

# Annual Report 2003-04



Central Institute of Fisheries Education  
Mumbai India



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# 1. PREFACE

It is during this year that a very special, and one of the most cherished dreams of CIFE blossomed into reality and the Institute moved into its prestigious new campus which was inaugurated formally on 23 December, 2003 by the then Hon'ble Union Minister of Agriculture, Shri Rajnath Singhji. The inauguration was marked with emotional overtones for the CIFEans for the new campus is an ever lasting edifice that stands tall and proud in testimony of a glorious past and a grand future for this Deemed University. The grandeur of the new building is symbolic of the spirit of CIFE, and it ushered in not merely a new year, but a whole new era in fisheries education.



The Institute, which is the flagship of the Indian Council of Agricultural Research in the field of HRD in fisheries, forged ahead in its educational ventures with different streams of specialization, including one on Fisheries Business Management that is growing in popularity, and its Diploma Programme at Kolkata. Necessary infrastructural facilities are in position to initiate the first-ever Ph.D programme in Fisheries Business Management from October 2004, a logical extension of the M.F.Sc in Fisheries Business Management that was commenced in 2002, in line with the National Agricultural Policy emphasizing agri-business and self-employment ventures. Additional financial and infrastructural support came forth from the Education Division, especially under the CAS in Fishery Science Scheme as also from the Sir Dorabji Tata Endowment, which enabled two students to be trained overseas, one in Thailand and the other in Malaysia, all of which are gratefully acknowledged.

I am proud to note that research activities at CIFE made new inroads in the intellectual arena with the development of new technologies such as the immunodiagnosics kits for detection of white spot syndrome virus (WSSV) and other bacteria, and an anesthetic formulation (CIFECALM) to reduce stress for finfishes and shellfishes during handling and transport. Both these products have already been commercialized. Fish Nuggets and Fish Munch are two mouth-watering dishes culled out by the Institute for utilization of deep-sea fishes as also other fish that are currently underutilized. The technology of cage culture in reservoirs, for rearing of fry to fingerlings, and fingerlings to advanced fingerlings, has become extremely popular and the Fisheries Departments of various States are clamoring to adopt the same. Another technology that has earned acclamation and approbation in international fora is the hatchery technology developed for giant freshwater prawn using Inland Ground Saline Water (IGSW). Contract research was carried out for field testing of Raafres, a neutraceutical developed by M/s. Guybro Chemical, Mumbai. These and other research endeavors of the Institute found expression in about 100 and odd publications of varied technical categories. CIFE joined hands by signing Memoranda of Understanding with the Interactive Research School of Health Affairs (IRSHA) Pune for the development of "Diet Fish" and with the CAS in Marine Biology, Parangipettai for research and training in areas of Marine Biology and Oceanography.

In due recognition of the excellence of the Institute's Extension machinery, CIFE has been identified as one of the 12 Kisan Call Centres to provide technical support to the industry through telecom services.

Faculty members won accolades for their contributions to science and technology and brought laurels to the Institute. My congratulations in this regard to Dr.(Ms.) G.V. Deshmukhe (Kalawati Award and Dr. Zahoor Qasim Gold Medal), Dr. R.C. Das (Fellowship of the Academy of Environmental Biology), Dr. (Ms.) Archana Sinha (Fellowship of the Zoological Society of India), Mr. D. Bhoomaiah (Letter of

Appreciation from ASRB) and Mr. R. P. Uniyal (*Sahitya Samman Award*). The Institute bagged the prestigious Rajshree Tandon Award for Hindi implementation and the *Kisan Shreshth Magazine Award* for the Hindi Publication *Jalchari* for which due credit must be given to the entire staff of the Hindi Cell.

The Institute's sports team as usual came out with flying colors in the ICAR Inter Institutional Sports Meet, conducted in a grand way by CIFE. Three cheers to the entire team, especially Ms. Nalini Poojary who was adjudged the Best Women Athlete of the Tournament for the third consecutive year.

The newly constituted Post Graduate School Students Union took up new ventures such as Clean and Green, *Shram Daan*, Blood Donation Camps, Fund-raising for Cancer and AIDS patients, etc. to contribute their mite to social causes. Creative talents of the students were expressed through *Bhoomika*, the wall magazine and through a newly introduced innovative Student Talk programme. *Medha*, and *Spandan*, CIFE's first student news bulletin and first student annual magazine respectively, and a web site exclusively that of the PGSSU are new feathers in their cap. Kudos to Dr. S. K. Chakraborty, Dean (Students Welfare); Mr. Suresh Kumar, Warden; Mr. Chandrakant M. H., and Ms. Asha T. Landge, Deputy Wardens; and Mr. Sumanth Kumar Kunda, President, and his entire team of Office Bearers, of the PGSSU. Campus related developmental activities received a new fillip and mass vaccination scheme was arranged for children of the campus. Health management, of course was not restricted to the campus alone, and free health check up programmes, not one but five, were arranged for the fisherwomen.

My sincere thanks are due to Dr. Mangala Rai, Secretary, DARE and Director General, ICAR; Dr. S. Ayyappan, Deputy Director General (Fisheries), Dr. J. C. Katyal, Deputy Director General (Education), Dr. A. D. Diwan, Assistant Director General (Marine Fisheries), Dr. V. R. Chitranshi, Assistant Director General (Inland Fisheries), ICAR, for their unstinted cooperation, support and guidance without which none of these would have been possible. I am extremely thankful to the Chairman and Members of the RAC and the QRT, as also the distinguished Members, both external and internal, of the Board of Management, Academic Council, Staff Research Council, Extension Council, Board of Examiners, and various other in-house Committees for their constructive criticism and guidance. I gratefully acknowledge the support received from various agencies viz. Department of Biotechnology, Department of Atomic Energy, Department of Ocean Development, Department of Science and Technology, Department of Environment and Forest, Council of Scientific and Industrial Research, Bhabha Atomic Research Centre, Tata Institute of Fundamental Research, Therapeutic Drug Monitoring Laboratory, National Institute of Oceanography, Indian National Centre for Ocean Information Sciences, National Bank for Agriculture and Rural Development, Central Drug Research Institute, Industrial Toxicology Research Centre, Fisheries Research Institutes of ICAR, Fisheries Colleges, State Agricultural Universities, CAS in Marine Biology, and a host of other organizations including INRA, NORAD, ACIAR, ICLARM, DFID, NACA, AKVAFORSK, SARDI and well wishers of this Deemed University. I thank all my faculty and students, the Senior Administrative Officer and his staff, the Finance and accounts Officer and his staff, and the Sailing Staff of the vessels, for everything during this wonderful year. Last but not the least, my special thanks are due to Mr. K. Venkateshvaran, Dr. K. Pani Prasad, Mr. D. Bhoomiah, Ms. Nalini Poojary, and Ms. Sujata Pawar as also Mr. R. P. Uniyal for all their strenuous efforts in the timely release of this Report.

CIFE, Mumbai  
April 01, 2004

**(S.C. MUKHERJEE)**  
Director

The academic programmes at Masters' and Doctoral levels, offered by the Institute at its Head quarters and Centres, as also at the Central Marine Fisheries Research Institute, Kochi; the Central Institute of Fisheries Technology, Kochi; and the Central Institute of Freshwater Aquaculture, Bhubaneswar progressed satisfactorily as per schedule. 56 students obtained their Masters' Degrees, and 17 their Ph.D. degrees; 16 trainees successfully completed the one-year PG Certificate Programme in Inland Fisheries Development and Administration.

48 students enrolled under the nine Masters' programmes, while 23 students enrolled for the eight Ph.D. programmes. 25 trainees were admitted to the PG Diploma Programme in Inland Fisheries Development and Administration at Kolkata Centre. Under the Sir Dorabji Tata Endearment, two students underwent training overseas, one in Thailand and the other in Malaysia, in specialized areas of their research work. Two Guest lectures were arranged for the benefit of the students while the CIFE faculty delivered twelve guest lectures at other Institutes. Two training programmes were conducted under the CAS in Fishery Science Scheme, one on Disease diagnostics and another on fish Biotechnology.

Twenty Institutional Projects and 19 Externally Funded Projects were in operation. Notable research achievements during the year were the practical utility of cage culture technology in reservoirs; continued inputs to the database of the marine fisheries of Maharashtra; development of immunodiagnosics kits for detection of white spot syndrome virus (WSSV) and other bacteria, and an anesthetic formulation (CIFECALM) to reduce stress for finfishes; development of Fish Nuggets and Fish Munch; the development of hatchery technology for giant freshwater prawn using Inland Ground Saline Water (IGSW); detection of analgesic activity in saliva of cone snails, etc.

56 dissertations were submitted by the M.F.Sc. students. A total of 104 research/ educational publications of various technical categories were made. A total of 8 Seminar/ Symposia/Brainstorming Sessions were conducted on various aspects of research in fisheries sciences. The Institute conducted 30 Short-term Training Programmes of varying durations and a total of 397 were trained; five training workshops were conducted exclusively for fisherwomen under which 246 fisherwomen were trained on aspects of health and nutritional security. Hundred and ninety seven students and 189 farmers from all over India visited the Institute during the period.

Construction work on the first phase of Academic- Cum-Administrative building at the new campus was completed. MFV Narmada was regularly cruising the Mumbai waters for student training and for research work of the Institute and sister institutes at Mumbai. MFV Saraswati undertook two training cruises.

CIFE won the prestigious Rajshree Tandon Award for Hindi implementation and the *Kisan Shreshth* Magazine Award for the Hindi Publication *Jaichari*. The award of Dr. Zahoor Quasim Gold Medal as also the Kalawati award Gold Medal to Dr. (Ms) G.V. Deshmukhe, the Fellowship of the Academy of Environmental Biology Dr. R.C. Das, the Fellowship of the Zoological Society of India to Dr. (Ms.) Archana Sinha, (the *Sahitya Samman* Award to Mr. R.P. Uniyal all added feathers to the cap of CIFE. The Institute also bagged a number of prizes at the ICAR Inter-Institutional Sports Tournament.

This year is a very special and most remarkable one, one in which the most cherished dream of CIFE blossomed into reality since the Institute moved into its prestigious new campus which was inaugurated formally on 23 December, 2003 by none other than the Hon'ble Union Minister of Agriculture, Shri Rajnath Singhji. The inauguration was marked with emotional overtones for the CIFEans for the new campus is an edifice in testimony of a glorious past and a grand future for this Deemed University. The grandeur of the new building is symbolic of the spirit of CIFE.

The Institute forged ahead in its educational ventures with its different streams of specialization, including one on Fisheries Business Management that is growing in popularity, and its Diploma Programme at Kolkata. A total of 72 students graduated under these programme while 17 students completed their Ph.D. work during the year. A total of 96 students enrolled for these programmes during the year. While 2 guest lectures were arranged for the students, our own faculty were very much sought after by other Institutes and they delivered about a dozen lectures on specialized topics. A total of 42 faculty members of other Universities and researchers from R & D laboratories were trained under 2 CAS in Fishery Science programmes. Under the Sir Dorabji Tata Endowment, two students underwent training overseas, one in Thailand and the other in Malaysia.

Research activities made new inroads in the intellectual arena with the development of new technologies such as the immunodiagnostics kits for detection of white spot syndrome virus (WSSV) and other bacteria, and an anesthetic formulation (CIFECALM) to reduce stress for finfishes and shellfishes during handling and transport. Both these products have already been commercialized. Fish Muggets and Fish Munch are two mouth-watering dishes culled out by the Institute for utilization of deep-sea fishes as also other fish that are currently underutilized. The technology of cage culture in reservoirs, for rearing of fry to fingerlings, and fingerlings to advanced fingerlings, has become extremely popular and the Fisheries Departments of various States are clamoring to adopt the same. Another technology that has earned acclamation and approbation in international for a is the hatchery technology developed for giant freshwater prawn using Inland Ground Saline Water (IGSW). Contract research was carried out for field testing of Raafres, a neutraceutical developed by M/s. Guybro Chemical, Mumbai. These and other research endeavors of the Institute found expression in about 19 national and international publications, 61 abstracts/popular articles etc., 9 books/Proceedings, besides 14 other brochures/booklets/training manuals.

168 persons were trained in various aspects of fisheries under 11 training programmes at Mumbai while 229 were trained under a total of 19 Short Term Training Programmes at the Centres. The Extension Division ensured a successful participation of the Institute in 6 Exhibitions besides preparing the exhibits for the ICAR Extension Division. The Institute has been identified as one of the 12 Kisan Call Centres to provide technical support to the industry through telecom services. Staff of the Institute also delivered about 8 radio/TV talks.

Two faculty members went on Sabbatical abroad, while four underwent training abroad and one acted as a technical expert.

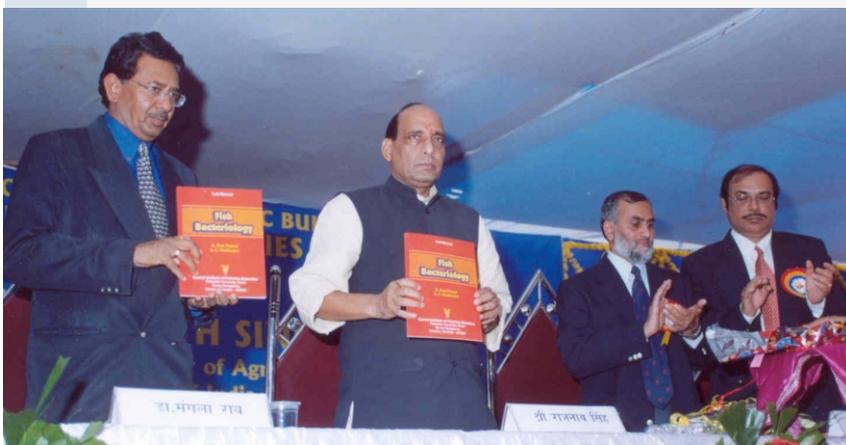
CIFE joined hands with the Interactive Research School of Health Affairs (IRSHA) Pune for the development of "Diet Fish" and with the CAS in Marine Biology, Parangipettai for research and training in areas of Marine Biology and Oceanography.

Ever since its establishment in 1961, the Central Institute of Fisheries Education (CIFE), Mumbai, has played a pivotal role in post-graduate fisheries education and training. Research and extension endeavours were strengthened with the transfer of administrative control of CIFE from the Government of India to the Indian Council of Agricultural Research (ICAR) in 1979. In due recognition of its yeomen services to the development of Indian fisheries in general and human resource development for the purpose in particular, CIFE was deservedly conferred the coveted status of Deemed University in 1989, has registered remarkable progress since then. Today, CIFE stands tall as a premier *alma mater* in the global fisheries map. The present campus of CIFE is located in a lush green campus of about 2.22 ha at a distance of about half a kilometer from the Versova beach at Mumbai. The administration dept, accounts section and library are located in the old campus whereas the New academic building of CIFE is located at Yari Road, Versova which is spread over 16.5 acres of land. It has facilities like classrooms, laboratories, auditorium, committee room, conference hall etc. and further construction work is underway.



#### 3.1 Mandate

- ! To conduct education and research programmes leading to post-graduate (M.F.Sc.) and doctoral (Ph.D.) degrees in specialised disciplines of fisheries science and technology.
- ! To conduct capsule courses for catering to the refresher training needs of fisheries developmental and extension personnel.
- ! To conduct basic research in frontier areas of fisheries science and technology through institutional and collaborative efforts.
- ! To conduct need-based capsule/vocational training on various technologies related to fisheries and allied disciplines.
- ! To provide institutional support for consultancy and participation in sponsored projects and programmes with other institutions and agencies for fisheries research in inland, coastal and marine (both within EEZ and beyond) sectors.



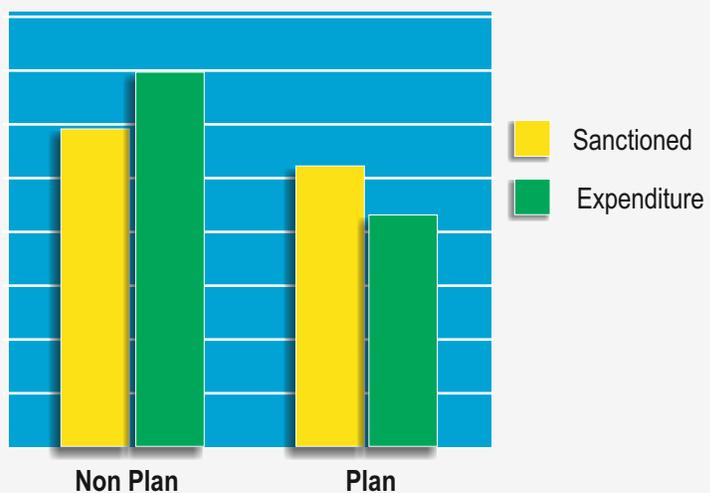
### 3.3 Staff position on 31 March 2004

Name of the Post	Sanctioned	Filled	Vacant
<b>SCIENTIFIC</b>			
RMP	02	01	01
PRINCIPAL SCIENTIST	10	07	03
SENIOR SCIENTIST	20	11	09
SCIENTIST	60	36	24
<b>TOTAL</b>	<b>92</b>	<b>55</b>	<b>37</b>
<b>TECHNICAL</b>			
T-7	04	03	01
T-6	03	03	-
T-5	13	13	-
T-4	12	12	-
T-II-3	39	37	02
T-2	12	12	-
T-1	45	42	03
<b>TOTAL</b>	<b>128</b>	<b>122</b>	<b>06</b>
<b>NON-MINISTERIAL</b>	<b>01</b>	<b>01</b>	<b>-</b>
<b>ADMINISTRATIVE</b>			
SR.A.O.	01	01	-
A.O.	01	01	-
F. & A.O.	01	01	-
AAO	05	03	02
ASSTT. DIRECTOR (OL)	01	01	-
PRIVATE SECRETARY	02	02	-
PERSONAL ASSTT.	01	01	-
ASSISTANT	15	14	01
STENOGRAPHER-III	03	03	-
UDC	17	17	-
LDC	21	21	-
<b>TOTAL</b>	<b>68</b>	<b>65</b>	<b>03</b>
<b>SUPPORTING</b>			
S.S.Gr.I	35	27	08
S.S.Gr.II	33	32	01
S.S.Gr.III	20	20	-
S.S.Gr.IV	10	10	-
S.S.Gr.IV (VESSEL)	03	02	01
<b>TOTAL</b>	<b>101</b>	<b>91</b>	<b>10</b>
<b>GRAND TOTAL</b>	<b>390</b>	<b>335</b>	<b>55</b>

### 3.4 Budget (2003-2004)

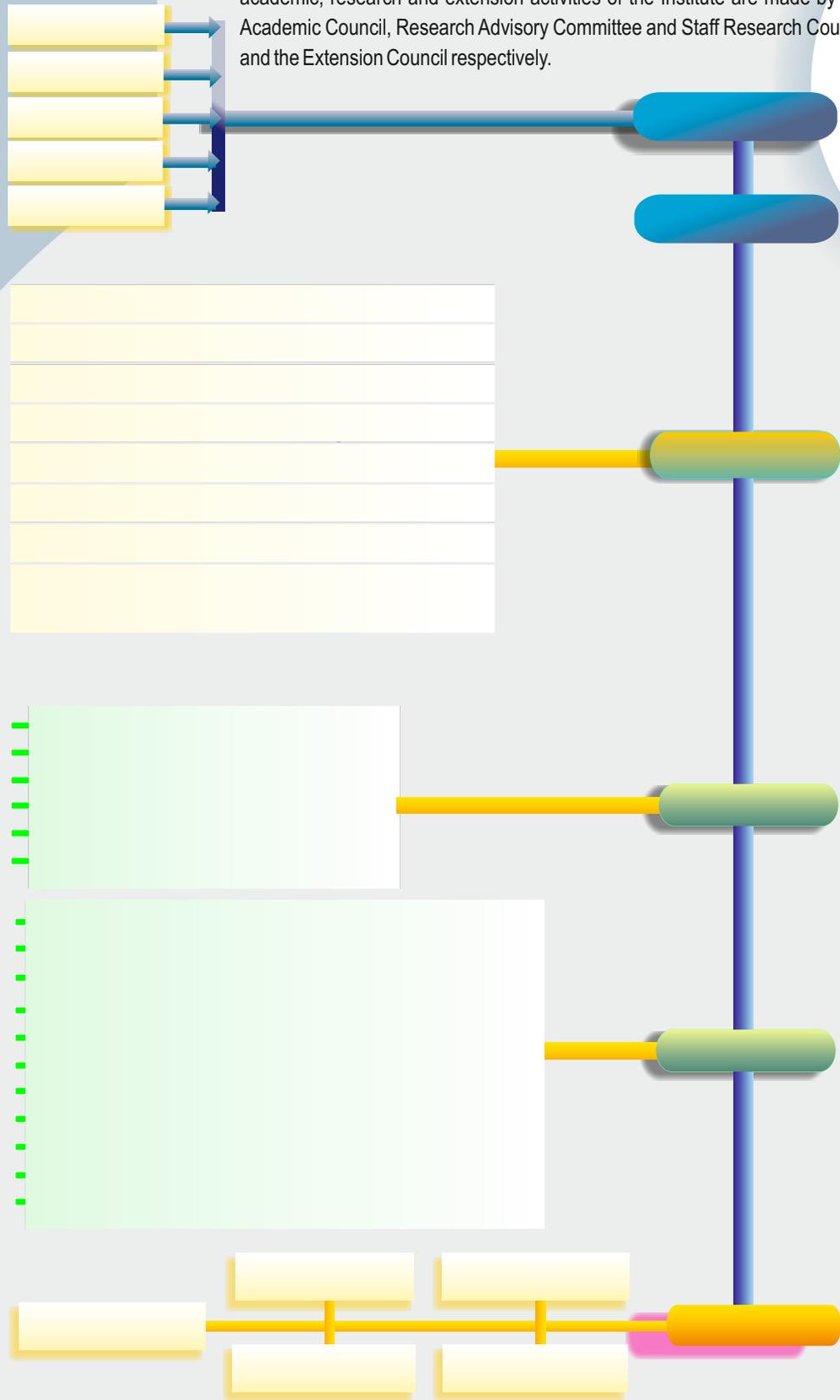
(Rs. in Lakhs)

Heads	Sanctioned	Expenditure
Non Plan	1171.49	1390.00
Plan	1036.99	860.00
NATP	83.19	103.14
CAS	4.58	6.64
SDU	46.47	---
AP CESS	16.46	32.09
Jr. & Sr. Fellowship	16.67	---
Emeritus Scientist	1.38	1.67
NEH	3.95	4.00
<b>Total</b>	<b>2381.18</b>	<b>2397.54</b>



### 3.2 Organisation and Management

At the helm of affairs of overall Institutional Management, CIFE has a Board of Management which is the highest decision making body at Institute level on all matters. The decisions and recommendations pertaining to academic, research and extension activities of the Institute are made by the Academic Council, Research Advisory Committee and Staff Research Council and the Extension Council respectively.



## 4.1 Institutional Projects

**Title : Refinement of cage Aquaculture for rearing and raising table size fish in open waters, with emphasis on nutrition.**

Cages were made of HDPE (high density poly ethylene) knotless webbing 6-8 mm mesh size, measuring 3 m X 3 m X 3 m were installed in Halali reservoir and Gobindsagar reservoir.

Results which are presented below in tabular form indicate the viability on the technology for rearing of fry to fingerling stage and from fingerling to advanced fingerling stage. As fingerlings and advanced fingerlings form the stocking material in reservoirs, the technology is a boon for aquafarmers around reservoirs and lakes in India.



**Table: Growth of Carps *Catla catla* & *Labeo rohita* in Floating Cages at Halali reservoir, Madhya Pradesh**

Experiments carried out for rearing of fingerlings from 04.04.03 to 14.08.03 (102 days)								
Fish Species (No of cages)	Stocking Density/m <sup>3</sup> (Nos/Cage) (Average)	Initial Stocking (average)		Final Harvesting (Average)		Survival Nos (Average)	Survival (%) (Average)	growth/day (Average) (g/Day) Weight-g)
		Length (mm)	Weight (g)	Length (mm)	Weight (g)			
Catla catla (2)	11.39 (205)	114.67 ±7.93	14.87 ±7.93	265.04 ±13.70	264.00 ±21.89	189	92.20	2.44
Labeo rohita (8)	11.11 (200)	117.54 ±10.97	19.17 ±6.64	226.59 ±17.06	152.57 ±22.05	185	92.50	2.03
C.catla (40%)	16.67 (300)	114.28 +8.07	17.56 +6.01	279.19 +17.77	302.42 +17.77	283	94.33	2.79
L.rohita (40%)		116.43 +11.68	18.17 +7.09	259.58 +21.67	204.61 +39.57			1.83
C.mrigala (20%)		99.63 +5.77	9.80 +2.16	192.39 +13.93	108.05 +6.28			0.96
(8)								
Experiments carried for rearing of fry stage from 15.08.03 to 1.10.03 (62 days)								
L.rohita (6)	250 (4500)	33.87 ±0.13	0.570 ±0.13	109.57 ±4.57	14.79 ±2.17	3,987	88.60	0.23
C..catla (6)	250 (4500)	43.67 ±3.39	0.690 ±0.11	110.89 ±6.46	20.72 ±3.56	3,970	88.22	0.32
Experiments carried for rearing of fry stage from 16.10.03 to 0.12.03 (45 days)								
L.rohita (6)	166.67 (3000)	35.67 ±2.09	0.685 ±0.15	109.57 ±3.53	13.33 ±1.61	2439	81.30	0.28
C.catla (6)	69.44 (1250)	50.93 ±5.48	1.13 ±0.26	110.24 ±3.48	16.78 ±3.17	971	85.43	0.35

**Table: Growth of Carps *Catla catla* & *Labeo rohita* in Floating Cages at Halalli reservoir, Madhya Pradesh**

Experiments being carried out for rearing of fingerlings from 09.12.03 to 07.04.04 ( 89 days)								
Fish Species (No of cages)	Stocking Density/m <sup>3</sup> (Nos/Cage) (Average)	Initial Stocking (average)		Final Harvesting (Average)		Survival Nos (Average)	Survival% (Average)	growth/day (Average Weight-g)
		Length (mm)	Weight (g)	Length (mm)	Weight (g)			
<i>C.catla</i> & <i>L.rohita</i> (50% each) (12)	(30) 540	112.93	18.20	153.31	52.95	6185	95.44	0.39 0.23
		+ 6.87	+4.63	+14.40	+19.22			
		109.60	14.13	149.18	34.71			
		+4.14	+1.88	+12.43	+6.66			
		1. +8.07+7.09						

**Table: Growth of Carps *Catla catla*, *Labeo rohita* and *Cyrinus carpio* in Floating Cages at Gobindsagar reservoir, Himachal Pradesh**

Fish Species (No of cages)	Stocking Density/m <sup>3</sup> (Nos/Cage) (Average)	Period (Days)	Initial Stocking on 01.10.03 (average)		Growth on 19.04.04 Average)		Growth per day (g)
			Length (mm)	Weight (g)	Length (m)	Wight (g)	
<i>Catla catla</i> (2)	100 (1800)	202	32.60 +1.77	0.326 +0.02	121.35 +13.40	15.35 +3.68	0.08
<i>Labeo rohita</i> (2)	200 (3600)	202	31.55 +1.56	0.349 +0.03	111.45+ 10.92	12.30 +7.86	0.06
<i>Labeo rohita</i> (4)	200 (3600)	202	31.55 +2.40	0.308 +0.02	128.20 +20.17	17.75 +7.48	0.09
			Initial Stocking on 01.11.03 (average)				
<i>Cyprinus carpio</i> (2)	100 (1800)	171	34.50 + 3.63	0.684 +0.12	92.00 +12.21	13.98 +6.33	0.07



**Title: Evaluation of Permethrin and Deltamethrin Toxicity and efficacy of Ascorbic Acid in reducing Toxicity related stress in Common Carp.**

Pyrethroid analysis by GC ECD Spectrophotometer reveal the presence of both the pesticides Permethin and Deltamethrin in the water samples ranging from nil to 0.35 ppm

The 24, 48, 72 and 96 h LC<sub>50</sub> values of permethin for fingerlings of common carp were obtained from Khopoli (1.4-1.6 g) were found to be 0.076, 0.061, 0.049 and 0.043 ppm respectively. The LC<sub>0</sub> values for corresponding time interval were 0.062, 0.055, 0.042 and 0.039 ppm for fish while LC<sub>100</sub> values for similar time intervals were 0.092, 0.076, 0.059 and 0.051 ppm were recorded.

The 24, 48, 72 and 96 h LC<sub>50</sub> value of deltamethrin for the fish (1.4 1.6 g) were found to be 0.092, 0.073, 0.058 and 0.043 ppm respectively. The LC<sub>0</sub> values for corresponding time interval were 0.070, 0.061, 0.050 and 0.040 for fish while LC<sub>100</sub> values for similar time intervals were 0.115, 0.090, 0.070 and 0.053 ppm were recorded.

**Table: Physico-chemical Parameters of Water Samples Collected from Experimental Sites**

S.No.	PARAMETERS	POSARI	KOSHANI	VYWU	CHINCHVALI
1.	pH	7.4	7.8	7.5	7.6
2.	Dissolved Oxygen (mg/l)	5.8	5.4	6.2	6.0
3.	Carbondioxide (mg/l)	3.8	3.4	3.6	3.4
4.	Alkalinity (mg/l)	112	156	116	132
5.	Salinity (ppt)	Nil	Nil	Nil	Nil
6.	Ammonia nitrogen (NH <sub>4</sub> <sup>+</sup> -N) (mg/l)	0.10	0.16	0.12	0.14
7.	Nitrite nitrogen (NO <sub>2</sub> -N) (mg/l)	0.04	0.12	0.04	0.10
8.	Nitrate nitrogen (NO <sub>3</sub> -N) (mg/l)	1.20	1.37	1.31	1.30
9.	Phosphate (PO <sub>4</sub> -P)(mg/l)	0.05	0.06	0.05	0.06
10.	Chloride (mg/l)	24	32	28	30
11.	Hardness(mg/l)	130	164	130	140
12.	Chemical Oxygen demand (mg/l)	8.2	7.0	11.0	13.6

**Table: Physico-chemical Parameters of Soil Samples Collected from Experimental Sites**

S. No.	PARAMETERS	POSARI	KOSHANI	VYWU	CHINCHVALI
1.	pH	7.2	6.8	6.9	7.1
2.	Soil Composition: Sand (%)	43.0	42.0	37.0	39.0
	Silt(%)	26.5	24.0	25.0	26.0
	Clay(%)	30.5	34.0	38.0	35.0
3.	Water retention capacity (%)	44.2	39.4	38.0	35.3
4.	Organic carbon(%)	1.58	1.38	1.16	1.22
5.	Organic matter (%)	2.72	2.37	1.99	2.10
6.	Total Nitrogen (mg/100 gm of soil sample)	158	138	116	122

**Table: Pesticide Analysis Data in Samples Collected From Experimental Sites**

Experimental Site	Permethrin (ppm)	Deltamethrin (ppm)
First Sampling, Jan., 2004		
Posari	Nil	Nil
Koshani	0.22	0.15
Vywu	0.17	0.21
Chinchvali	0.19	0.23
Second Sampling, April, 2004		
Posari	Nil	Nil
Koshani	0.31	0.33
Vywu	0.27	0.23
Chinchvali	0.32	0.35

**Table: LCo, LC<sub>50</sub> and LC<sub>100</sub> values (ppm) of Permethrin for Common Carp (1.4-1.6 g); 95% confidence limit are given in parentheses**

Time (hrs.)	LC <sub>0</sub>	LC <sub>50</sub>	LC <sub>100</sub>
24	0.062	0.076 (0.062 – 0.083)	0.092
48	0.055	0.061 (0.052 - 0.070)	0.076
72	0.042	0.049 (0.043 – 0.051)	0.059
96	0.039	0.043 (0.039 – 0.046)	0.051

**Table:** LC<sub>0</sub>, LC<sub>50</sub> and LC<sub>100</sub> values (ppm) of Deltamethrin for Common Carp (1.4-1.6 g); 95% confidence limit are given in parentheses.

Time (hrs.)	LC <sub>0</sub>	LC <sub>50</sub>	LC <sub>100</sub>
24	0.070	0.92 (0.081 – 0.099)	0.115
48	0.061	0.073 (0.065 – 0.080)	0.090
72	0.050	0.058 (0.050 – 0.069)	0.070
96	0.040	0.043 (0.039 – 0.048)	0.053

**Title: Development of Database for Marine Fisheries of Maharashtra**

Computerised database has been developed for marine fisheries of Maharashtra using Visual Basic as front end and MS-access as back end. The database encompasses important aspects of fisheries such as marine fish landings for different years according to quarters (seasons), districts and fish species, fishing fleet size and composition, utilisation of fish landings, processing units, price of fish, water quality and population parameters, etc. The database contains about 1500 records. The software developed allows the user to store and retrieve the information in report format. The main menu of this software consists of 7 buttons. The database can be easily updated and operated by the user. The database developed allows the user to retrieve the information according to requirements. From query, user can retrieve data on any field combinations. Each report viewed allows the user to take hard copy for ready reference.

**Title: Fish Consumption Profile of Suburban Mumbai Households A Pilot Study**

Data on various aspects were collected from a sample of 500 households selected on random basis from Andheri East and West of Mumbai city. Analysis of data indicated that pomfrets were the most preferred (82.2%) followed by prawn/shrimp (71.7 %). Mackerels were the least preferred species (13.3 %) followed by Bombay duck (17 %). The preferences among the different forms of fish for consumption of the selected respondents indicated that fresh form were the most preferred (97.7 %) followed by dried form (30.0 %). Frozen form was the least preferred fish (6.7 %) followed by Processed product (8.3 %). Majority of the respondents who consumed fish used to purchase from the local market (42.0 %). The local sellers constituted 20.0 % of the purchase of the fishes. The purchases from the cold storage were the least preferred (5.0 %). Among different problems encountered in the consumption of fish majority of respondents felt that the high

cost prevailing was the major reason followed by the non availability of fish (19 %) and irregular supply in the market (12.3 %). The wide fluctuations in price within a week tempted the respondents not to consume fish. The highly perishable nature of the fish also accounted for its lesser consumption, among the different households. The preferences among fish and other related products (substitutes) like meat and egg for the surveyed respondents indicated that meat was the most preferred (51.3 %) followed by fish (37.3 %). The high cost of meat and meat products and also a sizeable proportion of respondents being fishermen or related to fishing contributed the varied preferences. Egg also featured as the most preferred product among 11.3 % of the respondents. About 24.3 % of the annual income was spent on fish/ animal products. This increased with the level of income. The data also depicted that the expenditure on meat was the highest. That was followed by fish and eggs. The data further depicts that excepting for the lower income group, fish was consumed daily by the rest of the population.

