch)
6	Giant Snakhead	*Channa marulius* (Hamilton-Buchanan)
7	Spotted Snakehead	*Channa punctatus* (Bloch)
8	Asiatic Snakehead	*Channa gachua* (Bloch & Schneider)
9	Catla	*Catla catla* (Hamilton-Buchanan)
10	Mrigal	*Cirrhinus mrigala* (Hamilton-Buchanan)
11	Reba Carp	*Cirrhinus reba* (Hamilton-Buchanan)
12	Olive Barb	*Puntius sarana* (Hamilton-Buchanan)
13	Two-spot Barb	*Puntius ticto* (Hamilton-Buchanan)
14	Spotfin Swamp Barb	*Puntius sophore* (Hamilton-Buchanan)
15	Swamp Barb	*Puntius chola* (Hamilton – Buchanan)
16	Loktak	*Lepidocephalus irrorata* (Hora)
17	Loach Boal	*Wallago attu* (Schneider)
18	Grey Featherback	*Notopterus notopterus*(Pallas)
19	Humped Featherback	*Notopterus chitala* (Hamilton-Buchanan)
20	Magur	*Clarius batrachus* (Linnaeus)
21	Stinging Catfish	*Heteropneustis fossillis* (Bloch)
22	Climbing Perch	*Anabas testudineus* (Bloch)
23	Striped Dwarf Fish	*Mystus vittatus* (Bloch)
24	Gangetic Mystus	*Mystus cavasius* (Hamilton- Buchanan)
25	Pabdah Catfish	*Ompak pabda* (Hamilton-Buchanan)
26	Sleepy Goby	*Glossogobius biocellatus* (Valenciennes)
27	Tank Goby	*Glossogobius giuris* (Hamilton-Buchanan)
28	Marbled Spiny Eel	*Mastacembalus armatus* z(Lacepede)
29	Striped Spiny Eel	*Mastacembalus pancalus* (Hamilton-Buchanan)
30	Common Carp	*Cyprinus carpio* (Linnaeus)
31	Grass Carp	*Ctenopharyngodon idellus* (Valenciennes)
32	Giant Gourami	*Colisa fasciatus* (Schneider)
33	Indian Longfin Eel	*Anguilla bengalensis* (Gray)
34	Freshwater Garfish	*Xenentodon cancila* (Hamilton- Buchanan)
35	Coito	*Osteobrama coito* (Hamilton-Buchanan)
36	Leafy fish	*Nadus nandus* (Hamilton - Buchanan)
37	Large razor-belly minnow	*Salmostoma bacaila* (Hamilton-Buchanan)
38	Indian River Shad	*Gadusia chapra* (Hamilton-Buchanan)
39	Gangetic Ailia	*Ailia coila* (Hamilton-Buchanan)
40	Mola Carplet	*Amblypharyngodon mola* (Hamilton-Buchanan)
41	Large Razor -belly minnow	*Oxygaster bacaila* (Hamilton-Buchanan)
42	Indian Flying Barb	*Esomus danrica* (Weber & Beaufort)
43	Indian Glassy Fish	*Pseudoambassis ranga* (Hamilton-Buchanan)
44	Elongate glass-perchlet	*Chanda nama* (Hamilton-Buchanan)
45	Panchax Minnow	*Aplocheius panchax* (Hamilton-Buchanan)
46	Black line Rasbora	*Rasbora daniconius* (Hamilton)
47	Ocellated Pufferfish	*Tetradon cutcutia* (Hamilton-Buchanan)

Table 2 : Checklist of the amphibian fauna of Kanjia lake and surrounding vegetation.

Sl. No.	Common Name	Scientific Name
1	Common Indian Toad	*Bufo melanostictus* (Schneider)
2	Ornate Microhylid	*Microhyla ornata* (Dum. & Bibr.)
3	Common Tree Frog	*Polypedates maculatus* (Gray)
4	Skittering Frog	*Euphlyctis cyanophlyctis* (Schneider)
5	Indian Pond Frog	*Euphlyctis hexadactylus* (Lesson)
6	Indian Bull Frog	*Hoplobatrachus tigerinus* (Daudin)
7	Jerdon's Bull Frog	*Hoplobatrachus crassus* (Jerdon
8	Indian Cricket Frog	*Fejervarya limnocharis* (Gravenhorst)
9	White striped Frog	*Rana taipehensis* (Denburgh)

Table 3 : Checklist of reptilian fauna of Kanjia lake and surrounding vegetation

Sl. No.	Common Name	Scientific Name
1	Bark Gecko	*Hemidactylus leschenaultii* (Demeril & Bibron)
2	Bloodsucker	*Calotes versicolor* (Daudin)
3	Fan-throated lizard	*Sitana ponticeriana* (Cuvier)
4	Indian Chameleon	*Chamaeleon zeylanicus* (Laurenti)
5	Brahminy Skink	*Mabuya carinata* (Schneider)
6	Common Indian Monitor	*Varanus bengalensis* (Schneider)
7	Blind Snake	*Typhlops diardii* (Schlegal)
8	Earth Boa	*Eryx johni* (Schneider)
9	Indian Python	*Python molurus* (Linnaeus)
10	Common Ratsnake	*Ptyas mucosus* (Linnaeus)
11	Common Indian bronzeback	*Dendrelaphis tristis* (Daudin)
12	Common Wolf Snake	*Lycodon aulicus* (Linnaeus)
13	Checkered Keelback	*Xenochrophis piscator* (Schneider)
14	Buffstriped Keelback	*Amphiesma stolata* (Linnaeus)
15	Common Whip Snake	*Ahaetulla nasuta* (Lacepede)
16	Common Indian Krait	*Bungarus caeruleus* (Schneider)
17	Banded Krait	*Bungarus fasciatus* (Schneider)
18	Binocellate Cobra	*Naja naja* (Linnaeus)
19	Monocellate Cobra	*Naja kaouthia* (Linnaeus)
20	Rusell's Viper	*Daboia russelii* (Shaw & Nodder)

Table 4 : Checklist of avifauna of Kanjia lake and its surrounding vegetation.

Sl. No.	Common Name	Scientific Name
1	Little Cormorant	*Phalocrocorax niger* (Vieillot)
2	Pond Heron	*Ardeola grayii* (Sykes)
3	Night Heron	*Nycticorax nycticorax* (Linnaeus)
4	Little Egret	*Egretta garzetta* (Linnaeus)
5	Median Egret	*Egretta intermedia* (Wagler)
6	Cattle Egret	*Bubulcus ibis* (Linnaeus)
7	Lesser Whistling Teal	*Dendrocygna javanica* (Horsfield)
8	Cotton Teal	*Nettapus coromandelianus* (Gmelin)
9	Common Teal	*Anas crecca* (Linnaeus)
10	Openbill Stork	*Anastomus oscitans* (Boddaert)
11	Bronze-winged Jacana	*Metopidius indicus* (Latham)
12	Indian Purple Moorhen	*Porphyrio porphyrio* (Linnaeus)
13	White-breasted Water Hen	*Amaurornis phoenicurus* (Pennant)
14	Brahmini Duck	*Tadorna ferruginea* (Pallas)
15	Grey Duck	*Anas poecilorhyncha* (Forster)
16	Pintail	*Anas acuta* (Linnaeus)
17	Shikra	*Accipiter badius* (Gmelin)
18	Pariah Kite	*Milvus migrans* (Boddaert)
19	Hoopoe	*Upupa epops* (Linnaeus)
20	Nightjar	*Caprimulgus* sp.
21	Pheasant tailed Jacana	*Hydrophasianus chirurgus* (Scopoli)
22	Tailor Bird	*Orthotomus sutorius* (Pennant)
23	Jungle Babbler	*Turdoides striatus* (Dumont)
24	Common Babbler	*Turdoides caudatus* (Dumont)
25	Peafowl/ Peacock	*Pavo cristatus* (Linnaeus)
26	Blue Rock pigeon	*Columba livia* (Gmelin)
27	Spotted Dove	*Strepptopelia chinensis* (Scopoli)
28	Grey Partridge	*Francolinus pondicerianus* (Gmelin)
29	Bittern	*Botaurus stellaris* (Linnaeus)
30	Crow Pheasant	*Centropus sinensis* (Stephens)
31	Common Myna	*Acridotheres tristis* (Linnaeus)
32	Pied Myna	*Sturnus contra* (Linnaeus)
33	Common Crow	*Corvus spendens* (Viellot)
34	Jungle Crow	*Corvus macrorhynchos* (Wagler)
35	Rose-ringed Parakeet	*Psittacularia krameri* (Scopoli)
36	Cuckoo	*Cuculus* sp. (Linnaues)
37	Koel	*Eudynamys scolopacea* (Linnaeus)
38	Black-headed Oriole	*Oriolus xanthornus* (Linnaeus)
39	Golden Oriole	*Oriolus oriolus* (Linnaeus)
40	White-breasted Kingfisher	*Alcedo atthis* (Linnaeus)
41	Little Blue Kingfisher	*Halcyon smyrnensis* (Linnaeus)
42	Lesser Pied Kingfisher	*Ceryle rudis* (Linnaeus)
43	Black Drongo	*Dicrurus adsimilis* (Bechstein)
44	Magpie Robin	*Copsychus saularis* (Linnaeus)
45	Tree Pie	*Dendrocitta vagabunda* (Latham)
46	Black-headed Muniah	*Lonchura malacca* (Linnaeus)
47	Red-vented Bulbul	*Pycnonotus cafer* (Linnaeus)
48	Red-whiskered Bulbul	*Pycnonotus jocosus* (Linnaeus)
49	Common Swallow	*Hirundo rustica* (Linnaeus)
50	Roller or Blue Jay	*Coracias bengalensis* (Linnaeus)
51	Curlew	*Numenius arquata* (Linnaeus)
52	Barn Owl	*Tyto alba* (Scopoli)
53	Large Green Barbet	*Megalaima zeylanica* (Gmelin)

Table 5 : Checklist of mammals recorded at Kanjia Lake and its surrounding vegetation

Sl. No.	Common Name	Scientific Name
1	Small Indian mongoose	*Herpestes javanicus* (Geoffroy)
2	Bandicoot	*Bandicota indica*
3	Small Indian Civet	*Viverricula indica* (Desmarest)
4	Brown Rat	*Rattus* sp. (Fischer de Waldheim)
5	Indian Palm Squirrel	*Funambulus palmarum* (Linnaeus)
6	Rhesus monkey	*Macaca mullata* (Zimmermann)
7	Hanuman Langur	*Semnopithecus* sp. (Dufresne)

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ROLE OF WILDLIFE IN EMERGING ZOONOSES

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INTRODUCTION

Zoonoses are infectious diseases that can be transmitted from animals to human beings. Emerging and re-emerging zoonoses are infectious diseases that are newly recognized or are newly evolved or have occurred previously but have more recently shown an increase in incidence leading to expansion of a new geographic, host or vector range.

Wildlife constitutes a large and often unknown reservoir of these new and emerging zoonoses. Wildlife can also be a source for re-emergence of zoonoses that were thought to be under control. It has been estimated that approximately 60% of recognised human pathogens are zoonotic and 75% of the diseases that have emerged over the past two decades have come from wildlife sources (Wool house, 2002).

The processes and factors that may have given rise to emerging or re-emerging infectious and zoonotic diseases, which originated in wildlife, include the following (Williams *et al.*, 2002):

(i) Expanding human populations and increased contact with wild animals or their products.

(ii) Ecosystem changes of natural or anthropogenic origin, with climatic and geographic influences on pathogens and vectors.

(iii) Increased human-assisted movement of animals and animal products.