**Title: Production Possibilities of Fish Products from Low- cost Fish in the Coastal Village Condition**

In this project a fisherwomen co-operative society was formed at Vasai, Thane, Maharashtra. Fishers were educated on technological opportunities in fisheries. Fisher women were provided training on value added fish products and support was provided in the form of infrastructural facility for business activities. After field trials, networking was done with Technology Information Forecasting and Assessment Council, DST, New Delhi for financial support. Production capacity of the firm at present is envisaged as 5000 kg/yr, production cost per unit output is about Rs 300/kg, and expected percentage profit is 20%. Production and marketing efforts were started from local villages and adjoining towns from where it is spreading to cities. The fisherwomen group is also registered as Matsyagandha Mahila Gruh Udyog. The objectives of the organization presently are to empower fisherwomen by providing self-employment round the year by utilizing the locally available fish and agriculture produce and to bring the awareness about such programmes amongst the fisherwomen in such coastal villages. Fisherwomen of this society are actively involved in preparation and marketing of the value added fish products and benefiting from the same.

**Title: Fisherwomen and Livelihoods- An Ergonomics Perspective**

Profile of women fishers is being studied with a questionnaire which has been pre tested, and its reliability and validity ascertained along with parameters to measure HDI of fishers. It has been found that 20.54% of boat owners in Versova fishing village are women. Influence of socio-economic factors on food and nutrient intake is being studied along with recording of nutritional status which will be compared with RDA (ICMR) along with identification of target groups for

prioritization for improvement of nutritional status. Among health problems 39.1% of women had haemoglobin (%) less than normal range (12-16gms%). The problems of overweight, high blood pressure, pain in knee and lower leg, high temperature and humidity at work place have also been reported and ascertained. Suggestions for mitigation were made by experts.

Fish drying activity could be categorised as 'moderately heavy activity'. (Mean Heart Rate:110 beats/min.) Environmental recording showed that 'radiant temperature' and 'humidity' are high as they work in open under direct sun. Nature of work as well as environmental condition seems to be responsible for moderately heavy activity of fish drying. As per NIOSH (1981) energy expenditure should not exceed 3.5 Kcal/min for women in an 8 hour shift. In fish drying activity it is more than NIOSH's limit which may have adverse effect on health.

#### **Title: Impact of Trade Liberalization & WTO Agreements on Exports of Indian Fish Products**

Certain important features about the seafood trade they are a). Export volume (4.67 lakh tons) and value (Rs.6881 Crores) were all time high in 2002-03 but fluctuating since 1998, and though significant growth is evident in India's export quantity and value, the unit value realization is declining in recent years; b) Increasing exports to East Asian and Middle East markets signals diversification of Indian export market. And the US has replaced Japan as our single largest market. Commodity diversification is also evident with declining share of shrimp, and increasing share of cuttlefish & frozen fish in recent years; c) Post liberalisation period has brought greater degree of instability in global seafood market. Since 2001, international shrimp prices is on the decline-total value (\$8.8 bn.) fell by 5% due to weakening/saturation of demand in US market; economic recession in Japan, reduced import prices in EU, increased aqua production in Vietnam/Brazil and increased catch of EU coldwater shrimp; d) Though the performance of Indian fisheries export compared to world fisheries export per se was better, our competitors (Thailand, Vietnam) have performed far better taking a major share of the cake; e) The international seafood market is increasingly becoming a buyers' market with more and more being expected of the exporters in terms of product varieties, sizes, quantity, health standards and continuity in supply. Rejection of export consignments on spurious quality concerns, increasing resort to technical barriers to trade are cases in point. The recent proposal of US to put in place Anti-Dumping Duty to protect their domestic shrimp producers would further unsettle shrimp exports from India.

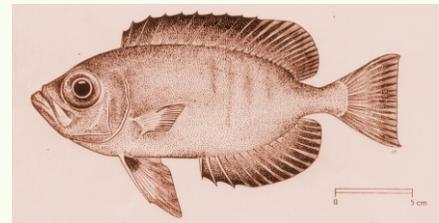
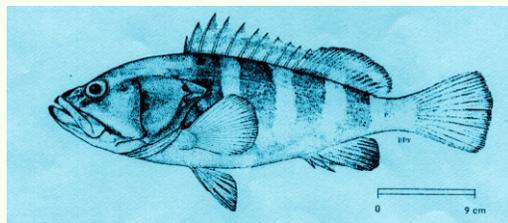
**Title: Studies on the Stock Assessment of Demersal Fishes off Maharashtra”**

During this 4 years a total of 84,120 specimens were measured. From the analysis it appears that mean length declined in *J. macrorhynchus*, *J. vogleri*, *O. cuvieri*, *N. mesoprion* & *P. hamrur*. Juveniles of both the nemipterids were recorded in November-January. Young ones of *E. diacanthus* was recorded in September-November period. The exploitation ratio was higher in most of the species except *O. cuvieri*, *P. hamrur* and *E. diacanthus*. The yield isopleth diagrams shows that for most of species the optimum yield can be obtained below the present level of *E*. The Thompson and Bell analysis shows that for most of the species there is a decline in the catch at the present level of fishing. .

**Table: Annual size range, number of specimen measured and total catch**

**Title: Stock assessment of some of Fishery Resource of Mumbai Coast.**

S.No.	Species	Length range (mm)	No. of specimen measured	Total catch (tons)	Mean Length (mm)	Mean Length (mm) 2002-2003
1	<i>Jonius macrorhynchus</i>	85 - 330	2841	714.700	203.13	193.00
2	<i>Jonieops vogleri</i>	70 - 365	3011	805.265	216.43	205.00
3	<i>Otolithes cuvieri</i>	52 - 390	2905	725.059	195.25	196.00
4	<i>Jonieops sina</i>	89 - 220	1815	237.885	155.42	157.00
5	<i>Nemipterus mesoprion</i>	50 - 313	3288	860.525	139.17	137.70
6	<i>Nemipterus japonicus</i>	68 - 323	2664	617.133	151.82	147.75
7	<i>Priacanthus hamrur</i>	104 - 348	1684	284.400	216.10	213.02
8	<i>Epinephelus diacanthus</i>	62 - 498	2162	597.850	220.75	247.20
9	<i>Loligo duvauceli</i>	33 - 315	3829	726.300	101.37	
10	<i>Sepia aculeata</i>	35 - 153	2342	535.291	90.61	
11	<i>Sepiella inermis</i> - Male	26 - 88	1960	265.101	49.91	
12	<i>Sepiella inermis</i> - Female	14 - 85	2269	291.029	49.79	
	<b>Total</b>		<b>30770</b>	<b>6660.538</b>		



There has been decline in the mean lengths of *J. macrorhynchus*, *J. vogleri* and *E. diacanthus*. For the other species the decline as well as increase has been minor.

*J. macrorhynchus*: A total of 2841 specimens were measured in the length range of 85-330 mm. The mainstay of the fishery was about 1+ to 2 year olds in the length range of 160-250 mm size. The estimated annual catch was 715 t which was slightly more than 607 t recorded in 2002 - 2003 period.

*J. vogleri*: A total of 3011 specimens in the length range of 70 -365 mm were recorded in the eleven month period. The estimated annual catch of the species is 805 t which is higher than 771t recorded during the same period last year. Fishery was mainly supported by 1.5 year to 2 year groups.

*O. cuvieri*: Recorded in the length range of 103 - 390 mm a total 2905 specimens were measured. The estimated annual catch of the species was 725 t which was slightly higher than 683 t estimated during the same period last year. Juvenile component was high in September to November period.

*J. sina*: Among the four sciaenids that are being covered at present, this species grows to smaller size. A total of 1815 specimens in the length range of 89 - 220 mm were measured. The estimated annual landing of this species was 238 t which was exactly the same recorded during the same period last year. The fishery was supported by zero to one year age fishes in the length range of 140-180 mm.

*N. japonicus*: A total of 2664 specimens measured in the length range of 60-323 mm. during the same period previous year the length range was 60-309 mm. The annual catch being 617 t as compared to 551 t during the same period last year. A large number of juveniles were recorded in January - March period.

*N. mesoprion*: The species was recorded in the length range of 50-313 mm and a total of 3288 specimens were measured. As compared to same period last year the maximum size of the species has shown an increase. The largest size recorded last year was 269 mm only. The annual estimated catch was 860 t which was also higher than that of last year by about 150 t. Juveniles were recorded in December - March period.

*P. hamrur*: A total of 1684 specimens were measured in the length range of 104-348 mm. Overall catch of this species was poor. No. measurements could be taken in July, Jan-February period. Fishery was supported by 1 and 2 year class individuals.

*E. diacanthus*: Recorded in the length range of 62-498 mm a total of 2162 specimens were measured during eleven month period. In October and November large numbers of big sized specimens of this fish was recorded. However, in most of the other months juveniles were more in the catch as compared to adults. The annual estimated catch was around 221 t which was slightly less as compared to 247 t recorded last year during the same period.

*L. duvauceli*: A total of 3829 specimens in the length range of 33 - 315 mm were recorded during the eleven month period. The estimated annual catch of this species was 726 t. The third quarter October - December recorded higher catch as compared to other months.

*S. aculeata*: During the two month period a total of 2342 specimens were measured in the length range of 35-153 mm. The estimated annual catch of this species was 535 t.

*S. inermis*: As sexual dimorphism is easily detected in the field itself the males and females of the species were separately measured. The length range of *S. inermis* (Male) was 26-88 mm and the estimated catch of this species was around 265 t. *S. inermis* (females): This was recorded in the length range of 14-85 mm and a total of 2269 specimens were measured. The annual estimated catch of this species was 291 t. In general the catch of females of *S. inermis* (in numbers) was more as compared to males.

#### **Mortality, stock and population parameters:**

The total mortality coefficient was estimated by length converted catch curve and the natural mortality coefficient by Pauly's method. The exploitation rate, total stock standing stock and MSY by standard methods available in literature. The details of the same has been presented in Table. Among the fishes the 'Z' was high for *J. sina* and *N. japonicus* and among cephalopods the 'Z' was very high for *S. aculeata* and *S. innermis* (female). For most of the species the MSY is less than the annual yield recorded. The natural mortality coefficient was more or less at the same level for all the species. For the shell fish *L. duvauceli*, *S. aculeata* and *S. inermis* application of Pauly's empirical formula is questionable as it is generally not used for invertebrates. However, using Cushing's formula the 'M' was coming very high for *S. aculeata*. The chief reason for that is the largest size recorded for this species is only 153 mm where as the L is estimated at 297 mm. The exploitation rate is also very high in case of *S. aculeata*, *J. sina*, and *N. japonicus*. In case of *N. mesoprion* and *L. duvauceli* also it is on the higher side.

#### **Stock estimation by Relative Yield/Recruit model and Yield-isopleth's diagram:**

*J. macrorhynchus*: Taking  $L_c/L$  of 0.56 and M/K ratio of 1.82 the E of this species was obtained at 0.89. The E of the species is 0.59. However, at E of 0.86 the biomass will be reduced to about 15% of the virgin. The yield isopleth diagram shows that optimum catch can be obtained at E of 0.5 at  $L_c/L$  value of 0.40. However, the present  $L_c/L$  value is relatively higher 0.56.

*J. vogleri*: Taking  $L_c/L$  value of 0.46 and M/K ratio of 1.79 the relative yield per recruit model gave E of 0.70 whereas the present E is 0.52. The yield isopleth diagram shows that the optimum yield could be obtained at E of 0.65 and  $L_c/L$  value of 0.5. The present  $L_c/L$  value is 0.46.

*O. cuvieri*: Using the  $L_c/L$  value of 0.47 and M/K ratio of 1.92 the relative yield per recruit model of Beverton & Holt (knife edge) gave  $E_{max}$  of 0.732 whereas the present E is 0.43. The selection Ogive gave optimum yield at E of 0.5 and  $L_c/L$  value of 0.40 whereas the present  $L_c/L$  value is 0.47.

*J. sina*: Taking the  $L_c/L$  value of 0.60 and M/K ratio of 1.71 the relative yield per recruit model of Beverton and Holt gave  $E_{max}$  of 0.91 whereas the present E is 0.58. the yield isopleth diagram shows that optimum yield could be obtained at E of 0.58 at  $L_c/L$  value of 0.5.

*N. japonicus*: The basic input parameters of  $L_c/L$  (0.344) and M/K (1.80) was employed to generate the relative yield per recruit model. It gave  $E_{max}$  of 0.56 whereas the present E is 0.71. For generating selection Ogive  $L$  and  $L_c/L$  values were fed. Optimum yield was obtained at E of 0.65 and  $L_c/L$  value of 0.50.

*N. mesoprion*: A  $L_c/L$  value of 0.45 and M/K ratio of 1.82 was employed to

generate relative yield per recruit model, this gave  $E_{max}$  at 0.69 whereas the present  $E$  is 0.61. Similarly the optimum yield using the yield isopleth diagram was obtained at  $E$  of 0.55 and  $L_c/L$  value of 0.45.

*P. hamrur*: For this species at  $L_c/L$  value of 0.53 and  $M/K$  ratio of 1.94 the  $E_{max}$  was obtained at 0.83 whereas the present  $E$  is a low of 0.52. The yield isopleth diagram indicated that optimum yield at  $E$  of 0.60 and  $L_c/L$  value of 0.45.

*E. diacanthus*: Using  $L_c/L$  value which is very low 0.27 and  $M/K$  ratio of 1.94 gave an  $E_{max}$  of 0.50 which is same as the present  $E$  of 0.51. The yield isopleth diagram gave optimum yield at  $E$  0.60 and  $L_c/L$  value of 0.45.

*L. duvauceli*: Using  $L_c/L$  value of 0.28 and  $M/K$  ratio of 2.38 the  $E_{max}$  was obtained at 0.35. The present  $E$  however, is 0.61. The yield isopleth diagram gives optimum yield at  $E$  of 0.65 and  $L_c/L$  value of 0.55.

*S. aculeata*: The relative yield per recruit was generated using  $L_c/L$  value of 0.32 and  $M/K$  of 1.94. The  $E_{max}$  was obtained at 0.35 the yield isopleth diagram shows that optimum yield can be obtained at  $E$  of 0.55 and  $L_c/L$  value of 0.58.

*S. innermis* (Male): Taking  $E$  of 0.65 and  $M/K$  ratio of 1.63 the  $E_{max}$  was obtained at 0.52. The optimum yield was obtained at  $L_c/L$  value of 0.58 and  $E$  of 0.57.

*S. innermis* (Female): Employing  $L_c/L$  values of 0.63 and  $M/K$  ratio of 1.57.  $E_{max}$  was obtained at 0.38. The yield isopleth diagram shows that optimum yield could be obtained at  $E$  of 0.50 at  $L_c/L$  value of 0.45

#### Some Important Observations:

- a) The monsoon ban of mechanized fishing was strictly followed.
- b) September/October 2003 recorded heavy catches of 'Koth' *Otolithoides bauritus*.
- c) Heavy catch of *E. diacanthus* and particularly bigger size 350-450 mm was recorded in October, 2003.
- d) *Sepioteuthis lessonianca* was recorded in the catch for the first time in Mumbai coast in October 2003. This species is the major squid in Palk Bay areas.
- e) A rare species of Priacanthus *Cockeolus boops* was recorded in the catch in December 2003.
- f) Large number of juveniles of both the species of threadfin breams *N. japonicus* & *N. mesoprion* were landed in January March 2004.

**Table: The input parameters for relative yield/recruit & yield isopleth diagram.**

Species	M	$L_{\infty}$	K	Lc	M/K
<i>J. macrorhynchus</i>	1.50	350	0.82	177	1.82
<i>J. vogleri</i>	1.47	378	0.82	164	1.79
<i>O. cuvieri</i>	1.21	410	0.63	175	1.92
<i>J. sina</i>	2.01	255	1.17	142	1.71
<i>N. japonicus</i>	1.53	360	0.85	121	1.80
<i>N. mesoprion</i>	1.64	320	0.90	141	1.82
<i>E. diacanthus</i>	1.14	525	0.64	138	1.78
<i>P. hamrur</i>	1.30	362	0.67	185	1.94
<i>L. duvauceli</i>	2.21	365	0.95	146	2.30
<i>S. aculeata</i>	1.52	298	0.78	138	1.94
<i>S. inermis (Male)</i>	2.61	98	1.10	79	2.37
<i>S. inermis (Female)</i>	2.84	102	1.8	82	1.57

**Table: The mortality, population and stock parameters of all the species.**

SPECIES	Z	M	F	E	U	Y	Y/U Total stock	Y/F Standing stock	MSY
<i>J. macrorhynchus</i>	3.72	1.50	2.22	0.59	0.57	715	1254.38	322.07	599.05
<i>J. vogleri</i>	3.09	1.47	1.62	0.52	0.49	805	1642.85	496.91	767.73
<i>O. cuvieri</i>	2.12	1.21	0.91	0.43	0.38	725	1907.89	796.70	844.50
<i>J. sina</i>	5.85	2.01	3.84	0.66	0.65	238	332.30	56.25	175.53
<i>N. japonicus</i>	5.30	1.53	3.77	0.71	0.71	617	869.01	163.66	433.70
<i>N. mesoprion</i>	4.17	1.64	2.53	0.61	0.60	860	1433.33	339.92	708.73
<i>P. hamrur</i>	2.70	1.30	1.40	0.52	0.48	597	466.66	160.00	402.50
<i>E. diacanthus</i>	2.32	1.14	1.18	0.51	0.46	284	617.39	240.67	279.18
<i>L. duvauceli</i>	4.21	1.63	2.58	0.61	0.60	727	1211.66	281.00	592.51
<i>S. aculeata</i>	9.33	1.52	7.81	0.84	0.84	536	638.85	68.62	320.15
<i>S. inermis- Male</i>	6.28	2.61	3.67	0.58	0.58	265	458.47	72.20	226.72
<i>S. inermis -Female</i>	10.13	2.84	7.29	0.72	0.71	291	410.00	40.00	202.30

**Title: Development of Ready- to-cook Fish Products from Under-utilized fish**

Dry ready-to-cook fish chunks from the low cost fish, Sciaenids were prepared using twin-screw extruder. Starches like corn flour, tapioca flour and wheat flour did not impart desired texture to the extrudate. Actually the extrudate had quite tough texture with little expansion and little water absorption capacity. In many cases the starch gelatinization was incomplete and raw starch came out in the soak water. Defatted soyabean flour imparted meaty texture to the extrudate with good expansion.

**Kolkata Centre**

**Title: Studies on the influence of different water, soil and organic matter parameters on chemo-toxicological effects of xenobiotics to fish**

Temperature had profound influence on the toxicity of deltamethrin, mercury and arsenic. It was observed that increase in ambient temperature significantly lowered the toxicity of these three xenobiotics to scale carp. pH of water had a great influence on the toxicity of lead, mercury and arsenic to common carp fry. Increase in pH value of water from pH 6.3 to 11.3, reduced the toxicity of lead but toxicity of arsenic and mercury decreased with increase of pH from 5.25 to 8.25 and then decreased as the pH increased from 8.3 - 11.3. With the increase of DOC level i.e. from 0 mg/L to 1.6 mg/L, acute toxicity of Pb to common carp was decreased significantly, probably due to complexation of Pb with dissolved organic matters facilitated metal (Pb) removal by sweeping organically bound metals into particulate phases via colloid aggregation. Ca had positive effect in reducing the toxicity of metallic xenobiotics (e.g. Cd, Pb and Hg) but had no effect in reducing the toxicity of non-metallic xenobiotics (e.g. Cypermethrin). The positive effect was more pronounced for Cd and Hg than Pb. Carbonate anion was able to reduce the toxicity of cadmium, lead and mercury significantly, but effect was more pronounced for lead than cadmium or mercury.

**Title: Integrated fish and prawn farming systems in rural areas of Sunderbans, W.B, to motivate local pisciculturists (Institute based)**

Farmers demonstration on paddy-fish-prawn culture demonstration held on February, 2004. 50 progressive pisciculturists attended during demonstration programme.

Two paddy plots of 6430 sq.meter were selected for demonstration programme. No fish and prawn was introduced in control field. Patnai variety of paddy was tried in each plot during first week of August,2003.

The seed and fertilizer application rate was 70 kg per ha and RCD @5000 kg per ha. Crop-Fish growth and yield parameters were recorded at regular

intervals. No pesticide was used during the experiment. Seven days preparation of paddy plot and pond, carp fingerlings of 4-5 cm and larvae of *M. rosenbergii* (PL20) were released in the paddy field and pond @5000nos. and 1600 nos. per hectare respectfully.

**Title: Seed production of *M. rosenbergii* in Rajasthan using sea water (Natural/Artificial) and inland saline groundwater and demonstration of successful technology to beneficiaries**

While the larvae of *M. rosenbergii* could be reared using seawater and artificial sea water, Larval rearing could not be completed in inland salinewater; calcium and potassium were identified as limiting factors in survival of *M. rosenbergii* in inland salinewater.

#### **Rohtak Centre**

**Title: Development and standardization of techniques of grow-out of finfishes and shellfishes and seed production of freshwater prawn and magur using inland underground saline water**

**Sub Project: Development of packages of grow-out practices of finfishes and shellfishes in low and higher saline underground water**

#### **Survival of Tiger shrimp (*Penaeus monodon*) in inland ground saline water**

The water quality of inland ground saline water of Lahli-Baniyani Fish Farm, Rohtak was analyzed at 16 ppt salinity and the levels of calcium and magnesium were found to be higher by 3.15 and 1.4 times higher in inland ground saline water with that of coastal seawater. However on the contrary, the level of potassium was assessed one tenth less than the coastal seawater. Accordingly, three test media were prepared following ionic amendments with calcium, magnesium and potassium and the survival of tiger shrimp was assessed along with two control sets of raw saline ground water and artificial seawater respectively in a triplicate set of 15 aquaria of size 2'x1'x1' having provision for continuous aeration. Each aquarium was plotted with 50 number of PL-20 of *P. monodon* in 20-litre water and reared for 35 days. Total mortality was observed within 8 hours in tiger shrimp plotted with raw ground saline water whereas, a survival of 44%, 42% 36% and 28% respectively was achieved in shrimps reared with artificial seawater; ground saline water; amended with calcium-magnesium-potassium, calcium-potassium and potassium only. The study indicated that the difference in the levels of potassium, calcium and magnesium in the raw inland ground saline water are responsible for early mortality of tiger shrimp and suitable amendments of these ions will help in raising tiger shrimps in inland ground saline water.

### **Polyculture in earthen pond**

The polyculture of freshwater giant prawn was also undertaken in an earthen pond of 0.15 ha along with the Indian Major Carps (Catla and Rohu). The post larvae were procured from Chennai and directly stocked in the pond on 3<sup>rd</sup> May 2003 @ stocking density 23,000/ha (3680 nos per pond). The 25 mm fry of Catla and Rohu each 750 in number (stocking density 18,750/ha) were stocked in this pond on 13.8.2003. The growth parameters recorded after 6 months of rearing for prawn indicated an average growth in length  $17.30 \pm 1.86$  cm and in weight  $61.80 \pm 25.78$  gm from a population of 130 prawns. The morphometric parameters of other parts have been recorded sex-wise and are to be analysed in due course of time. The water quality recorded for this pond ranged between temperature 18-31 °C, pH 8.0-8.4, salinity 4-5 ppt, alkalinity 240-280 mg/l, total hardness 1220-1320 mg/l. The pond has been partly harvested with prawn (20.0 kg numbering 257) without draining in the month of December and sold out. Since, it was difficult to drain out the pond due to severe cold climatic conditions; the left over prawns are being further cultured along with the IMC. The growth parameters indicated that if prawns are polycultured near a stocking density of 23,000/ha along with the Catla and Rohu could provide a better size and better price of prawns and the IMC could be reared for another 5-6 months in the same pond.

### **Monoculture of freshwater giant prawn in cement tank**

Two ponds were initially manured with cow dung @ 500 kg/ha and subsequently only with DAP on monthly basis @ 20.0 kg/ha. The 40 days old juveniles of prawns were stocked in these ponds at a stocking density of 33,333 (1500 nos.) in tank-I and 44,444/ha (2000 nos.) in tank-II on 17 July 2003. The prawns were fed on various graded commercial palletized (Waterbase brand) feeds (Starter-II, Grower-I and Grower-II) during the study period. The water quality of the pond was recorded as water temperature 18-30 °C, pH 7.9-8.4, salinity 4-5 ppt, D.O. 3-12 mg/l in tank-I and 1-13 mg/l in tank-II and alkalinity 232-285 mg/l, total hardness 1200-1300 mg/l. 20-30% of the pond water was changed with fresh tube well water once in a month. The tank-II maintained with a stocking density of 44,444 juveniles per hectare showed sudden mortality on the early morning of 3<sup>rd</sup> October 2003 i.e. 85 days of culture when the D.O. was dropped to 0.5 mg/l and the whole stock died. However, the other tank, which has been maintained with 33,333 juveniles per hectare, could be reared successfully up to 19<sup>th</sup> November 2003 and a total of 14.2 kg prawn numbering 452 was harvested (Av. length  $14.3 \pm 1.98$  cm and a weight  $38.0 \pm 12.97$  gm). Thus, a net production of 315.55 kg of prawn per hectare in 4 months was obtained from this pond. The experiment thus indicated that freshwater prawn could be cultured in cement tanks with low saline ground water without use of aerators and regular change of water with a net production of 315.55 kg/ha.

### **Grow-out experiments on Milkfish and Grey mullet**

The experiments on the above fishes could not be taken up during the period reported as the tube well of the high saline Baniyani Fish Farm was failed beyond repairs. These experiments can be undertaken only after the construction of a new tube well.

### **Sub-Project: Seed production of Asian catfish (Magur) in inland ecosystem**

Since brooders procured from the Ghazipur Fish Market, Delhi did not survive due to severe infection, they are now being raised in inland ground saline water of 4 ppt in an earthen pond of 0.02 ha area at the Lahli Fish Farm after procuring 1700 fry of magur from the CIFE Balabhadrapuram Fish Farm. The seed is fed with on-farm formulated semi-moistened feed @ 5% body weight containing 40% CP. During the period reported, the survival of fish has been seen in trial netting however, the growth parameters will be recorded after total draining of the pond. The study has indicated that magur brooder can be reared in ground saline water of 4-5 ppt salinity.

### **Sub-Project: Recycling of seepage water through sub-surface drainage system in the fishponds for semi-arid region**

**A.K. Verma (PI)**

One of the major problems for aquaculture in semi-arid and arid region is the high rate of percolation in the soil. This not only enhances the production cost but also impede pond management. The aim of the present study is to evaluate seepage rate in such ponds and to develop a suitable drainage system for cost-effective recharge of seeped water. A laboratory-based small drainage system was designed and after its successful operation a pond-based drainage system was designed and installed in an earthen pond of 10x20 m size. The drainage system comprised of 80 cm dia x 30 m length PVC perforated pipe enwrapped with a synthetic filter cloth and laid down in the centre of the pond inside a 1.25 m deep trench. The trench was provided a gradient of 0.2 percent towards outlet side to avoid accumulation of muck in the drainpipe. A vertical vent-pipe was fitted towards low gradient side so that air might not trap within the drainpipe. The out-let of the drainpipe was laid down up to the adjacent pond where a sump of size 1.5 x 1.5 x 2.0 m along with a trench of 18.0 x 1.5 x 1.75 m was constructed. An electric pipping set of 0.5 HP was installed near the sump for pumping the seepage water through sprinkle system back in a cement pond. When water was filled in the experimental pond, the seepage water started entering in the adjacent sump. The average rate of seepage in the experimental pond and the water collected in the collection sump was evaluated to be 30-35% in 60 days operation and the so collected water was easily recharge with a small pump which aided in recharge of nutrients and oxygenation of the water. The system was thus found successful and will help in water budgeting in ponds having higher seepage. Further experiments will be continued with a battery of ponds with emphasis on nutrient safety of the water.

## Kakinada Centre

### Title: Experiments on Eco-friendly culture practices in brackish water aquaculture

- i) Experiments on monoculture of *Penaeus monodon*
- ii) Experiments on polyculture of *Penaeus monodon* with *Chanos chanos*
- iii) Experiments on crop rotation with *Chanos chanos*

### Sub-Project : Experiments on mono culture of *P. monodon*

- Culture of *P. monodon* was conducted in 3 ponds of 0.2, 0.2 & 0.4 ha each.
- The ponds were treated with bleaching powder and fertilized with inorganic fertilizers to develop plankton population.
- The post larvae (PL 20) was tested for WSSV by use of PCR and virus free seed was procured and stocked in ponds after through acclimation.
- The stocking density of 50,000 PL/ha (5/m<sup>2</sup>) was adopted.
- Commercial “CP” feed was used and suitable feeding strategies were employed as per requirement.
- Samples of prawn were drawn at weekly intervals to monitor the growth, health and survival and accordingly feed ration was also manipulated.
- Water and plankton sample were collected at weekly intervals for TA, NO<sub>3</sub>, NO<sub>2</sub>, PO<sub>4</sub> and pH, D.O., were analyzed day twice a day. Plankton samples for quantitative analysis of phyto and zoo plankton, were done at weekly intervals.
- Bacteriological test for pathogenic bacteria (*Vibrio*) was tested at fortnightly intervals.
- No water exchange was done for first 75 days of culture and subsequently at fortnightly intervals 15-20% water exchange was adopted.
- Paddle wheel aerators were used from midnight till morning 0600 hrs.
- Effect of probiotics was studied to evaluate its performance. The commercially available two probiotics were tested.

**Production results** : After 120-130 days of culture the ponds were harvested and production details were analyzed for different parameters, however, gist of results is given below in table.

Cultured Species	Pond area in ha	DOC	Avg. L mm	Avg. Wt. gm	Sur. %	Prod. Kg	Prod/ha kg
P.monodon	(0.2)	121	153.3	31.48	65.91	207.25	1036.25
-do-	(0.2)	122	152.1	30.45	58.78	179	895
-do-	(0.4)	133	158	33.62	63.08	423.25	1058.125

### Sub-Project: Experiments on Polyculture of *P.monodon* with *Chanos chanos*

- Polyculture experiments were conducted in two ponds of 0.2 ha each by using *P. monodon* (PL 20) and *Chanos* (fingerlings).
- Pond preparation protocol adopted was same as monoculture.
- Stocking density of *P. monodon* was 5/m<sup>2</sup> and *C. chanos* was 0.2/m<sup>2</sup> (2000/ha) was followed.
- Commercial prawn feed of C.P. was used and no feed was applied for fish.
- Pond management practices adopted were similar as that of monoculture.
- No probiotic were applied and no subsequent fertilization was done.

**Production results:** After 120-130 days of culture of the ponds were harvested and production details were analyzed for different parameters, however, a gist of results is given below.

Cultured Species	Pond area in ha	DOC	Avg. L mm	Avg. Wt. gm	Sur. %	Prod. Kg	Prod/ha kg
<i>P.monodon</i> <i>Chanos</i>	(0.2)	107 124	147.85 300.6	29.20 216	85.95 68.75	250 59	1250 299
<i>P.monodon</i> <i>C.chanos</i>	(0.2)	100 113	152.44 316	28.57 228	78.93 81	225.5 37	1127.5 185

### Sub Title: Experiments on crop rotation with *Chanos chanos*

- Shrimp (*P. monodon*) harvested ponds (mono and poly culture) were selected and prawns were used for culture of milk fish, as crop rotational phenomenon.
- No fertilization was applied after ponds were filled with creek water.
- Milk fish fingerlings were stocked @ 1500 nos/ha.
- Fish were allowed to sustain on accumulated organic matter of the pond, bottom.
- After 30 days of culture fermented Rice bran was used. Supernatant liquid was sprayed over the pond surface.
- Application of fermented Rice bran was carried at @ monthly intervals.
- Ponds were harvested after 120-140 days of culture.

**Production results :** After 120-130 days of culture of the ponds were harvested and production details were analyzed for different parameters, however, against of results is given below in table I

Cultured Species	Pond area in ha	DOC	Avg. L mm	Avg. Wt. gm	Sur. %	Prod. Kg	Prod/ha kg
<i>Chanos</i>	(0.2)	130	250	123.75	70	29.13	145.65
<i>Chanos</i>	(0.2)	130	275	144	62	35.75	178.75
<i>Chanos</i>	(0.4)	132	299	200	70	111.8	279.5
<i>Chanos</i>	(0.2)	125	285	159	100	58.5	292.5
<i>Chanos</i>	(0.2)	130	290	170	62.5	42.23	211

### Important achievements

1. A successful crop of *P. monodon* was achieved in monoculture and polyculture system adopting eco-friendly farming method during the period June-Oct 2003. In the context of the disease outbreak of WSSV in and around Kakinada area. Where most of the farms lost the crop due to virus infection, the results obtained in the research projects assume special significance
2. Judicious use of probiotics, pond aerators, maintenance of good water quality. Monitoring of pathogenic bacterial load and monitoring of plankton density to avoid algal blooms and its crash are vital management parameters in eco-friendly culture systems.
3. No antibiotics were used during entire crop period.
4. Crop rotation with Fin fish, *Chanos chanos* in shrimp ponds increases chances of success of subsequent shrimp crop.
5. In poly culture system presence of milk fish has helped to keep the pond water quality free of pathogenic bacteria (*Vibrio*) and free of planktonic blooms and did not necessitate the use of probiotics.

### Powarkheda Centre

#### Project Title : Integrated fish/agro farming in Hoshangabad

##### Fish Farming

The rearing of Indian major carps initiated in culture tank SP6 (2.5 ha) from June 2001. Total about 17,000 fingerlings were stocked during June to September, 2001. Fish harvesting started from February, 2002. Fish production/harvest up to June 30, 2003. Nearly 4 tons of feed was given to the stock during the rearing period costing approx. Rs.20,000/-. The average growth of the fishes was more than 500 g/year despite very low feeding rate and not applying any manure/fertilizers. Thus satisfactory production was achieved in view of the low inputs applied for rearing the fishes.

##### Agro farming

Two agricultural crops i.e. Soybean (Kharif) and Wheat (Kharif) and Wheat (Rabi) were taken in about 2 acre area during this project period. Soybean production was 10.85 Qt. Sold for Rs.9735/- against product cost of Rs.5,340/- wheat production was 31.80 Qt. Worth Rs.20,991/- against a production cost of about Rs.10,500/-.

Thus the total revenue generated through this project was about Rs.1.06 lakh against a total expenditure of approx. Rs.36,000/- giving a net profit of Rs.70,000/-.

## Summary

Fish Production	:	2.3 tons
Value	:	Rs.76,000/-
Soyabean Production	:	10.85 Qt.
Value	:	Rs.9,735/-
Wheat Production	:	31.80 Qt.
Value	:	Rs.20,991/-
<b>Total Income</b>	:	<b>Rs.1.06 lakh</b>

## 4.2 External Funded Project

**Title: Laboratory and Field Culture of Edible Seaweeds along the Maharashtra Coast and Product Development for Health and Nutrition (Department of Ocean Development)**

Soup powder from *Ulva* was prepared using several ingredients and demonstrated at NAAS meeting on Seaweed Research in India.

- Axenic culture technique protocol for *Ulva* had been established by using ASP-12 media and the germination of the spores.
- Protoplasts from Dahanu samples (*U. lobata*) had been produced and tested for regeneration.
- Cultures of *Ulva lobata*, *U. propenguinensis* established under laboratory conditions and field trials are being held at Kakinada center and Udaipur (in-land saline conditions).

## DNA Analysis

DNA from *Ulva* species was isolated by using the three protocols out of which two protocols yielded good quality DNA (CTAB method and Wattier *et al.* method) whereas DNA isolated by protocol III were of negligible quantity. CTAB method has given DNA with smear. DNA isolated from both of the methods were used for the PCR amplification. Success of amplification product was 100 % by protocol I (Wittier *et al.* method) and 80 % with protocol II (CTAB method). The pigmentation percentage was found to be minimum by protocol I (10%) and maximum by protocol III (88 %).



*Ulva*



The DNA samples of each species of *Ulva* were selected randomly from the total number of sample (20) for primer screening. Total of 4 primers, two 10- mer and two 20 mer plant universal primers were tested for amplification in 4 sp. of *Ulva* viz. *U. lactuca*, *U. fasciata*, *U. lobata*, *U. reticulata*. Of these two 10 mer primers yielded strong amplification product whereas the remaining two did not generate amplification product. Therefore only these two

primers were selected for the present investigation. These two primers generated total 43 bands. Out of which 23 bands were monomorphic (53%) and remaining 16 bands were polymorphic (47%). The size of amplified product generated by two primers ranged from 300 bp to 2500 bp.

**Title: In-service training programme in molecular Biology (DBT, New Delhi)**

Three persons were trained and worked on a) Identification of specific DNA probe for diagnosis of common microsporadial parasite of shrimp *P. stylifera* b) Genetic characterization of *H. fossilis* (singi), c) RAPD analysis of East and West coast population of *P. merguensis*. A training manual for course curriculum was also prepared

**Title: Wound Healing, Antineoplastic and Antioxidant Compounds from two marine crinotoxic fishes (CGP/NATP, New Delhi)**

Crude mucus extracts of *Arius dussumieri* and *Osteogobius militaris* had an edematogenic activity of 160% and 125% respectively. Partially purified extract mucus of *O. militaris* had two edematogenic factors, one in unadsorbed (U1) and another in adsorbed (F2) fractions. Blocking of edematogenic activity with three drugs, Avil, Dolonex and Atropine had different effects.

**Title: Predictive modelling of Bombay duck landings off north-west coast of India (Department of Ocean Development, New Delhi)**

Bombay duck, *Harpodon nehereus* is important fishery resource along the northwest coast of India. Its fishery ranks third only to Indian oil sardine and ribbon fishes in terms of total landings of the country. Annual landings of Bombay duck for the period 1961 to 2001 for north-west coast of India were collected and are being subjected to ARIMA modeling. Collection of data on size composition of Bombay duck landings from New Ferry Warf landing center in Greater Mumbai district, Arnala landing center in Thane district and Jaffarabad in Gujarat is in progress.

**Title: Integrated Aquaculture for Sustainable Resource Management in Bio-villages (Department of Biotechnology, New Delhi)**

Two villages Mahim and Masavan have been selected as study area. Meetings were held in the selected villages with the villagers. Base line survey has been carried out. The work of hatchery shed for giant fresh water prawn has started. In addition to this, group formation activities have also started. Steps have been taken to install the fish feed meal unit under the beneficiary selection procedure, meeting with ladies groups was carried out, for Ornamental Fish and Horticulture component along with collection & analysis of soil and water sample from Masvan Village. PRA maps showing various resources for Mahim and Masavan village have been prepared with the help of villagers. Formation of marketing & agriculture group at Mahim Village to collect information about various markets regarding the possible produce in the project is being done. In the project village, renovation of ponds, dewatering programme for the fresh water village pond, gate construction for renovated pond etc. have been undertaken.

**Title: National Risk Assessment programme for fish and fish products in domestic and international markets (AP Cess Fund, ICAR, New Delhi)**

Six samples of *P. monodon* collected from Ferry Warf landing centre Mumbai were analyzed. All the sample had contamination of faecal *E. coli* and Streptococci. However none was positive for salmonella and *V. cholera*. *V. parahaemolyticus* and clostridium was also nil in all the marine sample. 4 fresh water samples of *Macrobrachium rosenbergii* were collected from Palghar (Wada) of Maharashtra state. All the samples showed faecal contamination of *E. coli* and Streptococci and only one sample showed the Contamination of Clostridium. Further study is in progress.

**Title: Application of probiotics in fish nutrition. (AP Cess Fund, ICAR, New Delhi)**

The experimental fishes were collected from different resources and acclimatized in the laboratory. Fishes were fed with laboratory prepared feed having 30% protein. The entire fish gut was taken out aseptically; its weight was taken and plated onto sterile Nutrient Agar (for taking the Total Plate Count) and MRS Agar (for taking the Total Lactic Acid Bacteria Count). The plates were kept for incubation at  $30 \pm 2^\circ \text{C}$  for 48 hours and the number of colony forming units counted for Total Plate Count and Total Lactic Acid Bacteria Count. The MRS Agar containing Lactic Acid Bacteria were then overlaid with soft Tryptone Soy Agar containing a pathogenic *Pseudomonas* sp strain at concentration of  $10^5$  cfu/ml and left for incubation at  $30^\circ \text{C}$  for overnight. The Lactic Acid Bacteria, which produced a clear inhibitory zone with a diameter more than 1mm larger macro colony was judged to be a tentative probiotic strain. The tentative probiotic strain was further confirmed against multiple pathogens (three in this case *Pseudomonas* sp, *Aeromonas* sp & *Edwardsiella* sp) by antagonistic assay by cross streak method. The four tentative probiotic strains (SM1, SM2, ST1, and ST2) identified by agar overlay technique were further confirmed for its antagonistic properties by antagonistic assay by cross-streak method using three pathogenic strains. Among the four tentative probiotic strains, only two (SM2 and ST1) showed some degree of antagonism to the three pathogenic strains and confirmed their status as probiotic strains. The two producer strains SM2 and ST1 (i.e. the two confirmed probiotic strains) exhibited an inhibition of 2 mm and 1 mm respectively, against the three pathogenic test strains.

**Title: Fish production using brackishwater in arid ecosystem (NATP)**

*Mugil cephalus* and *Macrobrachium rosenbergii* were cultured in inland salinewater of 8-11 ppt at Bharatpur, Rajasthan. Under mixed culture, *M.cephalus* attained an average weight of  $209.8 \pm 278.6$  g and *M.rosenbergii* attained an average weight of 85.58 g during 198 days culture period. Total harvest was 711 Kg from a pond of 0.25 ha including 671 kg of *M.cephalus* and 40 kg. of *M.rosenbergii*. Under monoculture system at Bharatpur *Chanos chanos*, attained an average weight of  $247.6 \pm 41.259$  g during culture period of 4 months. Total production was 324.8 Kg from a pond of 0.25 ha. Growth of *C.chanos* was found poor at higher salinities of 50-60 ppt. At Rohat (Distt. Pali), Rajasthan, *C.chanos* grew to 150 g after a culture period of 287 days.

**Title: Impact assessment of water pollution by heavy metals on commercially important fishes of freshwater ecosystem of Rohtak (Haryana) (ICAR ad-hoc Research- Department of Biosciences, M.D. University)**

Total 20 different village ponds in and around Rohtak were selected and monthly sampling of soil and water was done to study physico-chemical characteristics and levels of copper and zinc. An attempt was also made to assess the acute toxicity of copper and zinc to the fry of Indian Major Carps (Catla and Rohu). The LC<sub>50</sub> values of copper and zinc in fry of Catla were .25 mg/l and 0.60 mg/l and in Rohu it was 0.50 mg/l and 0.85 mg/l respectively.

Developing aquaculture in degraded inland areas in India and Australia A bilateral research project to be jointly operated by the Australian Centre for International Agricultural Research (ACIAR), Australia and the Indian Council of Agricultural Research, India at this centre. The project has been approved on technical merits by the ACIAR (Funding Agency) and has been vetted by the DARE for execution of work and work will be started soon.

Prepared and submitted a proposal for the establishment of a Freshwater Prawn Hatchery with a capacity to produce 1.0 million seed at the centre under the ICAR project on Seed production of agricultural crops and fisheries. The hatchery constructed under the project will generate revenue for the centre.

### 4.3 Other Research Activities (at Rohtak Centre)

#### Breeding of Ornamental Fishes

##### Blue Gorami

The breeding trials on Blue Gorami (*Trichogaster trichopterus*) were undertaken at the centre during the reporting period. Though the Blue gorami grows successfully in the low ground saline water (4-5 ppt) and attained maturity but it did not spawn in the saline water. However, when the brooders were transferred in freshwater, they started courtship and spawn naturally in aquaria. The eggs hatch out within 23-25 hours and 500-900 hatchlings were recorded from female fish of size 95-112 mm. The hatchlings were grown successfully on artemia nauplii. The study indicated that the ground saline water of 5 ppt salinity could be used for raising broodstock of blue gorami, but its transfer in freshwater is essential for spawning.

##### Black Molly

Six pair of gravid black mollies of both the sexes in 1:1 ratio (5 black and 1 albino) of size 6-8 cm in case of female and 3-5 cm in case of male were plotted in a FRP tank of 1.0 tonne capacity. The tank was filled up with low saline water having water quality; temperature between 25-30 ° C, salinity 5 ppt, pH between 7.9-8.0, total hardness 1280-1320 mg/l, total alkalinity 191-231 mg/l, DO between 5.0-8.2 mg/l, sodium 1030 mg/l, and potassium 6.7 mg/l. The female started delivering the offspring's in batches and a total of 213 fry were obtained within 60 days time. The first maturity in F<sub>1</sub> generation was seen after 60 days and within 70-90 das age they gave birth to F<sub>2</sub> offspring's. The study indicated that inland ground saline water of low salinity could be suitably used for the commercial production of black mollies without any additional input.

**Culture of other ornamental fishes**

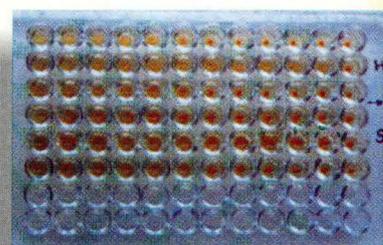
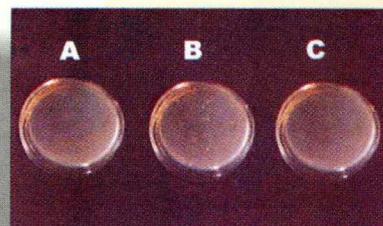
The inland ground water of 4-5 ppt has also been found suitable for the culture of guppy (*Poecilia reticulata*), sword tail (*Xiphophorus heeleri*), platy (*Xiphophorus maculatus*), gold fish including Shubanku strain (*Carassius auratus*), tiger barb (*Barbus tetrazona*), Siamese fighter fish (*Betta splendens*), widow tetra (*Gymnocorymbus* sps.), rosy barb (*Barbus conchoniuis*), angels (*Pterophyllum scalaris*) and koi carp (*Cyprinus carpio*) at the centre's farm. The broodstock of all the above species is being grown in low saline water to observe growth, maturity and possibility of seed production will be evaluated in the coming days.

#### 4.4. Students Research Programmes

##### Ph. D

#### SOME IMMUNOBIOLOGICAL ASPECTS OF THE SPINY LOBSTER *PANULIRUS HOMARUS* (LINNAEUS, 1758) BINDHU VERGHESE

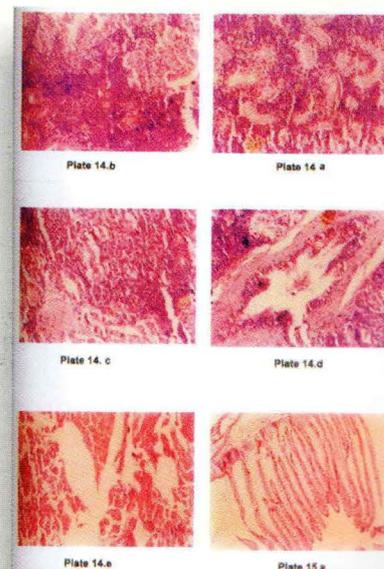
Study on the defence mechanisms in *Panulirus homarus* showed three cell types in the haemolymph: hyaline cells, semi granular cells and large granular cells. The haemocytes, produced from the haematopoietic tissue located in the epigastric region, are lobular with a size range of 30-875  $\mu\text{m}$ . The immune status of healthy lobsters showed that the total haemocyte count was  $8.7 \pm 3.8 \times 10^6 \text{ cell ml}^{-1}$  and the phenoloxidase activity  $30.61 \pm 5.6 \text{ IU mg protein}^{-1}$ . Studies on physiological stress like moulting and eyestalk ablation showed variation in the immune parameters ( $P < 0.05$ ). Upon starvation the THC and PO activity was found to decrease drastically. Environmental stress factors showed significant effect on the immune system of *P. homarus*. Live transportation of lobsters by dry method was found to suppress the PO activity but no change was seen in THC. Injection studies with bacteria showed the lowest peak during 30 minutes incubation for THC whereas it showed highest peak for PO activity for the same incubation time. Both THC and PO levels returned to normal after 24 hours. Farm made artificial feed supplemented with chitosan was found to enhance the activity of the immune system. Satisfactory result for immune enhancement was not observed with commercial immunostimulant supplement.



#### BIOCHEMICAL RESPONSES OF *CHANNA PUNCTATUS* TO ENDOSULFAN AND ITS IMPLICATION IN ENVIRONMENTAL MONITORING

KAMAL SARMA

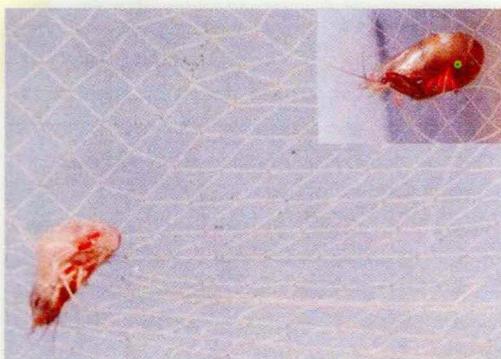
96 hours  $\text{LC}_{50}$  for Endosulfan was 0.0243 ppm. Short term sublethal toxicity test using  $1/3 \text{ LC}_{50}$  revealed that glycogen, vitamin C, total lipids, triglyceride and free fatty acid, unsaturated fatty acids and lymphocyte count were significantly ( $p < 0.05$ ) reduced whereas cortical, glucose, WBC, NBT, granulocyte and monocyte concentrations increased. However, haemoglobin, RBC, total phospholipid and cholesterol level showed an increase after an initial reduction. The mineral concentrations in the liver and gill tissues showed a decrease whereas in kidneys, the concentrations were found to be increased. Histological alterations were very prominent in liver, kidney, gill and brain tissue. In enzymatic studies, the activities of AChE and ATPase in brain, and that of AST, AL T, A TP, ALP and ACP in gill tissues were inhibited with an increase in duration of exposure. In liver tissue, the activities of G6PDH, FDPase, AST, AL T, ATP and ACP were elevated whereas MDH and G6Pase activities showed a reduction. Activity of G6Pase in kidney tissue was inhibited however FDPase activity was elevated in fishes exposed to pesticide. The activities of AChE and A TP in muscle tissues also decreased, while AST and AL T activities were found to increase. LDH activity in gill and muscle tissue showed a decrease after an initial elevation, whereas in liver it showed almost a similar trend as that of control. In long term toxicity test all the enzymatic activities were inhibited at 90 days of exposure



and Na<sup>+</sup> K<sup>+</sup>-ATPase activity was inhibited throughout the exposure period. This reduction in the activity of the enzyme indicates that Na<sup>+</sup> K<sup>+</sup>-ATPase can be used as an important biomarker for organochlorine pesticide studies. The ameliorating effect of high protein and high vitamin C in the diets of fishes exposed to pesticide was evident from the enzymatic studies, lipid profile of different organs, haemoglobin, RBC, WBC and NBT analysis. In growth studies, fishes fed with normal diet showed a negative growth, whereas those fed with high protein and high vitamin C showed growth almost similar to that of control. Residual study of the fish muscle also showed significant ( $p < 0.05$ ) reduction of pesticide burden in fishes fed with high protein and high protein with high vitamin C in comparison to normal diet.

### STUDIES ON SHRIMP HARVESTING TECHNIQUES IN AQUACULTURE PUTHRA, PRAVIN

Six seasonal and six perennial farms located at Vypeen Island (Ernakulam District, Kerala) were selected for the study. Different harvesting techniques deployed for harvesting shrimps in the traditional shrimp farms, both seasonal and perennial, were studied in detail with respect to design, construction details and methods of operation. Sluice nets are the principal gear system operated in both the seasonal and perennial farms. Harvesting using other gears such as gill net, cast net and hand picking are done periodically and also during the final harvest. The Intensity of operation of different gears and details on the production of shrimp from these fishing techniques have been worked out separately for seasonal and perennial farms. The species composition, length statistics, sex ratio and total weight of different species of shrimps landed in the different harvesting systems have been discussed. The catching efficiency of gill nets and cast nets, and selectivity of gill nets have also been studied. Major factors influencing the efficiency of shrimp harvest from traditional shrimp farms, such as lunar phases, tide, flow rate of water and intensity of light at sluice gates, have been investigated in detail. Economic aspects of seasonal and perennial farms with special emphasis on the harvesting issues have been analysed.



### CRYOPRESERVATION AND ULTRASTRUCTURE OF THE SPERMATOZOA OF *TOR KHUDREE* AND *TOR PUTITORA* RAVINDRAGOUDA PATIL

The present study was undertaken to develop a cryopreservation protocol for the spermatozoa of two species of mahseer viz., *Tor khudree* and *T. putitora* and to study the ensuing ultrastructural and physiological changes. The concentration of spermatozoa and the spermatocrit values were  $3.88 \pm 0.14 \times 10^7$  spermatozoa / ml and 66.89:1.40% for *T. khudree* and  $3.92 \pm 0.16 \times 10^7$  and 69.22:1.88 % for *T. putitora* respectively. The optimum number of spermatozoa required to fertilize a single egg was found to be 103 for both the species. Among the six extenders tested, BWW extender without egg yolk was found to be the most suitable extender. 9%DMSO+11%glycerol, an equilibration time of 30 minutes and freezing with a height of 5 cm above LN2 surface gave higher hatching percentages in both the species. The biochemical analyses of fresh seminal plasma revealed that the concentration of K<sup>+</sup> was higher when compared to the other elements in both the fish species. The concentrations of total reducing sugars and the total proteins were

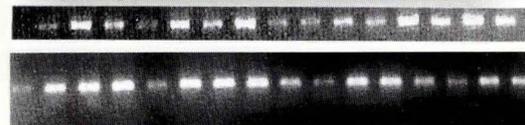
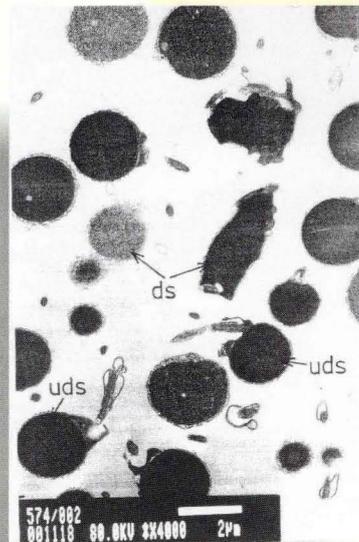
significantly higher in *T. putitora* than those for *T. khudree*. During the ultrastructural studies using SEM, the diameter of head of spermatozoa in *T. khudree* was smaller when compared to that of *T. putitora* but the tail was longer than that of *T. putitora*. The TEM studies of fresh spermatozoa of both the species revealed a spherical head, no prominent mid-piece and an elongated tail. The cross section of the tail revealed the typical arrangement of nine pair of peripheral doublets and a central pair. The freeze-thaw damages to the spermatozoa included, loosening of chromatin in the nucleus, disruption of the cytoplasmic membrane of the head, mid-piece and tail. The NBT test indicated a definite loss in the structural and functional integrity of the enzymes of the mitochondrial complex in cryopreserved spermatozoa.

## FISH GENETICS AND BIOTECHNOLOGY

### PHYLOGENETIC ANALYSIS OF INDIAN SEAHORSE *Hippocampus kuda* BLEEKER, USING mtDNA CYTOCHROME b GENE SEQUENCES

BINOD KUMAR CHOUDHARY

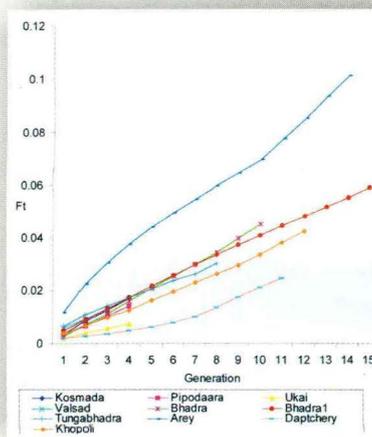
The seahorse *Hippocampus kuda* generally inhabits shallow waters and lives on coral reefs, sea grass and mangroves. A species of great importance for Traditional Chinese Medicine (TCM), it has been rated by IUCN as an endangered and threatened to be extinct. For the first time, the cytochrome b gene sequence of mtDNA of this seahorse was analyzed to evaluate the genetic relationship within and between two populations (Ratnagiri and Tuticorin) of Indian *H. kuda*. In addition, we also extended our study to trace their phylogenetic relationship with *H. kuda* population inhabited in different parts of world. There was no common haplotype between both Tuticorin and Ratnagiri samples. However, one Sri Lankan and one Pakistan samples shared a common haplotype with Tuticorin and Ratnagiri samples, respectively. NJ tree constructed using cytochrome b sequence of different species of Syngnathidae revealed 3 lineages among *H. kuda*, one consists of Tuticorin, Sri Lanka and Indopacific, other lineage consists of Ratnagiri and Pakistan, and the third lineage consists of samples from other Asian region.



### PREDICTION OF CUMULATIVE INBREEDING RATE IN FUTURE GENERATIONS OF HATCHERY REARED INDIAN MAJOR CARPS

DEEPAK, P.K.

State owned hatcheries, which mainly breed catla, rohu and mrigal and are the main suppliers of fish seed to the farmers of India, do not consider the genetic aspects for brood stock management and this has resulted in stocks being isolated and genetically closed. In genetically isolated stocks with small effective population size



inbreeding accumulates at a faster rate. Effective population size, cumulative inbreeding rates were estimated and predictive models for cumulative inbreeding rates were developed for catla, mrigal and rohu. The cumulative inbreeding rate ranged from 0.42 to 1.63, 3.18 to 5.91 and 0.73 to 1.71 per cent for catla, mrigal and rohu, respectively in Gujarat and it ranged from 2.69 to 13.75, 8.63 to 15.21 and 3.02 to 5.88 per cent for the above three species in Karnataka in that order. Cumulative inbreeding rate in Maharashtra hatcheries ranged from 7.81 to 39.34, 5.84 to 14.09 and 2.46 to 10.20 per cent for catla, mrigal and rohu, respectively.

#### ESTIMATION OF CERTAIN GENETIC PARAMETERS OF GOLDEN MAHSEER, *TOR PUTITORA* (HAM.)

JEENA, N. S.

Estimation of genetic parameters of Golden mahseer, *Tor putitora* (Ham.), was done



utilizing the data from 12 families produced in a nested breeding model and reared for 17 weeks. The average performance of the progeny from each genetic group for growth characters at different time intervals was studied and compared with the performance of natural population. There was significant difference between the two, and natural population was performing better. It was found that the female F2 was performing significantly better than other females and the genetic group M4XF2 was superior in growth compared to other families. The average performances of the families were ranging from 21.11 mm :t 0.21 to 23.05mm :t 0.18 for length and 154.55 mg :t 3.82 to 167.33mg :t 0.93 for weight at 17 weeks. The heritability for length from the sire component ranged from 0.06 :t 0.06 to 0.33 :t 0.20 from week 1 to week 17 and from dam component ranged from 0.57 :t 0.42 to 1.31 :t 0.71 at 1 and 7 weeks respectively. The maternal effects were found to be reducing after 9 weeks. Heritability for weight from sire components ranged from 0.14 :t 0.17 to 0.17 :t 0.24. Heritabilities from dam components were between 0.89 :t 0.63 to 0.70 :t 0.57 respectively from 11 to 17 weeks. The estimates of heritability for length were found to be higher than that for weight. The genetic

correlations between the traits ranged from 1.14 to 1.00 from 11 weeks to 17 weeks, indicating a strong relationship. The phenotypic correlations from 11 to 17 weeks were between 0.48 :t 0.06 to 0.25 :t 0.09.

#### GENETIC CHARACTERISATION OF *Heteropneustes fossilis* (BLOCH, 1797) POPULATIONS OF INDIA AND EVALUATION OF *H. fossilis* AND *Clarias gariepinus* DNA SEQUENCES AS FINGERPRINTING PROBES

NEETU SHAHI

Genetic characterization of *H. fossilis* populations from five different geographical locations, Andhra Pradesh, Assam, Bihar, Chhatisgarh and Maharashtra, has been carried out using morphometric and biochemical parameters. Total of samples from all the population were analyzed for twelve morphometric parameters. The Bihar

population was found to be significantly different from other populations on the basis of several morphometric traits. Since the muscle tissue of *tossilis* is rich in iron, which is an important economic trait, the iron content was imated in 10 samples of each population. Assam population was significantly erent from other populations and had considerably high iron content, the average ng 51 g/gm.

In an earlier study in the lab, species-specific bands were identified using lisatellite associated sequence amplification (MASA). The 1391 bp band from *C. iepinus* and 2472 bp band from *H. tossilis* were cloned in pTZ57R/T vector and clones called pHf25 and pCg13 were sequenced. Two probes were generated n pHf25 and two from pCg13 and evaluated for their ability to generate DNA lrint patterns when Southern hybridized with digested genomic DNA of three ihwater catfishes. Only the 800 bp probe generated from pCg13 a band profile le the others yielded only smears.

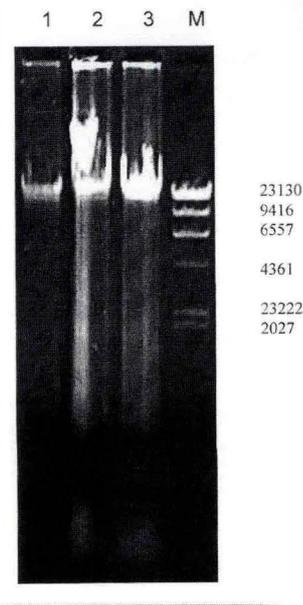
Thus, it can be concluded from this study that genetic variation exists Neen different geographical populations of *H. tossilis* and that the 800 bp luence can perhaps be used as an RFLP probe to study genetic variation in .hwater catfishes at the molecular level.



### STUDIES ON GENE FRAGMENT ENCODING MOLT INHIBITING HORMONE IN GIANT FRESH WATER PRAWN, *MACROBRACHIUM ROSENBERGII*(DE MAN)

VIDYA BALAGOPAL

Characterization and studies on polymorphism of MIH encoding gene will be an important primary step towards understanding and modulating growth pattern and growth rate of *Macrobrachium rosenbergii*. The specimens were collected from Gujarat, Andhra Pradesh, Maharashtra and Orissa. Primers were designed based on the published sequence of SGP A (MIH) cDNA for a 157 bp region of open reading frame. The 157 bp region of SGP A was amplified by PCR and sequenced. The complete sequence of the 157 bp region was determined for two samples by sequencing them with both forward and reverse primers. This revealed the partial gene sequence of the MIH gene and the sequenced portion encodes for 52 amino acids of the total 119 amino acid residue peptide hormone. Partial sequence of -100 bp was obtained for four more samples. From the analysis of the sequence data generated, it was seen that the gene fragment showed polymorphism at nucleotide and amino acid level.



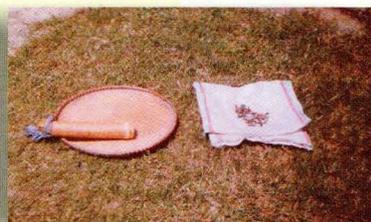
### FISHERIES RESOURCE MANAGEMENT

#### INDIGENOUS TECHNICAL KNOWLEDGE RELATED TO FISHERIES AND AQUACULTURE IN THE HILLS ZONE OF ASSAM

BHAGABAN KALIT, A.

Most of the inhabitants of the Hills Zone of Assam survive on indigenous knowledge base. A total of 70 fishers' households of Hills Zone of Assam

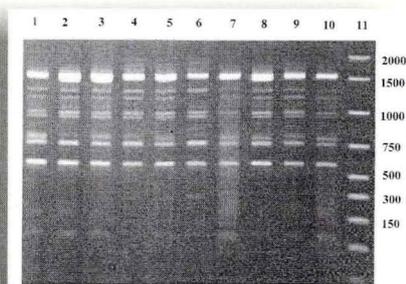




were interviewed through a pre-tested interview schedule and unique indigenous knowledge related to fisheries viz. fish harvesting (fishing with indigenous gear, community fishing, light fishing, fishing with attractants and plant piscicides), indigenous sinkers/floats, preservation of fishing net, fish processing, fish preservation and also fish as human medicine were documented. Regarding aquaculture, ITK related to pond construction/maintenance, natural fish seed collection, fish seed transportation, supplementary feeding, integrated farming (Duck-cum-fish culture, pig-cum-fish culture, integration with cattle, and poultry-cum-fish culture) and fish health management were documented.

### RANDOM AMPLIFIED POLYMORPHIC DNA-POLYMERASE CHAIN REACTION ANALYSIS FOR DELINEATING POPULATIONS OF *TENUALOSA ILISHA* (HAMILTON, 1822)

BIBEK SHARMA



Random Amplification of Polymorphic DNA (RAPD) analysis was utilized for investigating genetic variation in samples of Hilsa shad (*Tenualosa ilisha*) collected from rivers of Hooghly and Padma respectively. Six decamer primers were screened initially, of which three were selected and used in final analysis of ten individuals from each of the two locations. The three decamer primers amplified a total of 28 DNA fragments ranging in the size from 260 to 1700 basepairs. The overall genetic similarity within populations was found to be relatively high.

### BIOACTIVITIES OF EXTRACTS FROM MARINE SPONGE *Halichondria panicea* (Johnston 1842)

JITENDRA SONI

The crude protein content was found to be 1.12 mg/ml in case of methanolic extract and 1.20 mg/ml in case of aqueous extract. Crude methanolic extract was found to be lethal while aqueous extract was found to be non lethal, when injected intraperitoneally to 20±2 g Kasauli strain male albino mice.



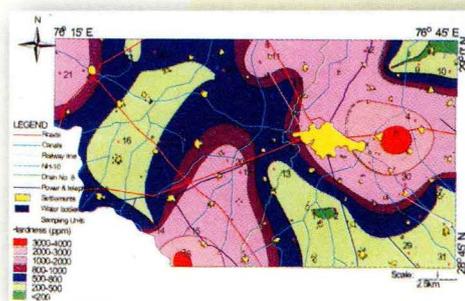
The toxin affected the central nervous, cardiovascular and urinary systems. Histopathological study revealed hemolysis of erythrocytes in blood vessels, occasional necrosis and formation of edema fluid in kidney, lungs and liver. The methanolic extract was found to increase the activity of Mg<sup>++</sup> ATP-ase at 1000 µl. Hemolytic activity of the crude toxin on chicken erythrocytes, was 14.28 HT/mg and 13.33 HT/mg in case of methanolic extract and aqueous extract respectively. The crude toxin showed the marginal analgesic activity, which was found to be higher in methanolic extract as compared to aqueous extract. The

Fatty acid profile showed the dominance of Myristic acid (14.67%) in case of methanolic extract and Palmitic acid (45.56%) in case of aqueous extract.

## MAPPING OF SALT-AFFECTED AND WATERLOGGED AREAS FOR AQUACULTURE IN ROHTAK (HARYANA) USING REMOTE SENSING AND GIS

KUMARNAIK, A. S.

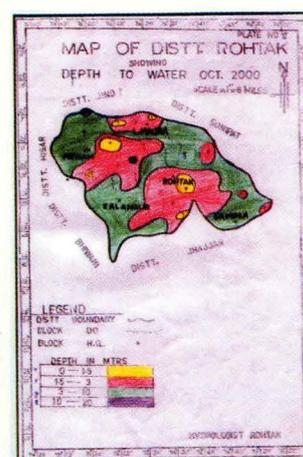
The Indo-gangetic plain of arid and semi-arid region is subjected to serious problems of waterlogging and subsequent salinization/alkalization. IRS-10 LISS-III FCC (1:250000 scale) imagery of Rohtak (Haryana) falling under SOI toposheet No. 530/5 and 530/9 acquired during May 2002 was analysed synergistically. Vertically samples of soil from three different depths i.e. 1-15 cm, 30-45 cm and 45-60 cm were collected and analysed for mapping of salt-affected and waterlogged areas for development of aquaculture on an ARC/INFO GIS software system (version 7.1). Of the 1,24,029 ha area mapped, the resources were categorized as salt-affected barren lands (18,884.3 ha), waterlogged and salt affected areas (19,277.8 ha), fully waterlogged area (9,614.3 ha) and normal areas (76,253 ha), while 576 ha were identified as water bodies. The physico-chemical parameters of soil showed great variations between the layers. The layer A of depth 1 to 15 cm showed considerably higher values for E<sub>c</sub>, SAR, sodium and lesser level of pH and clay content when compared to other two layers of depth. The layer C (45 - 60 cm depth) showed relatively optimum values of parameters for aquaculture. E<sub>c</sub> and SAR values were found to be comparatively less in layer C than layer A. The organic carbon, phosphate and available nitrogen were generally low in all the layers and in all the units when compared with that of the other inland areas. The water quality parameters also showed higher values with average pH, EC, SAR, salinity, alkalinity, hardness and sodium when compared to that of the other unaffected inland areas. Assessment of the potential areas for aquaculture yielded as excellent (4%), very good (33.8%), good (52.2%) and poor (8%) of the study area. IRS 10 LISS III spatial imagery of 23.5 m resolution and of 1:250000 scales could give clear demarcation of the land use pattern.