(iv) Wildlife-associated microbes entering intensive livestock-based agricultural systems.

(v) Intensive farming of formerly wild species.

(vi) Increased frequency and speed of local and international travels.

(vii) Changes in the microbes themselves, or their host spectrum (crossing the species barrier).

(viii) Improved technical diagnostic and epidemiological techniques, which have resulted in the recent detection of an existing or novel disease agent.

RECENT EMERGING DISEASES

(i) Simian immunodeficiency viruses and human immunodeficiency virus/acquired immuno deficiency syndrome

Human immunodeficiency virus (HIV)/ AIDS is caused by two of the 26 simian immunodeficiency virus (SIV) strains known to occur in African primates. The HIV-1 and HIV-2 viruses have evolved from a chimpanzee (*Pan troglodytes*) strain and a Sooty mangabey (*Cercocebus torquatus*) strain, respectively. Transmission of these SIV strains to humans appear to be linked to hunting apes and using them for food. From these transmission events, virus strains which were both highly adapted to humans and contagious among humans evolved as HIV-1 and HIV-2, and these are now maintained and spreading in human populations, independent of their simian origin (Bengis *et al*., 2004).

(ii) Ebola virus

Ebola virus infection of humans was first described in Central Africa in 1976 and several lethal outbreaks have been recorded over the years in Africa. Each human epidemic has been linked to the handling of a distinct gorilla (*Gorilla* sp.), chimpanzee or duiker (*Sylvicapra grimmia*) carcass followed by horizontal human-to-human spread.

(iii) Hanta virus

Hanta viruses are the causative agents of haemorrhagic fever with renal syndrome (HFRS) in Europe and Asia and hanta virus pulmonary syndrome (HPS) in America. The pathogens responsible for HFRS include Hantaan, Seoul, Dobrava and Puumala hanta viruses, whereas HPS is caused by the Sin Nombre group of hanta viruses. All these viruses are maintained in wild rodent reservoirs, and human infections occur through the respiratory route as a result of aerosolisation of rodent excreta. Human activities such as rodent trapping, farming, cleaning rodent-infested premises, camping and hunting have also been identified as risk factors in the occurrence of hanta virus disease (Mahy and Murphy, 1998).

(iv) Hendra virus

In 1994, two outbreaks of fatal, viral disease affecting horses and humans occurred in Queensland, Australia. Virological testing suggests that bats of the Megachiroptera family (*Pteropus* sp.) are the natural reservoirs of the virus. The method of transmission from bats to horses may be urinary contamination of feed or water.

(v) Nipah virus

From 1998 to 1999, a new highly contagious respiratory and neurological disease of pigs and humans associated with pigs was reported in the Malaysian peninsula, which was diagnosed as Nipah virus of paramyxiviridae family. Evidence from virological and serological techniques implicated fruit bats of the genus *Pteropus* as the natural host and reservoir for this virus. Human infection with Nipah virus was also confirmed in Bangladesh in 2001, 2003 and 2004, with high fatality rates. Highly mobile fruit bats with large home ranges were again implicated as the source of infection (WHO, 2004).

(vi) West Nile virus infection

WNV, a flavivirus emerged in North America is a well-known virus of Europe, western Asia and Africa presenting a threat to human and equine health and certain wild bird populations. It is maintained in a wide species range of wild birds and bird-feeding mosquitoes and cause febrile disease and encephalitis in a number of mammal species, including humans. In 2002 and 2003 WNV epidemics was recorded as the largest recognised arbovirus meningo-encephalitis epidemics in the western hemisphere, with more than 500 deaths (CDC, 1999).

(vii) Severe Acute Respiratory Syndrome(SARS)

During 2002 and 2003, a viral respiratory disease emerged in humans in south-east Asia called SARS. It is caused by corona virus and infections to humans occurred first in the southern region of the China and the virus was subsequently isolated in masked palm civets (*Paguma larvata*) in that area, which has been commercialized for food and other products (Bengis *et al*., 2004).

(viii) Avian influenza (Influenza A)

Influenza A viruses are responsible for highly contagious acute illness in humans, pigs, horses, marine mammals and birds, occasionally resulting in devastating epidemics and pandemics, and studies suggest that aquatic birds could be the original source of the genetic material of all influenza A viruses in other species. Virus strains isolated from wild birds have generally been weak pathogens, but strains may become both pathogenic and well adapted to host species such as poultry, pigs and humans. The most serious of these pandemics occurred in 1918, during which an estimated 20 to 50 million people died and in 2003 and 2004, outbreaks of an H5N1 virus sub-type occurred in intensive poultry farms over large areas of south-east Asia (FAO, 2004).

(ix) Monkey pox virus infection

Monkey pox virus infection of humans occurred in West and Central Africa. The virus reservoir is tree squirrels and other rodents in the African tropical rain forests, and humans became infected by hunting and handling these animals. During June and July 2003, 71 suspected cases of monkey pox were reported in different states of USA. Most of these people became infected by contact with pet prairie dogs (rodents of the genus *Cynomys*), which in turn became infected through contact with Gambian giant rats (*Cricetomys* spp.) and dormice (*Graphiurus* sp.) [OIE, 2004].

(x) Ross River virus

It is an arbovirus which spreads by mosquito bites. Other similar viruses are Barmah Forest virus; Australian encephalitis (Murray Valley encephalitis) virus and; Kunjin virus found in Australia. The reserviors of the virus are Eastern grey kangaroos, wallabies and *musquito Aedes vigilax*. *Culex annulirostris* mosquitoes transfer the virus between the hosts (Brown, 2004).

(xi) Lyssa virus

This virus is related to rabies virus and is endemic in bat populations in Australia. Lyssa virus has been found in several species of flying foxes, with a high incidence in Little Red Flying foxes; and microbats (the yellow-bellied sheath-tailed bat, and lesser long-eared bats in particular) and is transmitted by biting or contamination of open cuts.

(xii) Lyme Borreliosis

Lyme borreliosis has become the most common vector borne infection in the northern hemisphere. This disease is caused by spirochaetessuch as

Borrelia burgdorferi. The maintenance hosts and reservoirs are small and medium-sized mammals (white-tailed deer, rodent reservoirs like *Peromyscus* spp. and *Tamias* sp.) and ground-feeding birds in the endemic areas (Bengis *et al*., 2004).

(xiii) Ehrlichiosis

Ehrlichia and *Anaplasma* spp. are obligate intra-cellular tick-transmitted bacteria. *Ehrlichia chaffeensis* and *Ehrlichia ewingii* are primarily maintained in nature by white-tailed deer (*O. virginianus*) and the lone-star tick (*Amblyomma americanum*) as host and vector respectively. *Anaplasma (Ehrlichia) phagocytophilum*, a human pathogen is found in white-footed mouse (*Peromyscus leucopus*) and in white tailed deer (Chomel *et al.*, 2004).

(xiv) Cryptosporidiosis

Cryptosporidium is a coccidian protozoa, *which* is mostly found in water contaminated by faeces and the sources of this protoza include reptiles and possibly other animals, such as the Mountain Brushtail possum, the bilby and the kangaroo. It can be transmitted either directly from animal to human, or by drinking contaminated water (Krause *et al*., 2004).

CONCLUSION

Emerging infectious diseases have a major impact on human and animal health and can bear a tremendous economic burden. Animals, particularly wild animals, are thought to be the source of more than 70% of all emerging infections. It is therefore essential to increase the capability of recognizing zoonoses with a wildlife reservoir. So, better national surveillance systems for humans and animals as well as better international integration and sharing of information from such systems are highly required. Improved reporting systems and screening programs for human/ animal infections are warranted to detect new and emerging zoonoses. Efficient surveillance is dependent upon a laboratory system that is capable of identifying and characterizing the pathogens. Further research is required to better understand the epidemiology and pathogenesis of various zoonoses. Training and education are prerequisites to enable the personnel involved at various stages, from field to laboratory, to detect zoonoses, both new and old. Interdisciplinary and international collaboration is necessary for the rapid identification and effective management of outbreaks of zoonoses. Hence, zoonoses with a wildlife reservoir relies on efficient national, regional, and international cross-sectional networks that can improve data sharing, thereby inviting alertness for creating timely and effective response to combat different disease outbreaks.

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OBSERVATION ON FRESH WATER SPONGE INSIDE AQUARIUM AT REGIONAL MUSEUM FOR NATURAL HISTORY BHUBANESWAR

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INTRODUCTION

The bath sponge was known to the Greeks at an early dates and Homer refered to it as being used for cleaning furniture, for expunging writing and for ablutionary purposes. He also mentions its peculiar structure “with many holes”.

Sponges are the most ancient multicellular animals having existed for more than 580 milllion years ago (Muller *et al.* 2004). At least 15000 species are classified into three classes i.e Hexacitirellida, Demospongiae and Calcarea based on the nature of their mineral skeleton. Sponges are colonized most aquatic habitat from polar seas to tropical waters and approxmitaely 150 species (Spongillidae) have become adapted to fresh water (Manconi and Pronzato, 2002).

In spongillidae the spicules and the skeleton are more important as regards the recognition of genera and species than the soft parts. The skeleton is usually reticulate, but sometimes consist a mass of spicules almost without arrangement. The amount of sponging present is also different in different species.

MATERIALS AND METHODS

Samples were collected inside aquarium at Regional Museum of Natural History (RMNH) which is placed outside the biodiversity gallery (Fig.1).

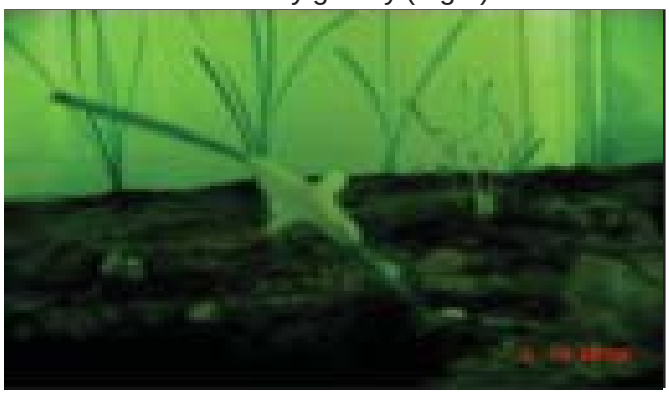

Fig. 1 : Aquarium of RMNH showing the sponge

The samples were transported to the laboratory with water. Samples were observed the Zeiss Stemi under SV6 stereo zoom microscope and Olympus compound microscope. Then the sample were photographed by Leica stereozoom with Nikkon F-65 camera. The nitric acid technique was used to dissolve the sponge tissue.

RESULTS AND DISCUSSION

Under the study Spongilla alba bengalensis was identified by using compound microscope following their classical morphological and skeletal structures (Fig.2).

Fig. 2 : Development of sponge in complete form

Morphological Character- Sponge forming masses, surface smooth, undulating, hard but brittle, whitish in colour, radiating, furrows very short, external membrane adhering to the substance of the sponge skeleton forming a moderately dense network of slender radiating and transverse fiber held together and little sponging present.

Gemmule Spicule- Slender cylindrical abruptly pointed at the end moderately thick granular layer. Spicule laying horizontally on the external surface of the gemmule as well as tagentically in the granular layer. No foraminal tuble.

The identification of sponge has traditionally been based on their morphological character, among which the skeletal architecture and spicule compensation

have been of particular importance. The skeleton of sponge provides the most useful set of characteristics for their identification. The diverse range of kind and size of spicules in particular those present in gemmules (Gemmuloscleres) makes them an indispensable means for a sponge taxonomist (Hooper and Van Soest, 2002).