## PRODUCTIVITY OF PONDS AND PROSPECTS OF AQUACULTURE IN SALT-AFFECTED AND WATERLOGGED AREAS OF ROHTAK (HARYANA)

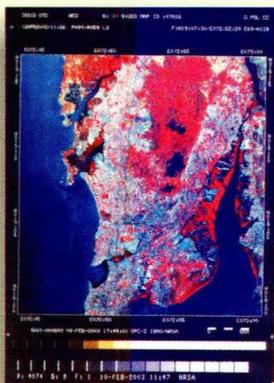
M. JAIRAJ

Low levels of organic carbon, available phosphorus, available nitrogen and high pH were typical of the ponds in salt-affected and waterlogged areas of Rohtak District. In soil, clay content ranged from 7.2 to 55.2%; organic carbon from 0.08 to 0.67%; Olsen's phosphorus (as P<sub>2</sub>O<sub>5</sub>) from 0.1 to 0.38 mg/100g soil; available nitrogen from 5.58 to 12.88 mg/100g soil; available potassium (as K<sub>2</sub>O) from 13.2 to 35.6 mg/100g soil; pH 7.78 to 9.33; and EC 0.29 to 1.68 dS/cm. In water, pH ranged from 7.6 to 8.9; secchi disc depth from 13 to 60 cm. SAR of water ranged from 1.53 to 15.8. Primary productivity ranged from 37.5 to 403.0 mg C/m<sup>3</sup>/h and was significantly correlated with Olsen's phosphorus, dissolved potassium and alkalinity. Poor plankton development was noted in most of the ponds. Organic carbon, soil pH and clay content though not significantly correlated with primary productivity, wielded a great influence on it by influencing the availability of nutrients.



## A STUDY ON SHORELINE CHANGES OF MUMBAI COAST USING REMOTE SENSING AND GIS

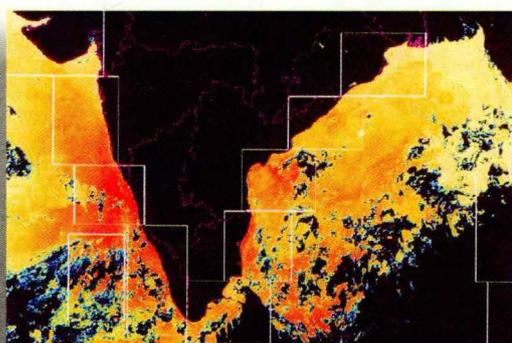
NAV RAJAN TIRKEY



Indian remote sensing satellite images (IRS 10 LISS III) of 2002 of Mumbai shoreline along with Survey of India (SOI) toposheet (47 A/16) (1966-67) was compared to detect the shoreline changes along Mumbai coast. This comparison was made by using GRAM++ GIS software. The total areas of accretion and erosion recorded were approximately 26 km<sup>2</sup> and 1.1 km<sup>2</sup> respectively on the time scale of 36 years. The accretion was detected at many places while erosion was found comparatively insignificant. Some areas like Malad-Manori creek has shown high accretion while erosion was observed only at few locations such as Versova and Madh. The reason for the changes in the shoreline is of anthropogenic nature, like reclamation, human settlement, etc.

## VALIDATION OF POTENTIAL FISHING ZONES FORECAST OFF MUMBAI, NORTHWEST COAST OF INDIA

RAVEESHA, K. P.



Experimental trawling operations were carried out to validate the potential fishing zone (PFZ) advisories disseminated by Indian National Center for Ocean Information Services (INCOIS), Hyderabad. Fish catch per unit effort of PFZ were compared with data available with the Department of Fisheries, Government of Maharashtra during November 2002 to January 2003. The CPUE (50 kg/h) obtained from PFZ was two to three times higher compared to CPUE of (17 kg/h) recorded by the Department of Fisheries. Further, an attempt was made to correlate the abundance of fishery with measured *in situ* hydrographic parameters and NOAA, AVHRR and IPS-P4, OCM satellite derived data. The CPUE and occurrence of some species viz., *Coilia dussumieri*, *Harpadon nehereus* and ribbon fish were found to have significant relationship with the water temperature and pigment concentration. The results suggest that remotely sensed data can provide useful clues for locating areas of demersal fish aggregation.

## BIOLOGY, GROWTH AND POPULATION STUDIES OF *PARAPANAEOPSIS STYLIFERA* (H. MILNE EDWARDS, 1857) FROM MUMBAI WATERS

SANATAN SHREAY



Based on 7 months data collected for *Parapanaeopsis stylifera*, the morphometry, food and feeding, reproductive biology, growth, mortality, Exploitation rate and MSY were estimated. The morphometric characters showed mostly a good correlation among themselves. Length weight relationship shows a good degree of correlation for both males and females. Findings on food and feeding suggest that females were better fed than males.  $L_0$  and  $K$  calculated by ELEFAN for male

and female were 115 mm and 2.15 year<sup>-1</sup> and 139 mm & 2.28 year<sup>-1</sup>. Length converted catch curve of Pauly gave the Total mortality coefficient (Z) for male and female as 11.82 and 7.64 respectively. The exploitation ratio and rates for male and female *P. stylifera* were 0.54 & 0.53 and 0.49 & 0.48. The estimate yield of males during even month's period was 230 t and that of female was around 315 t.

## ORNAMENTAL FISH BIODIVERSITY OF CENTRAL BRAHMAPUTRA VALLEY ZONE OF ASSAM

SANJAY SARMA

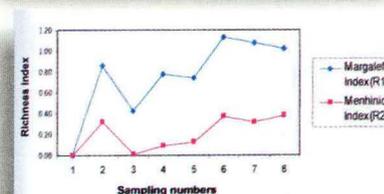
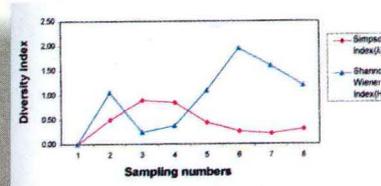
Many of the fish species of Assam have potential value as ornamental fishes since they possess attractive colouration and unusual shapes. The study area Central Brahmaputra Valley Zone of Assam comprising Nagaon and Morigaon Districts is centrally located and, therefore, is representative of the whole Brahmaputra valley. A total of 61 potential ornamental fish species had been identified belonging 22 families and 42 genera in the study area in which many of fish species having International demand. Family Cyprinidae and Genus *Puntius* contributed the highest number of fishes. It may be risky to export these species based on the natural collection alone. Efforts should be made for captive breeding and larval rearing of these species for augmenting their trade as ornamental fishes. The soil and water quality were congenial for optimal growth and survival of fishes.



## BIODIVERSITY OF DECAPOD CRUSTACEANS OFF MUMBAI COAST

SHAHNAWAZ ALI

Margalef richness index for decapod crustaceans off Mumbai coast was 0.86. The average values of Shannon-Wiener index (H') and Simpson index (A) were 1.07 and 0.49, respectively. The evenness was measured using a variety of evenness indices. The average values of E1, E2, E3, E4 and E5 were 0.54, 0.46, 0.37, 0.79 and 0.61, respectively. The diversity was found to be poor in the area while evenness indices show dominance of some of the species over others. Hill diversity numbers further confirmed this fact. Continuous monitoring of physico-chemical parameters and heavy metal estimations in the sediment of the area indicated a disturbed condition of the environment. This was further strengthened by the relation of H' with pollution. Low H' value (1.07) confirmed moderate pollution as well as a disturbed environment.



## EFFECT OF SOME ENVIRONMENTAL FACTORS ON THE TOXICITY OF ARSENIC AND MERCURY TO CYPRINUS CARPIO COMMUNIS (L.)

SHYAMAL CHANDRA SUKLA DAS

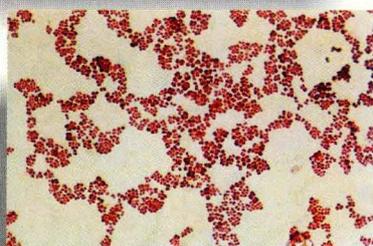
Lower room temperature reduced the toxicity of As and Hg to common carp fry (av. length: 3.9 ± 0.5 cm and av. weight: 0.9 ± 0.20g). Least toxic effect of arsenic and mercury was seen at slightly alkaline pH (8.25). Toxicity increased when water pH moved up or down from this pH value. Contamination time (ageing) was inversely correlated with the acute toxicity of arsenic and



mercury to common carp fry (i.e. higher the contact time lower the toxic effect and vice versa). This effect was more pronounced in case of mercury than arsenic. As the concentration of dissolved organic matter increased, the acute toxicity of mercury decreased. The toxicity of arsenic decreased with increasing level of phosphorous up to 0.25 mg/l of phosphate then again toxicity increased. High increase in toxicity of arsenic was observed above 5 mg/l of phosphate. Arsenic was present in most of the wastewater samples collected from sewage channels of Kolkata (0.1 mg/l to 0.3 mg/l). But in the culture ponds of sewage-fed fisheries of Kolkata, concentrations were below 0.1 mg/l. Mercury concentrations in the water of entry point and culture area of sewage-fed fisheries were also within the maximum permissible level for open water. Hg and As concentrations in the soil and fish flesh samples from the cultural area of sewage-fed fisheries of Kolkata were also well below the maximum permissible limits.

### EFFICACY OF BIOREMEDIATION PRODUCT IN CONTROLLING FISH AND PRAWN PROCESS PLANT WASTEWATER

YUGANDHAR KAMIREDDY



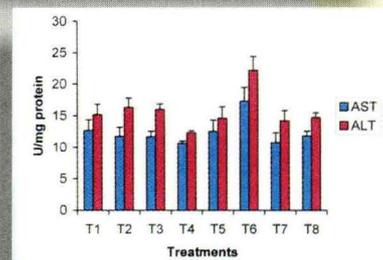
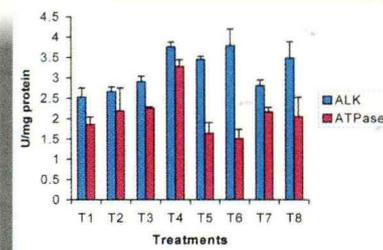
Wastewater from seafood processing plants affects the environment. It is necessary to use 10 liters of potable water for processing 1 kg of fish or shrimp. Almost all the water used in the fish processing plants becomes waste. The effect of the commercial probiotic "Biogreen" in treating the wastewater was studied. Treatment with probiotic and aeration reduced COD,  $\text{NH}_3$ ,  $\text{PO}_4\text{-P}$ , and increasing DO, pH, and nitrate. There was significant difference in reducing harmful effects of water quality parameters ( $p < 0.05$ ). Bioassay indicated the largest zone of inhibition was noticed on *Lactobacillus* (3.0 cm) followed by *Enterobacter* and *Klebsiella* (2.8 cm) and the lowest inhibition on *Shewanella putrefaciens* (0.8 cm). Total plate count was significantly higher in control tub ( $96 \times 10^4$  cfu/ml or  $98 \times 10^4$  cfu/ml) and the least was on treatment with probiotic and aeration. SSB did not show any change when treated with probiotic and 1 log reduction of SSB was noticed when treated with probiotic without aeration. *Pseudomonas*, *E.coli*, coliforms and faecal streptococci showed gradual reduction when treated with probiotic.

## FISH NUTRITION AND BIOCHEMISTRY

### EFFECT OF DIETARY MICROBIAL PHYTASE SUPPLEMENTATION ON GROWTH AND BODY COMPOSITION OF *PANGASIU PANGASIU* FINGERLING

DIPESH DEBNATH

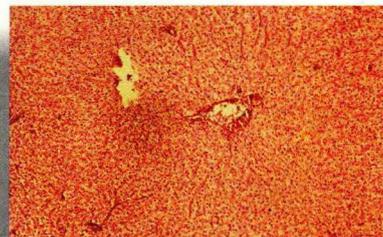
Eight isoproteinaceous (35.67%) and isocaloric (3.87 kcal/g) diets were prepared by partially replacing animal protein with plant-based proteins and supplemented with phytase at the levels of 0 (T 1), 150 (T 2), 250 (T 3), 350 (T 4), 500 (T 5), 1000 (T 6), 2000 (T 7) FTU kg<sup>-1</sup>, or 0.75% tricalcium phosphate (T 8). Three hundred and sixty fingerlings of *P. pangasius* (av. wt: 1.99 - 2.13 g) were distributed randomly into 24 experimental units that were divided into 8 distinct treatments with three replicates each. Statistically significant ( $P < 0.01$ ) responses were observed in weight gain, specific growth rate, feed conversion ratio, feed efficiency ratio, protein efficiency ratio, energy retention value, dry matter digestibility, apparent protein digestibility in phytase-supplemented groups as compared to unsupplemented groups (T 1 and T 8). A supplementation of 500 FTU phytase per kg diet would be sufficient to give better results in *Pangasius pangasius* culture.



### BIOCHEMICAL AND IMMUNOLOGICAL RESPONSES OF *CATLA* *CATLA* FINGERLINGS TO DIFFERENT DIETARY LIPIDS

PRIYA, K.

Ninety fingerlings (av. wt. 16 g) were randomly distributed into six distinct treatment groups with 3 replications each. Six isonitrogenous (Crude Protein: 40.00 - 41.90%) and isocaloric (426 kcal/ 100g) semi-purified diets were prepared which contained soyabean oil, cod liver oil or a combination of both to maintain 8% lipid except in the control diet, which lacked lipids. The diets were Control, T 1 (8% soyabean oil), T 2 (6% soyabean oil and 2% cod liver oil), T 3 (4% soyabean oil and 4% cod liver oil), T 4 (2% soyabean oil and 6% cod liver oil) and T 5 (8% cod liver oil). Though, higher weight gain, specific growth rate, feed efficiency ratio and protein efficiency ratio were noted in T 4 group, it did not vary significantly from T 2 and T 3 groups. The percentage of linolenic acid (n-3 fatty acid) was significantly higher ( $P < 0.05$ ) in the muscle of fish from T 4 and T 3 groups followed by T 2 group, which suggests the possibility of quality enrichment of fish flesh by dietary lipid incorporation. Intestinal lipase activity, Glucose-6-phosphate dehydrogenase (G6PDH) activity and Aspartate amino transferase (AST) activity in the liver and muscle of the treatment groups varied significantly ( $P < 0.05$ ) from the control group. Hepatosomatic index also differed significantly. The immunomodulatory effects of dietary lipids were studied using Nitroblue Tetrazolium (NBT) assay in which the respiratory burst activity of the phagocytes were higher in T 1 followed by T 2 group which varied significantly ( $P < 0.05$ ) from the other groups. Plasma globulin values also differed significantly ( $P < 0.05$ ) among the treatment groups. Albumin-globulin ratio (A/G) was lower in T 2 group, which indicates the presence of higher percentage of globulins in the plasma. Histopathological studies of liver showed normal hepatocytes in T 1 and



T 2 groups whereas inclusion of cod liver oil above 2% showed pathological signs in hepatocytes. It is suggested that inclusion of soyabean oil and cod liver oil in the diet at levels of 6% and 2% respectively would yield better growth, quality and immune responses in *Catla catla* fingerlings and would be cost effective.

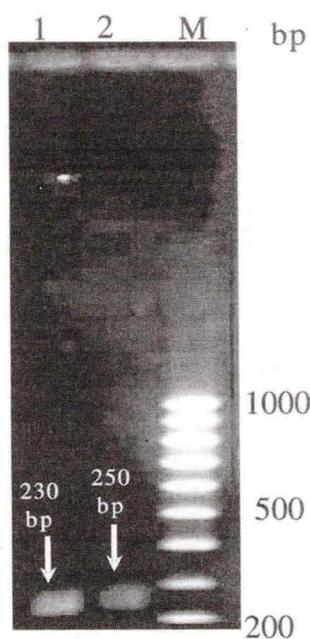
### STUDIES ON DNA FRAGMENTS OF GROWTH HORMONE GENE CONTAINING MICROSATELLITE IN ASIAN SEABASS, *LATES CALCARIFER* FROM INDIA

Raj Naresh Gopal

Growth hormone (GH) is a 22-KD single chain polypeptide, which plays significant role in normal somatic growth, osmoregulation and other metabolic functions in fish. By using specific primers four bands were amplified by PCR out of which two DNA fragments namely SGMS1 (233 bp) and SGMS2 (239 bp) of Sea bass genome from Indian water. The above-targeted DNA bands were eluted from gel, cloned into *E. coli* DH5a, characterized by Restriction Endonuclease analysis and sequenced using automated sequencer. On BLAST searching and multiple sequence alignment of the above DNA fragments with *Lates calcarifer* (GenBank U16816), SGMS1

showed 97% and SGMS2 93.3 % sequence homology with promoter region of GH gene containing microsatellite of Australian Sea bass and 94.6% homology was observed between both the fragments. Through critical sequence analysis surprisingly, we have found (CA)<sub>2</sub> extra repeats in sequence of SGMS1 and (CA)<sub>5</sub> extra repeats in SGMS2 comparison to (CA)<sub>14</sub> repeats reported for the Asian sea bass in GenBank. Further on sequence comparison, very interesting single nucleotide mismatches at several positions of both DNA fragments of GH gene containing microsatellite were found. These variations in nucleotide sequences of SGMS1 and SGMS2 of GH gene containing microsatellite may be due to substitution/insertion of bases leading to mutation. These alterations may be due to mutation at nucleotide sequence caused by environmental or habitat changes of Sea bass of Indian and Australian origin. On blasting the sequence of SGMS1 & SGMS2 with gene databases partial homology with *Seriola quinqueradiata* (26.9%, 12.9%); Flounder (15.8%, 12.9%); *Tilapia nilotica* (23%, 7.9%); *Oreochromis mossambicus* (23%, 7.9%) and only (8.2%, 7.5%) homology with Zebrafish was observed. These observations indicate the high degree of sequence homology in GH encoding genes of Osteichthys class. Significant findings on single nucleotide substitution and

variation in the number of dinucleotide (CA) microsatellite repeats in SGMS1 and SGMS2 DNA fragments of Sea bass GH gene may be useful as genetic markers for applications in the identification of broodstocks with desirable commercial traits, such as high growth rate breeding, conservation, systematics and management of wild fish stocks.



## STUDIES ON DEVELOPMENT OF SPECIES-SPECIFIC DNA MARKER FOR *TOR KHUDREE* BASED ON MICROSATELLITE AND RAPD PCR

SMITHA, P.

Microsatellite and Randomly Amplified Polymorphic DNA (RAPD) based PCR techniques were used to identify species-specific markers of Deccan mahseer, *Tor khudree*. A total of three microsatellite primers and ten decamer primers were used. Out of three microsatellite primers, two yielded species-specific DNA markers in *Tor khudree*. With these selected microsatellite primers, two species-specific markers were observed in *Torkhudree*, which were 290 bp with MS1 and 170 bp with MS2. Six diagnostic markers were observed in *Tor khudree*. Species-specific DNA marker bands of size 980 bp and 1125 bp with OPC-02, 700 bp and 1141 bp with OPC-07, 440 bp with OPC-08 and 1270 bp with OPC-09 were observed. Out of these species-specific DNA fragments obtained by both microsatellite and RAPD based PCR, 170 bp with MS2, 290 bp with MS1, 440 bp with OPC-08 and 700 bp with OPC-07 were eluted, reamplified with the original primers, ligated into linear vector pTZ57Rff (2.88Kb) and transformed into *E. coli* DH5a cells in presence of ampicillin and produced a very good transformation with an efficiency of  $1 \times 10^5$  transformants  $\mu$ g plasmid. The r-plasmids pTK170 (insert of 170 bp with MS2) and pTK440 (insert of 440 with OPC-08) on restriction enzyme analysis with BamH11 XbaI could produce the desired size of the inserts. The recombinant plasmid pTK290 (insert of 290 bp with MS1) and pTK700 (insert of 700 bp with OPC-07) on restriction enzyme analysis with EcoRI converted the covalently closed circular plasmid into linear plasmid with the insert intact. These specific DNA fragments could be used as species-specific diagnostic markers for the molecular identification of *Tor khudree* after labeling and DNA: DNA hybridization.

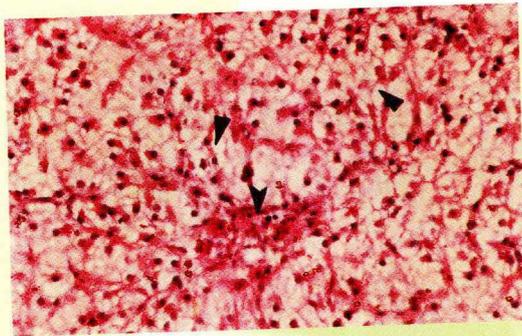


## EFFECT OF DIFFERENT SOURCES AND LEVELS OF GELATINIZED CARBOHYDRATE ON NUTRIENT UTILIZATION IN *CATLA CATLA* FINGERLINGS

SONA YENGGOKPAM

Effects of different sources and levels of gelatinized carbohydrate on nutrient utilization in *Calla calla* fingerlings were studied. One hundred fingerlings of *Calla calla* (average weight of 15.2 g) were distributed in six different treatment groups, having 3 replicates each. Thus, six isocaloric (4.15 Kcal/g) semi-purified diets were prepared with different sources of carbohydrates at different levels of gelatinized carbohydrates (GC) and crude proteins (CP) viz., R40 (Rice source: 40% GC, 35% CP), R50 (Rice source: 50% GC, 25% CP), C40 (Corn source: 40% GC, 35% CP), C50 (Corn source: 50% GC, 25% CP), T40 (Tapioca source: 40% GC, 35% CP), T50 (Tapioca source: 50% GC, 25% CP). Carbohydrate gelatinization was higher for corn (94.34 :t 1.29) and tapioca (96.52 :t 0.41) than rice (85.19 :t 1.41) under similar cooking condition. The dry matter (85.58 :t 0.29), carbohydrate (85.63 :t 0.40), protein (92.42 :t 0.31) and lipid (96.86 :t 0.29) digestibility was highest in T40. However, higher weight gain% (91.95 :t 4.33), SGR (1.09 :t 0.04) and PER (1.52 :t 0.07) were noted in the C50 group, which indicates better utilization of nutrients

from corn. But, 40% gelatinized tapioca have better feed conversion capacity compared to corn and rice fed groups. Lipid deposition, glycogen content, HSI, amylase activity and glucose-6-phosphate dehydrogenase activity were significantly ( $P < 0.01$ ) higher in those groups fed with 50% GC for all the carbohydrate sources. With the increase level of GC in the diet, hypertrophy and vacuolation of the hepatic cells increased. However, maximum hypertrophy of the hepatic cells was noticed in tapioca fed group (50% GC) with extensive vacuolation in the cytoplasm. The protein sparing effect was pronounced in corn (40 & 50% GC) and tapioca (40% GC) fed groups. The order of carbohydrate utilization in *Calla calla* fingerlings were corn 50% > corn 40% > tapioca 40%. Rice utilization was poor in the diet of fingerlings. There was no affect on the survivability due to feeding of different source and levels of GC.

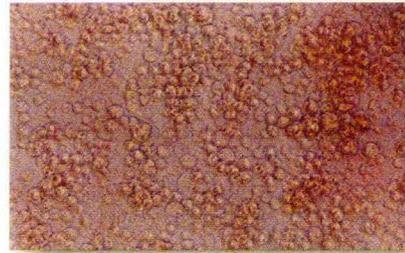


## FISH PATHOLOGY & MICROBIOLOGY

### ADAPTABILITY OF WHITE SPOT SYNDROME VIRUS (WSSV) TO ARTHROPOD AND FISH CELL LINES

BABY SUJA, A.

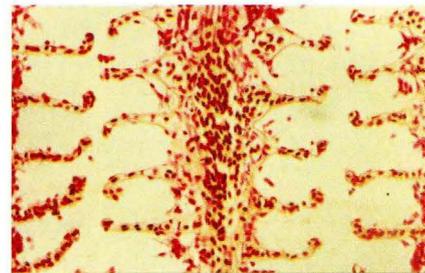
The adaptability of WSSV was tested in two established cell lines i.e., RTG-2 (rainbow trout gonad) and C6-36 (cloned cell line of *Aedes aegypti*). The crude inoculum and purified virus were inoculated to confluent fish and insect monolayers that were maintained in 24 well plates and were observed for the presence of cytopathic effect (CPE). There was no evidence of CPE even after 96 hours of inoculation. A second passage, which was conducted by inoculating the culture medium taken from the first passage cell lines to fresh cell lines, did not show any CPE 3 days post inoculation. TEM and LAT showed no presence of the virus. But immunoblot test gave a slight positive reaction. Immunofluorescence showed only diffuse non-specific reaction.



### HEMATOBIOCHEMICAL AND HISTOPATHOLOGICAL STUDIES IN LASEO ROHITA (HAM.) INFECTED WITH AEROMONAS HYDROPHILA BY IMMERSION CHALLENGE

MANOJ C. K.

The hematobiochemical and histopathological changes in rohu, *Labeo rohita*, experimentally infected with *Aeromonas hydrophila* via immersion challenge were investigated. The experimental fishes were descaled close to the operculum (approximately 1 cm<sup>2</sup>) and the bacterial culture (10<sup>8</sup> cfu/ml) was smeared. The infected fishes exhibited a decrease in the total erythrocyte count and the hemoglobin level but an increase in the total leucocyte counts. The enzyme activities of alkaline phosphatase, aspartate aminotransferase and alanine aminotransferase were the highest on the third day post infection. There was marked black pigmentation at the descaled area accompanied with dermal edema and muscular degeneration. Focal hemorrhages and necrosis were visible in liver. Kidney exhibited necrotic changes of hemopoietic tissue, glomeruli and the renal tubules. There was marked pigment accumulation throughout the head kidney and spleen. Hyperplasia of the cells of the gill lamellae was detectable resulting in filling up of the interlamellar space. Mucosal epithelium of intestine was damaged. Myocardium revealed mild degenerative changes. The hematobiochemical and histopathological findings portray the impaired health status of the fish due to immersion challenge. It should be noted that, the occurrence of this potent bacteria at higher concentrations are competent to predispose the fish to secondary invaders leading to serious disease outbreaks.



### CHARACTERIZATION OF MICROSPORIDIAN INFECTING SHRIMP

PRAKASHA B.K.

A six months survey to examine the microsporean infection in feral shrimp revealed that only *Parapenaopsis stylifera* was infected with a microsporean, *Perezia* sp. Other species examined (*Metapenaeus brevicomis*, *Metapenaeus affinis*, and *Solenocera* sp.) did not reveal any infection. Transmission studies were also carried out using different species of shrimp (*Penaeus monodon* and *P. indicus*) and a

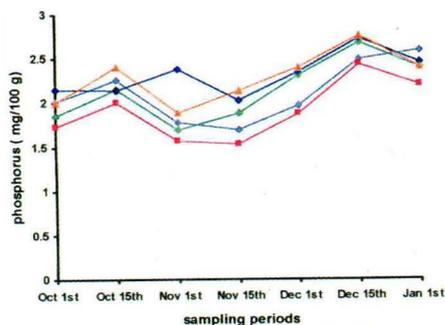


species of freshwater prawn (*Macrobrachium rosenbergii*). However, microsporidian infection could not be transmitted experimentally. The prevalence of the microsporidian, *Perezia* infecting *P. stylifera* was found to be very low (1.76%). The spores (1.4-2.8  $\mu\text{m}$  x 0.9-1.9  $\mu\text{m}$ ) were found only in the skeletal musculature and the infected shrimp appeared milky white in colour. The histological sections revealed extensive lesions that appeared more homogeneous and muscle fibers found to be completely replaced by spores. The Gram's and H&E stained spores at higher magnification often showed a darkly reddish coloured circular body at the one end. Prussian blue stained histological sections showed bluish tinge near the necrotized area of muscle, due to growth of spores. SEM of the spore showed that the spores were of smooth surfaced and elliptical in shape. TEM of the spore showed the most striking features of the spore such as the outer regions of polaroplast that appeared as a globular sac composed of compact membranes enclosing the inner polaroplast which in turn surround the straight part of the polar tube. The spore also possessed the isofilar polar tube, which was arranged in a tight cluster of two layers of coils. Each showed a dense core and several layers within a double membrane sleeve. The number of coils ranged from 8 to 10. The spore protein profile study revealed that 3 bands 28 kD, 24 kD, and 14 kD were of spore origin. The exospore protein profile study revealed that 3 major bands 149 kD, 52 kD, and 46 kD out of four bands were of exospore protein specific to microsporidian.

### NITROGENASE ACTIVITY IN NORTH MUMBAICOASTALWATERS

SREELU, N. S.

Biological nitrogen-fixation is one of the most important processes in nitrogen cycle in aquatic environments. In the present study, an attempt has been made to assess the nitrogen-fixing bacterial population of Mumbai coast, its enumeration, identification, effect of physico-chemical parameters of water and soil on the distribution of nitrogen-fixing bacteria and nitrogen-fixing capacity of nitrogen-fixing bacteria. Four species of nitrogen-fixing bacteria (*Azotobacter chroococcum*, *Azotobacter vine/andii*, *Azotobacter beijerinckii*, and *Azotobacter armeniacus*) could be identified from water and soil of Mumbai coast. Higher number of nitrogen-fixing bacterial populations could be observed in coastal soil than in coastal water. A positive correlation was observed between dissolved organic matter and nitrogen-fixing bacterial populations of water. A



positive correlation was observed between available phosphorus and nitrogen-fixing bacteria of soil. Nitrogen-fixing capacity of *Azotobacter chroococcum* was found to be 1.076 n mol  $\text{C}_2\text{H}_4$ /l/day and that of, *Azotobacter vinelandii* was 0.965 n mol  $\text{C}_2\text{H}_4$ /l/day. Station 1 showed higher level of nitrogenase activity in comparison to other four stations.

## FISH POST-HARVEST TECHNOLOGY

### COMPOSITION AND PROPERTIES OF *ENTEROBACTERIACEAE* IN FISH WITH EMPHASIS ON TOTAL COLIFORMS AND *E. COLI*

A.SURENDRARAJ

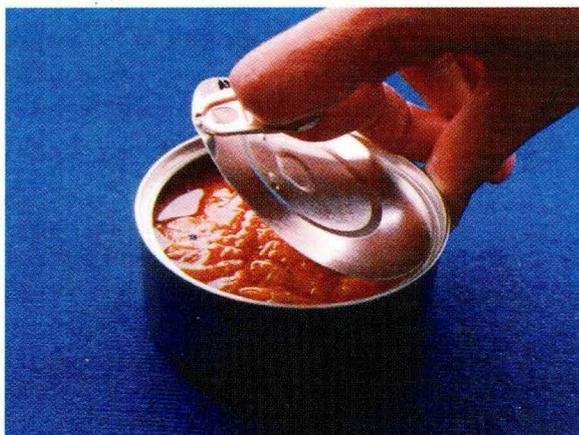
Relatively higher values of TPC (5.5 to 8.5 log cfu/g), *Enterobacteriaceae* (2.5 to 6.5-log cfu/g), Coliforms (2 to 6 log cfu/g), *E. coli* (2 to 5.5 log cfu/g), and faecal streptococci (2 to 5 log cfu/g) than the earlier reports show that the sanitary and hygienic practices of Cochin city fish markets have not improved in recent years. Due to high microbial count none of the samples were in acceptable limit for consumption as per Indian Standards specifications for fresh fishes. *Enterobacteriaceae* as percentage of TPC (0.74-84.9%) showed a wide variation among the different markets. Direct plating on selective media for total coliforms (VRBLA) and *E. coli* (T 7) was able to recover a count of 1 to 3 log cycles in excess of MPN method. *Enterobacteriaceae* composition in fish samples showed that *Enterobacter*, *Escherichia*, *Edwardsiella*, and *Citrobacter* were dominant groups among the market samples with different percentage contributions. Elevated coliform study shows that these are thermo tolerant coliforms. These *E. coli* were resistant to novobiocin, tetracyclin, bacitracin, and rifampicin and are sensitive to neomycin and trimethoprim. Among the *Enterobacteriaceae* isolates only a few *Citrobacter*, *Edwardsiella* and *Providencia* were able to decarboxylate histidine at room temperature and at 37°C. Temperature of incubation had a profound effect on lactose fermentation, BGLB, EC and Indole reactions. Other *Enterobacteriaceae* members and oxidase positive *Aeromonas* were found to interfere in total coliform and faecal coliform test.



### SUITABILITY OF POLYMER COATED TIN FREE STEEL CANS FOR CANNING ROHU (*Labeo rohita*) IN CURRY MEDIUM

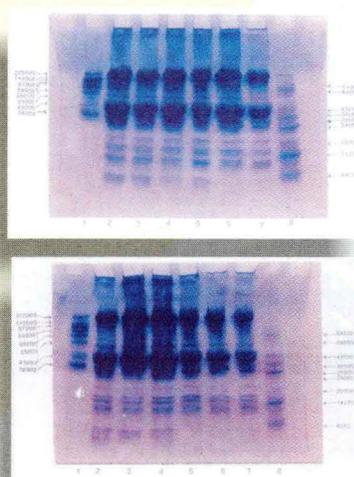
ARUNA KUMAR MALLICK

Curry of rohu (*Labeo rohita*) was prepared in north Indian style, packed in Tin Free Steel (TFS) cans in 60:40 ratio (curry:fish) and thermal processed in an over pressure retort. Physical tests of the can showed that TFS cans can be used for canning fish products. Fo value of the product was 8.79 when thermal processed at 121°C for 48.94 min. and cook value meant to achieve. tenderness of product was 102 min. The processed product was found to be commercially sterile. The product was acceptable after 4 months of storage at ambient and 37°C with regard to all sensory attributes. Texture attributes such as hardness, chewiness, springiness and cohesiveness did not show marked variation in values in samples stored at ambient temperature and at 37 °C. There was no significant change in chemical parameters studied during storage period.