Fig. 3 : Gemmule of Spongilla alba bengalensis

Though the resolution of light microscope is usually sufficient for the morphological analysis of sponge spicules, in some cases the discrimination between certain species *Spongilla lacustris* and *Eunepilus fragilis* may be difficult. So we are confirmed the results of light microscopy by stereozoom microscopy and compound microscopy which permits to characterize fine ultra structure features of spicules (Fig. 4).

The sponge samples analyzed in this work were collected from RMNH. They were found in Vallicinaria plant at depth of 1foot. The present work provides for the identification of aquarium fresh water sponges contributing to the systematic studies of the fresh water invertebrate fauna of an aquarium.

Fig. 4 : Spicule of Spongilla alba bengalensis

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EARTHQUAKE RESISTANT DESIGN OF BUILDINGS

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INTRODUCTION

An earthquake is a natural phenomenon that results from underground movement along a fault plane. Sometimes it is so mild that it passes unnoticed. Sometimes it is quite strong and creates vast openings in the earth's surface and in the impact buildings fall down and many lives are lost.

PREDICTION OF EARTHQUAKE

With careful study, geologists are slowly learning about such questions like, can earthquake be predicted? Can we stop earthquake before it occurs? Can we design a city to withstand an earthquake? Studies and research are going on. To know about earthquake the following clues are generally referred *viz.* strange animal behavior, increase in the rate of smaller earthquake, gap in the regular frequency of the earthquake etc. But fact remains none has correctly predicted it.

Recently earthquakes and the subsequent disastrous effect have established an urgent need of evolving a coordinated design system to provide earthquake resistant structures in our country. One can not construct a dwelling completely earthquake proof but it can certainly be made earthquake resistant to some extent depending upon seismic zones.

EARTHQUAKES IN INDIA

About 54% of India's land are vulnerable to earthquakes (Patnaik KK, 2005). The increase in demographic pressure, unplanned and ill-planned development practices and poor quality construction techniques have contributed immensely to the proliferation of seismic risk. In India, where 90% of the population lives in buildings built without proper guidance from qualified structural engineers and architects.

INDIAN SEISMIC CODES

It is necessary to design and construct earthquake resistant buildings in the seismic prone zones. The principles of seismic design should be kept in mind in this regard.

The Bureau of Indian standards, the National Standard Body of India, is a statutory organization under the Bureau of Indian Standards Act 1986. One of the activities is formulation of Indian standards on different subjects of engineering through various councils.

Seismic codes are unique to a particular region or country. They take into account the local seismology, accepted level of seismic risk, building typologies, and materials and methods used in construction.

The first formal seismic code in India, namely IS 1893, was published in 1962. Today, the Bureau of Indian Standards (BIS) has the following seismic codes:

IS 1893 (Part I), 2002, Indian Standard Criteria for Earthquake Resistant Design of Structures (5th Revision)

IS 4326, 1993, Indian Standard Code of Practice for Earthquake Resistant Design and Construction of Buildings (2nd Revision)

IS 13827, 1993, Indian Standard Guidelines for Improving Earthquake Resistance of Earthen Buildings

IS 13828, 1993, Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings

IS 13920, 1993, Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces

IS 13935, 1993, Indian Standard Guidelines for Repair and Seismic Strengthening of Buildings

The code covers all aspects of design including analysis, detailing, construction and strengthening of existing structure. These codes define the provisions required according to risk zone in which structure is located. Inadequate knowledge and practice result in failure of the structure.

EARTHQUAKE ZONES IN INDIA

The varying geology at different locations in the country implies that the likelihood of damaging earthquakes taking place at different locations is different. Thus, a seismic zone map is required so that buildings and other structures located in different regions can be designed to withstand different level of ground shaking.

Region falling in various zones of the country

The following earthquake zones have been catagorized considering its region, its risk factors, intensity and tune rate of damage.

Zone V (Earthquake Very high damage risk zone - areas may expectintensity maximum ofMSK IX or more) The entire North-east, including all the seven sister states, the Kutch district, parts of Himachal and Jammu and Kashmir, and the Andaman and Nicobar islands.

Zone IV (Earthquake High Damage Risk Zone -areas may expectintensity maximum of MSK VIII) Parts of the Northern belt starting from Jammu and Kashmir to Himachal Pradesh. Also including Delhi and parts of Haryana. The Koyna region of Maharashtra is also in this zone.

Zone III (Earthquake Moderate Damage Risk Zone - areas may expectintensity maximum ofMSK VII) A large part of the country stretching from the North including some parts of Rajasthan to the South through the Konkan coast, and also the Eastern parts of the country.

Zone II (Earthquake Low Damage Risk Zone -areas may experienceintensity MSK VI) These two zones are contiguous, covering parts of Karnataka, Andhra Pradesh, Orissa, Madhya Pradesh, and Rajasthan, known as low risk earthquake zones.

KNOWLEDGE ABOUT THE SOIL

Before beginning construction of any building, it is very much important to have the complete knowledge about the soil. Soil tests should be conducted to know the type of soil, bearing capacity, strata, composition etc.

There are mainly three soil types:

Firm : Those soils which have an allowable bearing capacity of more than 10 t/m2

Soft : Those soils, which have allowable bearing capacity less than or equal to 10 t / m2.

Weak : Those soils, which are liable to large differential settlement or liquefaction during an earthquake.

Buildings can be constructed on firm and soft soils but it will be dangerous to build them on weak soils. Hence, appropriate soil investigations should be carried out to establish the allowable bearing capacity and nature of soil. Weak soils must be avoided or compacted to improve them so as to qualify as firm or soft.

GENERAL PLANNING AND DESIGN ASPECTS

Lay-out of the block

The lay out of buildings should be as simple as possible, and there should not be any sudden change or sharp angles in the plan. Depending upon the seismic zones, heights of the buildings and thickness of walls are decided.

Symmetry

The building as a whole or its various blocks should be kept symmetrical about both the axes. Asymmetry leads to torsion during earthquakes and is dangerous. Symmetry is also desirable in the placing and sizing of door and window openings, as far as possible.

Regularity

Simple rectangular shapes, behave better in an earthquake than shapes with many projections. Torsional effects of ground motion are pronounced in long narrow rectangular blocks. Therefore, it is desirable to restrict the length of a block to three times its width. If longer lengths are required two separate blocks with sufficient separation in between should be provided.

Separation of Blocks

Separation of a large building into several blocks may be required so as to obtain symmetry and regularity of each block. For preventing hammering or pounding damage between blocks, a physical separation of 3 to 4 cm through out the height above the plinth level will be adequate. The separation section can be treated just like expansion joint or it may be filled or covered with a weak material which would easily crush and crumble during earthquake shaking. Such separation may be considered in larger buildings since it may not be convenient in small buildings.

Simplicity

Ornamentation involving large cornices, vertical or horizontal cantilever projections, facia stones etc. are dangerous and undesirable from a seismic view point. Simplicity is the best approach. Where ornamentation is insisted upon, it must be reinforced with steel, which should be properly embedded or tied into the main structure of the building.

Enclosed Area

A small building enclosure with properly inter connected walls acts like a rigid box since the earthquake strength which long walls derive from transverse walls, increases as their length decreases. Therefore, structurally it will be advisable to have separately enclosed rooms rather than one long room. Heavy structures are more unsafe in the earthquake. Uses of light building materials are recommended in such areas. Maximum three storeyed structures are recommended in load bearing walls. In such cases ground floor walls are of one and a half brick thickness and upper two levels are constructed with one brick thick wall. Opposite walls should nearly be equal in weight and size. Otherwise waves can cause differential settlement. Usually tall buildings and buildings with fewer columns or walls in a particular storey tends to damage or collapse.

CONCLUSION

Seismic risk reduction demands a systematic evaluation of the hazards, vulnerability and risk mapping of the entire region. Town and Country Planning Acts, Master Plan, Development Control Rules and Building Regulations of some of the metro cities in the country have mentioned adequately on the importance of safety requirements against natural hazards. To summarize it is essential that the services of experienced Architect and Structural Engineers with experience in earthquake resistant construction, and having awareness with respect to the provisions given in I.S. Codes is highly needed for design of earthquake resistant buildings. It should be made mandatory for all owners and developers to get their buildings certified from structural engineers for safety reasons.

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GREEN BUILDINGS ECOLOGY IN INDIA

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INTRODUCTION

The extreme climatic condition we are facing now days is a clear indication of the global warming issues. The third assessment report of the Inter governmental Panel on Climate Change (IPCC) predicts an increase in surface temperature of 1.4°C to 5.8°C over the period from 1990 to 2100 together with an increase in climate variability and extreme events viz. hot days, heat waves, heavy precipitation, lower cold days etc. This has been a regular occurrence in India in the last 3-4 years. Figure 1 shows Global warming rise in 2100. The root cause for climate change is energy supply followed by transportation and industry (IPCC); i) 40 % of global emissions attributed to buildings ii) 60 % of waste generated by buildings or activities contributing to the building sector. The construction of buildings is reported to consume 3 billion tones (Chatterjee 2009) of raw materials per year out of which 40 % of the raw stone, gravel, and sand used globally each year, and 25 % of the raw timber. Buildings also account 16 % of the water used annually worldwide (Lippiatt 1999). Majority of urban water consumption and wastage attributable to buildings responsible for raising urban temperatures by 7 degrees centigrade and generates 10 and 40 % of the solid waste streams in most countries.

GREEN BUILDING INITIATIVES IN INDIA

In India the concept of green building came into being with the CII – Godrej initiative in 2006, when the Indian Green Building Council was formed (Srinivas, 2006). The council is represented by all stake holders of the construction industry such as corporate bodies, governmental agencies, architects, material manufacturers, relevant research bodies and academia, etc. The vision of the council is to serve as a nodal body to facilitate green building activities in India. Today a variety of green building projects are coming up in the country like residential complexes, exhibition centers, hospitals, educational institutions, laboratories, information technology(IT) parks, airports, government buildings and corporate offices. Figure 1 shows the growth of green buildings in India from 2003 to 2006.

GREEN BUILDINGS

The “green building” practice is a process to create buildings and infrastructure that minimize the use of resources, reduce harmful effects on the ecology and create healthier environments for people.

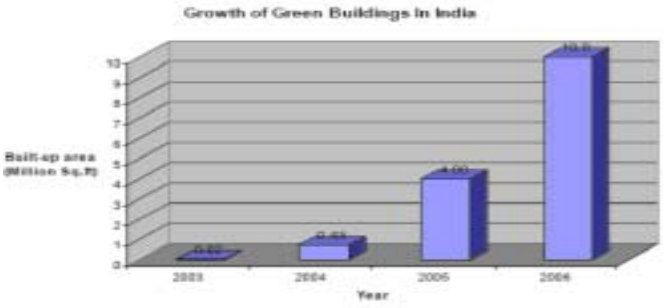

Fig 1: Growth of green buildings in India (source: Srinivas 2006)

Green buildings are expected to exhibit a high level of environmental, economic and engineering performance that include: Energy efficiency and conservation, improved indoor air quality, resource and material efficiency, occupant’s health and productivity, proximity to public transport system, improved environmental quality covering air, water, land and ecosystems. There are different criteria that are applied to choose materials that can be used in green buildings. They include materials made of recycled and salvaged agro industrial wastes; materials that reduce the quantity used without sacrificing the durability, materials that are biodegradable, materials with low emission of volatile organic chemicals (VOC), materials that avoid toxic emissions or does not add to the ozone depletion,

Fig. 2 : Impact of construction on the environment

natural and minimally processed products, alternatives to natural wood but not made of PVC, products that reduce or minimize pesticide treatments and reduce pollution; products that reduce environmental impacts during construction, demolition, renovation or retrofitting, materials that save energy and water and so on. Besides, these buildings can be made green by taking following measures.(i) Proper building construction (ii) Use of energy efficient lighting system and (iii) Better use of water.

Proper building construction

Building construction damages the eco-system; disturb the natural vegetation as well as top soil vegetation (Figure 3). It destroy the mature trees. The site and the building plan is selected in such a way that it should protect the existing trees or compensatory forestation. Use of locally available material to avoid unwanted transportation. Building can be constructed with eco friendly building materials, including re-use of waste and other secondary materials such as water, fuel cementious materials. The construction chemical industry has a host of product to offer green concrete world wide, viz. Hyper plasticized concrete, high volume flyash concrete, self compacting concrete etc. Along with reduced waste, energy use, and

Energy efficient lighting system

water use, it has been quoted that natural lighting and improved air quality lead to increased productivity and increased user satisfaction with the building. There should be maximum reliance on natural lighting by systemic efficiency in external as well as internal lighting with solar chimneys, double skin façade, solar walls, geothermal heat sinks etc. Use of solar photo-voltaic applications, wind, fuel cells, bio-mass etc. may reduce the energy load.

Better use of water

With glaciers melting and rivers drying, the tropical countries are likely to face severe water shortages in future. Reckless depletion of the ground water aquifer is adding to the pressure on urban water resources : (i) Xeriscaping and native species tree plantation, to control: (ii) Microclimate (iii) Minimal landscape water demand (iv) Urban heat island effect (v) High permeability and ground water recharge (vi) Reduced building water consumption (vii) Increased recycling and reuse of waste water (viii)Ensure potable water quality.

The management and use of water within a building and its surrounding landscape is one component of green building design and operation (Kibert, 2005). One of the objectives of green building design is to minimize the use of treated water for landscaping, and maintenance purposes. The cost and energy use inherent with the treatment and distribution of water can thus be minimized. An efficient approach to minimize treated water use is the integration of a rain barrel (Guo and Baetz, 2007) in a house setting or a cistern in a larger building context. The rain barrel or cistern is operated during non-winter seasons to collect and store rainwater from the roof of the building for use on dry days between successive rainfall events.

CONCLUSION

The building ecology aiming with constant cycling of materials from the earth, through plants and animals, to the atmosphere and back through the earth. The design decisions address the imbalances in biogeochemical flaws caused in construction and their buildings help support the diversity of ecosystems. The engineers need to understand that a sustainable building is not one that last for ever but one that can easily adapt to change. They should apply their experience and expertise to create buildings that are resilient to environmental conditions and can cater to a diversity of human needs and minimize resource consumption and waste generation. There is perhaps a need for a culture change towards greater flexibility in building designs and construction practices. There is an imperative need for appreciation and adoption of building ecology. Let all real-estate infrastructure developers, local body authorities, people etc. focus on the practice of increasing the efficiency with which buildings use resources such as energy, water and materials, in making the buildings green.

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STRESS FACTORS IN FISH CULTURE PONDS

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INTRODUCTION

Edible fishes are not only sources of nutrition but also a dire necessity as a food which is gaining abundant popularity. Accordingly various cultural practices are adopted to increase the productivity. However, quite often constraints are encountered in terms of accumulation of toxins such as xenobiotic ammonical excreta in the limited water bodies to rear a large population of fish. Their impaired metabolism and growth, immune functions, reproductive capacity, and normal behavior pose high density rearing system is subjected to a number of stress factors such as ammonia, nitrite, pH as well as dissolved oxygen demand inaddition to others. Stress depends on external environmental factors influencing the bioavailability of stressors related to the hydrological parameters. High stocking density i.e., high biomass coupled with fertilization and feeding can result in the accumulation of toxic metabolites which act as a stress within the system.

Fish culture in captive condition is an age-old practice. With increased popularity of fish as a food item for human being, the demand for fish is increasing over the years. The recent trend in increasing fish production through intensive farming with a high amount of supplementation of feed, seed and fertilizers, the intensification of cultural practices has resulted in a rise in the yield. Higher stocking densities are a typical characteristic of intensive culture system for higher production, while minimizing the total land requirement and water usage. However, the high biomass (total weight of fish in a water body) coupled with fertilization and feeding can result in the accumulation of toxic metabolites (Ver and Chiu, 1986). Hence, intensification of aquaculture system is inherently associated with the enrichment of water with respect to ammonium and other organic nitrogenous species (Boyd, 1982; Avnimeleech, 1999).

Fish accumulate xenobiotic chemicals (with poor water solubility) and excrete ammonia in the pond. The growth depressors being common in ammonia (both ionic and unionic form) and nitrite are usually in the form of accumulated metabolites. Low dissolved oxygen aggravates the effects of other toxicants present in the medium and increase the probability of disease occurrence. Temperature play an important role in biological activity (like enzyme activity, metabolic rate etc) and acts directly or indirectly through its influence on other factors.

STRESS

Stress has been defined as “the non-specific response of the body to any demand made upon it” (Selye, 1973). Stress is a physical response induced by extreme levels of environment, chemical, physical and /or social factors, which causes bodily reactions that may contribute to disease and death (Pickering, 1981). There are mainly two approaches to quantify the response of animal to stress. The first approach is based upon quantifying the immediate physiological responses of animal to stress and the second is concerned with measuring long-term changes in the performance capacity of an animal. Every organism, irrespective of the level of organization, produces a reaction to any stimulus. It may be a normal adaptive response or a stress response to the stimulus and it is a difficult task to distinguish between the two.

Fish are more susceptible to stress than many other animals because of a greater dependence upon their surrounding environment. Intensive aquaculture produces toxic metabolites through the use of higher level of inputs, which interact with each other and with different water quality parameters in a complex manner and produce unhealthy environment and stress to the aquatic animals. Fish reared under intensive aquaculture conditions are confined to the production unit and are weakened by stress condition including:

(i) Increased fish density and poor water quality (i.e., low dissolved oxygen, undesirable temperature or pH, increased levels of carbon dioxide, ammonia nitrite, hydrogen sulphide, organic matter in the water)

(ii) Injury during handling (i.e., capture, sorting, shipping)

(iii) Inadequate nutrition and

(iv) Poor sanitation. These conditions can result in decreased resistance by the fish, resulting in the spread of disease and parasite infestation.

Any response or adaptation to stress requires the expenditure of energy that would otherwise be utilized for maintaining normal body functions such as growth, digestion, osmoregulation, disease resistance, healing and reproduction. Stress and injury initially trigger an alarm reaction, which results in a series of changes within the fish. Stress evokes elevated cortisol blood plasma levels, resulting in suppressed immune function, and drains metabolic energy. The effects of stress are cumulative, reducing the capacity to tolerate subsequent or additional stressors. Stress suppresses the immune response and can predispose fish to disease. Stress reduces antibody production, slows the body's response to injury or infection and increases susceptibility to pathogens. This is particularly true with facultative or opportunistic pathogens.

Fish are able to adapt to stress for a period of time; they may look and act normal. However energy reserves eventually depleted and hormone imbalance occurs, suppressing their immune system and increasing their susceptibility to infectious disease. Long term or chronic stress can slow or stop growth, due in part to cortisol released in response to stress that affects the metabolism of carbohydrates, lipids, and proteins. This reduces the useable amount of nutrition animals receive from foods. Stress can prevent reproductive activity while energy that in normally directed toward spawning is diverted to the more immediate need of homeostasis. Stress inducers like overcrowding, handling, hypoxia and elevated ammonia and nitrite concentrations affect homeostatic regulation in fish.

The stress responses are primarily divided into three categories viz, primary (neural and neuroendocrine responses), secondary (physiological consequences of such primary response such as metabolic disturbance, osmotic disturbance, etc) and tertiary responses such as changes in behavior reduced the growth rate and enhanced susceptibility to diseases (Wedemeyer and MeLeay, 1981).

SOURCES OF STRESS

Fertilization

Pond fertilization affects water quality with positive or negative consequence to fish survival and growth by acting as stress factors. Inorganic fertilization in higher doses results in anaerobic conditions and the release of microbial metabolites, such as nitrite and H_2S into the water column, which are toxic to aquatic animals. Higher doses of organic manure enhance the biological oxygen demand (BOD) and Chemical Oxygen Demand (COD), affecting the productivity of the water body with negative consequence to fish survival and growth by acting as stress factor.

Stocking Density

Increasing stocking density is one of the common practices followed in intensive aquaculture is considered a stressor which exert severe adverse effects on survival, growth and health status of teleosts.

The species composition and environmental condition under which the fish are reared affect the relationship between rearing variables and rearing density or load. High loading rate can lead to reduced dissolved oxygen level and accumulation of toxic unionized ammonia, factors that directly retard the growth and health of cultured fish. Studies have shown that fish reared at high densities grow poorly and show increased susceptibility to diseases due to chronically elevated cortisol levels which have immunosuppressive and catabolic actions in fish.

Supplementary Feeding

Higher stocking densities coupled with supplementary feed, necessary to achieve the normal or increased growth rate in an intensive culture pond, are the two most important variables responsible for creating a higher oxygen demand in

a pond. In intensive farming supplementary feeding with protein-rich balanced diet is practiced to get rapid growth of fish. These protein-rich diets produce relatively more nitrogenous metabolites in fish excreta and deteriorate the water quality when remains in water body.

STRESS FACTORS

Ammonia toxicity

The principal source of ammonia in pond is fish excretion. Ammonia is excreted as the end product of protein catabolism. High protein diets usually fed to fish may result in high level of ammonia in water. Ammonia occurs in two forms in aquaculture system as ionised (NH_4^+) in aqueous form and unionized (NH_3) in gaseous form. Unionized ammonia is regarded as the form of ammonia that is toxic to freshwater fishes. The equilibrium between gaseous unionized ammonia (NH_3) and aqueous ionized ammonia (NH_4^+) is strongly affected by pH and much less strongly affected by temperature. The optimum range of unionized ammonia in freshwater pond water ranges from 0.02-0.05 mg/l.

An increased ammonia concentration in pond water increases the level of ammonia in blood and tissue. This results in an elevation in blood pH and adverse effects on enzyme-catalyzed reactions and membrane stability. Several stressed fish exhibit characteristics like unstable swimming, frequent jumping, erratic motion, abnormally rapid movement with continuous opening and closing of mouth. The major symptoms due to ammonia pollution observed are hyperventilation, hyper-excitability, coma and convulsion.

Nitrite toxicity

Nitrite (NO^-_2) is a naturally occurring anion in fresh and saline waters. Ammonia is first converted by bacterial action to nitrite (a relatively less toxic product) and then to nitrate (a relatively non-toxic form). Nitrite toxicity is aggravated by factors or situation like low oxygen concentration, pH at extreme concentration (below pH 5 and above pH 10) and temperature. Nitrite ion diffuses into the gill through epithelial cells and comes in contact with blood plasma where it diffuses into the blood cells and oxidizes the iron in haemoglobin to the +3 oxidation state. Nitrite oxidizes haemoglobin to methemoglobin or ferrihaemoglobin, which lacks the capacity to bind oxygen reversibly (Bodansky, 1951)

pH stress

pH is the negative logarithm of hydrogen ion (H^+) concentration in water which indicate how much water is acidic or basic. Water pH affects metabolism and physiological process of fish and exerts considerable influence on toxicity of NH_3 and H_2S. Changes in pH alter the relative concentration of unionized NH_3 in water. At equilibrium the ratio of NH_3 to total NH_3-NH_4^+ increases as pH increases and decreases as pH decreases (Ver and Chiu 1986).