## CHARACTERISTICS OF MYOFIBRILLAR PROTEIN CONCENTRATE FROM *CYPRINUS CARPIO* AND *LASEO CALSASU*

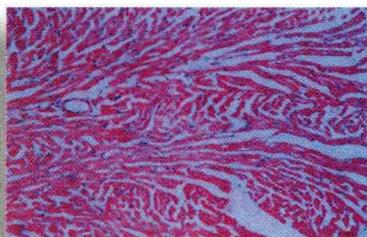
R. YATHAVAMOORTHY



Fresh Chinese common carp (*cyprinus carpio*) and Indian calbasu (*Labeo calbasu*) were manually filleted and deskinning and minced in a mechanical mincer. The mince was washed with a mince/water ratio of 1:4 for 10 minutes, drained and dewatered in a screw press. Yield of carp mince was 22.8% and calbasu mince 39.1%. Yield of washed and dewatered mince (MFP) was 18.3% and 31.5% from carp and calbasu respectively. Washing of mince resulted in significant removal of the characteristic muddy odour and improved the colour and appearance. About 50% loss in water-soluble protein and 45% loss of body lipids occurred during washing. Total soluble protein decreased by 26% in carp and 28% in calbasu as a result of leaching. SOS-PAGE analysis showed the removal of low molecular weight protein fractions below 14,200 Dalton. Texture profile analysis and gel strength measurement showed that washing significantly improved the functionality of protein from both carp and calbasu. Fish stored in ice for 24 hours and 48 hours gave better mince yield, but the yield of Myofibrillar Protein was lower compared to control. Ice storage resulted in significant loss of total extractable protein.

## PROTECTIVE EFFECT OF SQUALENE ON ISOPROTERENOL- INDUCED MYOCARDIAL INFARCTION IN RATS

SABEENA FARVIN.K.HABEEBULLAH



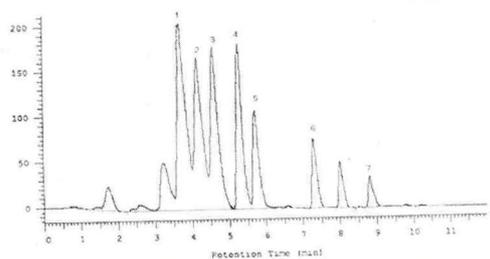
Significant elevation in the levels of diagnostic marker enzymes in plasma and notable alterations in the architecture of heart tissue were observed in isoproterenol-administered rats as compared to control rats. Supplementation of squalene at 2% level along with feed significantly prevented the isoproterenol- induced elevation in the levels of these diagnostic marker enzymes and maintained the normal architecture of heart tissue. Administration of isoproterenol caused significant reduction in the levels of proteins and glycoprotein components in the heart tissue of myocardial infarction induced animals as compared to normal rats. The significant rise noticed in the levels of protein and glycoprotein components in the plasma might be due to leakage of enzymes and proteins from the damaged heart tissue into the systemic circulation. The rats pretreated with squalene showed nearly normal levels of proteins and glycoprotein components as compared to isoproterenol-treated rats, indicating its cytoprotective activity. A tendency to prevent the isoproterenol-induced alterations in the levels of cholesterol, triglycerides, free fatty acids, phospholipids and triglyceride lipase was also observed. Intraperitoneal administration of isoproterenol induced a significant increase in lipid peroxidation, which was paralleled by decreases in the activities of glutathione-dependent antioxidant enzymes (glutathione peroxidase and glutathione-S-transferase) and antiperoxidative enzymes (catalase and superoxide dismutase) in the heart tissue as compared with control rats. In the present study, oral pretreatment with squalene significantly prevented these adverse effects and maintained the tissue antioxidant status at near normal level. Supplementation of squalene also exerted a membrane stabilizing action against isoproterenol- induced myocardial infarction by preventing the reduction in the activities of membrane-bound ATPases and by maintaining the mineral status at

near normal levels. The cardioprotective potential of squalene might be ascribable to the antioxidant and hypolipidemic nature of squalene.

### CHANGES IN BIOGENIC AMINES AND NUCLEOTIDES DURING ICED AND AMBIENT TEMPERATURE STORAGE OF TILAPIA

SUBHASIS SIL

The present study was conducted to assess the postmortem changes in non-protein nitrogenous compounds both during iced storage and ambient temperature storage of tilapia. The special emphasis was given on the changes in nucleotide breakdown products and biogenic amines. An increase was noticed in non-protein nitrogen (NPN) and total volatile basic nitrogen (TYB-N) in tilapia during 18 hours storage at ambient temperature. But in ice storage there was a decrease in NPN values after 10 days. The TYB-N values did not show any specific pattern. The alpha - amino nitrogen (AAN) value in iced storage does not show any decreasing pattern although it shows initial increasing trend at ambient temperature. The K value and nucleotide products were measured in high performance liquid chromatography (HPLC) with isocratic elution. The nucleotides content rapidly changed from A TP to inosine monophosphate (IMP) at ambient temperature within a very short time. The hypoxanthine concentration was significant after 6 hours of study. The K value was increasing correspondingly with time. The seven biogenic amines content in tilapia was measured in HPLC with gradient elution system using acetonitrile and water as solvents. The different amines were significantly low in tilapia after long storage period.



## MARICULTURE

### EFFECT OF TRANSPORTATION ON THE DIFFERENT REPRODUCTIVE STAGES OF PEARL OYSTER *Pinctada fucata* (GOULD)

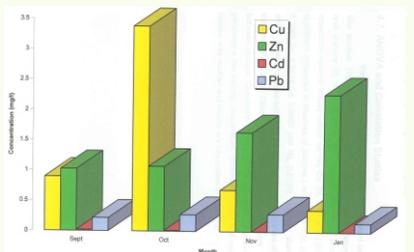
ANAND PRASAD PATURI



Pearl oysters could be transported in immature stage for 12 and 24 hours in water with temperature control at 20 - 24° C. The survival rates obtained for 12 and 24 hours transportation in water were 80% and 76.67% respectively. A survival rate of <10% obtained in the other trials without water indicated that this type of transportation is unsuitable for pearl oysters. The overall survival rates obtained for oysters transported in this study were 74.51%, 44%, 31.25%, 10.00%, and 3.10% respectively for immature, maturing, spent, partially spent and mature stages.

## STUDIES ON HEAVY METAL POLLUTION IN SELECTED EDIBLE BIVALVES OF NORTH KERALA

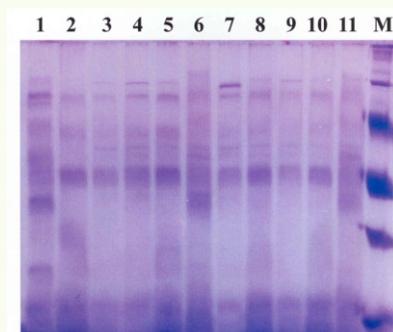
ASHALATHA. K. B.



Bivalves accumulate most of the heavy metals several times more than that found in water. Accumulation of Zinc was found highest followed by Copper, Cadmium and Mercury in the months of November - December in all stations; during the entire period of study in the bivalves as well as in sediments. Copper was found more in the water samples. While Cadmium was detected above the permissible level in the bivalves in all the stations during the entire period of study, mercury contents were above the permissible limits in bivalves during certain months (mainly August - September) in all the stations. The pattern of accumulation in different bivalves did not exhibit much difference. The biomagnification of heavy metals was maximum in *Saccostrea cucullata* followed by *Crassostrea madrasensis* and *Sunetta scripta*. No correlation could be discernible between metal concentration in bivalves and aquatic abiotic parameters such as salinity, temperature, dissolved oxygen and length of the animal collected from different estuaries and mangrove areas.

## EXTRA CHROMOSOMAL DNA DIVERSITY AND DRUG RESISTANCE IN *AEROMONAS HYDROPHILA* OF AQUACULTURE SYSTEMS

BRIJESH KUMAR HALAWAI



Twenty-two isolates of *Aeromonas hydrophila* collected from fish, water and sediment samples of aquaculture systems were screened for their plasmid DNA and protein profiles as well as susceptibility to twenty antimicrobial agents. The plasmid occurrence rate was 100% and a 21 Kilo base plasmid was common to all isolates. The number of plasmid ranged from 1 to 4 while size ranged from 1 to 21 Kilo base. The eight different types of plasmid profiles among these isolates reflected diversity of extrachromosomal DNA. The most common plasmid profile was a single banded of 21 kilo base exhibited by 50% of the isolates. All the isolates showed multiple resistance patterns and were resistant to ampicillin, amoxycillin, cephalixin, vancomycin, bacitracin, penicillin-G and lincomycin, while all were sensitive to ofloxacin, nitrofurazone, gentamycin, chloramphenicol and pefloxacin. Cellular protein profile resolved through NATIVE-PAGE and SDS-PAGE also revealed heterogeneity among the isolates. While some of the protein bands were shared by all isolates, others were varied in the isolates. Random primed PCR amplification of the plasmid DNA from

different plasmid profile groups was also carried out to generate RAPD profile. While some of the amplicons were species specific, produced by all the isolates, others were discriminatory. The RAPD analysis revealed high level of plasmid DNA diversity among the isolates, which were not evident in simple plasmid profiling, making it good tool for evaluation of extrachromosomal diversity and epidemiological studies of *A. hydrophila*. Intraspecies diversity of extrachromosomal DNA of *A. hydrophila* from aquaculture systems was indicated from plasmid profile, antibiogram, cellular protein profile and IRAPD pattern of plasmid DNA.

## APPLICATION OF LINEAR PROGRAMMING FOR FEED FORMULATION

DIPANKAR GHOSH

Optimum feed formulations are determined, as solutions of linear programming, for juveniles of Tiger shrimp (*Penaeus monodon*) and Scampi (*Macrobrachium rosenbergii*), as also the fry of Rohu (*Labeo rohita*), Catfish, Milkfish (*Chanos chanos*), Tilapia, Asian sea bass (*Lates calcarifer*) and Grouper with their nutritional requirements as constraints and considering market prices of twenty five feed ingredients at Kochi, Tuticorin and Bhubaneswar. Feed formulated through linear programming for juveniles of *P. monodon* was composed of five feed ingredients costing Rs. 37.32 at Kochi market price, Rs. 42.46 at Tuticorin market price and Rs. 29.84 at Bhubaneswar market price. When the constraints were relaxed by removing ten essential amino acid constraints, the formulated feed was composed of four ingredients costing Rs. 7.40 and Rs. 5.87 respectively for Kochi and Tuticorin market prices and five ingredients costing Rs. 4.05 for market price of Bhubaneswar. The nutritional status of the feed formulae in terms of the 16 nutrients considered was computed for each of the feed formulations obtained.

## SPECTRAL SIGNATURE OF PHYTO PLANKTON PIGMENTS AND THEIR SIGNIFICANCE TO REMOTE SENSING

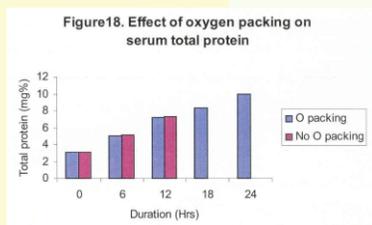
HONNANANDA, B. R.

The present study embodies the spectral signatures of monoculture of five taxonomic groups of phytoplankton, in acetone extract as well as in the intact cell suspensions. These spectral signatures of known taxonomic groups are compared with the spectral signatures of phytoplankton collected from the west coast of India onboard FORV *Sagar Sampada* during January 2003. Spectral signatures of monoculture of phytoplankton showed striking similarity within the taxonomic groups such as *Nanochloropsis* and *Chlorella* and considerable difference between different taxa. The spectral signature of phytoplankton collected along the southwest coast of India indicate the predominance of diatoms and green algae in southern latitudes (Wadge bank to Ponnani) and the Cyanophyta and Chlorophyta groups in the northern latitudes (beyond 12° N to 14° N). Levels of silicate also indicate the latitudinal difference registering 511 % increase in the southern latitudes. The spectral signature of bloom noticed off Jamnagar, Gujarat coast (21° N, 64° E) indicated the predominance of single species, whereas the stations eastward to the bloom station had complex signatures indicating the presence of diverse groups of phytoplankton.



## STRESS AMELIORATION DURING LIVE TRANSPORT OF FISH

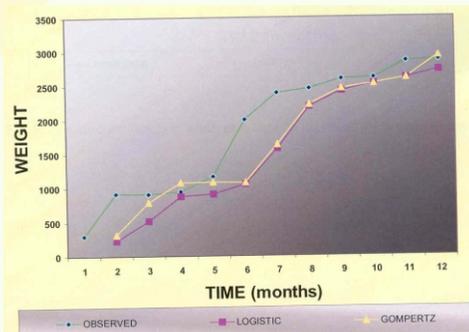
Mohammed Koya, K.



Elevated levels of ammonia and all the serum parameters and lower levels of dissolved oxygen and pH leading to mortality observed in the control group indicate that the treatments succeeded in ameliorating the stress caused by the transportation procedures. Packing water temperature of 15°C to 20°C, anaesthesia with 100ppm clove oil and oxygen packing are found essential for transporting live grouper of biomass 700g for period extending up to 24h.

## PRODUCTION FUNCTIONS IN MARICULTURE

NEETHA SUSAN DAVID



Production function of mariculture systems have been evaluated. The functions evaluated were Gompertz, Logistic, von Bertalanffy, Richards, modified Janoschek and polynomial growth equations. The Gauss-Newton and Quasi-Newton method of the nonlinear regression procedure of SYSTAT was used to estimate parameters of each function for individual weight-age curves. The growth models were used for the derivation of production functions along with no assumption on mortality and different assumptions of mortality like linear and exponential model. In the case of grey mullet *Mugil cephalus* logistic growth model gave the best fit while that for molluscs *Crassostrea madrasensis* and *Perna vepis* Gompertz growth curve was the best. The production function was estimated for the oyster data. It was found that the linear and exponential assumptions in mortality along with the Gompertz

growth curve gave better results.

## STUDIES ON THE BIOACCUMULATION AND EFFECT OF ENVIRONMENTAL STRESS ON THE GREEN MUSSEL, *Perna viridis* (Linnaeus, 1758)

RAJAT KUMAR VARSHNEY

The LC<sub>50</sub> value for large (25 to 40mm) and small size seed (10 to 25 mm) were estimated as 14 and 21 ppt respectively indicating the sturdiness of larger seed.



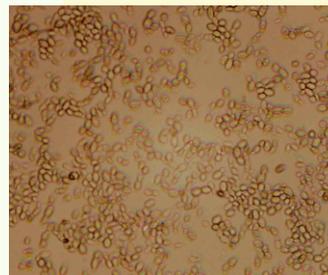
The larger sized seed were less tolerant to lower salinities (LC<sub>50</sub> = 32 ppt) when exposed directly without conditioning in ambient salinity. The condition indices of the surviving seed were comparable to that of the control. Stress related to desiccation was studied by exposing the seed for various durations and the survivorship in the recovery period was evaluated. In seed exposed for 12 and 24 hours of desiccation, mortality ranged between 6 and 26% during the recovery period at the end of 30 hours and was stabilized thereafter. Desiccation for 26 to 30 hours resulted in very high mortality ranging from 42 to 96% at the end of 30 hours of the recovery time while, above 30 hours and up to 48 hours of desiccation, none of the seed survived. The order of magnitude of bioaccumulation of the trace metals was In>Cu>Pb>Cd in the mussel collected from the natural bed while in the mussel cultured in the off-bottom system in bay and estuarine pond were In>Pb>Cd>Cu and In>Pb>Cu>Cd respectively. Positive correlation with size was observed in the accumulation of zinc (R<sub>2</sub> = 0.7869) and lead (R<sub>2</sub> = 0.7266) in the natural bed mussels, while in the off bottom farms the accumulation of In, Cd, Pb and Cu were negatively related to size with very low to nil values of Cd and Cu in harvestable size (> 60mm) mussels. Gender based bioaccumulation of heavy metals was

inconsistent in different size groups of mussels collected from the natural bed and in farmed systems.

## EFFECT OF BACTERIAL LOAD AND PROBIOTICS ON THE SUSTAINABILITY OF MICROALGAL CULTURES

RAJEEV KUMAR

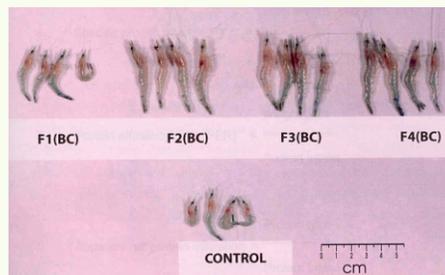
If microalgal cultures are used when they are in the log and stationary phase rather than in the declining phase, the amount of bacteria added to the larval culture medium can be reduced by 3-4 orders of magnitude. All the measures of bacterial diversity except species richness showed an increasing trend with increasing algal density in both *Chaetoceros* and *Isochrysis galbana* cultures. There was marked clustering of bacterial taxa during lag, early log, peak log and death phases in the microalgal cultures tested. The addition of the probiotic yeast *S. boulardii* in treatment SA resulted in significantly ( $P < 0.01$ ) improved algal growth rates with prolonged log and stationary period, when compared to control and DA treatment. The mean total aerobic flora showed a steeply increasing trend in control and DA treatments, while the trend in SA treatment was that of slow increase. The hierarchical cluster analysis showed remarkable differences between treatments. There was a marked increase in the similarity percentage of bacterial clusters.



## SOLID STATE FERMENTATION OF OIL CAKES AND WHEAT FLOUR AND EVALUATION OF THE PRODUCTS IN SHRIMP FEED

VIJAYAKUMAR, M.

Solid-State Fermentation (SSF) was carried out using pure strains of industrial microbes, either the bacterium *Bacillus coagulans* or the fungus *Aspergillus niger* strain 616. There was significant ( $p < 0.05$ ) improvement in nutritional quality of the substrate after 36 h using *Bacillus coagulans* and 96 h using *Aspergillus niger*. A 52 d feeding experiment was conducted on *Penaeus monodon* post larvae to evaluate the efficacy of diets incorporated with the fermented products at varying levels of fish meal replacement (14, 43, 71 and 100%) on growth, digestibility and body composition. The shrimp that were fed diet containing 35% bacterial fermented ingredient (100% fishmeal substitution) showed the best specific growth rate (12.12), food conversion ratio (1.58), apparent net protein utilization (25.65), protein efficiency ratio (1.71), apparent protein digestibility (86.56), apparent fat digestibility (94.55) and apparent digestibility coefficient (73.35) among the diets incorporated with bacterial fermented ingredients and control diet. The shrimp fed diet containing 15% fungal fermented ingredient (43% fishmeal replacement) showed the best specific growth rate (14.79), food conversion ratio (1.62), apparent net protein utilization (25.39) and protein efficiency ratio (1.64). The diet with 35% fungal fermented ingredient showed the best apparent protein digestibility (87.74), apparent fat digestibility (97.95) and apparent digestibility coefficient (77.09) among the diets containing the fungal fermented ingredient.



## INLAND AQUACULTURE

## A COMPARATIVE STUDY ON GROWTH POTENTIAL OF RAINBOW TROUT (*Oncorhynchus mykiss*) IN SPRING AND STREAM WATERS OF KASHMIR

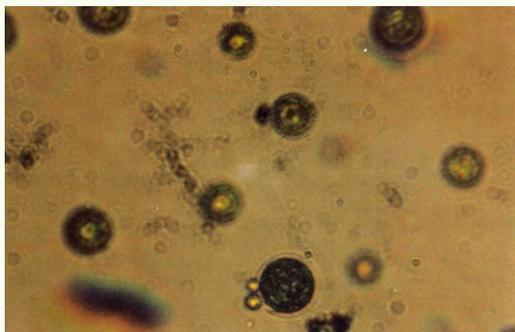
ABDUL AHAD MIR



The yearlings reared in spring water were fed with pelletized feed at the rate of 1.4% of their body weight whereas those reared in stream water were fed at the rate of 1.2% with the same feed, but fingerlings reared in spring water were fed 2%. The spring water at Kokernag showed a temperature range of 11.0-14.2°C, pH range of 7.1-8.1, dissolved oxygen (D.O.) of 7.5-10.4 mg/l and free carbon dioxide (CO<sub>2</sub>) was found between 0.5 and 1.7 mg/l. The stream water at Laribal showed a temperature range of 5.8-15.5°C, pH of 7.1-7.9, D.O. between 7.7 and 10.8 mg/l and free CO<sub>2</sub> of 0.8-1.6 mg/l respectively. However, the range of these parameters in spring water at Laribal was 10.8-13.7°C, 7.0-8.0, 7.0-10.0 mg/l and 0.5-1.8 mg/l respectively. The percentage increase in fish biomass obtained in case of yearlings, reared in spring water at Kokernag was 74.11 % with an SGR of 0.26% and FCR value of 2.11 whereas those reared in stream water at Laribal showed 60% increase in biomass, 0.22% of SGR and FCR value to the extent of 2.14. However, the fingerlings reared in spring water at Laribal gave the highest increase of 275% in fish biomass, 0.63% SGR and the lowest FCR value of 1.15. In case of yearlings reared in spring water, the exponent 'b' value for length-weight relationship was 3.0537 whereas, for those reared in stream water, the value was 2.9328, and for fingerlings reared in spring water it was 3.0385. The coefficient of correlation in all the cases was 0.99 indicating a positive correlation between the length and weight of the species.

## EFFECT OF CULTURE CONDITIONS ON GROWTH AND BIOCHEMICAL COMPOSITION OF *CHLORELLA* AND USE OF THE CULTURED ALGA ON *DAPHNIA* GROWTH PERFORMANCES

AIYAPPA, P. I.

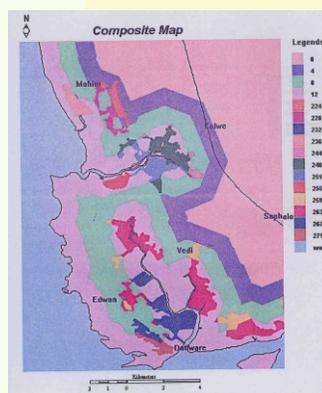


Physiological experiments to determine the optimum nutrient (nitrogen, phosphorus and potassium) requirement for accelerating growth rate and nutritive value of *Chlorella* were designed keeping in view its importance as single cell protein in aquaculture. The effect of different levels of live *Chlorella* on the population density of *Daphnia* was also studied. The results reveal that growth and chemical composition were closely coupled to changes in the nutrient concentrations. Maximum cellular density of  $19.3 \times 10^4$  cells  $\text{ml}^{-1}$  in 4N media,  $18.7 \times 10^4$  cells  $\text{ml}^{-1}$  in 2P media and  $15.9 \times 10^4$  cells  $\text{ml}^{-1}$  in 4K media from an initial inoculum of  $7.8 \times 10^4$  cells  $\text{ml}^{-1}$  were recorded in the physiological experiment. The mass culture of *Chlorella* revealed that 4N media supported maximum cellular density ( $23.7 \times 10^5$  cells  $\text{ml}^{-1}$ ) and maximum levels of protein (60.57 %), which is superior to the other media under consideration. The growth patterns were similar to the hypothetical growth curve. Statistical analysis revealed a significant difference ( $P < 0.005$ ) between the cellular densities in the treatments with nitrogen and also between the cellular densities in the treatments with phosphorus.

## SITE SELECTION FOR BRACKISHWATER AQUACULTURE USING REMOTE SENSING AND GIS TECHNIQUES

KARTHIK, M.

Current land use pattern of the study area (coastal area of Palgar taluk, Thane district, Maharashtra, India.) was extracted from the satellite image (IRS 10 FCC Print) with the help of Global Positioning System (GPS). Suitability of mud land area was considered for the development of brackishwater aquaculture (Shrimp farming) and the data on 36 parameters under 6 major categories namely, engineering parameters, water quality parameters, soil quality parameters, infrastructure facility, meteorological Parameters and social restriction were collected for different sites of mud lands and compiled. GRAM++ (Geo Referenced Arc Management System) GIS software was used in this study for data analysis. Weighted overlay method was adopted in GIS to delineate the potential area into 4 major categories as Highly suitable, Suitable, Moderately Suitable and Unsuitable. The study revealed that of the total study area (20431.034 ha) 0.377% is highly suitable, 9.873% is suitable, 1.772 % is moderately suitable and 85.027% is unsuitable, while 2.951 % comes under existing aquafarms. Suitable area was further classified into 11 categories based on priority.



## REPRODUCTIVE BIOLOGY AND SEED PRODUCTION TECHNOLOGY OF *TOR PUTITORA (HAMILTON)*

MURTAZA ALI

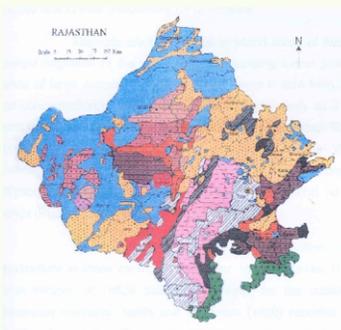
Artificial spawning experiments on *Tor putitora* were carried out by giving a single dose of ovotide and eggs were obtained by stripping. Subsequent hatching was done in trays at a specially designed hatchery yielding 8526 young fry. The average weight of brooders ranged from 360 gm to 440 gm female and 280 gm to 415 gm male while the size ranged from 260-355 and 205-310 in females and males respectively. The number of eggs / ml ranged from 28-31. The hatching percentage of eggs was obtained 78% with a survival rate of 85% from newly hatched hatchlings to young fry. Seasonal changes in gonad were fairly regular and peak ripeness was observed in September, its spawning season. The size at maturity in male was 205 mm and 230 mm in female. The fecundity ranged from 3,636 to 7,695.



## SURVIVAL AND GROWTH OF *PENAEUS MONODON (FABRICIUS)* IN INLAND SALINE GROUNDWATER OF WESTERN RAJASTHAN, (INDIA)

SHAKEEB UR RAHMAN

Ionic composition of Inland Saline groundwater (ISGW) of Rahat, Dist. Pali, Rajasthan (73°04' N latitude and 25°57' E longitude), India was found different from seawater (Arabian Sea). ISGW was more saline (58 ppt) with high contents of Ca<sup>2+</sup> (921.8 mg/l) and low contents of K<sup>+</sup> (159.4 mg/l) as compared to seawater. Survival of juveniles of *P.monodon* (Av. Length 1.59 ± 0.38 cm, Avg. weight 0.0298 ± 0.0010 g) was tested in ISGW at its original (58 ppt) salinity and diluted salinities of 50, 40, 30, 20, and 10 ppt for 96 hrs. Complete mortality of the juveniles was observed at all the salinities except at 10 ppt before 96 hrs. At 10 ppt the Ca<sup>2+</sup> concentration was 260.5 mg/l. Hence, the survival of *P.monodon* was tested at 10, 12.5, 15, 17.5 and 20 ppt salinities each with Ca<sup>2+</sup> contents of 100, 150, 200, 250 and 300 mg/l. The best survival was recorded at 12.5 ppt salinity and 200 mg/l of Ca<sup>2+</sup>. But the juveniles survived only for a period of 7 days. The concentration of Mg<sup>2+</sup> in diluted ISGW of 12.5 ppt at 200 mg/l of Ca<sup>2+</sup> was noted



to be 208.5 mg/l which was observed to be significantly less than the control (seawater; 12.5 ppt salinity) with Mg<sup>2+</sup> concentration of 425 mg/l. Hence, in another trial the survival of juveniles of *P.monodon* was tested at 12.5 ppt salinity with Ca<sup>2+</sup> contents of 200 mg/l and Mg<sup>2+</sup> contents of 400 mg/l. The survival could be prolonged for a period of 17 days. Thereafter, complete mortality was recorded. The diluted ISGW of 12.5 ppt salinity was observed to have K<sup>+</sup> concentration of 30.03 mg/l whereas in control it was 174.72 mg/l. Therefore, the survival of juveniles of *P.monodon* was tested in ISGW of 12.5 ppt with Ca<sup>2+</sup> contents of about 200 mg/l at K<sup>+</sup> concentrations of 100, 150 and 200 mg/l. The best survival similar to that of control (seawater; 12.5 ppt) was noted at 200 mg/l of K<sup>+</sup>. The average length and weight were  $2.851 \pm 0.558$  cm &  $0.276 \pm 0.0487$  g in ISGW and  $2.79 \pm 0.384$  cm &  $0.278 \pm 0.037$  g in control respectively. The ionic ratio of K<sup>+</sup>, Cl<sup>-</sup>, Na<sup>+</sup>/Cl<sup>-</sup>, Ca<sup>2+</sup>, Cl<sup>-</sup> and Mg<sup>2+</sup>, Cl<sup>-</sup> in the K<sup>+</sup> (200 mg/l) fortified culture medium were 0.026, 0.32, 0.026 and 0.026 respectively which were very close to that of seawater. ISGW could be used for culture of *P.monodon* by modifying its ionic concentrations.

### STUDIES ON THE ICHTHYOFAUNA OF RIVER SIJIN WEST SIANG DISTRICT OF ARUNACHAL PRADESH

TAGI YONGGAM

River Siji is a small tributary of Brahmaputra river system in Arunachal Pradesh. It is located at Likabali sub-division in extreme southern region of West Siang district. The river has remained unfocussed in terms of its ichthyofauna and



physicochemical studies since long time. In the present investigation of ichthyofauna from September 2002 to January 2003, 27 species belonging to six orders and eleven families were recorded from the river. Of these, 3 species were purely true hill stream forms, 7 were semi torrential, 10 were migratory, and another 10 were species were plain water forms. Again 11 species were of cold-water type and 18 were warm water type. These species are also found common in Brahmaputra river system that shows the upriver migration of the fish species to river Siji

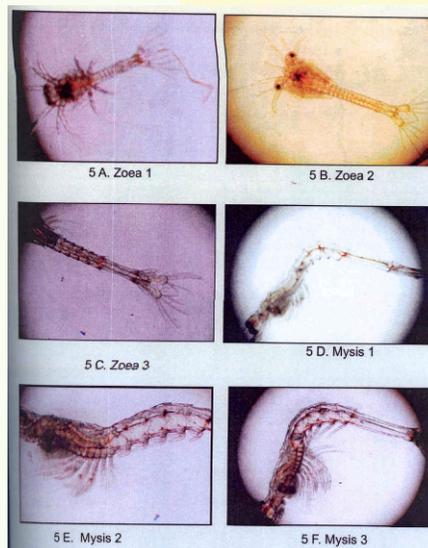
during rainy season. Two species namely *Balitora brucei* (Gray) and *Mystus tengra* (Hamilton) have been recorded first time in the state. *Schizothoracichthys esocinus* (Heckel) was found to exist in wide range of altitude from the investigation. Market value of some cold-water fish species like loach, *Barilius*, *Garra*, *semplotus*, etc has been found suggestible for commercialization in the area. Suitable water quality parameters for fish culture practices have been recorded during the investigation period. Indigenous gears like Esap (Cast net), Pashi jal (gill net), Shipe, Takom, Idir, Raju, hook and line. Sibok, Lipum, Litek, and poisoning by plant materials and sometime bleaching powder and dynamite are mostly used for fishing purpose in the locality.

### EFFICACY OF AN ECOFRIENDLY ORGANIC COMPOUND 'SHIV ANISTIM' ON GROWTH AND SURVIVAL OF *PENAEUS MONODON* (FABRICIUS, 1798) LARVAE AND POST LARVAE

M. KATHIRESAN

An experiment was carried out to test the efficacy of 100 % biodegradable organic compound "Shivanistim" (Zygro Corporation, USA) on growth, molting duration and survival of Giant tiger prawn *Penaeus monodon* (Fabricius, 1798) larvae and post larvae. The experiment consisted of three trials. Each trials was done in triplicates,

in which three tanks were used as controls and another three tanks were treated with the organic compound. The first, second and third trial were conducted in circular Fiberglass Reinforced Plastic (FRP) tanks (500 l capacity), rectangular cement tanks (12 ton capacity) and rectangular cement tanks (12 ton capacity) respectively. The stocking density was 38 nos, 100 nos and 100 nos in trial I, II and III respectively. Water quality parameters like temperature, salinity, dissolved oxygen, free CO<sub>2</sub>, pH, alkalinity and salinity were analysed everyday at the same time (before water exchange), whereas NH<sub>3</sub>-N, NO<sub>2</sub>-N and NO<sub>3</sub>-N were measured once in every four days. Similar rates of feeding and water exchange were followed in all the tanks. The growth was significantly better in 'Shivanistim' treated tanks for all larval and post larval stages. The length of zoea stages, mysis stages, PL 1-5 and PL 6-10 ranged from 0.11-0.289 cm, 0.452-0.585 cm, 0.62-0.84 cm and 0.85-1.02 cm in control trials I, II and III respectively, where as it was 0.118-0.315 cm, 0.462-0.62 cm, 0.64-0.87 and 0.88-1.11 cm in treated trials I, II and III respectively. Molting duration were reduced by 7 Y<sub>2</sub>, 9.0 and 10 Y<sub>2</sub> hrs in experiment I, II and III respectively when treated with 'Shivanistim'. The survival rate in case of 'Shivanistim' treated tanks was better in all trials than the control: the final survival rate (PL 10) was 41.2%, 55.23% and 54.63% in control trials I, II and III respectively, while it was 62.26%, 70.86% and 73.86% in treated trials I, II and III respectively. Animals treated with 'Shivanistim' also seemed to show increased disease resistance. Finally it was concluded from this study that the animals treated with 'Shivanistim' have better growth, molting duration, survival and disease resistance as compared to controls.



## EFFECT OF SPIRULINA AS A FEED SUPPLEMENT TO ENHANCE PIGMENTATION IN BLUE GOURAMI

M. ALAGAPPAN

Bright colouration is one of the major factors, which determines the value of ornamental fish in the world market. In the present study, an attempt has been made to study the effect of spirulina on pigmentation of an ornamental fish, Blue Gourami, *Trichogaster trichopterus*. The experiment was carried out in triplicates in five sets of glass aquarium tanks - one control and four treatment groups by supplementing spirulina in the diet at different levels viz., 0g, 1 g, 2g, 3g and 4g/kg of basal diet.