Ammonia secretion through the gill decreases at higher water pH values. At the same time the pH of fish blood increases along with the increase in water pH. Therefore an increase in water pH results in the increased accumulation of ammonia in blood as well as increase in blood pH, where as low pH brings damage to fish through damaging the gill.

Dissolved Oxygen stress

Dissolved oxygen (DO) is one of the measure characteristics of water quality important to the growth and survival of fish. The optimum DO content of pond waters ranges from 5 mg/l to saturation level. The measure effect of low oxygen concentration in the water is the hypoxia, which is otherwise referred to as respiratory stress. Higher content of DO in water (super saturation) leads to gas emboli in fishes. Some species of fish are extremely resistant to low level of oxygen while others are very much susceptible.

Temperature

Temperature plays an important role in fish metabolism by controlling molecular dynamics (diffusibility, solubility, fluidity) and biochemical reaction rates. Adverse effect of temperature (extreme low or extreme high) leads to poor growth, susceptibility of disease and mass mortality. High temperature also reduces the ability of the water to hold oxygen and increases the metabolic rate and resulting oxygen demand of the fish. Cold temperatures can completely halt the activity of the immune system, eliminating defense against invading disease organisms. The optimum temperature range for several cold water and warm water fishes are 14^0-18^0 C and 24^0-30^0C,

respectively. Abrupt or drastic temperature changes may weaken fish to the point that latent bacteria infections worsen.

Carbon Dioxide stress

Elevated concentrations of free CO_2 are of significant to fish culturist. The harmful effect of CO_2 on fish has usually been associated with reduction in oxygen affinity and oxygen capability of the blood. The acute toxicity of free CO_2 is caused by the inability of fish to eliminate bicarbonate ion through gill with a consequent reduction in dissolved oxygen uptake (Post, 1976). Fishes subjected to high levels of free CO_2 loose equilibrium, develop anoxia and die with little or no activity.

CONCLUSION

The knowledge, understanding and mechanism of what constitutes stress in fish has increased immensely in the past few decades in the area of physiological and ecological mechanism and responses that lead to changes in metabolism and growth, immune functions, reproductive capacity and normal behavior. Stress depends on external environmental factors influencing the bioavailability of stressors and related to the hydrological parameters. High stocking density i.e., high biomass coupled with fertilization and feeding can result in the accumulation of toxic metabolites which act as a stress factor (Ver and Chiu, 1986). The aspects of intensification pertaining to fertilization and feeding rate often results in production of environmental stress factor. Accumulated metabolites like ammonia (both ionic and unionic), nitrite and hydrogen sulfide act as stressors by affecting the growth, survivality and disease resistance. Use of fertilizer and manure beyond the threshold limit may produce significant levels of nitrogen and toxic metabolites in the aquatic ecosystem (Sarkar, 1991) acting as stress factor. Temperature acts directly or indirectly through its influence on other factors like enzyme activity, metabolic rate and other environmental factors such as dissolved oxygen. Metabolically produced CO_2 and CO_2 produced from respiration accumulate in water and are associated with the reduction in oxygen affinity and oxygen carrying capacity of blood in fish.

Identification of stress, stress factors and stress condition is a challenge in intensive aquaculture. It is very important to know the accumulation levels of the toxic metabolites derived from different inputs under intensive culture practice and their effect on fish growth, survival and biomass production in field condition.

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CARBON SEQUESTRATION- A STRATEGY FOR MITIGATING CLIMATE CHANGE

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INTRODUCTION

One way of contributing to a reduction in greenhouse gases in the short term could be a process known as carbon sequestration. This involves the deliberate removal or storage of carbon in a place (a sink) where it will remain. By signing up the Kyoto Protocol, the developed countries have agreed to reduce their emissions of greenhouse gases collectively by 5.2% from 1990 levels between 2008 and 2012. The UK is legally committed to a reduction of 12% by 2008-2012, although the Government has also set a higher domestic target of 20% by 2010. Carbon sequestration projects in the context of the Clean Development Mechanism (CDM) suffer from the stigma of permanence risk. The risk that carbon reduced or sequestered in forestry projects is release further down the road is in fact undeniable, whoever bears the onus. The merit of the so-called "ton/year approach" is to destroy the fiction of infinity when talking about permanent sequestration (Dutschke M, 2001). The Kyoto protocol is a start but definitely more intensive reductions are required in the long term, if climate change is to be stabilized. A whole bundle of so-called "flexible mechanisms" has been foreseen by the Kyoto Protocol in order to help industrial countries to fulfill their agreed reduction targets in the most cost-effective way (Dutschke *et al*., 1998). According to The Royal Commission on Environmental Pollution, the UK will need to reduce its emissions of carbon dioxide from burning fossil fuels by 60% over the next 50 years. Sequestration could have a significant role to play in meeting these targets. The Kyoto Protocol includes, as a strategy for mitigating climate change, the option of removing CO_2 from the atmosphere through biological carbon sequestration. This includes activities such as massive tree plantation. The objective in this paper is to bring perspective to carbon sequestration in mitigating climate change of carbon sequestration.

OCEAN SEQUESTRATION

One approach is to enhance the natural oceanic uptake of carbon dioxide (CO_2) by microscopic plants called phytoplankton. The theory is that fertilising the world's oceans with iron (a micro-nutrient) would increase biological productivity and enable phytoplankton near the sea surface to absorb more CO_2, thereby removing it from the atmosphere and storing it in the ocean's interior. However, there are major concerns about the impact such fertilization would have on marine ecology, as well as doubts about how effective it would be at increasing the long term storage of CO_2 in the oceans..Another approach is to inject liquid CO_2 into the deep ocean. Model studies suggest that CO_2 injected at depths of 1500m, could, with careful site selection be stored for several hundred years. Long-term storage could be achieved by injecting CO_2 at depths greater than 3000m, where the density of liquid CO_2 exceeds that of water. In theory, this would enable liquid CO_2 to be injected into a hollow or trench on the seabed, where it would remain as a submarine lake. In the long term, it might also be feasible to produce solid CO_2 blocks which would sink to the ocean floor, with little impact on the ocean environment.

There is a great deal of uncertainty about the permanence and stability of carbon stored in the deep ocean and many concerns about the impact it would have on the sensitive deep ocean environment.

GEOLOGICAL SEQUESTRATION

One of the principal causes of global warming is the vast amount of carbon dioxide we pump into the atmosphere by burning fossil fuels such as coal, natural gas and oil. A possible alternative way of sequestering carbon dioxide would be to bury it underground. Collecting and compressing carbon dioxide from power plant exhausts, and then burying it in, for example, old oil wells at sea, deep deposits of briny water or depleted natural gas fields, is technically feasible. The Norwegian energy company Statoil has practised the technique in the North Sea since 1996, as part of a European research project. They extract carbon dioxide from the natural gas being produced and then inject it into porous sandstone some 3,000 feet below the floor of the ocean.

The US Geological Survey has an interesting page about volcanic gas. Apparently it is not uncommon for small animals to be killed when CO_2 forms pools in low lying areas. When CO_2 escapes from geo-sequestration the same might happen with humans.

They also have a page about CO_2killing trees at Mammoth Mountain. It was never realised that plants could be killed by excessive CO_2. Apparently tree roots need oxygen and CO_2 in the ground would kill them. The release of 300 tons of CO_2 per day killed 100 acres of trees. The Gen next trial power plant is designed to support sequestration of over 1,000,000 tons of CO_2 per year (that is over 2,700 tons per day). Leakage of 1/9th of the CO_2 can have a damage comparable to the Mammoth Mountain. The Gen next trial plant will be a fraction of the size of a real coal power station. So an escape of significantly less than 1/9 of the CO_2 from a real sequestration plant would have such a bad result. It's interesting to note that tents and basements are documented as CO_2 risks. Camping in areas near power plants should necessarily be avoided. A record number of comments have been received as to why Hydrogen powered cars would never work. Some of them suggested that carbon geo-sequestration (storing carbon-dioxide at high pressure under-ground) is the solution to the climate change problem. The idea is that you can mix natural gas or coal gas with steam at high temperature to give carbon-dioxide and hydrogen. Then the carbon dioxide gets stored under-ground while the hydrogen is used for relatively clean fuel. One overwhealming problem with geo-sequestration for coal based power plants is that it is significantly more expensive than the current coal-fired power plant design. Currently the price difference between coal power and wind power is quite small and there are several technologies that are almost ready for production which will decrease the cost of wind power. It is expected that before so-called "clean coal" becomes viable, planning is there for the first production plants to go live in 2022 so that the cost of renewable energy will be lower than the current cost of coal power. There is no reasonable possibility of "clean coal" being cheaper than renewable energy. Climate change is a matter of great interest and worldwide concern. The latest evidences from scientific studies and official documents produced by the International Panel on Climate Change (IPCC) show that the challenges posed by climate change need to be taken seriously if they are ever to be tackled properly. (Dutschke, 2009).

FOREST SEQUESTRATION

Although geological sequestration may be important, it is biological sequestration of carbon in plants and soils that may have the greatest impact during the immediate few decades. The world's forests represent an important carbon sink, and just as deforestation can reduce this sink, so afforestation can be used to increase this sink. On this basis, the Kyoto Protocol makes provision for developed countries to take into account forestry activities and land-use changes to meet their commitments. Forests could be incorporated into an emissions trading system by allocating credits, for the amount of carbon sequestered. Satellite remote sensing could be used to determine initial areas of land use, as well as the extent, rates of change and locations of activities that result in forest depletion and regrowth. Changes in other carbon stocks, such as soils, are much harder to verify because they are so variable over time and space. Despite this uncertainty, the soil carbon stock is greater than the carbon stored in vegetation. Consequently, soil conservation is important for minimising the oxidation and subsequent emission of soil carbon to the atmosphere. There is increasing concern that planting more trees should not be seen as the solution to the problem of increasing atmospheric CO_2. Forests are only sinks when they are expanding in area or growing. In the absence of major disturbances, newly planted or regenerating forests only continue to uptake carbon for 20-50 years, depending on species and site conditions. It is also feared that unless global warming is gradual enough, forest decay and fires may turn forests into a global source of carbon. Furthermore, it has been suggested that an increase in forests could alter the mean global albedo (reflectivity of the land surface) and lead to more radiation being absorbed, warming up the earth !

ALL PLANTS ABSORB CARBON DIOXIDE, BUT TREES ARE BEST

While all living plants absorb CO_2 as part of photosynthesis, trees process significantly more than smaller plants due to their large size and extensive root structures. In essence, trees, as kings of the plant world, have much more "woody biomass" to store CO_2than smaller plants, and as a result are considered nature's most efficient "carbon sinks." According to the U.S. Department of Energy (DOE), tree species that grow quickly and live long are ideal carbon sinks. Unfortunately, these two attributes are usually mutually exclusive. Given the choice, foresters interested in maximizing the absorption and storage of CO_2 usually favor younger trees that grow more quickly than their older cohorts. However, slower growing trees can store much more carbon over their significantly longer lives.

PLANT THE RIGHT TREE FOR THE RIGHT LOCATION

Scientists are busy studying the carbon sequestration potential of different types of trees in various parts of the world, including eucalyptus in Hawaii, loblolly pine in the South-East, bottomland hardwoods in Mississippi, and poplars in the Great Lakes."There are literally dozens of tree species that could be planted depending upon location, climate and soils," says Stan Wullschleger, a researcher at Tennessee's Oak Ridge National Laboratory who specializes in the physiological response of plants to global climate change.

CHOOSE LOW-MAINTENANCE TREES TO MAXIMIZE CARBON ABSORPTION

Dave Nowak, a researcher at the U.S. Forest Service's Northern Research Station in Syracuse, New York has studied the use of trees for carbon sequestration in urban settings across the United States. A 2002 study he co-authored lists the Common horse-chestnut, Black walnut, American sweetgum, Ponderosa pine, Red pine, White pine, London plane, Hispaniolan pine, Douglas fir, Scarlet oak, Red oak, Virginia live oak and Bald cypress as examples of trees especially good at absorbing and storing CO_2. Nowak advises urban land managers to avoid trees that require a lot of maintenance, as the burning of fossil fuels to power equipment like trucks and chainsaws will only erase the carbon absorption gains otherwise made.

PLANT ANY TREE APPROPRIATE FOR REGION AND CLIMATE TO OFFSET GLOBAL WARMING

Ultimately, trees of any shape, size or genetic origin help absorb CO_2. Most climate concious citizens agree that the least expensive and perhaps easiest way for individuals to help offset the CO_2 that they generate in their everyday lives is to plant a tree, as long as it is appropriate for the given region and climate. A campaign to plant a billion trees in a single year was launched at the United Nations Climate Change Conference in Nairobi, Kenya, in November 2006. The 'Plant for the Planet: Billion Tree Campaign' is intended to encourage people and organizations everywhere to take small but practical steps to reduce global warming, which many experts believe is the most important environmental challenge of the 21st century.

INVOLVEMENT AND ACTION TO PLANT A TREE

"Action does not need to be confined to the corridors of the negotiation halls," said Achim Steiner, executive director of the United Nations Environment Programme (UNEP), which is coordinating the campaign. Steiner noted that intergovernmental talks on tackling climate change can often be "difficult, protracted and sometimes frustrating, especially for those looking on instead of participating directly". The campaign, which aims to plant a minimum of 3 billion trees in 2009, offers a direct and straightforward path down which all sectors of society can step to contribute to meeting the climate change challenge."

A PRINCE AND A NOBEL LAUREATE ADVOCATE TREE PLANTING

In addition to the UNEP, 'Plant for the Planet: Billion Tree Campaign' is backed by Kenyan environmentalist and politician Wangari Maathai, who won the Nobel Peace Prize in 2004; Prince Albert II of Monaco; and the World Agroforestry Centre-ICRAF. According to the UNEP, rehabilitating tens of millions of hectares of degraded land and reforesting the earth is necessary to restore the productivity of soil and water resources, and more trees will restore lost habitat, preserve biodiversity, and help to mitigate the build-up of carbon dioxide in the atmosphere, thereby helping to slow or reduce global warming.

TAKE THE PLEDGE AND PLANT A TREE

The campaign encourages people and organizations around the world to enter pledges on a web site hosted by the UNEP. The campaign is open to everyone—concerned citizens, schools, community groups, nonprofit organizations, farmers, busines houses, and local and national governments. A pledge can be anything from a single tree to 10 million trees. The campaign identifies four key areas for planting: degraded natural forests and wilderness areas; farms and rural landscapes; sustainably managed plantations; and urban environments, but it can also begin with a single tree in a back yard. Advice on choosing and planting trees is available through the web site.

CARBON SEQUESTRATION CAN BE NEW PAYCHECK FOR FARMERS

It's rare that farmers can get paid extra for their choices in production methods. But, for producers in select regions of the high plains, the benefits of conservation tillage methods may soon mean more to their profit margins than their production yields.

According to Charles Rice, soil microbiologist the, methane, carbon dioxide and nitrous oxide are three greenhouse gasses that concern scientists. These gasses, in the atmosphere absorb sunlight and heat energy and in normal doses provide a moderate climate. These gasses have been on the rise in the

last 150 years, since the prairie was first ploughed that coincided with the deforestation of the rain forest and the increasing use of carbon-based fossil fuels. "Five to eight degrees Fahrenheit may not seem like much, but we can see that the Arctic sea ice boundary, since 1979, is shrinking," Rice said. This is just one sign of global warming, he said. Scientists have identified several ways to reduce atmospheric levels of greenhouse gasses. They include: Reducing fossil fuel consumption; increasing the efficiency of fuels; increasing the use of renewable fuels; and using sequestration. For all practical purposes, Rice said, sequestration is the most feasible route as of now. The simplest explanation of carbon sequestration is that plants take in carbon dioxide from the air to make oxygen and grow. The plant grows and its biomass, the residue and roots of the plant capture the carbon dioxide in its cells. As long as the residue is not disturbed greatly, the carbon dioxide stays in gaseous form and is taken out of the atmosphere where it can do damage. The carbon dioxide can be released by burning the plant mass or by tilling the soil and disturbing the organic matter.

"Since we first broke the soil to plant a crop on the Plains, we've lost on an average about 50 %_of the organic matter, carbon, stored in the soil," Rice said. Now, with new technologies and the use of reduced tillage, no-tillage, and crop varieties we can increase the carbon that we store in the soil. Carbon dioxide can be stored in the soil through no-till planting, restoring wetlands, converting cropland to permanent grass or trees, planting conservation buffers and using cover crops. Research has shown that no-till corn fields can store one-half ton per acre of carbon dioxide annually, for example. By establishing a new grass stand on previous cropped land, a producer can sequester at least three-quarters of a ton more carbon dioxide per acre.

FUTURE COMMITMENTS

Finally, while a country can use carbon sequestration credits to achieve some proportion of its current Kyoto emissions-reduction target, this may create problems for the future if the country remains committed to long-term climate mitigation. Suppose a country is committed, in a future commitment period (a second period is currently being negotiated), to reduce emissions beyond what it committed for 2008-2012, it must then meet the new target plus any shortfall from the first commitment period; in particular, it still needs to reduce emissions by the amount covered in 2008-2012 by biological sink activities. However, more: countries are also technically liable for carbon stored in the nonpermanent terrestrial sink (Grimeaud DJE 2001).

CONCLUSION

Julianna Priskin stated that those who intend to be "carbon neutral travelers need to be well-informed about carbon credits that finance tree plantations. The singular action of tree planting will not solve climate change problems; notably because it does not lead to a reduction of fossil fuel reliance." The same applies to other biological sequestration, particularly agricultural activities. Are we then left with no role whatsoever for terrestrial carbon sequestration? On the contrary, plants remove CO_2 from the atmosphere, while providing a host of other benefits. Thus, it makes sense to implement certain environmentally sound sequestration activities. However, there seems to be no role for biological sequestration in a carbon trading scheme given the temporary, volatility and onerous transaction costs related to duration, measurement and monitoring. One possible solution, however, is to provide a predetermined schedule of carbon storage for sequestration alternatives and base subsidies and penalties on this schedule. A subsidy is provided while the sequestration activity continues and a penalty assessed when land use reverts to the prior practice. Actual carbon flux need not be monitored or verified as carbon flux would be determined by the pre-determined schedule, with the value of carbon determined in the emissions trading market. The only relevant transaction costs relate to the establishment of a contract on the property that covers future landowner liability for carbon stored.

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MAN – MONKEY CONFLICT - A CASE STUDY AT MAHAKAL DARA (OBSERVATORY HILL), DARJEELING

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INTRODUCTION

The Himalayan monkey also known as Assamese macaque (*Macaca assamensis* Mc.Cld.Hfd) is one of the three non- human primates recorded from West Bengal. The hilly tracts and foothills of North Bengal are the only resorts for this species. They are generally confined to broad leafed evergreen forests of approximately 200-2500 mts of elevation. They are widely distributed throughout North and Northeast India and are highly adapted to human proximity and have learnt to exploit human habitation (Srivastava, 1999). Also monkey menace has been reported in other states like Orissa, Andhra Pradesh etc. Because of habitation depletion, lack of space, shortage of food, population explosion, breeding, hierachical dominacy and after all, the naughty behaviour of the species there are increasing report of monkey menace at the state of Oirssa. (Samanta ray, 2006)

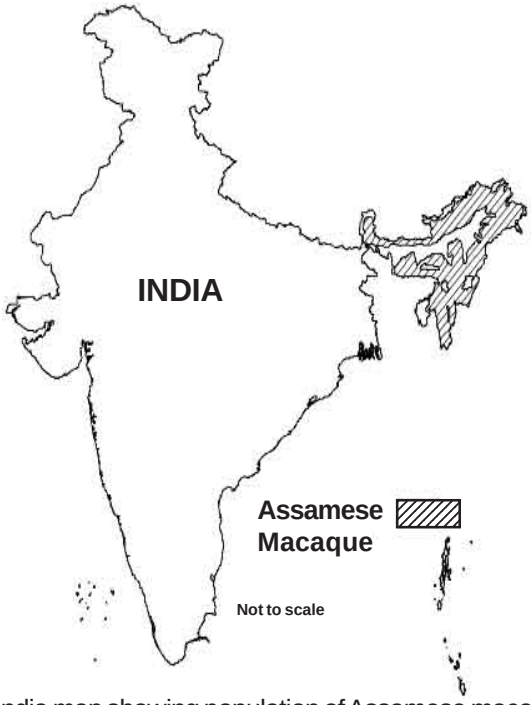

Fig. 1 : India map showing population of Assamese macaque

The study was conducted to know about the intensity and the types of damages caused by the monkeys in the study area with the following objectives: (i) Demographic study of the species.

(ii) Damages caused by the macaque on humans and properties.

(iii) Possible reasons for the prevailing human – monkey conflict.

(iv) Measures to minimize the problem in the study area.

MATERIALS AND METHODS

The following methods were employed in the study:

Population Survey

Total count method (Bibby et al., 1992) i.e. a direct method of population estimation by visual count was taken for a period of three months from December 2008 to February 2009.

Record Collection

A pre- prepared questionnaire was distributed to people from different walks of life randomly.

(i) What might be the possible causes of the monkey's invasion in this area?

(ii) Where do these monkeys come from?

(iii) Do they visit this place in a specific time?

(iv) Do the monkeys come in groups or in single, if they come in troup what is the total number of monkeys in a troup ?

(v) Do they target a particular item? If yes, specify ?

(vi) What are the problems faced by the people often visiting this place ?

(vii) Under what circumstances do these monkeys attack ?

(viii) Do the males or the females attack the people more frequently ?

(ix) Did the monkey ever attack you or any of your family members ?

Interview

Also random interviews were taken at vulnerable points like zoological park, temples, educational

Fig. 2 : Interviews being taken from the temple priest.

institutions, tourist spots etc. Interviews were taken using taprecorder support by record keeping (Fig.2)

Number of incidences observed during the study period such as injuries (wounds and bites), threat (snatching, scaring and pulling of hairs, clothes, bags etc) and pictures taken whenever such incidences were witnessed.

RESULTS AND DISCUSSION

Total population of Assamese macaque (*Macaca assamensis*) recorded was approximately 216 (adult and juvenile). The total population was divided into four separate groups with group sizes of 52,,56,60,48 respectively.

Table 1 : Age wise population size of Assamese macaque (*Macaca assamensis*) .

Type of animal	GrI	Gr II	Gr III	Gr IV
Juvenile	21	19	23	17
Adult	31	37	37	31
TOTAL	52	56	60	48

A total of 5 cases of monkey bite and 93 cases of

Fig. 3 : Monkeys snatching food form the visitors

aggressive threats were reported; some are witnessed, with physical attacks in the form of scratching by nails, biting during survey period. According to the collected data all these cases occurred when the monkey tried to snatch the food items and clothes from the people and houses. (Fig.3) The macaques become aggressive and attack people, when they resist the monkeys from taking away the food and household items. Incidences as such are common when the macaques invade human settlement for food and shelter. The cases of monkey's attacks outside the human settlement areas were very occasional and rare .From the study, it was also known that the women and children were bitten and attacked more frequently than the adult men.