The experimental fish were stocked @ 10 fishes/tank and were maintained on a uniform water quality conditions. The study was conducted in two phases. In the first phase, different experimental groups were fed with the respective diets for 8 weeks and in the second phase, the treated fish in all groups were fed with control diet for 4 weeks. At the end of 8 weeks of experiment, the intensity of skin color and total carotenoid content in skin and flesh increased throughout the trial in groups receiving pigment supplements. The color scores and total carotenoid levels were significantly related to the level of algal supplementation in the diet. The maximum concentration of carotenoid content in skin (13.6259 ~g/g wet weight) and muscle (11.2416 ~g/g wet weight) were observed in the group receiving 4g/kg of spirulina supplementation in the diet. When the micro algal supplement diet was replaced with control diet, the fish showed varied concentrations of skin and muscle carotenoids and color intensity diminished. Addition of natural pigment to the diet also had a significant effect on growth parameters. Micro algal supplements appeared to have no effect on survival, while there was an improvement in the body composition of the fish. Based on the present study, it is concluded that 4 g/kg



supplementation of Spirulina in diet is effective in pigmentation and enhancement of growth in Blue Gourami.

### **INFLUENCE OF SALINITY ON NURSERY REARING OF ASIAN SEABASS *LATES CALCARIFER* (BLOCH, 1790) JUVENILES**

M. SURESHKUMAR

The effect of salinity on the rearing of Asian seabass (*Lates calcarifer*) was assessed. Data on growth, survival rate, food consumption rate, Food Conversion Ratio (FCR), Food Efficiency Ratio (FER) and biochemical constituents like protein, lipid, carbohydrate, ash and moisture content were calculated. Two sets of experiments with 15 days old seabass larvae (average size  $5.2 \pm 0.483$  mm in TL and  $2.3 \pm 0.0005$  mg) in weight and 30 days old fry (average size  $27.0 \pm 0.082$  mm/ $170.0 \pm 13.4$  mg) were conducted under laboratory conditions for 30 days and 21 days respectively in 0, 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 % salinities. Larvae were fed with *Artemia* nauplii @ 2-6 nos/ml. Fry were fed with *Artemia* biomass *ad libitum*. At the end of first set experiment larvae attained maximum growth in 15 %, (29.80 mm to 2.15mm/ $389 \pm 102.9$  mg) followed by 10, 5, 20, 25, 30, 35, 40, 45 and 50 %.



Feed consumption rate was in the order of  $25 > 30 > 20 > 15 > 35 > 10 > 40 > 5 > 45 > 0 > 50$  %0. Food conversion efficiency with low FCR and the FER were better in 20 % salinity and the  $20 > 25 > 15 > 10 > 0 > 5 > 30 > 35 > 40 > 45 > 50$  %.

High content of protein ( $63.47 \pm 0.39$ %) was observed in larvae reared in 20 % salinity and low values in 50 %. However, lipid content was maximum in larvae reared in 50% ( $18.00 \pm 0.90$  %) and the minimum was in 15 % ( $16.00 \pm 0.90$  %). Maximum carbohydrate content was observed in larvae reared in 20 % ( $3.31 \pm 0.24$ %) and minimum content in 50% ( $2.00 \pm 0.38$ %). The ash content also showed a similar trend;  $7.3 \pm 0.58$ % in 50 % and  $5.3 \pm 0.58$ % in 20 %. In the second set of experiment where 30 days old fry was reared in different salinities, the growth was in the order of 15% ( $31.20 \pm 0.39$ mm/ $427 \pm 18.45$  mg), 20, 10, 5, 30, 35, 40, 45 and 50 %; FCR and FER also showed a similar trend. Food Conversion Efficiency with low FCR was maximum in 15 % ( $1.64 \pm 0.12$ ) and minimum in 15 % ( $2.35 \pm 0.07$ ). In the biochemical constituents maximum protein value ( $65.9 \pm 0.7$ %) was observed in larvae reared in 15% and minimum was in 50% ( $62.25 \pm 0.31$  %). However, the lipid content was minimum in 20 % ( $12.00 \pm 0.29$ %) and maximum in 50 % ( $17.00 \pm 0.050$ %). Carbohydrates content was maximum ( $10.72 \pm 1.42$ %) in fry reared in 20 % salinity and minimum in 50 % ( $6.028 \pm 1.14$ %). The results clearly indicated that salinity in the range of 15-20% was highly suitable for sea bass rearing followed by 5 - 10 %, but higher salinities were not desirable.

### **CONSTRAINTS OF FISH FARMERS IN INFORMATION ACQUISITION IN DISTRICT JAMMU OF J&K STATE SANJESH GUPTA**

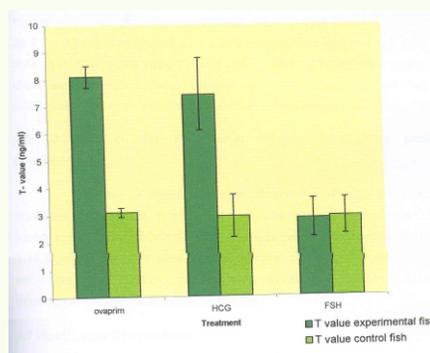
The present study was conducted during the year 2002-2003 in district Jammu of Jammu and Kashmir state to know the constraints of fish farmers in information acquisition. Purposive and random sampling was adopted to select 45 fish farmers as respondents. The data was collected in pre-tested interview schedule. The study revealed that majority of fish farmers used fellow fish farmers as main source of information. Respondents stored the information by memorizing. They

discussed the information mainly with the fellow fish farmers followed by Fishery Extension Agents. Respondents evaluated the information by seeing the profitability. Among the personal contact programs, majority (55.55%) had meetings with the extension workers. Participation in training programs was the maximum (60%) followed by exhibitions (51.11 %) in the group contact programs. Extension literature was received by about two third of respondents. Most of the respondents had preferred two to three hours in the morning for meetings, 10am to 4pm for demonstrations, full day for training and 9am to 5pm for exhibitions. Majority of the respondents were not having preference for any month for the conducting meetings and demonstrations, whereas, month of July and public holidays were preferred for trainings and exhibitions. Most of the respondents (35.55%) had preferred for the local language to be used during training and demonstration lectures. Most (60%) of them showed their preference towards the visuals / practicals regarding disease diagnosis and control. Majority (26.66%) had felt that training programs were of short duration and prior information was not given to them regarding training programs. In mass contact programs majority (20%) had felt that there were no detailed information about fisheries in radio programs. Most of the respondents (95.55%) preferred visuals to be used in addition to the text in extension literatures. Majority (73.33%) had preferred Hindi in addition to the local language to be used in extension materials. There was positive and significant relationship between the awareness and extent of adoption. The socio- economic characteristic namely family income, age, land holding, experience, education and pond size were positively and significantly correlated with the fish production of farmers' pond.



### **HORMONAL INFLUENCE ON THE REVIVAL OF SEXUAL MATURITY IN *CLARIAS BATRACHUS* (LINNAEUS, 1758)** **SIMI ROSE ANDREWS**

The present study was undertaken to explore the possibility of inducing the sexual maturity in *Clarias batrachus* (Linnaeus, 1758) during post spawning phase by hormonal treatments. Adult *Clarias batrachus* of both the sexes were injected with sGnRH (ovaprim), HCG, FSH at 21.1g, 50 IU and 3.75 IU / 100g body weight respectively, during the resting phase of sexual cycle. Injections were given at weekly intervals for a period of 30 days. Seven days after the last injection, the fish were sacrificed and both testes and ovary were processed for histological observations. Sex steroids and vitellogenin were also assayed in blood plasma. sGnRH and HCG treated fishes showed initiation of spermatogenesis, and stage I and stage II oocytes. In sGnRH treated fish, testosterone level increased to  $8.1 \pm 0.4$  ng/ml, whereas it was only  $3.1 \pm 0.17$  ng/ml in control fish. In the HCG treated fish, T value increased to  $7.43 \pm 1.34$  ng/ml. But the FSH treated fish did not shows any significant change. In E2 value, sGnRH treated fish show elevated level of  $18.32 \pm 1.13$  ng/ml compared to control ( $4.57 \pm 0.67$  ng/ml). 17 $\alpha$  P value of sGnRH treated fish was higher ( $9.2 \pm 0.53$  ng/ml) when compared to that of the control ( $3.9 \pm 0.72$  ng/ml). The results revealed that under proper management practices, hormonal manipulation could influence the sexual maturation even during the resting phase of fish.



## EXPERIMENTS ON COMPARATIVE EVALUATION OF DIFFERENT INDUCING AGENTS ON SEED PRODUCTION OF ASIATIC CATFISH, *CLARIAS BATRACHUS* (LINN)

SUMANTA KUMAR MALLIK

The present study was carried out to evaluate the efficacy of inducing agents on seed production of *Clarias batrachus* (Linn. 1758). For the present investigation four types of inducing agents were taken viz: Ovatide, Ovaprim, Wova-FH and carp pituitary. For each stimulant six experiments were conducted. Results obtained from each stimulant were analysed in respect of total eggs, percentage of fertilization rate, total number of good eggs, total number of fry obtained and percentage of fry survival.



The average total number of eggs yielded by Ovatide injected females was 6240 where as in case of Ovaprim injected females, it was 5340. The average total number of eggs produced in Wova-FH and Carp pituitary were 4380 each. There was significant difference in total number of eggs produced between Ovatide and Ovaprim experiments ( $p < 0.05$ ) but not in between Wova-FH and Carp pituitary ( $p > 0.05$ ). The highest fertilization rate of 71 % was found in Ovaprim injected experiments while it was 65 % in case of Ovatide. The Carp pituitary experiment gave a least fertilization rate of 39%. The mean total number of good eggs assessed in respect of Ovatide, Ovaprim, and Wova-FH were 4082, 3781 and 2046 respectively. The least mean of total number of good eggs observed in Carp

pituitary injected experiment was 1729. The average total number of fry yielded in Ovatide and Ovaprim injected females were 2149 and 2132 respectively showing no significant difference ( $p > 0.05$ ). The average total number of fry produced in Wova-FH and Carp pituitary experiments were 648 and 457 respectively showing a significant difference in total number of fry produced between Wova -FH and Carp pituitary ( $p < 0.05$ ). The least average fry survival of 25.8% was found in Carp pituitary injected experiments, where as maximum survival of 55.42% was observed in Ovaprim. In the present investigation, efficacy of Ovatide stimulant is seen to be on par with Ovaprim. For the second part of investigation that covers up the rearing of fry to fingerling, two circular nursery ponds of 42.5m<sup>2</sup> each and two rectangular ponds of 67.5m<sup>2</sup> each were taken. The ponds were stocked with the fry obeying a stocking density of 100m<sup>2</sup> each. The stocked animals were fed with a prepared diet. Sampling was done weekly once and average weight was taken to assess the growth and amount of feed to be given. The rearing animals were fed @ 50%, 25%, 15%, and 10% of average body weight in 1st, 2nd, 3rd and 4h week respectively during 28days of nursery rearing. After final harvesting maximum survival of 72% was assessed in circular pond 2, while survival of 70%, 63% and 58% were observed in rectangular nursery pond 4, 3 and circular nursery pond 1 respectively. The fingerling production opens a new avenue for private sectors to take up rearing activities, which serves as very good stocking material for culture pond for encouraging and commercializing magur culture in India.

## A STUDY ON THE FISHERFOLK OF DAL LAKE IN THE STATE OF JAMMU AND KASHMIR

TASADUQ HUSSAIN SHAH

Dal Lake is a Himalayan urban lake, situated to the east of Srinagar at an average altitude of 1,586 metres above mean sea level. It has been a subject of innumerable

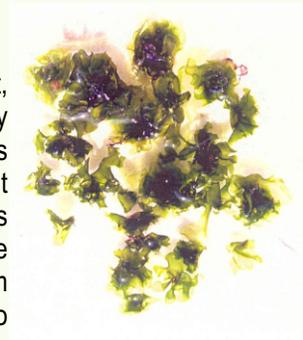
biological and ecological studies. However, not much has been done to document the socio-economic status of its fisherfolk. A short-term investigation was carried out to study the socio-economic status of fishers of Dal Lake, as well as, the factors contributing towards the catch of fish. About 54% of the male respondents were literate but 91 % of them had formal education lesser than eighth standard. The investigation revealed that almost 40% of the respondents were earning between Rs.38,400 to Rs.55,200 per annum. The literacy rate of females was only about 20%. It was observed that about 77% of the respondents had incurred debts. Average catch per fisherman per day in summer was about  $5.18 \text{ kg} \pm 0.69$  while in winter it was about  $2.85 \text{ kg} \pm 0.40$ . The mass media exposure of the respondents was poor. About 79% of the fishers opined that pollution was responsible for the decline in fish catch. Apart from this, use of gill nets, over-exploitation, catching of juveniles, excessive weed growth and siltation of Telbal Nallah were reported to be the other reasons for decline in fish catch. The study also indicated that the fishermen who sold the fish to the middleman got 20-30% lesser price than the fishermen who sold the fish directly to the consumer. The role of middleman can be eliminated by establishing a cooperative society of the fishermen for undertaking fish marketing and processing for socio-economic upliftment of fishers of Dal Lake.



### STANDARDIZATION OF DNA ISOLATION AND DETECTION OF GENETIC VARIATION IN FOUR *ULVA* SPECIES BASED ON RAPD TECHNIQUE

UMA SHANKAR PRASAD, D

*Ulva* is one of the most important commercial seaweed of Indian subcontinent, which nutritionally benefit to mankind. DNA is prerequisite for any molecular biology work of seaweed. DNA isolation from the seaweeds was proven very difficult. In this study an attempt has been made to standardize the DNA isolation by using different protocols with some modifications. Isolated DNA was used for RAPD-PCR analysis for estimation of genetic variation in 4 species of *Ulva*. Two 10-mer primers were chosen from 4, that amplified a total 52 possible DNA fragment, ranging in size from 500-2100bp. Similarity co-efficient based on Nei and Li (1979) were calculated to quantify the genetic divergent between species. The study provides RAPD as complementary tools for study of genetic variation at species level.



### USE OF PROBIOTICS AS A NUTRITIONAL SUPPLEMENT IN FEED OF AN ORNAMENTAL FISH, *CARASSIUS AURATUS* (LINN.)

VIJULA, K

Probiotics are harmless bacteria that help the well being of the host animal and involve, directly or indirectly in the nutrition of fish. The aim of his study is to evaluate the efficacy of probiotics, 'LactoBacil', intended for human use as a nutritional supplement in an ornamental fish, *Carassius auratus* (Linn.). The study was conducted in four sets of plastic troughs each one of 50 l capacity in triplicate. A basal diet was prepared and the probiotics were incorporated at different levels viz., - Og, 0.5g, 1 g and 2g/kg to the basal diet. The experimental fishes were stocked at 15 numbers/tank and maintained in an uniform water quality conditions. The fishes were fed with the respective experimental diet for a period of 8 weeks. At the end of 8 weeks of experiment, various bio-growth parameters of the fishes were determined and the fishes were also subjected to proximate and carotenoid analysis. The growth and survival of Goldfish were significantly improved with the addition of LactoBacil in fish diet at different levels ranging from 0.5 to 2.0 g/kg. The



maximum growth (3.4777 g) and survival (86.6667 %) were observed in the fishes fed with 2.0 g/kg of probiotic incorporated feed. The body composition of fish also improved significantly. An increment in the protein content was observed in the probiotic treated fishes. The supplementation of probiotics in the diet also enhanced the skin carotenoid content of the fish. It can be concluded remarkably that 2.0 g supplementation of LactoBacil in the basal diet has a positive impact on the growth, survival, body composition and the colouration in Goldfish.

## 5. Educational Achievements

# 5

### 5.1 Academic Programmes

#### Results

Name of the programme	Year	Number of successful candidates
M.F.Sc. (Fisheries Resource Management)	2003-2004	12
M.F.Sc. (Inland Aquaculture)	2003-2004	15
M.F.Sc (Mariculture)	2003-2004	5
M.F.Sc. (Fish Pathology & Microbiology)	2003-2004	5
M.F.Sc (Freshwater Aquaculture)	2003-2004	4
M.F.Sc. (Fish Nutrition & Biochemistry)	2003-2004	5
M.F.Sc. (Fish Genetic & Biotechnology)	2003-2004	5
M.F.Sc (Post-harvest Technology)	2003-2004	5
Ph.D. (Fisheries Resource Management)		5
Ph.D. (Inland Aquaculture)		6
Ph.D. (Mariculture)		6
P.G. Diploma in Inland Fisheries Development & Administration	2003-2004	16
<b>Total</b>		<b>89</b>

## Enrolments 2003-2004

Name of the programme	Number of students admitted
M.F.Sc. (Fisheries Resource Management)	6
M.F.Sc (Inland Aquaculture)	5
M.F.Sc (Mariculture)	5
M.F.Sc (Freshwater Aquaculture)	6
M.F.Sc (Post-harvest Technology)	5
M.F.Sc (Fish Pathology & Microbiology)	6
M.F.Sc. Fish Business Management	5
M.F.Sc (Fish Nutrition & Biochemistry)	5
M.F.Sc (Fish Genetics & Biotechnology)	5
Ph.D. (Fisheries Resource Management)	5
Ph.D. (Inland Aquaculture)	7
Ph.D. (Mariculture)	2
Ph.D. (Post Harvest Technology)	4
P.G. Diploma in Inland Fisheries Development & Administration	25
Ph.D. Fisheries Biotechnology	2
Ph.D. Fish Pathology & Microbiology	1
Ph.D. Fish Nutritional & Biochemistry	1
Ph.D. Fish Genetics	1
<b>Total</b>	<b>96</b>

## 5.2 Guest lectures

Sl.No.	Name & Designation	Place	Title	Date
1.	Prof. Keshav Nireshwalia, Emeritus Scientist, AICTE, Mysore	CIFE auditorium	Fish inspection for quality and safety	October 12, 2003
2.	Dr. Minoru Wada, Research Associate, Ocean Research Institute, University of Tokyo	CIFE auditorium	Luminous Symbiosis between Marine Bacteria and Fishes	March 8, 2004.

## 5.3 Lectures delivered

Sl.No.	Name & Designation	Place	Title	Date
1.	Sh K.Murali Mohan, Technical Officer T-5	Dept. of Fisheries, Govt. of Pondichhery, Yanam,	Shrimp Culture Practices	September 10, 2003
2.	Dr.P.Rami Reddy Technical Officer, T-6	Dept. of Fisheries, Govt. of Pondichhery, Yanam,	Shrimp Diseases	September 10, 2003
3.	Dr.G.Venugopal, Officer Incharge, Kakinada Centre	Kakinada., A.P.	Techniques of freshwater prawn farming	September 15, 2003
4.	Dr.G.Venugopal Officer Incharge Kakinada Centre	Kaikaluru, A.P.	Techniques in Magur seed production	September 19, 1003
5.	Dr.P.Rami Reddy Technical Officer T-6, and Sh,P.Srinivasa Rao Technical Officer T-5	A.P. state Fisheries Department	Good Management Practices of Shrimp Farming and Scampi Hatchery Management	October, 2003
6.	Dr.G.Venugopal Officer Incharge Kakinada Centre	State Institute of Fisheries Technology, Govt. of A.P.	Good management practices in shrimp culture	November 27-31, 2003
7.	Dr.P.Rami Reddy Technical Officer, T-6	Dept of fisheries Govt. of A.P.at East, West Godavari and Visakhapatnam Districts	Eight (8) lectures on Good management Practices in Shrimp Culture	November, 2003
8.	Dr. P. Rami Reddy Technical Officer	Narsapur, A.P Razole, E.G. Dt. Veeravasam, W.G. Dt. Ramanakkapeta village, E.G. Dt.	Shrimp Culture and Good Management Practices	December 24, 2003 January 20, 2004 January 21, 2004 January 31, 2004
9.	Dr.G.Venugopal Officer Incharge Kakinada Centre	Amalapuram, A.P.	Improved Management methods for Scampi farming	January 29, 2004



#### 5.4 CAS Training Programme

1.	Advances in Disease Diagnostic Techniques for Finfish and Shell fishes	January 15 to February 4, 2004	22
2.	Advances in Fish Biotechnology	February 7-27, 2004	20

#### 5.5 Campus Interview

Campus interviews were conducted for the recruitment of students by various companies. M/s. Shakti Aquaculture and M/s. Waterbase conducted interviews on July 21 and 22, 2003, whereas M/s. Garware Wall Ropes conducted campus interview on August 08, 2003. A total of 10 students were recruited by the above mentioned companies

#### 5.6 Overseas students training

Ms. Smitha R. Nair, M.F.Sc. FBM was selected for a short training at the University of Kasetsart, Thailand and Mr. Pranay Kr. Parida underwent training at World Fish Centre, Penang on Ecopathmodelling as a part of Sir Dorabji Tata Endowment fund scholarship for scoring highest mark in M.Sc. semester I and II and highest marks in Ph.D I and II Semester respectively



following Short-Term Training Programmes were conducted during the period under report:

**CIFE, Mumbai**

<b>S.No</b>	<b>Title</b>	<b>Duration</b>	<b>No. of participants</b>
1.	Catfish Nutrition and Feed Technology	May 2-8, 2003	20
2.	Management of Freshwater and Marine Aquaria	May 11-17, 2003	36
3.	Biochemical Techniques in Fisheries	June 10-19, 2003	15
4.	Aquaculture Engineering	June 23-30, 2003	19
5.	Genetics and Molecular Biology Techniques	July 15-21, 2003	09
6.	Carp and Catfish Breeding and Culture	July 22-28, 2003	20
7.	Breeding and Culture of Carp	August 21-27, 2003	10
8.	Management of Giant Freshwater Prawn Hatchery and Growout Technology	September 29-12, 2003	25
9.	Basic Techniques of Disease Diagnosis in Aquaculture	December 16-22, 2003	10
10.	Peal Culture	January 29 to February 4, 2004	03
11.	Culture of Live Food Organisms	February 20 - March 04, 2004	01

### Kakinada Centre

S.No.	Title of the programme	Duration	No. of participants
1.	Freshwater Giant Prawn Hatchery Management and Grow out Techniques	March 31- April 9, 2003	13
2.	Freshwater Giant Prawn Hatchery Management and Grow out Techniques	March 10-19, 2003	13
3.	Disease Diagnosis, Control and Treatment Methods for Scampi, Shrimp and Fish	July 25 – August 1, 2003	14
4.	Breeding and Culture of Carps	August 21-27, 2003	10
5.	Freshwater Giant Prawn Hatchery Management and Grow out Techniques	September 18-24, 2003	12
6.	Breeding & Culture of Air-Breathing Fishes	October 9- 5, 2003	15
7.	Freshwater Giant Prawn Hatchery Management and Grow out Techniques	October 28-November 3, 2003	16
8.	Freshwater Giant Prawn Farming	December 30 January 4, 2004	7
9.	Freshwater Giant Prawn Hatchery Management and Grow out Techniques	March 17– 23, 2004	10

### Kolkata Centre

SI No.	Name of the Training	Duration	No. of trainees participants
1.	Shell Fish and Fin Fish Culture in Bheris	March 10-15, 2003	5
2.	Nutrition and Biochemical Techniques in Fisheries	May 19-28, 2003	8
3.	Inland Fisheries	June 16 to July 05, 2003	32
4.	Integrated Fish Farming Systems	July 07-13, 2003	13
5.	Carp Hatchery Management	July 29 to August 04, 2003	10



### Powerkheda Centre

Sl.No.	Name of Training	Duration	Participants
1.	<i>Adiwashi Machua Samuh Kai Liyai Matsya Palan Prashikshan</i>	May 29-31, 2003.	12
2.	<i>Adiwashi Machua Samuha kai liyai Matsya Palan Prashikshan</i>	September 29 – October 01, 2003	12
3.	Manegment of fish farm	October 06 - 15, 2003	17
4.	<i>Vill.Dhar Pragti Samuh Matsya Palan Prashikshan</i>	November 05- 07, 2003	12
5	<i>Carp Farming</i>	July 21-30, 2003	01

### Exhibitions

S.No.	Event	Place	Dates
1	Exhibition on the occasion of International Conference & Exposition on Marine Living Resources of India for Food & Medicine Ocean Life Expo'04	Chennai	February 27-29, 2004
2	India International Trade Fair	New Delhi	November 14-27, 2004
3	Krishi 2003	Nagpur	November 27- December 1, 2004
4	Kisan Mela, IARI	New Delhi	February 27-28, 2004
5	Science Exhibition, Indian Science Congress 2003	Chandigarh	December 2003
6	Kisan Mela, J.N.K.V.	Powerkheda	March 3, 2004
7	On occasion of a international meet of Councilors; NASC	New Delhi	March 12, 2004

### Preparation of exhibits for ICAR Extension Division

The Rohtak centre designed 9 exhibit panels showing the technologies developed for saline water aquaculture at centre for ICAR Extension Division. These panels will be displayed in various national and international exhibitions

### Visit Coordination

The following visits were co-ordinated at the centre

Sl.No.	Category	Number
1	Fisheries Colleges (UG)	188
2	Under Graduate Students (General)	492
3	Post Graduate Students (General)	41
<b>Total</b>		<b>721</b>

## Kisan Call Centre

Kisan Call Centre was inaugurated on December 23, 2003 at CIFE, Mumbai. The Ministry of Agriculture Govt. of India had launched 12 Kisan Call Centres at 12 premier institutes and Department of Agriculture in order to extend extension services to farming community through telecom services. Central Institute of Fisheries Education is identified as one of the centers to provide services of fisheries in the country.

## T.V. programmes

Television programmes were given by the faculty of Kakinada centre along with coverage of the various freshwater farming activities:

S.No	Topic	Faculty	Coverage Channel	Telecast on
1	Magur breeding, rearing and culture aspects,	Dr.G.Venugopal, Sr. Scientist and Mr. J. Krishna Prasad , Technical Officer	Annadata in Telugu Channel E.T.V.	September 21-22, 2003
2	Nursery pond management	K.B.S.Murty, Technical Officer	Annadata in Telugu Channel E.T.V	October 4, 2003
3	Scampi culture in carp nurseries	K.Radha Krishna Reddy, Technical Asstt.	Annadata in Telugu Channel E.T.V	November 21, 2003
4	Common carp breeding	Sh.K.B.S.Murty, Technical Officer	Annadata in Telugu Channel E.T.V	January 5, 2004

**Radio Talks :** The faculty of Kakinada Centre delivered talks at All India Radio, Visakhapatnam, the details are as follows:

S.No	Topic	Faculty	Date of broad cast
1	<i>Chepa pillala nurserylalo adhikothpathiki theesukovalasina charyalu</i>	K.B.S.Murty, Technical Officer	September 12, 2003
2	<i>Lates calcarifer culture</i>	Dr.P.Rami Reddy, Technical Officer	September 17, 2003
3	<i>Scampi royyala pempakam lo Adhikotpathi ki Aadhunika Paddatulu</i>	P.Srinivasa Rao, Technical Officer	October 24, 2003
4	<i>Marpu chepala Pempakapu vidhanam</i>	Sh.J.Krishna Prasad Technical Officer	01-01-04

## Interactive CD on Fisheries

For the benefit of the farmers and students an interactive CD on Fisheries of Rajasthan has been prepared by the Udaipur lab of Rohtak Centre.

## Farm Demonstrations:

Officer Incharge and technical staff of Kakinada & Balabhadrapuram farm have delivered introductory lectures and conducted practical farm demonstration to the following visitors.

**Postgraduate students:****No.of students**

! M.Sc. Pre & final year students & Faculty of	
! SV University, PG Centre, Kavali, A.P.	20
! M.Sc.(Aqua.) Final year students, A.C. college, Guntur	22
! M.Sc.students, Nagarjuna University, Guntur	36
! M.Sc Students and faculty from Govt.college, Rajahmundry	30
! M.Sc.students, Vivekavardhini College, Hyderabad	17

**Graduates:**

• B.F.Sc.students, College of fishery science, ANGRAU, Nellore, A.P.	11
• B.F.Sc.students, final year College of fisheries, Dholi, RAU Muzaffarpur, Bihar	12
• B.Sc.(BZC) III year students, MSN Degree College, Kakinada	20
• B.Sc. (ZOO) I, II, III Year students, Dr.SRK.Govt. Arts College, Yanam, (Pondichery)	12
• B.Sc. Final year Govt. Degree College, Tekkali	15

**Others.**

• United Fishermen Association, Bodduchinavenkatayapalem, E.G.Dt., A.P.	25
• CIFENET, Vishakapatnam with faculty	20
• Fish farmers from NEPAL state	8
• A P State Fishery officers	16
• Shrimp farmers from Razolu Mandal	40
• Students & teachers from Akshara School, Kakinada	80

**Technical guidance**

At the CIFE Head quarters technical guidance was given to *Ganesh Macchhimar Society* regularly regarding polyculture of carps and giant freshwater prawn. Farmers and entrepreneurs were given guidance on various aspects of aquaculture like carp and freshwater prawn culture, intensive carp culture, use of probiotics, polyculture of carps, etc.

Technical guidance on fish culture aspects was given to a score of fish farmers who visited the Powarkheda center besides a number of students and other entrepreneurs.

The faculty of the Kakinada center have rendered technical advisory services to private farmers on Magur seed production and culture, freshwater prawn farming and Brackishwater farming (finfish and shellfish).



**7.1 Kalawati Award**

Dr. G. V. Deshmukhe, Sr. Scientist received “Kalawati Award Gold Medal” from Dr. Panjab Singh, Ex-DG, ICAR and Secretary DARE (Chief Guest) on February 21, 2004.

**7.2 Dr. Zahoor Qasim Gold Medal**

Dr. G. V. Deshmukhe, Sr. Scientist, received “Dr. Zahoor Qasim Gold Medal “ of Society of Biosciences from Dr. Harsh K. Gupta, Secretary to the Govt. of India, Deptt. Of Ocean Development, New Delhi, on January 22, 2004.

**7.3 Fellowship conferred**

Dr. R. C. Das has been conferred with fellowship award by the Academy of Environmental Biology, Lucknow on October 9, 2003.

Dr. Archana Sinha, Senior Scientist, received the Fellowship of Zoological Society of India, Bodh Gaya on December 21, 2004.

**7.4 Prize for Poster Presentation**

Dr Archana Sinha, Sr. Scientist and Shri. S. K. Sharma, Technical Officer, received second prize in Poster presentation of research paper in Hindi organized by CIFE, Mumbai on September 22, 2003 on the occasion of Hindi Diwas. The certificate was awarded by Indian Agricultural Research Committee, Karnal on November 22, 2003.

## 7.5 ICAR Inter Institutional Sports Tournament

CIFE Mumbai organized the ICAR Inter institutional sports meet during January 5-9, 2004. The staff participated and won the following prizes.

### Mens event

4 x 100 mt Relay Race - Second Position

- 1) Mr. Surajbali Jaiswar
- 2) Mr. Vijay Kuveskar
- 3) Mr. J.M. Koli
- 4) Mr. Mahesh Waghela

### Women's event

Ms.Nalini Poojary	100 mt	First
Ms.Nalini Poojary	200 mt	Second
Ms.Nalini Poojary	High Jump	First
Ms.Nalini Poojary	Long Jump	Second
Ms.Madhavi Pikle	Shot put	Second
Ms.Shubhada Bagwe	Discus throw	First
Ms.Pragati Gadre/Ms. Venilla	Badminton Doubles	First
Ms. Venilla	Badminton Single	Second



Mrs. Nalini Poojary was adjudged the Best Women Athlete of the tournament for the third consecutive year

## 7.6 Ph.D. Awards

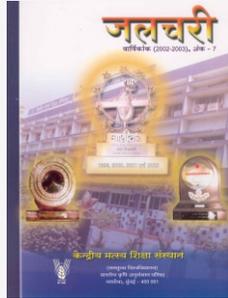
Dr. Shyam Salim, Scientist was awarded Ph.D. in Agricultural Economics (2004) for his thesis titled Trade liberalization and its impact on Indian fisheries export by the Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu-641 003.



## 7.7 Letter of Appreciation

Mr. Dasari Bhoomaiah was awarded a letter of appreciation from the ASRB, ICAR, New Delhi for his contributions in designing of the cover pages of ASRB Annual Reports.

## 7.8 Awards For Progress In Hindi



- The Rajshri Tandon Awards constituted by ICAR is awarded to those institutes who do commendable work in the progress of Hindi. This year CIFE Mumbai was awarded the second prize which was received by Dr. M.P.Singh Kohli, Principal Scientist at a function organized by ICAR Delhi on November 25, 2003.

- The CIFE annual Hindi Magazine *Jalchari* Vol. 17 was awarded the Rajbhasha Kiran Shresht Magazine Award at a grand function on December 12, 2003 at Mount Abu. The award was received by Shri Rajeshwar Uniyal, Assistant Director (O.L.)



- Mr. R.P. Uniyal, Assistant Director (O.L.) was awarded the *Sahitya Samman* Award by the Paraj Weekly Magazine during the 13<sup>th</sup> Paraj Savvottam Samman-2003 awards on November 9, 2003 at Mumbai.

## 7.10 Miscellaneous

Dr. K. Chandra acted as one of the National Advisory Committee Members in International Workshop on Marine Pollution and Eco-toxicology held at NIO, Goa during 23-26, February, 2004.

### **CIFE and IRSHA join hands together for development of “DIET FISH” for human health**

A Memorandum of understanding (MOU) was signed on December 19, 2003 between Central Institute of Fisheries Education (CIFE), Mumbai and Interactive Research School of Health Affairs (IRSHA), Pune, for scientific collaboration in the following fields:

- 1) To formulate the fish and prawn feed for improving the quality of meat & health of fishes by regulating the levels of Vitamin E, Vitamin C, Carotene, Saturated fatty acids, Cholesterol, Omega 3 fatty acid, Omega 6 fatty acid, EPA, DHA, other important fatty acids and amino acids.
- 2) To analyze the meat for the above and other related constituents.
- 3) To check the fish health with different parameters.
- 4) To study the Bio availability and clinical trial for human health.

### **MOU between CAS in Marine Biology, Annamalai University**

MOU between CAS in Marine biology, Parangipettai, Annamalai University and CIFE, Mumbai was signed on February 26, 2004 by Dr. S.C. Mukherjee, Director, (CIFE) and Dr. T. Balasubramanian, Director, CAS in Marine Biology who represented the Registrar, Annamalai University.

## 9. Publications

### 9a. Research Papers in National and International refereed Journals

- Barse, A.V., Jadhao, S.B., Sahu, N.P., Srivastava, P.P., Jain, K.K. and Pal, A.K. (2004). Responses of *Labeo rohita* for dietary *Lathyrus sativus*. *Asian Australian J. Animal Sciences*, 17(1): 127-130.
- Chakraborty S.K., 2003. Growth mortality and yield per recruit of *Nemipterus mesoprius* (Bleeker) from Mumbai waters. *Indian J. Fish.* 49(4): 389-395.
- Chatterjee N., A.K. Pal, S.M. Manush, T. Das, S.C. Mukherjee, 2004. Thermal tolerance and oxygen consumption of *Labeo rohita* and *Cyprinus carpio* early fingerlings acclimated to three different temperatures. *Journal of Thermal Biology*, 29: 265-270.
- Choudhury S., P. Pattnaik, A. Sree, M. Bapuji and S.C. Mukherjee, 2003. Antibacterial activity of sponge extracts against fish pathogens. *Aquaculture Research*, 34: 1075-1077.
- Das T., A.K. Pal., S.K. Chakraborty, S.M. Manush, N. Chatterjee, S.C. Mukherjee, 2004. Thermal tolerance and oxygen consumption of Indian Major Carps acclimated to four temperatures. *Journal of Thermal Biology*, 29: 157-163.
- Deka, A, Sahu, N.P., and Jain, K.K., 2003. Utilisation of food processing wastes in the diet of *Labeo rohita* fingerlings. *Asian-Australian J. anim. Sci.* 16 (1) : 1661-1665.
- Hemabindu, V., Sahu, N.P., and Jain, K.K. 2004 Effect of feeding lactobacillus based probiotics on the gut microflora, growth and survival of post-larvae of *Macrobrachium rosenbergii* (deMan). *Aquaculture Res.*, 35: 1-7.
- Jaiswar A. K., S. K. Chakraborty, R. Palaniswami, Raja Prasad and Suneel Boomy Reddy, 2003. Population dynamics of lizard fish *Saurida tumbil* (Bloch) from Mumbai, India. *Indian J. Mar. Sci.*, 32(2):147-150.
- M. Afzal Khan, A.K. Jafri, N.K. Chadha and U. Usmani, 2003. Growth and body composition of rohu (*Labeo rohita*) fed diets containing oil seed meals: partial or total replacement of fishmeal with soybean meal. *Aquaculture Nutrition*, 9: 391-396.
- Manush S.M., A.K. Pal, N. Chatterjee, T. Das, S.C. Mukherjee, 2004. Thermal tolerance and oxygen consumption of *Macrobrachium rosenbergii* acclimated to three temperatures. *Journal of Biology*, 29: 15-19.
- Masud, S and K. Pani Prasad. 2003. Outbreak of ich infection in an aquarium fish. *Journal of Current Sciences*. Vol. 2 (II).
- Mishra Chandra Kanta, Basanta Kumar Das, Jyotirmayee Pradhan, Phalguni Pattnaik, Satyanarayan Sethi, S.C. Mukherjee, 2004. Changes in Lysosomal enzyme activity and protection against *Vibrio* infection of *Macrobrachium rosenbergii* (de Mann) post larvae after bath immunostimulation and -glucan. *Fish and Shellfish Immunology*, 17: 389-395.
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## 10. LIST OF APPROVED ON-GOING PROJECTS

### 10.1 Institutional Projects

S.No	Sub-project code	Title of the Project	Team	Status
<b>AQUACULTURE DIVISION</b>				
1	CIFE (M)-2003/1-AQ	Refinement of cage culture for rearing and raising table size fish in open waters with emphasis on nutrition and econom	M.P.Singh Kohli	Ongoing project
2	CIFE (M)-2003/2-AQ	Evaluation of permethrin and deltamethrin toxicity and efficacy of ascorbic acid in reducing toxicity related stress in common	<b>Neelam Saharan</b> Kiran Dubey Chandra Prakash P.P. Srivastava	Ongoing project
3	CIFE (M)-2003/3-AQ	Seed Production of <i>Macrobrachium rosenbergii</i> in Rajasthan using sea water (Natural/artificial) and inland saline ground water, and the demonstration of successful technology to the beneficiaries	<b>Atul Kumar Jain</b>	Ongoing project
4	CIFE (M)-2003/19-AQ	Induced breeding, hatchery development and seed rearing of large river catfishes, <i>Aorichthys seenghala</i> , <i>Aorichthys aor</i> and <i>Wallago attu</i>	<b>M.P.Singh Kohli</b>	New project
5	CIFE (M)-2003/20-AQ	Aquaculture through rainwater harvesting	<b>S.C. Mukherjee</b>	New project
<b>FISH GENETICS AND BIOTECHNOLOGY DIVISION</b>				
6	CIFE (M)-2003/4-FGB	Estimation of Intra-species Variations among the Hatchery bred rohu Populations Different State	<b>Shrinivas Jahageerdar</b>	Ongoing project
7	CIFE (M)-2003/5-FGB	Sperm preservation of the Asian catfish <i>Clarias batrachus</i>	<b>Gopal Krishna</b>	Ongoing project
8	CIFE (M)-2003/6-FGB	Development of RAPD markers for the identification of various populations of <i>Penaeus monodon</i> of India	<b>Aparna Chaudhari</b>	Ongoing project
<b>FISH HEALTH MANAGEMENT DIVISION</b>				
9	CIFE (M)-2004/21-FHM	Evaluation of antibiotic residues in farmed shrimp and prawns of coastal India and antibiotic resistance of different bacteria of aquafarms	<b>K. Pani Prasad</b> S.C. Mukherjee R.P. Raman Nalini Poojary	New project

<b>AQUATIC ENVIRONMENTAL MANAGEMENT DIVISION</b>				
10	CIFE (M)-2003/7-AE	Documentation of Halophilic Bacterial Diversity in Western	<b>C.S. Purushothaman</b> A.K. Jain P.K. Pandey A Vennila A.K. Padmanabhan R.D. Tandel A.T. Landge	Ongoing
11	CIFE (M)-2003/8-AE	Evaluation of the neuro-modulatory activity of conopeptides	<b>K. Venkateshvaran</b> Ram Raghbir CDRI Lucknow (Subject Matter Specialist) Asha T. Landge Nalini Poojari	Ongoing project
12	CIFE (M)-2003/9-AE	Microcystin-LR and Anacystin in Powai Lake and their Impact on the Zooplankton and Ichthyofauna	<b>A Vennila</b> K. Venkateshvaran Asha T. Landge	Ongoing project
<b>FISHERIES INFORMATICS AND TECHNOLOGY EVALUATION AND TRANSFER DIVISION</b>				
13	CIFE (M)-2003/10-IT	Fisher-Women and Livelihoods: An Ergonomic Perspective	<b>Arpita Sharma</b> S.N.Ojha P.S. Ananthan A.D. Ragabhagat G.K. Rao D. Khogre Rajani Khandagale D.L. Sawant	Ongoing project
14	CIFE (M)-2003/11-IT	Impact of Trade Liberalisation and WTO Agreement on Exports of Indian Fish Products	<b>P.S. Ananthan</b> R.S. Biradar S.N.Ojha Shyam Salim A.D. Ragabhagat	Ongoing project
15	CIFE (M)-2004/22-IT	Geographical information system for sustainable brackishwater aquaculture development in Maharashtra and Gujarat	<b>R.S. Biradar</b> Neelam Saharan Krishna Reddy Ram Singh M. Pikle S.S. Gajbhiye Rajani H. Khandagale Narendra Agalawe	New project
16	CIFE (M)-2004/23-IT	A pilot study on supply chain management in fisheries	<b>S. N. Ojha</b> R.S. Biradar Shyam S. Salim P.S. Ananthan	New project

<b>FISHERIES RESOURCE MANAGEMENT</b>				
17	CIFE (M)- 2003/12-FRM	Stock Assessment of Some Fishery Resources off Mumbai Coast	<b>S. K. Chakraborty</b> R.S. Biradar A.K. Jaiswar Palani Swamy	
18	CIFE(M)- 2004/24-FRM	Fishing Technologies: Optimal designs and Economic Viability of fishing Craft and gears along the coast of Maharashtra	<b>Latha Shenoy</b>	
<b>FISH NUTRITION AND BIOCHEMISTRY DIVISION</b>				
19	CIFE (M)- 2004/26-FNB	Studies on production and conversion efficiency of omega-3 fatty acids in India major carps	<b>G. Venkatshwarlu</b> A.K.Pal S.D. Singh	New project
20	CIFE(M)- 2004/27-FNB	Prevalence of Aflatoxin in feed ingredients, remedial measures and its effects on growth performance and metabolic responses in Indian Major carp <i>L. rohita</i> (L.)		
21	CIFE (M)- 2004/28-FNB	Studies on nutrient dense micro-particulate diet for hatchery rearing of <i>Macrobrachium rosenbergii</i>	<b>A.K. Pal</b> N.P.Sahu G. Venkateswarlu A.K. Reddy	New project
22	CIFE (M)- 2004/29-FNB	Molecular studies on promoters and growth enhancers of commercially important fishes	<b>S.D. Singh</b> P.P. Srivastava J.P.Patil	New project
<b>POST-HARVESTING TECHNOLOGY DIVISION</b>				
23	CIFE(M)- 2003/15-PHT	Development of Value-added Products from Under-utilised Low-cost Fish	<b>S. Basu</b>	
<b>CIFE, KOLKATA CENTRE</b>				
24	CIFE (K)-2003/16	Studies on the Influence of Different Water, Soil and Organic Matter Parameters on the Chemo-toxicological Xenobiotics to Fish	<b>Subhendu Datta</b>	Ongoing project
25	CIFE(K)-2003/17	EIA Studies of the Rivers and Associated Ecosystems of Eastern States to identify Strategies for the Enhancement of Fish Production in the Region		
26	CIFE (K)-2004/30	Induced maturation and spawning of egg layer ornamental fishes through artificial feed supplemented with probiotics	<b>Archana Sinha</b>	New project

27	CIFE (K)-2004/31	Strategical approach for development of compounded feed for carp and prawn based polyculture system in West Benga	<b>Parimal Sardar</b>	New project
28	CIFE (K)-2004/32	Breeding and mass scale seed raising in five endangered fish species in field condition	<b>R.C. Das</b>	New project
<b>CIFE, LUCKNOW CENTRE</b>				
29	CIFE (L)-2003/18	Dissemination of Existing Pisciculture Technologies in Barabanki District through Multi-Directional Approach	<b>Alok K. Jain</b>	Ongoing project
<b>CIFE, POWERKHEDA CENTRE</b>				
30	CIFE (P)-2003/20	Constraints identification in freshwater prawn ( <i>Macrobrachium rosenbergii</i> ), culture in agro-climatic condition of Western M.P. and its extension	<b>Somduitt</b> S.S.H. Razvi Dr. R.K. Upadhyay V.G. Dubey G.B. Singh	Ongoing project
<b>CIFE, KAKINADA CENTRE</b>				
31	CIFE (KAK)-2001/S-KAK-I	Experiments on Eco-friendly Culture Practices in Aquaculture	<b>G. Venugopal</b> K. Murali Mohan K. Srinivasa Rao P. V.N. Acharyulu P. Satyanarayana R.R.S. Patnaik S.S.N. Murthy	Ongoing project
32	CIFE (KAK)-2004/33	Development of alternative shellfish and finfish in brackishwater aquaculture	<b>G. Venugopal</b>	New project
<b>CIFE, ROHTAK CENTRE</b>				
33	CIFE (R)-2002/10-ROH-I	Development and Standardizations of Aquaculture Techniques for Inland Underground Saline Water	<b>Sudhir Raizada</b>	Ongoing project
34	CIFE (R)-2002/10-ROH-I (S2)	Development of hatchery technology of giant freshwater prawn using inland sub-surface water	<b>Sudhir Raizada</b> N.K. Chadha Ashok Kumar Hasan Javed Sanjeevan Kumar	Ongoing project
35	CIFE (R)-2002/10-ROH-I (S3)	Seed production of Asian catfish (major) in inland saline ecosystem	<b>N.K.Chadha</b> S. Raizada M. Ali Inderjit Singh Ashok Kumar Hasan Javed Sanjeevan Kumar	Ongoing project
36	CIFE (R)-2002/10-ROH-I (S4)	Recycling of Seepage Water through sub-surface Drainage System in the Fishponds for Semi-arid Region	<b>A.K. Verma</b> Ashok Kumar	Ongoing project

## 10.2 Externally Funded Projects

SN	Title of Project	Funding Agency	Duration	PI / Co-ordinator
1.	Thermal tolerance of important fish species from River Kali, Karnataka	DAE	November 1999 -2003	Dr. A. K. Pal
2.	Cytogenetic and molecular characterization of the giant freshwater prawn	A.P.Cess Fund ICAR	February 2001-April 2004	Dr. W.S. Lakra
3.	Laboratory and Field Culture of Edible Seaweeds Along Maharashtra Coast and Their Product Development for Health and Nutrition	DOD	August 2000 – September 2003	Dr. K. Dube
4.	Wound Healing, Antineo-plastic and Antioxidant Compounds from two marine crinotoxic fishes	NATP	April 2001 – December 2004	Mr. K. Venkateshwaran
5.	Intensive seed raising and growout production of carp through multiple cropping	DST	November 2001-October 2004	Dr. A. K. Reddy
6.	In-Service training programme in Molecular Biology	DBT	Oct. 2000 – October 2004	Dr. W. S. Lakra
7.	Development and characterization of cell lines from selected fish and shellfish species used in aquaculture	DBT	October 2001 – October 2004	Dr. W. S. Lakra, CIFE Dr. R. R. Bhonde, NCCS, Pune
8.	Fish production using brackish-water in arid ecosystem	NATP	May 2000 – December 2004	Dr. A. K. Jain
9.	Use of Probiotics in Fish Nutrition	A. P. Cess ICAR	October 2003 – September 2005	Dr. Archana Sinha
10.	Integrated Aquaculture for Sustainable Resources Management in Biovillages	DBT	May 2002 – April 2005	Dr. S. N. Ojha

11.	Development of Egg Yolk Antibodies (Edible Antibodies –IG Y) for Fish Health Management	AP-Cess, ICAR	July 2003 – May 2006	Dr. K. Pani Prasad
12.	Population Genetic Evaluation of Growth of Mahseer	AP-Cess, ICAR	October 2003 - Sept. 2006	Dr. Gopalkrishna
13.	Predictive modeling off Bombay Duck landings off north-west coast of India	DOD	April 2003 – March 2006	Dr. R. S. Biradar
14.	National Risk Assessment Programme for Fish and Fish Products for Domestic and International Markets – Assessment of Microbiological, Chemical and Parasitological risk Associated with Shell fishes along Maharashtra Coast	AP-Cess, ICAR	July 2003 – June 2006	Dr. S. Basu
15.	Identification of salt tolerance gene in marine shrimps <i>P. monodon</i>	AP Cess ICAR	February 2004 – January 2007	Aparna Chaudhari
16.	Assessment of Intertidal Biodiversity in and Around Mumbai.	AP Cess ICAR	June 2004 – May 2007	Dr. S. K. Chakraborty
17.	Potential Uses of Thermal Effluents of Nuclear Power plants for Carp Breeding and Seed Production	DAE	February 2004 - 2007	Dr. A. K. Pal

### 11.1 Contract Research

■ Raafres Aqua, a product of Guybro Chemical, was used for a Contract Research and laboratory trials in *Macrobrachium rosenbergii* (Freshwater Prawn) were conducted by Central Institute of Fisheries Education, Mumbai, for a period of 6 months. Raafres contains various organic acids - glucan, mannon oligosaccharide (derived from yeast cell wall). The product acts by reducing pH in the feed as well as in the gastrointestinal tract. This also restricts growth of intestinal pathogens. Glucan and MOS provide intestinal integrity and acts as an Immunomodulator.

After the trials, CIFE has certified the product which has shown increase weight gains (44%) and improve FCR (28%), reduction in disease incidence and stress and significant reduction in mortality.

The commercial trials in shellfish were authenticated by laboratory trials conducted by Dr. A.K. Pal, Mr. A.K. Reddy and Dr. Bam Deo Pandey of this Institute. The product formulated by Guybro Chemicals, Mumbai was officially and formally released by Dr. S.A.H. Abidi, Member, ASRB, New Delhi on July 5, 2003 at CIFE, Mumbai in presence of Dr. S. Ayyappan, Deputy Director General (Fisheries), ICAR, New Delhi.

■ Evaluation of cotton seed meal derived from transgenic Bollgard II cotton hybrids seed containing cry-X genes (*Cry 1 AC & Cry 2Ab*) as a feed ingredient for common carp, *Cyprinus carpio* (L.)

The genetically modified cotton seed (Bollgard-II) containing *Cry-IAC & Cry-2Ab* genes, in comparison to Bt.cotton variety without *Cry-IAC & Cry-2Ab* (Non-BG-II) genes shows similar growth pattern and there was no significant difference ( $P < 0.05$ ) among FCR, FER and PER of these two varieties on feeding to common carp (*Cyprinus carpio*) for 56 days. However, histopathological alterations in gill, liver, intestine and kidney have been recorded in all the three groups (BG-II, NBG-II and laboratory control feed MOC) during the experimentation. The BG-II and Non-BG-II feeds ( $F_1-F_3$  and  $F_4-F_5$ ) are compared with MOC incorporated feed ( $F_7-F_9$ ) on the basis of isocaloric and isoproteinaceous feeds in terms of growth studies. The team members are Dr. S. C. Mukherjee, PI, Dr. K. K. Jain, Co-PI and Dr. P. P. Srivastava, Co-PI.



# 12

## 12.1 Participation of faculty in Conference/Meetings etc. in India

Sl.No.	Meetings/Seminar/Symposia /Summer School	Date	Venue	Attended by
1	Vice Chancellor's Conference	April 1-2, 2003	New Delhi	Dr. S.C. Mukherjee, Director
2	Meeting at National Centre for Cell Science	April 8, 2003	Pune	Dr. C.S.Purushothaman, Principal Scientist
3	Indo-French Collaboration Meeting at KAB-II, ICAR	April 15, 2003	ICAR, New Delhi	Dr. S.C. Mukherjee, Director
4	Meeting regarding collaborative projects in the field of environment	April 16-17, 2003	CIFA, Bhubaneswar	Dr. C.S. Purushothaman, Principal Scientist
5	Brain Storming Session at Kolkatta as Task Force Member	April 16-17, 2003	IICB, Kolkatta	Dr. S.C. Mukherjee, Director
6	The consultancy group meeting and presented the paper on Need based research priority in ornamental fisheries	May 23, 2003	NABARD	Dr. Archana Singh, Sr. Scientist
7	Meeting with TIFAC and Signing of MOU with CDRI, Lucknow	June 1-3, 2003	CIFE Centre, Lucknow	Dr. S.C. Mukherjee, Director
8	Meeting of the Project Implementation and monitoring of TIFAC	June 3, 2003	CIFE Kolkata Centre	Dr. R.C. Das, Principal Scientist
9	One day brain storming workshop on Training Needs Assessment of ICAR Employees conducted by NAARM, Hyderabad	9 July, 2003	CIFE, Mumbai	Technical Staff from CIFE H.Q.
10	Interactive meeting with Dr. V. Sampath, FAO National consultant	July 20, 2003	State Institute of Fisheries Technology, Govt. of A.P.	Dr. P. Rami Reddy, Technical Officer Kakinada Centre
11	Meeting of the Directors of Fisheries Institute on NEH	July 29, 2003	ICAR, New Delhi	Dr. S.C. Mukherjee, Director
12	Directors' conference	July 30, 2003	ICAR, New Delhi	Dr. S.C. Mukherjee, Director
13	Meeting with RAC chairman and Principal Director (Finance)	July 31, 2003	ICAR, New Delhi	Dr. S.C. Mukherjee, Director
14	International Symposium on Fresh Water Prawns 2003	August 20 –23, 2003	Kochi	Dr.G.Venugopal, Sr. Scientist
15	Aquaculture Expo 2003	August 23, 2003	Nellore	Dr. S.C. Mukherjee, Director

16	Meeting for Prioritization of Biotechnology in Fisheries Science	August 25 and 26, 2003	CCMB, Hyderabad	Dr. S.C. Mukherjee, Director, Dr. W.S. Lakra, Principal Scientist, Dr. Aparna Chaudhary, Sr. Scientist and Dr. K. Pani Prasad, Scientist
17	International Symposium on Fish and Shellfish Diseases	August 27, 2003	Thiruvananthapuram	Dr. S.C. Mukherjee, Director
18	Shrimp Farmers Meet	September 10, 2003	Yanam	Dr. P. Rami Reddy, Technical Officer and Shri K. Murali Mohan Technical Officer
19	Farmers' Meet, Kakinada	September 15, 2003	Kakinada	Dr. G. Venugopal, Sr. Scientist
20	Prospect of fish and shrimp culture in Brackishwater	September 18, 2003	Jaipur	Dr.A.K.Jain, Sr. Scientist
21	Workshop on Freshwater Aquafarming in Andhra Pradesh- Lessons and Challenges in Sustainable Development	September 19, 2003	Kaikalulru, A.P.	Dr.G.Venugopal, Sr. Scientist and Sh.R.R.S.Patnaik Technical assistant
22	International Seminar on Downsizing Technology for Rural Development	October 7-9, 2003	TIFAC, RRL (CSIR) at Bhubaneswar	Dr. S.C. Mukherjee, Director
23	Meeting to Prioritize the research needs in fisheries sector	18-10-2003	Commissioner of Fisheries (Govt. of A.P.), Hyderabad.	Dr.G.Venugopal, Sr. Scientist
24	West Zone Vice Chancellors' Conference-2003	October 16-17, 2003	South Gujarat University, Surat	Dr. S.C. Mukherjee, Director
25	Meeting to extend the Memorandum of understanding with BARC	October 20, 2003	Bhabha Atomic Research Centre, Mumbai	Dr. C.S. Purushothaman, Principal Scientist
26	Meeting with the delegation of University of New South Wales, Australia	October 30, 2003	Mumbai	Dr. R.S. Biradar, Principal Scientist
27	DBT task force meetng	October 31, 2003	DBT, New Delhi	Dr. S.C. Mukherjee, Director
28	National Workshop on Methodologies for prioritization of fisheries research in India	November 10-11, 2003	NAARM, Hyderabad	Dr. R. S. Biradar, Principal Scientist Dr. S. N. Ojha, Sr. Scientist, Dr. Arpita Sharma, Sr. Scientist, Dr. Shyam Salim, Scientist and Dr. Ananthan, Scientist
29	Vice chancellor's Conference and National Symposium	November 13-14, 2003	Y.C.M. Open University, Nasik	Dr. S.C. Mukherjee, Director

30	Meeting on Sustainable Aquaculture and Training Programme to Aquafarmers	November 17, 2003	Hyderabad	Dr. G. Venugopal, Sr. Scientist
31	First Faculty Development Programme in Educational Technology	December 3-23, 2003	NAARM, Hyderabad	Dr. P.K. Pandey, Scientist(SS)
32	Meeting on Large Marine Eco-System Programmes	December 4, 2003	ICM, Kakinada	Dr.P.Rami Reddy, Technical Officer
33	Seminar-cum-Kisan Mela and Exhibition	December 17, 2003	Dhaura, Unnalo, Lucknow	Dr. S.C. Mukherjee, Director
34	3 <sup>rd</sup> Interaction workshop of NATP on Fish production using Brackishwater in Arid Ecosystem	December 17-18, 2003	CCS Haryana Agricultural University, Hisar	Dr.A.K.Jain, Sr. Scientist
35	Meeting to Investigate Disease Problem	December 31, 2003	CIFA, Bhubaneshwar	Dr. S.C. Mukherjee, Director
36	All-India Hatcheries Operators Meeting	January 8, 2004	Kakinada	Dr.G.Venugopal, Sr. Scientist, Sh.K.Murali Mohan Technical Officer, Mr. V.N. Acharyulu, Technical Officer and Mr. .R.Ravishankar Patnaik ,Technical Asst.
37	Inaugural function of training programme on Saline Water Aquaculture	January 13, 2004	Jodhpur	Dr. S.C. Mukherjee, Director
38	National Symposium of Seaweed Exposition	January 22-24, 2004	Kochi	Dr. G Deshmukhe
39	ICAR/ICLARM Workshop on Strategies and options for increasing fisheries and aquaculture production to benefit poor house holds of India	January 28-31, 2004	NCAP, New Delhi	Dr. R. S. Biradar, Principal Scientist, Dr. S. N. Ojha, Sr. Scientist and Dr. Ananthan P. S., Scientist
40	National Workshop on Strategies and Options for Increasing and Sustaining Fisheries and Aquaculture Production to benefit poor households in India	January 29-30, 2004	New Delhi	Dr. R.S. Biradar, Principal Scientist
41	Technical Conference on Aquaculture sector for better Business opportunities and to update the knowledge at Aqua Expo-2004	January 29-30, 2004	Amalapuram	Dr.G.Venugopal, Sr. Scientist, Dr.P.Rami Reddy, Technical Officer and Mr. V.N.Acharyulu, Technical Officer

42	Management of aquatic resources for biodiversity maintenance and conservation	February 2-4, 2004	J.N.V. University, Jodhpur	Dr.A.K.Jain, Sr. Scientist
43	Coastal Biodiversity Training and Capacity building workshop on Biodiversity of invertebrate and vertebrate	February 3-12, 2004	National Institute of Oceanography, GOA	Dr. A. K. Jaiswar, Technical Officer
44	National Symposium on Disease Problems in Aquaculture –Challenges, Approaches and Management	6-7 February 2004	CIFE, Mumbai	Dr.G.Venugopal, Sr. Scientist, Dr.P.Rami Reddy, Technical Officer, Mr.J.Krishna Prasad, Technical Officer and Mr.K.Murali Mohan Technical Officer
45	National Seminar on Prospects of Ornamental fish Breeding and culture in Eastern and North Eastern states	February 14-16, 2004	CIFE, Kolkata Centre	Dr. Arpita Sharma, Scientist
46	National Conference on Agriculture for Kharif Campaign-2004	February 15-17, 2004	New Delhi	Dr. R.S. Biradar, Principal Scientist
47	International Conference Exposition on Marine living resources of India for food and medicine	February 27-29, 2004	Image MRC Nagar, Chennai	Dr. G. Venugopal, Sr. Scientist and Mr. V.N. Acharyulu, Technical Officer
48	Meeting on release of Atlas on Mangrove wetlands of A.P.	March 4, 2004	M.S. Swaminathan, Research foundation at Kakinada	Dr.G.Venugopal, Sr. Scientist, Dr.P.Rami Reddy, Technical Officer and Mr.K.Murali Mohan, Technical Officer
49	The TIFAC Meeting	March 13, 2004	Chennai	Dr. S.C. Mukherjee, Director
50	Hindi Seminar	March 15, 2004	CICFRI, Allahabad	Dr. S.C. Mukherjee, Director
51	International Workshop on Isolation, preservation and conservation of agriculturally important microorganisms, and use of Potential tools for their identification	March 16-17, 2004	NBAIM, New Delhi	Dr. K. Pani Prasad, Scientist, Dr. P.K. Pandey, Scientist, Mr.V .N. Acharyulu Technical Officer and Mr.R.Ravishankar Patnaik, Technical Asstt
52	National Symposium on Problem and prospects of aquaculture	March 27-29, 2004	The Institute of Science, Mumbai	Dr. A. K. Jaiswar, Technical Officer

## 12.2 Manpower Development

SI.No.	Training	Duration	Venue	Attended by
1	Management Development Programme for women scientists	May 27 - June 6, 2003	NAARM, Hyderabad	Dr. Archana Sinha, Senior Scientist
2	Faculty Development Programme in Education Technology	June 5-July 2, 2003	Academy of Agricultural Research and Education Management, Directorate of Human Resource Management, Hissar	Shri Suryakant Patil, Scientist
3	Leadership and Personality Development	June 19-25, 2003	NAARM, Hyderabad	Mrs. Swati S. Parab, Assistant
4	134 <sup>th</sup> Cash & Accounts Training Course	July 7-5 September, 2003	ISTM, New Delhi	Shri Jogendra Singh, Asstt.
5	Advances in Videography and Photography	July 17-26, 2003	NAARM, Hyderabad	Shri D.L. Sawant, Photographer
6	Environmental Science	July 23, 2003	Trivendrum	Dr. P.K. Pandey Scientist (SS)
7	Disease Diagnosis, Control and Treatment Methods for Shrimp, Scampi and Fish	July 25- 31, 2003	CIFRI, Barrackpore	Mr. P.S.Pandey, Technical Officer
8	Stress Management for Scientists	August 1-7, 2003	NAARM, Hyderabad	Shri R.P. Raman, Scientist
9	Methodologies for Manpower Planning in Agriculture	August 6-8, 2003	NAARM, Hyderabad	Mrs. Arpita Sharma, Scientist
10	GRAM++ Software	August 2, 2003	IIT, Powai, Mumbai	Dr. S.N. Ojha, Sr. Scientist
11	Computer Applications in Social Sciences	October 14-23, 2003	University of Agricultural Sciences, Karnataka, Dharwad	Dr. S.N. Ojha, Sr. Scientist
12	Molecular Markers: Tools for Genetic Variability Analysis	November 3-5, 2003	National Bureau of Fish Genetic Resources, Lucknow	Dr. R.S. Rana, Technical Officer
13	Team Building & Effective Leadership – Organisational Growth	November 4-8, 2003	Centre for Human Resource Administration & Training, Mysore	Shri P.D. Sonawane, Admn, Officer
14	Quantitative Methodology for Natural Resources Economics, Empirical Analysis with Practical Applications	October 27 – November 07, 2003	NCAP, New Delhi	Dr. S.N. Ojha, Sr. Scientist
15	Recent Advances in Survey Sampling with special Emphasis on Computer Intensive Data Analysis Techiques	November 5-25, 2003	IASRI, New Delhi	Shri G.K. Rao, Technical Officer

16	National workshop on Methodologies for prioritization of Fisheries Research in India	November 10-11, 2003		Dr. R.S. Biradar, Principal Scientist and Dr. Shyam Salim, Scientist, Dr. Arpita Sharma, Scientist and Dr. Anathan, Scientist
17	Winter School on Training Management for subject Matter Specialists of State Agricultural Universities	November 10-30, 2003	University of Agricultural Sciences, Bangalore	Dr. Arpita Sharma, Scientist (SS)
18	Technology Demonstration cum Training on Cultivation and Processing of Medicinal and Aromatic Plants	November 10-14, 2003	National Bioresource Development Unit at Institute of Himalayan Bioresource Technology, Palampur (HP)	Shri R.P. Raman, Scientist (SS)
19	LEARNITY software	November 12-15, 2003	CIFE, Mumbai	Staff of Fisheries Informatics, Technology Evaluation & Transfer Division
20	Wastewater-fed Aquaculture	November 11-17, 2003	Central Institute of Freshwater Aquaculture (ICAR), Wastewater Aquaculture Division, West Bengal	Dr. R.K. Upadhyay, Technical Officer
21	Team Building & Effective Leadership- Organisational Growth	November 23-27, 2004	Centre for Human Resource Administration & Training, New Delhi	Mr. P.D. Sonawane, Admn. Officer
22	Administration of Establishment & Personnel Rules in Governments, PSUs & others	November 24-28, 2003	Hotel Plaza, Goa	Mr. Sunil Kumar, Asstt. Administrative Officer
23	Faculty Development Programme in Educational Technology	December 3-23, 2003	National Academy of Agricultural Research management, Hyderabad	Dr. P.K. Pandey, Scientist (SS)
24	Organic Farming in Aquaculture with respect to Farming System in Andhra Pradesh	December 5-11, 2003	CIFA, Vijayawada Centre	Mr. K. Radha Krishna Reddy, Technical Officer
25	GIS Applications in Agricultural Research	December 15-24, 2003	NAARM, Hyderabad	Dr. R.S. Biradar, Principal Scientist
26	Advances in Disease Diagnostic Techniques for finfish and shellfish	January 15 to February 4, 2004	CIFE, Mumbai	Mr. K. Murali Mohan, Technical Officer
27	Advances in Fish Biotechnology	February 7-27, 2004	CIFE, Mumbai	Dr. P. Rami Reddy, and Mr. J. Krishna Prasad, Technical Officers

### 12.3 Visits Abroad

Dr. K.V. Rajendran, Sr. Scientist has been deputed to Australia for the post of fish Pathologist at the Common wealth Scientific and Industrial Research Organisation (CSIRO), Australia for a period of three years with effect from April 30, 2003.

Dr. W.S. Lakra, Principal Scientist was deputed to attend a meeting on "Expert Consultation on Ecological Risk Assessment" in conjunction with the 7<sup>th</sup> Steering Committee Meeting of INGA from August 4-8, 2003 at Dhaka, Bangladesh.

Dr. G. Venkateshwarlu, Senior Scientist successfully completed a 1 year's Sabbatical at the Danish institute of Fisheries Research, Copanhagen, Denmark by September 30, 2003. Upon his return, he presented a Seminar on his work at Denmark on "Oxidation of Fresh Oil Enriched Foods".

Dr. Gopal Krishna, Sr. Scientist was deputed to attend the 4<sup>th</sup> Training course on "Quantitative Genetics and its Application in Aquaculture" from 20-31 October, 2003 at World Fish Center, Penang, Malaysia.

Dr.(Ms.) Aparna Chaudhari, Sr. Scientist was deputed to attend the training under National Agricultural Technology project in the field of "Development of Transgenic Fish Models to Scale Environmental Toxicity" from 23 October, 2003 to 21 January, 2004 at University of Minnesota, USA.

Dr. Shrinivas Jahageerdar, Scientist was deputed to attend the 4<sup>th</sup> training course on "Quantitative Genetics and its Application in Aquaculture" from October 13, 2003 to 12 December, 2003 at World Fish Center, Penang, Malaysia.

Dr. Atul Kumar Jain, Sr. Scientist and Principal Investigator of NATP project was deputed for the training on "Inland Saline water Aquaculture Research and Development at Inland Saline Aquaculture Research Centre (ISARC), Post Stephens Fisheries Center, NSW, Australia under NATP PSR sub-project "Fish Production using Brackish water in Arid Ecosysem" during March 28, 2004 to May 2, 2004.