Table 2 : Total Case of biting (wounds, bites) from December 2008 to February 2009.

Month	Year	No. of bites
December	2008	3
January	2009	-
February	2009	2

Table 3. : Percentage of threats to human population

Month	Year	Number of cases	% of threat
December	2008	38	40.8%
January	2009	23	24.7%
February	2009	32	32.6%

As per records, the number of Assamese macaques (*Macaca assamensis*) seen in Mahakal Dara area in late 1981-82 was very few over the years, the number gradually went on increasing.

Table 4 : Rough estimation on increasing number of Assamese macaque (Macaca assamensis) in every five year gap (from 1981-2009).

Year	increase in the no. of Assamese Macaque
1981-1986	30
1987-1992	75
1993-1998	132
1999-2005	186
2006-2009	216

The probable factors behind Human-Monkey conflict could be one or all of the following

Habitat destruction

Accelerating encroachment and manipulation of their natural habitats due to increasing human demands.

Variable food offered by the devotees/ visiting pilgrims

Availability of easy food, social taboos associated with it and others including presence of some naturally occurring edible plants.

Table 5: List of some edible fruit species found in Mahakal Dara area used by Assamese macaque (*Macaca assamensis*)

Edible fruit sp.	Fruiting time
Lapche Kawla*(Machilus edulis)*	January -March
Chutro (*Mahonia acanthifolia*)	March-April
Aselu *(Rubus ellipticus)*	April-June
Damai Phal *(Ardisia macrocarpa)*	October – April.
Bhadrase*Elaeocarpus varunua)*	September
Sanu Aselu (*Rubus acuminatus)*_	September -October
Katus *Castanopsis hystrix*	September-October

Over population

Competition for required food and shelter in a particular area/ habitat. The suitable topographical and physiographical features of the area like creeks caves, trees, climbers and roadside parapet which provide them shelter.

Improper waste Disposal

Careless dumping of waste and garbage in the surroundings provides easy food for the monkeys, which facilitates their frequent visit to the area.

Human interference

Assamese macaque has a multimale –multifemale social system. So they stay in a troup. Whenever there is a human interference, usually it invites a kind of conflict.

RESULTS AND DISCUSSION

One need not require the investigative skill in finding out the reasons for this abhorrence. The outcry and the bitterness by the people against the monkey could be either due to loss and damage to properties, injuries caused on the person or indirect health hazards through spread of contagious diseases in the localities .These three main sufferings could be either in isolation or in several combinations.

The monkeys can squarely be blamed for invading the human territory for meeting their livelihood means; correct it is – but little do we realize that it is only after human population have made forays into the territories of wild animals that the animals are forced to invade new areas –after all ,to survive their right, too .

People have habituated them of the provisioned food, which being more nutritious and easily accessible and highly cost effective. The cost likely to be incurred by a group in search for food in wild that too without ensuring the matching nutritious quality of provisioned food. Now if the monkeys do not get the food they resort to snatching and other related threats.

Inspite of being aware of this situation and also having solutions to control the conflict, there lies some limitations like financial constraints, religious fronts, man- power; otherwise there may be various ways in which the problem can be tackled such as

(i) Remove resource crunch situation by new creation of resources, aiding to grow the existing resource etc,

(ii) Capturing and translocation of troups of monkeys from human habitation, but here the question arises where do we take them; their original habitat has already been destroyed or either occupied, the next respite for them are the zoos but which are already overcrowded and also may run the risk of contracting some diseases from these commensal stock.

(iii) Culling and trade is prohibited by extant legislation.

(iv) Creation of a monkey park, if possible or awareness education about the species.

(iv) The problem was prevalent in the past too, although on a very low scale .But, even a single case is sufficient for the sufferer, to take step to ward off this problem.

CONCLUSION

In order to preserve biodiversity and to do something for the betterment of the people and as well as the species it is necessary to take some measures to reduce the Man –monkey conflict. Above all these, to understand the depth of damage caused by the macaques ,we need to conduct a long ,comprehensive study with specific focus on geographical and agro-climatic regions and most importantly on the community participation programme for the monkey management and habitat conservation programme in areas with high economic damage.

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FABACEAE FAMILY OF MALKANGIRI DISTRICT, ORISSA, INDIA: AN ASSESMENT

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ABSTRACT

The family Fabaceae is well known for its protein contents and other valuable uses. A total of 652 plant species were collected from the forest pockets of Malkangiri district during the survey work conducted from 2007 to 2009. About 9% of the total collections including 56 plant species belonging to this family are enumerated here.

Key words : Fabaceae, herbarium, species diversity, floristic composition

INTRODUCTION

Malkangiri separated from erstwhile Koraput became an independent district on 2nd October 1992. It lies between 81^0 10/ to 82^0 00/ E longitudes and 17^0 45/ to 18^0 40/ N latitudes covering a geographical area of 5,791 sq. km. It is surrounded on east mainly by Visakhapatnam and East Godavari district of Andhra Pradesh, on west by Bastar district of Chhattisgarh, on north by Koraput district of Orissa and on south by East Godavari and Khammam districts of Andhra Pradesh. The floristic account of this area has remained comparatively unknown. The luxuriant forest pockets have been used as hiding dwellings by the naxalites, maoists and other criminal elements of Orissa, Andhra Pradesh and Chhattisgarh. The district could not be botanised perfectly by Saxena and Brahmam (1994-96) may be owing to the above reasons. A few of literatures (Mooney, 1950) are also available containing sporadic references. Attempts were also made by Mishra and Das, 1988; Hemadri and Rao, 1989-91; Aminuddin and Girach, 1991; Prusty, 2007; Prusty and Behera, 2007; Pattnaik *et al.,* 2008 etc. but their works were mostly confined to ethnobotanical noting only. The authors have taken the hardship to explore the floristic possessions of the district so that the economy of the district can be improved in near future.

Family Fabaceae includes angiospermic dicotyledonous plants belonging to order-fabales, series-calyciflorae and subclass-polypetalae of class-magnoliopsida. The Fabaceae family (= Leguminosae) consists of approximately 650 genera and 18,000 species; it is one of the largest Angiosperm families (Polhill *et al.*, 1981; Judd *et al.*, 1999). The Faboideae is the largest of the three Fabaceae subfamilies with about 440 genera and 12,000 species (Polhill, 1981). Legume species have a great economic importance since many of them are nitrogen fixers, act in soil conservation, are used for the production of timber, fuel, pesticides, forage, gums, colorants, carbohydrates, proteins and oils (Polhill *et al.*, 1981) and there are also many with ornamental and/or apicultural importance (Rodriguez-Riano *et al*., 1999). Therefore, the present paper highlights different species of fabacede Malkangiri district, Orissa, India.

MATERIALS AND METHODS

Systematic field surveys were undertaken to almost all the forest ranges of Malkangiri (Map.1). The field trips were organized so as to cover all the areas of the district at regular intervals in different seasons. As a result it became possible to collect the plants in various developmental stages of their life cycle. After critical study the specimens were identified following Flora of Orissa (Saxena and Brahmam, 1994-96) and compared with the authentic specimens of the herbarium, RRL-Bhubaneswar and Calcutta. The identified specimens were finally incorporated in the herbarium, RRL, Bhubaneswar.

RESULTS AND DISCUSSION

During the year 2007-09, the forests of Malkangiri district were surveyed extensively. The existing vegetation is found to fall broadly under three types viz. tropical semi-evergreen forest, tropical dry deciduous forest and tropical moist deciduous forest as per the classification of revised forest types of India (Champion and Seth, 1968). Besides the above, several types and subtypes like bamboo brakes, riparian fringing forest, scrubs, grass lands etc. are noticed mostly either developed or resulted due to biotic influence. The state is the southern most limit of sal which is completely replaced by miscellaneous species from near Malkangiri in

undivided Koraput district. This is also the meeting place of sal and teak (Saxena and Brahmam, 1994).

There are some literatures about the legumes of India (Caius, 1989; Singh *et al.*, 1998), but no publication particularly related to Malkangiri or Orissa is available. In "The Flora of Orissa" (Saxena and Brahmam, 1994-96) there are 228 species of Fabaceae. In this piece of work a total of 56 species belonging to this family are enumerated (Table. 1) out of 652 total collections. This includes 30 herbs, 11 shrubs, 7 climbers and 8 tree species (Fig. 1). Vernacular names and pictures (Fig. 3) of some of the plant species are given for easy identification. The other major families viz. *Poaceae*, *Asteraceae*, *Euphorbiaceae, Acanthaceae*, *Cyperaceae* and *Rubiaceae* having 40, 34, 31, 29, 27 and 26 number of species respectively (Fig. 2) indicate Fabaceae has the largest species diversity. The cause of the species richness may be the topography and climatic conditions prevailing in the locality that support the luxuriant growth of the family. Apart from this the regeneration capacity or viability of these species can also be taken into account. Majority of the species are herbs and are found to be mostly of therapeutic uses. Though, 8 different tree species are found, their population is comparatively less as they are widely used in making agricultural implements and furniture which are of high economic

Fig. 1 : Map of India showing the state of Orissa

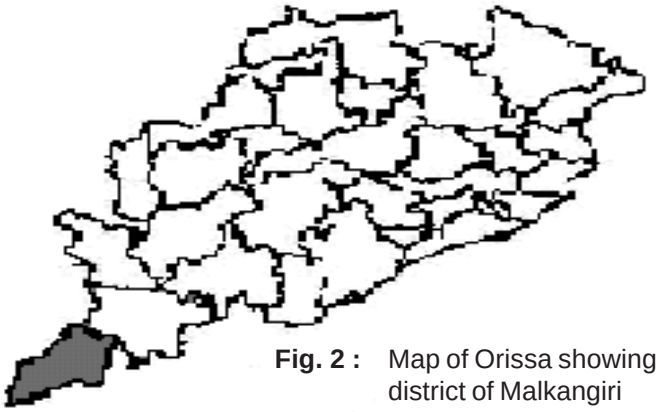

Fig. 2 : Map of Orissa showing the district of Malkangiri

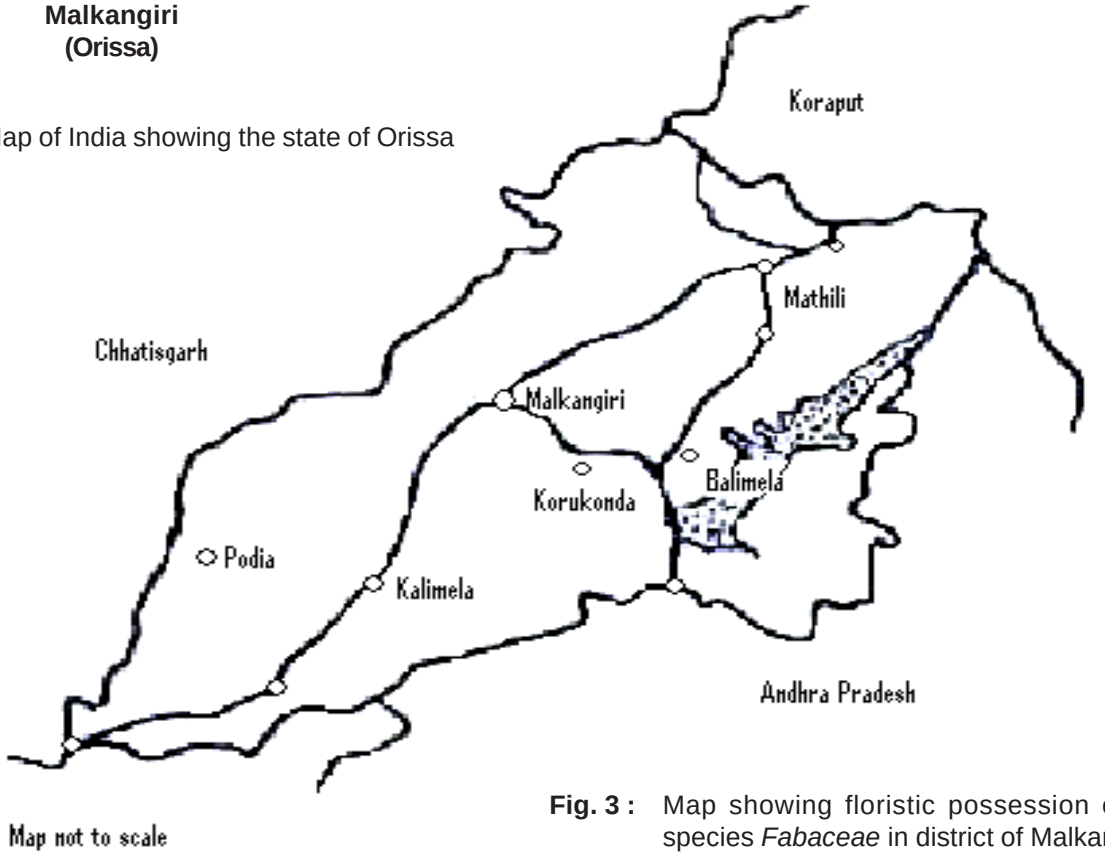

Fig. 3 : Map showing floristic possession of plant species *Fabaceae* in district of Malkangiri