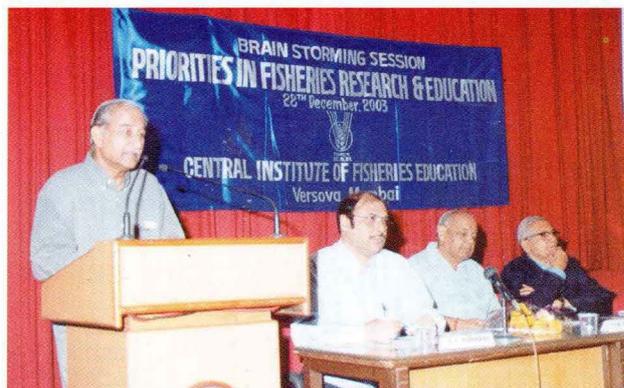
13.1 Meetings organized

Board of Management	March 23, 2004
Academic Council	June 5, 2003 September 19, 2003 March 19, 2004
Staff Research Council	April 23-26, 2003 February 28, 2004
Board of Examiners	June 3-4, 2003 September 9-10, 2003 October 21-22, 2003 February 26-27, 2004
Research Advisory Committee	July 5, 2003
Board of Studies	November 1, 2003 February 11, 2004
Official Language Implementation Committee	March 18, 2004
QRT (1998-2003) Meeting	August 18-19, 2003



### 13.2 Seminar/Symposia, etc. Organised

March 8-24, 2004	Workshop on Health and Nutritional Security for Fisherwomen
May 14-15, 2003	Workshop – cum – demonstration on Cage aquaculture in Open waters
December 19-20, 2003	A Hindi Seminar on Fish Processing - Present and Future prospects
December 28, 2003	Brain Storming Session on Priorities in Fisheries Research and Education
January 5-9, 2004	ICAR Inter Institutional Sports Meet (Zone II) 2003 - 2004
February 6-7, 2004	A National Symposium on Disease Problem in Aquaculture – Challenges Approached and Management
February 16-17, 2004	National Seminar on Prospects of Ornamental Fish Breeding And Culture In Eastern And North-Eastern India (CIFE Kolkata Centre)
March 1, 2004	Brainstorming Session on Policies on Utilization of Saline Water for Aquaculture
March 11, 2004	Meeting with CIFE-TIFAC-NIO regarding “Sustainable solutions for water and wastewater management in Aquaculture” and “Strategies for marketing of value added Aquatic products from small scale cottage industries” with the Chairman (Fishery Panel) of the Technology Information, Forecasting and Assessment Council (TIFAC)



## Workshop on Health and Nutritional security for fisher women

Women's health and nutritional status is bound up with social, cultural and economic factors that influence all aspects of their lives. In this context, CIFE Versova, Mumbai organized the following three day training workshops in fishing villages of Greater Mumbai and Thane districts.

S. No.	Name of training	Period	Locale	Participants
1	Health and Nutritional Security for Fisherwomen	March 8-10, 2004	Versova (Mumbai)	48
2	Health and Nutritional Security for Fisherwomen	March 11-13, 2004	Versova (Mumbai)	32
3	Health and Nutritional Security for Fisherwomen	March 15-17, 2004	Masavan (Thane)	28
4	Health and Nutritional Security for Fisherwomen	March 18-20, 2004	Mahim (Thane)	34
5	Health and Nutritional Security for Fisherwomen	March 22-24, 2004	Khar Danda (Mumbai)	104

In all the above mentioned workshop; presentations, discussions and interactive sessions were held on various topics related to health and nutritional security. The topics covered were awareness regarding health, general health status, anaemia, hypertension, weight management, kidney stone, work and posture, diet in anaemia and hypertension, nutrition and health and good nutrition and recommended dietary allowances. In addition to discussions and interactive sessions, health status checkup was also performed and women were made aware of their health status. The parameters which were measured were body weight, height, body mass index (BMI), complete blood picture (haemoglobin %), blood group, random blood sugar and other parameters eg., resting heart rate, blood pressure and ECG. Resource persons for the workshops included doctors and specialists from different fields.

Feedback received from fisherwomen revealed that this type of workshop was held for the first time in their fishing villages. Fisherwomen and their family members along with the society members appreciated the activities undertaken in this workshop. In order to make the fisherwomen aware of the health and nutrition related aspects a manual "Health and nutritional tips for fisherwomen" was prepared and released.

## Workshop-cum-demonstration on Cage Aquaculture in Open Waters

The Workshop was held at Indian Institute of Soil Science, Nabibag, Bhopal, Madhya Pradesh and the demonstration was arranged at Halali Reservoir, District Raisen, Madhya Pradesh. The Workshop was attended by 50 senior fisheries administrators and eminent fisheries scientists from all over India. Ms. Binoo Sen, IAS, Secretary, Department of Animal Husbandry and Dairying, Ministry of Agriculture, New Delhi, inaugurated the Workshop-cum demonstration on Cage Aquaculture by lighting the lamp. She also released the booklet on "Cage Aquaculture in Open Waters".



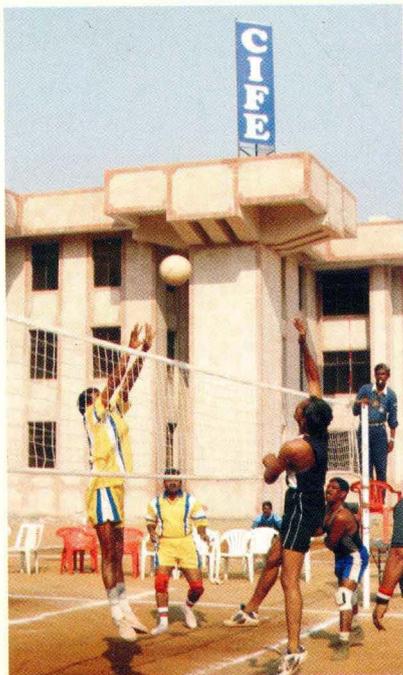
## National Seminar in Hindi on Fish Processing Present & Future Prospects

A National Seminar in Hindi on Fish Processing Present and Future Prospects was conducted in CIFE during December 19-20, 2003. The inaugural function was attended by Shri Gorakhmedh, IAS, Fisheries Commissioner of Govt. of Maharashtra as the Chief Guest. Dr. S.C. Mukherjee, Director, CIFE delivered the welcome address. Dr. S.D. Tripathi was the Guest of Honour of the function. Dr. S. Basu, Principal Scientist was the Convenor and Dr. M. K. Chowksey, Tech. Officer was Co-ordinator of the seminar. The Organising Secretary, Shri R.P. Uniyal, Asstt. Director (O.L.) compered the programme. Dr. M.P. Singh Kohli, Principal Scientist proposed the vote of thanks.

About 250 participants were present in the seminar & 41 papers were presented in three technical sessions. 13 important recommendations were proposed in the plenary session.

## ICAR Inter-Institutional sports tournament

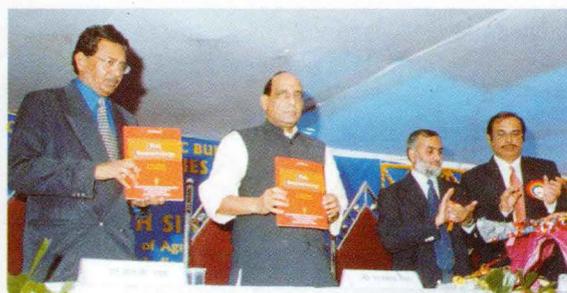
The ICAR Inter-Institutional sports meet was organized in the New campus of CIFE from January 5-9, 2004. All the major athletic events and other team events were organized in the New Campus itself. The ground was specially developed for the track events. More than 700 participants from 24 institutes participated in this tournament.



## Inauguration of the New Academic building of CIFE at Yari Road, Versova

The New Academic Building of CIFE was inaugurated by the Shri Rajnath Singh, Hon'ble Union Minister of Agriculture, Govt. of India on 27 December 2003. He also laid the foundation stones of the Library building, ladies hostel and staff quarters. On this occasion Shri Singh felicitated the former Deputy Director General Dr. P.V. Dehadrai and former Directors Dr. S.N. Dwivedi, Dr. S.D. Tripathi and Dr. S.A.H. Abidi for their valuable contribution to the establishment and development of this University. The other dignitaries present were Dr. Mangala Rai, Secretary DARE and Director General ICAR, New Delhi, Dr. S. Ayyappan, Deputy Director General (Fisheries), ICAR, New Delhi and Shri B.S. Kapur, Managing Director, Indian Railway Construction International Limited (IRCON) Govt. of India. The Hon'ble Minister also released the CIFE Publications *Matsya Darpan*, Practical Manual on Fish Bacteriology, Aquaculture Fisheries in Inland Saline Water and Fisheries Biotechnology.

In his inaugural address the Hon'ble Minister expressed his utmost satisfaction on the role CIFE played in contributing to technologies and product development along with education and training in fisheries and improving the life of the fishers and farmers.



## 14

**Dr. Mangala Rai, Director General visits CIFE**

Dr. Mangala Rai, took who over as Secretary, Department of Agricultural Research and Education, Govt. of India and Director General, Indian Council of Agricultural Research, visited the institute on April 18-19, 2003. He also visited the new campus of the institute at Yari road.

He visited different laboratories and departments/sections of the Institute. Addressing the staff and student of the Institutes he highlighted the achievements and contributions of the Institutes and emphasized the pivotal role it has to play in development of fisheries sector in the country.

**QRT Team**

The QRT team (1998-2003) under the Chairmanship of Dr. M.V. Rao visited the Institute during August 18-19, 2003. They visited different laboratories and sections of the Institute. The inaugural meeting was held on August 18, 2003 and various academic and research activities of the Institute was discussed with all scientists and technical officers of the institute during the 2 days' deliberation.

**Minister of State for Agriculture Shri Hukumdev Yadav**

Hon'ble Union Minister of State for Agriculture, Govt. of India Shri Hukumdev Narayan Yadav visited the Institute on December 30, 2003. He visited various labs and the new academic building of CIFE and later addressed all the staff members and students of the Institute and appreciated the work done by the Scientists.



### Library

Dr. Hiralal Chaudhary Library, CIFE is national facility for fisheries and allied disciplines. The Library has a total of 18132 priced books, 9229 back volumes of Indian and foreign Journals, 10642 donated publication and reports, and 1305 Micro-film and 1871 Dissertations/Thesis digitized.

During the year 515 Books were procured for Library. The CIFE Library subscribed 81 foreign journals during year 2004. The Library is providing Current contents pager service of the latest journals for the scientist at the Head-quarters Sub-centers. Library provided photocopying facilities to the staff and student users. The library also provided spiral binding and Lamination services. Library has 12 computers connected to internet 25 visitors/outsider users consult library per day.



### Staff Welfare Activities

A free Vaccination camp for Hepatitis-B virus was organised for all the staff members and their family members, and students in the month of March, April, May, 2004. A yoga camp for the benefit of students and staff members were organized from time to time.



### Annual Day

The 42<sup>nd</sup> Annual day function was celebrated on June 6, 2003 at CIFE, Mumbai. The inaugural function was attended by Dr. S.P.Aiyar who was the Chief Guest. Staff and students received their prizes for their co-curricular activities. Dr. Hiralal Chaudhari awards for the staff in recognition of their good work were also given. A grand cultural function was held in the evening.



### Hindi Fortnight

CIFE celebrated the Hindi fortnight with great zeal and enthusiasm during September 12-25, 2003. The programme was formally inaugurated by Dr. S.D.Tripathi, former Director, CIFE on September 12, 2003 by traditionally lighting the lamp. During the fortnight various competitions like essay writing, speech and poems in hindi besides cookery, drawing, rangoli, etc. were held. Mahila Diwas was celebrated on September 19, 2003. Mrs. Suravi





Mukherjee was the chief guest of this function. There was a colourful cultural programme on September 24, 2003 in which the staff and students participated. Valedictory function was held on September 25, 2003. Dr. S.N.Dwivedi (former Director of CIFE) was the Chief Guest of the function. He gave away the prizes and certificates to the winner of various competitions.



### Hindi Jalwani

A 1+0 credit course on Hindi language named "Hindi Jalwani" was introduced in master degree programme of this institute during the Hindi fortnight celebration. The inaugural function was held on September 19, 2003. By doing this the Hindi section has added one more feather to its cap. Dr. S.C. Mukherjee, Director, inaugurated the programme by lighting the lamp. CIFE is the first institute to have started such a course.



### Students Activities

Students Cultural activities for this year had a very auspicious beginning. *Diwali* was celebrated with *rangoli* competition and the final *Pooja* and the *Aarti*.

Other literary and cultural programmes began on 27<sup>th</sup> October and went on till 15<sup>th</sup> of November. The major literary events included essay, short story and poetry competitions in Hindi and English: poster, pencil sketching, cartoon and painting competitions, debate, group discussion and elocution competitions. The cultural activities in which the students participated most enthusiastically were song and dance competitions (group and solo); mime, skit and ad-zap competitions. These celebrations culminated in connection with the Hostel Day *tarang'03* on 23<sup>rd</sup> of



Nov'04 and the chief-guest Dr.G.S.Rautella, Director, Nehru Science Center gave an inspiring speech in a scientific way that was applauded by each nook and corner of the auditorium. The night witnessed full pledged audience and symphony of orchestra joined the *steps* and voices of the students

Christmas was celebrated with great joy. A carol party started from the hostel and visited all the houses in the campus.

Next was the occasion of welcoming the New Year 2004. Midnight celebration included small games and New Year messages that were delivered by the Director, the Dean (Academics) and other Faculty members who were staying in the campus.



Festive of colours *Holi*, *Dhandiya* and other festive occasions were celebrated with full rituals and traditional way where students joined hands with CIFE parivar in each occasion



A record number of 40 students took part in the 5<sup>th</sup> All India Agricultural University Sports and Games meet 2004 held at University of Agricultural Sciences, Bangalore from March 25- 28, 2004.

During the *Annual day* celebration sports and games meet were held from June 10<sup>th</sup> to 17<sup>th</sup> 2004 with the friendly cooperation of all the CIFE students.

## 16



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LIST OF STAFF\* (AS ON MARCH 31, 2004)  
(This is not a seniority list)

**Director**

Mr. S.K. Patil  
Dr. K. Pani Prasad  
Dr. N.P. Sahu

**Joint Director**

Dr. S.C. Mukherjee

**Principal Scientist**

Dr. M.P. Singh Kohli  
Dr. R.S. Biradar  
Dr. C.S. Purushothaman  
Dr. S.D. Singh  
Dr. W.S. Lakra  
Dr. Subrata Basu  
Dr. S.K. Chakraborty  
Dr. K.K. Jain

**Scientist**

Dr. B.B. Nayak  
Dr. Sanjay Jadhav  
Dr. Makesh M.  
Mr. Shyam Salim  
Dr. Sandeep J. Akare  
Mrs. Arpita Sharma  
Ms. A. Vennila  
Dr. P.S. Ananthan

**Senior Scientist**

Dr. (Ms.) Kiran Dube  
Dr. (Mrs.) Neelam Saharan  
Dr. (Ms.) Latha Shenoy  
Dr. S.N. Ojha  
Dr. K.V. Rajendran (on deputation)  
Dr. A.K. Pal  
Dr. G. Venkateshwarlu  
Dr. Geetanjali Deshmukhe  
Dr. Gopal Krishna Saxena  
Dr. (Mrs.) Aparna Chaudhari

**Technical Officer**

**T - 8**  
Mr. Nandlal Singh

**Scientist-SG**

Mr. K. Venkateshvaran

**T - 7**

Mr. A.K. Reddy  
Mr. S. Natarajan

**Scientist (SS)**

Dr. M.B. Patel  
Dr. S. Jahageerdar  
Mr. P.K. Pandey  
Mr. R.P. Raman

**T - 6**

Mr. R.K. Langer  
Dr. Chandra Prakash  
Mr. A.K. Padmanabhan  
Mr. A.R. Warange  
Dr. Ashok Kumar Jaiswar  
Dr. R.S. Rana  
Mr. Alkesh Dwivedi  
Dr. Prem Prakash Srivastava  
Mr. R.D. Tandel  
Mr. S.G.S. Zaidi  
Ms. Rama Sharma

Mr. G.K. Rao  
Mr. S.K. Pandey  
Mrs. Asha T. Landge  
Mr. A.D. Ragabhagat  
Mr. M.K. Chouksey  
Mr. Satish Kamat

**T - 5**

Mr. Chandrakant M.H  
Mr. D.L. Sawant  
Mr. Deepak Khogre  
Mr. Dasari Bhoomaiah  
Mr. K.P. Khalsa  
Mr. J.P. Patil  
Ms. Aravindra Mehta  
Ms. K. Thilagavathi  
Mr. Palaniswamy  
Ms. Nalini Poojary  
Mr. K.P. Shetty  
Mr. P.K. Das  
Ms. Madhavi Pikle

**Technical Assistant**

**T - 4**

Mr. A. Sadanandan  
Ms. S.M. Bagwe  
Mr. S.M. Shinde  
Ms. S.P. Nalawade  
Mr. Chandrakant Kareer  
Ms. S.S. Gajbhiye  
Mr. B.G. Mandhare  
Mr. R.G. Kudale  
Mr. Bhagat Singh Rawat  
Ms. Rajani Pagare  
Mr. J.M. Koli

Ms. Revati Dhongde  
Ms. Rekha Nair

**T - I - 3**

Mr. S.V. Patil  
Mr. B.J. Rathod  
Mr. Sanjeev Bandkar  
Mr. N.K. Aglave  
Ms. B.S. Ghagre  
Mr. Avinash Sable  
Mr. Baburam Jaiswar  
Mr. S.L. Koli  
Mr. B.T. Phande

**T - 2**

Mr. S.R. Vinarkar  
Mr. A. L. Kokane  
Mr. Arun Puri (Gosavi)  
Mr. Sikander Sheikh  
Mr. R. D. Deshmukh

**T-1**

Mr. Dhanpat Singh  
Mr. A.N. Mahadik  
Ms. V.D. Misale  
Mr. V.K. Bhawe  
Mr. Mohd. Baqar

**Administration & Finance**

**Senior Administrative Officer**

Mr. Suresh Kumar

**Finance & Accounts Officer**

Mr. Prem Shankar

**Administrative Officer**

Mr. P.D. Sonawane

**Assistant Director (Official Language)**

Mr. R.P. Uniyal

**Assistant Administrative Officer**

Mr. Sunil Kumar

Ms. Valsa Pavitran

Mr. S.S. Kocharekar

**Private Secretary**

Ms. T. Kuruvilla

Mr. G.S. Fernandes

**Stenographer (Grade III )**

Ms. S. R. Arutla

Mr. P.R. Ninawe

**Assistant**

Mr. T.D. Kumar

Ms. S.S. Parab

Mr. Y.P. Belgaonkar

Mr. B.L. Kokkula

Ms. N.Y. Raorane

Ms. Sushma Singh

Ms. S.R. Wadhavkar

Ms. Deepika N. Behl

Mr. P. B. Tandav

**Upper Division Clerks**

Ms. S.V. Kadam

Ms. A.A. Shukla

Ms. D.S. Naik

Mr. J.D. Chandramore

Ms. F. G. Fernandes

Ms. Chandrarekha S. Khundol

Mr. D.S. Ingle

Mr. R.R. Kadam

Mr. R.G. Gamare

Mrs. Swati S. Koli

Mr. Vijay S. Kuveskar

Mr. Devendra Raorane

**Lower Division Clerks**

Ms. Sujata V. Pawar

Ms. Anagha U. Joshi

Ms. Yashoda S. Dhatavkar

Mr. A.G. Kolambkar

Mr. Bharat Kumar P. Chauhan

Mrs. Sanyuja S. Parab

Mr. Pradeep G. Angane

Ms. Chaitali C. Raut

Ms. Pragati R. Gadre

Ms. Anu Grover

Mr. K.K. Jagtap

Mr. Suresh H. Bhosle

Ms. Nalini A. Sawant

Mr. M.B. Waghela

Mr. Nandu L. Ghane

Mr. Sajivan Lal

**Supporting Staff****Grade IV**

Mr. S.L. Garate

**Grade III**

Mr. K.D. Solanki  
Ms. S.M. Supat  
Mr. Madhu Wasnik  
Mr. S.V. Gawade  
Mr. Vinod P. Tiwari  
Mr. Surajbali R. Jaiswar  
Mr. B.S. Tamankar  
Mr. Ashok R. More

**Grade II**

Mr. D.B. Gaikwad  
Ms. Vandana Tambe  
Ms. K.R. Ahire  
Mr. T.G. Gaikwad  
Mr. J.K. Makwana  
Mr. Ankush R. Dore  
Mr. Bandu R. Chavan

**Grade I**

Mr. M.P. Kotian  
Mr. G. B. Kamble  
Mr. Ashok R. Shingade  
Mr. Jagdish Namdev Dhanu  
Mr. Vasant N. Ondkar  
Ms. Shantabai Kamble  
Mr. S.P. Malvankar  
Ms. R. H. Chavan  
Mr. R.N. Kamble  
Ms. Siddhi J. Kolambkar  
Mr. Ganesh N. Zendeekar  
Mr. Ankush N. Joyashi

**Vessel Staff****Skipper**

Mr. K. Satyanarayana(T-7)

**Engineer F.T.V. (T-8)**

Mr. Josey Jacob

**Engine Driver (T-6)**

Mr. S.K. Chodankar

**Additional Engine Driver(T-5)**

Mr. S.L. Kotian

**Mate (T-II-3)**

Mr. S. Maity

**Deckhand (T-2)**

Mr. K.V. Rajendran  
Mr. S.L. Mungekar  
Mr. A.P. Dhawde

**Cook**

Mr. S. Kamaraju

**Supporting Staff**

Mr. B.N. Sukur (Gr. IV)  
Mr. M.B. Bhokse (Gr. IV)  
Mr. Ayubkhan Bijali (Gr. IV)  
Mr. G.G. Zendeekar (Gr. III)  
Mr. Vishnu Patil (Gr. III)  
Mr. Sitaram Padyal (Gr. II)  
Mr. Arvind Lavande (Gr. I)



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Mr. N. K. Chaddha

**Scientist**

Mr. Ajit Kumar Verma

**Technical Officer**

**T-7**  
Dr. M. Ali

**Technical Assistant**

**T-II-3**  
Mr. Hasan Javed  
Mr. Sanjeevan Kumar

**T-1**

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**T-5**  
Mr. R.K. Upadhyay  
Mr. Vijay G. Dubey

**Technical Assistant**

**T-II-3**  
Mr. L.P. Bamalia

**T-2**

Mr. Gurbachan Singh

**T-1**

Mr. Anup Singh

**Administrative Staff**

**Senior. Clerk**  
Ms. Asha Dhurve  
Mr. Abhilash Thankappan

**Supporting Staff**

**Grade (II)**  
Mr. Hari M. Potpose  
Mr. Lallu Prasad  
Mr. Vishnulal  
Mr. Mangali Prasad  
Mr. Surendra Kumar  
Mr. Hari Singh

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Mr. Ram Swaroop  
Mr. Manoharlal  
Mr. Shambhu Dayal



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**T-6**

Dr. C.S. Chaturvedi,  
Dr. (Ms.) Zeba Jaffar

**T-5**

Mr. S.P. Singh  
Mr. A.K. Yadav

**T-4**

Mr. S.K. Upadhyay  
Mr. Mohmood Gayas  
Mr. P. Satyanarayana

**T-3**

Mr. Ravi Kumar  
Mr. S.K. Singh

**Technical Assistant**

**T-1**

Mr. Om Prakash  
Mr. P.C. Jaiswar  
Mr. Ram Bharosi

**Administrative Staff  
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Mr. P.K. Awasthi

**Lower Division Clerk**

Mr. P.C. Verma

**Supporting Staff**

Mr. Narayan, Gr. (IV)  
Mr. K. Dush Raj, Gr. (II)  
Mr. Suneet Kumar, Gr. (I)  
Mr. Ram Lakhan, Gr. (I)  
Mr. Anwar, Gr. (I)  
Mr. J.N. Tiwari, Gr. (I)  
Mr. Mahesh Chand, Gr. (I)  
Ms. Kamla Jai Kishore, Gr. (I)  
Mr. Vinod Kumar, (Cook)Gr. (I)



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**Technical Officer**

**T-5**

Mr. J. Krishna Prasad  
Mr. K. Murali Mohan  
Mr. P. Sreenivasa Rao  
Mr. V.N. Acharyulu

**Technical Assistant**

**T-4**

Mr. K. Radhakrishna Reddy  
Mr. Ravi Shankar Patnaik  
Mr. B. Krishna Rao

**T-2**

Mr. S.S. Murthy  
Mr. Y.S. Murthy

**T-1**

Mr. B. Satyanarayana  
Mr. M. Satyanarayana

**Administrative Staff  
Assistant**

Ms. T. Padmavathy  
Mr. P.V.G.K. Murthy  
Mr. B. Veera Raju

**Senior Clerk**

Mr. B. Laxman Rao

**Junior Clerk**

Ms. M. Rama Mani

**Supporting Staff**

Mr. K. Pothu Raju, Gr. (IV)  
Mr. M.Harichandra Reddy, Gr. (III)  
Mr. M. Krishna, Gr. (III)  
Mr. Sivaram Kale, Gr. (III)  
Mr. M. Ch. Appa Rao, Gr. (II)  
Mr. K. Malliah, Gr. (II)  
Mr. K. Satyanarayana, Gr. (II)  
Mr. Shaikh Nana Saheb, Gr. (II)  
Mr. K. Niranjan, Gr. (II)  
Mr. N. Venkata Ramana, Gr. (I)  
Mr. K. Prasad, Gr. (I)  
Mr. V. Shivaji, Gr. (I)  
Mr. O. Veeraraju, Gr. (I)  
Mr. K. Dharma Raju, Gr. (I)  
Mr. P. Brahmaananda Rao, Gr.(I)  
Mr. T. Satyanarayana, Gr. (I)  
Mr. P. Venkata K. Reddy, Gr. (I)  
Mr. P. Dora Reddy, Gr. (I)  
Mr. Shaikh Valisha, Gr. (I)  
Mr. A. Lakshman Reddy, Gr. (I)  
Mr. S. Subba Reddy, Gr.(I)  
Mr. Y. Butchilingam, Gr.(I)  
Mr. M. Govindu, Gr. (I)  
Mr. A. Anandu, Gr.(I)  
Mr. A. Gurriah, Gr.(I)  
Mr. G.V.V. Satyanarayana, Gr. (I)  
Mr. M.A. Rao , Gr. (I)



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**Principal Scientist**

Dr. Radha C. Das (Officer In-charge)  
Dr. P.K. Ghosh  
Dr. Krisjhna Chandra

**Sr. Scientist**

Dr. (Ms.) Archana Sinha

**Scientist-SG**

Mr. P. K. Roy  
Mr. B.N. Tiwari

**Scientist-SS**

Dr. Shubendhu Datta

**Scientist**

Dr. Parimal Sardar (on study leave)

**Technical Officer**

**(T - 5)**

Mr. P.S. Pandey  
Mr. S. K. Sharma  
Mr. R.K. Biswas  
Mr. A.K. Mondal

**Technical Assistant**

**T-1-3**

Mr. R.K. Mondal  
Mr. P.K. Patra  
Mr. S.K. Das

**T-1**

Mr. T.K. Ghosh  
Mr. M. Satyanarayana

**Stenographer**

Ms. Kaberi Biswas,

**Upper Division Clerks**

Mr. C.N. Sahani,

**Lower Division Clerks**

Mr. P.K. De  
Mr. Ram Milan Singh

**Supporting Staff**

Mr. G.C. Saha, Jr. Deckhand (Auxillary)  
Mr. B. Dhar, Masalchi, Gr. (IV)  
Mr. B.D. Mondal, Gr. (III)  
Mr. T.C. Balmiki, Gr. (III)  
Mr. Manju Paul, Gr. (III)  
Mr. Raghunath Das, Gr. (III)  
Mr. Ram Narain Prasad, Gr. (III)  
Mr. Ramesh Chowdhary Gr. (II)

## Promotions

The following staff members were promoted.

S.No.	Name	From	To
1.	Mr. N.K. Chadha	Scientist(SS)	Sr. Scientist
2.	Dr. V.K. Tiwari	Scientist(SS)	Sr. Scientist
3.	Dr. Alok Kumar Jain	Scientist(SS)	Sr. Scientist
4.	Dr. P. Rami Reddy	T-5	T-6
5.	Mr. S.L. Kotian	T-5	T-6
6.	Dr. R.K. Upadhyay	T-5	T-6
7.	Ms. Madhavi Pikle	T-4	T-5
8.	Mr. Vijay G. Dubey	T-4	T-5
9.	Mr. Raghuveer Prasad	SSGr. II	T-1
10.	Ms. Asha Durve	LDC	UDC
11.	Mr. Devendra Raorane	LDC	UDC
12.	Ms. Kaberi Biswas	Steno Gr. III	P.A.

The following staff were upgraded under ACP Scheme

S. No	Name	From	To
1.	Mr. P.R. Ninawe	Steno. Gr.III	Steno. Gr.IV
2.	Mr. Pradeep G. Angne	LDC	UDC
3.	Mrs. Anu Grover	LDC	UDC
4.	Ms. M. Rama Mani	LDC	UDC
5.	Mr. Y. Buchilingam	SSGr.I	SSGr.II
6.	Mr. M.P. Kotian	SSGr.I	SSGr.II
7.	Mr. G.B. Kamble	SSGr.I	SSGr.II
8.	Mr. Ram Lakhani Nishad	SSGr.I	SSGr.II
9.	Mr. Monohar Lal	SSGr.I	SSGr.II
10.	Mr. A.R. Shingade	SSGr.I	SSGr.II
11.	Mr. Ram Swarup	SSGr.I	SSGr.II
12.	Mr. S. Prajapati	SSGr.I	SSGr.II
13.	Mr. J.N. Dhanu	SSGr.I	SSGr.II
14.	Mr. G.V.V.Satyanarayana	SSGr.I	SSGr.II

### Transfers

S.No	Name	From	To
1.	Dr. Arpita Sharma, Scientist	Kolkata	Mumbai
2.	Mr. K.B.S. Murty, T-6	Powerkheda	Kakinada
3.	Mr. M.K. Pachauri, Admn.Officer	CIFE, Mumbai	CTRI, Thiruvananthapuram
4.	Mr. B. Laxman Rao, UDC	Kolkata	Kakinada

### New Appointment

Sl.No.	Name	Date	Posting at
1.	Mr. Ankush N. Joyashi, SSGr.I	April 1, 2003	CIFE, Mumbai
2.	Shri P.D.Sonawane, A.O.	April 8, 2003	CIFE, Mumbai

### Appointment of Emeritus Professor

1.	Dr. (Ms.) Suneela Mavinkurve Former Head, Department of Microbiology, University of Goa, Emeritus Professor	June 24, 2003	CIFE, Mumbai
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### Voluntary Retirement

Sl. No	Name	Date
1.	Miss U.V. Gadre, T-5	2.6.2003
2.	Mr. K.V. Rangaiah, T-I-3	1.8.2003
3.	Mr. J. Satyanarayana, T-4	1.8.2003
4.	Mr. K.A. Shirgaonkar, T-2	2.9.2003

### Superannuation

Sl.No.	Name	Date
1.	Mr. S.K. Pal, T-9	30.4.2003
2.	Mr. B.K. Raut, SSGr.IV	30.6.2003
3.	Shri K. Mohamood, A.A.O.	30.9.2003
4.	Mr. G.C. Saha, SSGr.IV	31.1.2004

### Death

Sl.No.	Name	Date
1.	Mr. R.R. Shah, UDC	03.02.2004
2.	Mr.B.L.Mahato, S.S.Gr.III	02.06.2003
3.	Mr. M. Gandhi Prasad, SSGr-II	06.06.2003

# IMPORTANT COMMITTEES OF CIFE

## Academic Council

1. Dr.S.C.Mukherjee  
Director/Chairman  
C.I.F.E., Mumbai.
2. Dr.M.P.Singh Kohli  
Dean (Academic)  
C.I.F.E., Mumbai.
3. Dr.C.S.Purushothaman  
Principal Scientist  
C.I.F.E., Mumbai.
4. Dr.R.S.Biradar  
Principal Scientist  
C.I.F.E., Mumbai.
5. Dr.S.N.Dwivedi  
E-1/106, Arera Colony  
Bhopal- 462 016
6. Dr. S.L. Shanbhogue,  
Former Director of Instruction,  
College of Fisheries  
Kankanady  
Mangalore - 575002 (Karnataka)
7. Dr.V.S.Durve,  
J-23, Sector 5  
Anant Vinayak Marg  
Udaipur - 313 002  
Rajasthan
8. Dr. K.K.Ghosh  
A-2, Mirch Masala  
Off. Ambadi Road  
Vasai P.O.  
Vasai Road (W)  
Distt. Thane - 401 202.
9. Dr.S.K.Chakraborty  
Principal Scientist  
C.I.F.E., Mumbai.
10. Dr.W.S.Lakra  
Principal Scientist  
C.I.F.E., Mumbai.
11. Dr.S.D.Singh  
Principal Scientist  
C.I.F.E., Mumbai.
12. Dr. S. Basu  
Principal Scientist  
C.I.F.E., Mumbai.
13. Dr.K.K.Jain  
Principal Scientist  
C.I.F.E., Mumbai.
14. Dr.(Ms.) Geetanjali Deshmukhe  
Sr. Scientist  
C.I.F.E., Mumbai.
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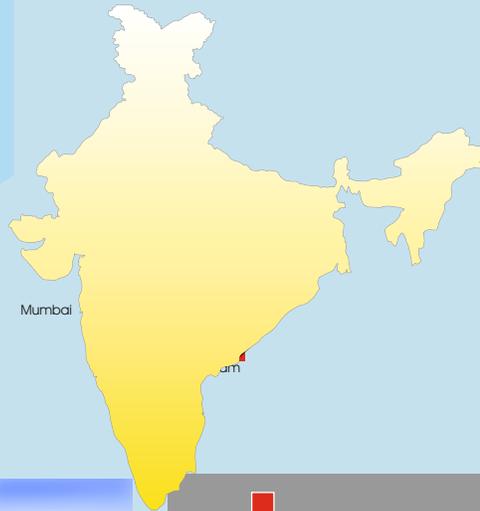
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