Fabaceae family of Malkangiri

Table 1: Enumeration

Plant names with field no.	Local names	Parts used	Uses	Locality
Abrus precatorius L.10390	Kaincha	Seed Root	For abortion, Cough & Cold	Kamalapadar
Aeschynomene americana L.10337	Sansol	Whole plant	As fodder & Manure	Govindapally
Aeschynomene aspera L.11755	Sola	Stem	In cork Manufacturing	Balisagar
Aeschynomene indica L.11022	Sola	Whole plant	As fodder & Manure	Chitrakonda
Alysicarpus vaginalis (L.) DC. var. *Vaginalis*11378	Pan-nata	Whole plant	As fodder & Manure	Goiparbat
Alysicarpus vaginalis (L.) DC. var. *numularifolius* Miq.10652	Pan-nata	Root	Against colic	Kalimela
Atylosia scarabaeoides (L.) Benth.10481	Kolthia	Whole plant	Against diarrhoea	Goiparbat
Atylosia volubilis (Blanco) amble11024	Ban harado	Whole plant	As fodder	Chitrakonda
Butea superba Roxb.10958	Palasa	Stem, Leaf & Bark	Cure piles and fibres for rope making	Chitapari
Cajanus cajan (L.) Huth.11447	Kandulo,Harada	Seed & Tender Leaves	As food and against gum problem	Pulkelkonda
Crotalaria acicularis Buch.-Ham. ex Benth.11728	Bichhamal	Whole plant	For manure	Bhubanapalli
Crotalaria albida Heyne.ex Roth.10316	Ban methi	Root & whole herb	As a Purgative and fodder	Saptadhara
Crotalaria pallida Ait.10359	Jhumuka	Whole plant	As fodder and Manure	Govindapally
Crotalaria prostrata Rottl. ex Willd.10477	Sana jhumka	Root	Against Infantile diarrhoea	Kamalapadar
Crotalaria ramosissima Roxb.11457	San jhumki	Root	Against dysentery	Pulkelkonda
Crotalaria spectabilis Roth.10679	Bado jhumka	Leaf & Whole plant	Against scabies and as fodder	Chitrakonda
Dalbergia lanceolaria L.f.12266	Chakundi	Trunk & bark	As timber and against fever	Chitapari
Dalbergia latifolia Roxb.11051	Sisua	Trunk & branches	Timber for household articles and fuel	Satiguda
Dalbergia sissoo Roxb.11751	Sisu	Bark & trunk	Against cholera	Malkangiri
Dalbergia volubilis Roxb.10628	San sisu	Root	Against gonorrhoea	Undragonda
Desmodium gangeticum (L.) DC.11081	Salpani	Whole plant	Antipyretic	Satiguda
Desmodium heterocarpon (L.) DC.10294	Krisnapani	Whole plant	As fodder and manure	Dasmantpur
Desmodium motorium (Houtt.) Merr.10367	Katkana	Whole plant	As fodder and manure	Govindapally
Desmodium oojeinensis (Roxb.) Ohashi10997	Bandhana	Bark & trunk	For joining fractured bones	Chitrakonda
Desmodium pulchellum (L.) Benth.11894	Bikarpi	Bark	Against haemorrhage	Nuaguda
Desmodium triflorum (L.) DC.11351	Kurhadia	Whole plant	Against dysentery	Goiparbat
Desmodium triquetrum (L.) DC.10991	Salpani	Roots	Carminative	Chitrakonda
Desmodium velutinum (Willd.) DC.10256	Dangarbuta	Whole plant	For manure	Biralaxmanpur
Erythraena variegata L.10964	Paldhua	Leaves & seed	Against worms and in soap industries	Chitapari
Flemingia bracteata (Roxb.) Wight.10369	Ranikathi	Roots	For sleeping	Govindapally
Indigofera astragalina DC.10297	Gunjeri	Whole plant	As fodder and Manure	Dasmantpur
Indigofera cassioides Rottl. ex DC.10972	Giridi	Flowers	Diuretic	Chitrakonda
Indigofera glabra L.11474	Lili	Whole plant	For manure	Motu
Indigofera linifolia (L.f.) Retz.10490	Torki	Whole plant	Against amenorrhoea	Chalanguda
Indigofera linnaei Ali11475	Latai	Whole plant	As fodder	Motu
Indigofera nummularifolia (L.) Liv. ex Alston.10382	Leel	Whole plant	As fodder and Manure	Kamalapadar
Indigofera prostrata Willd.11388	Nilbari	Seeds	Fish poisoning	Goiparbat
Millettia extensa (Benth.) Baker10336	Mardamal	Seed, bark & stem	In birth control and fish poisoning	Govindapally
Millettia racemosa (Roxb.) Benth.10425	Surbanga	Bark	In fish poisoning	Sitakund
Mucuna nigricans (Lour.) Steud.11090	Bada baidanko	Seeds	Against leprosy	Satiguda
Mucuna pruriens (L.) DC.10975	Baidanko	Root	Against Cholera	Chitrakonda
Pongamia pinnata (L.) Pierre11135	Karanja	Seed	In skin diseases and rheumatism	Chitapari
Pseudarthria viscida (L.) Wt. & Arn.11027	Jeri	Whole plant	Against rheumatism	Chitrakonda
Pterocarpus marsupium Roxb.10500	Bija	Gum & trunk	In diarrhoea and as timber	Chalanguda
Rothia indica (L.) Druce11496	Papna	Whole plant	As fodder	Motu
Sesbania bispinosa (Jacq.) W. F. Wight11479	Tentua	Stem	For fibre	Motu
Sesbania grandiflora (L.) Poir.11498	Agasti	Root	Against diarrhoea	Motu
Smithia conferta Sm.10486	Borora	Whole plant	Laxative	Chalanguda
Tephrosia purpurea (L.) Pers.10381	Gileri	Whole plant	Diuretic	Kamalapadar
Tephrosia villosa (L.) Pers.11717	Ban kolathia	Seed	In fish poisoning	Motu
Teramnus labialis (L. f.) Spreng.11484	Kolthi lata	Fruit	Astringent	Motu
Teramnus mollis Benth.12234	Mashni lata	Whole plant	As fodder	Sadasivpur
Uraria rufescens (DC.) Schindl.11743	Salaparni	Root	Aphrodisiac	Khirkoliguda
Vigna radiata (L.) Wilczek10410	Muga	Fruit & whole plant	As food and fodder	Mudulipara
Vigna umbellata (Thunb.) Ohwi & Ohashi11055	Bana muga	Whole plant	As fodder	Satiguda
Zornia gibbosa Spanoghe10420	Birmukh	Whole plant	For sleeping	Mudulipara

Fig. 6 : *Dalbergia latifolia* Roxb

Fig. 9 : *Crotalaria spectabilis* Roth

Fig. 7 : *Sesbania grandiflora* (L.) Poir

Fig. 10 : *Aeschynomene aspera* L.

Fig. 8 : *Uraria rufescens* (DC.) Schindl.

Fig. 11 : *Crotalaria ramosissima* Roxb

Fig. 4 : Chart showing habitat and number of species

value. This may lead to complete destruction of tree species from their natural habitat. There is a threat to the woody climbers also as they can not avail the support for their growth due to the rapid destruction of the trees from the forests. Hence there is an immediate need to give attention for the conservation measures, so that we can save these plants in wild.

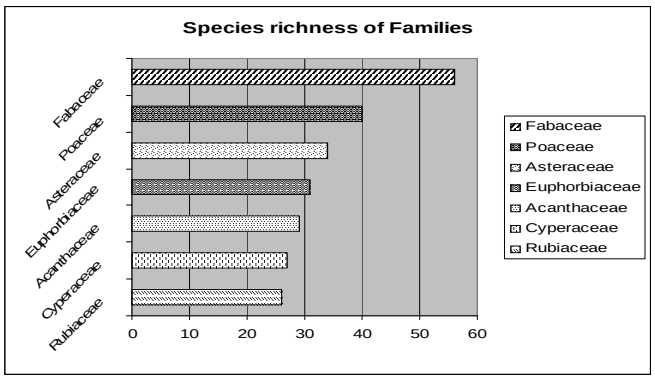

Fig. 5 : Chart showing major families and number of species

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2.4. **Abstract**. Maximum 200 words convening the objectives, methodology and the most important results.

2.5. **Key words.** Maximum of 5-6 key words should be provided for subject indexing.

2.6. **Introduction**. It should be concise and include the scope of the work in relation to the state of art in the same field along with specific objectives.

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2.8. **Results and Discussion.** In this section, only significant results of the experiment(s) should be reported. Along with the tables and figures, the discussion should deal with interpretation of results and relate the author's findings with the past work on the same subject. The conclusions drawn should be explicitly listed at the end of this section.

3. **References.** Refer this copy as sample for references. For ex.*:* Thankppan A, Das BK, Barman HK and Samal SK (2008) Genetic fingerprinting of *Aeromonas hydrophila* isolated from diseased fresh water fishes of eastern India; e-planet, 6(2): 01-06.Distinction for the same author and same year be done as e.g. 1969a, 1969b. Unpublished data, and personal communication are not acceptable as references but may be referred to parenthetically in the text.

4. **Tables.** Number the tables consecutively in Arabic numerals. Tables should have comprehensible legends. Conditions specific to a particular experiment should be stated. Zero results must be represented by 0 and not determined by n.d. The dash sign is ambiguous. For values <1, insert a zero before the decimal point.

5. **Illustrations.** All graphs, diagrams and half-tones should be referred to as Figure and should be numbered consecutively in Arabic numerals. The figures should either match with the column width (8.5 cm) or the printing area (17.8 x 22 cm). The legends should be brief and self-explanatory. All graphs, figures should be drawn by MS-EXCEL and submitted in editable format. Define in the footnote or legend any non-standard abbreviations or symbols used in a table or figure. Photographs, which must be kept to a minimum, should be good quality glossy prints.

6. **Short communication.** New results of special interest will be published as Short Communication. This need not provide separate headings for each section but the details should be separated by paragraphs. Short communication should have an Abstract.

7. **Reviews.** Review articles whether full or mini are invited. Very special review articles are also considered.