



CIFRI NEWSLETTER

Volume 4

September-October 1981

Number 5

☐ HILSA IN RESERVOIRS ☐ BREAKTHROUGH IN FISH
POISON ☐ ROLE ON INLAND FISHERIES IN IRD ☐ SIMLA
WORKSHOP ON RESERVOIRS ☐ PROMISING PROSPECTS
FROM BEELS ☐ NEWS ROUNDUP



CIFRI KNOW - HOW DEMONSTRATED

TAKMU LAKE CLEARED OF WATER HYACINTH

REPORT

A CIFRI led pilot project demonstrated the successful eradication of water hyacinth from the 500 ha Takmu lake in Manipur.

As a part of the overall development the North Eastern Council paid due attention to the problem of weeds infesting the beels and lakes that abounds in the region. A three-year Pilot Project was undertaken under the aegis of CIFRI and Shri V. Ramachandran, Fishery Scientist was engaged as its part time consultant and technical guide. The Project ended in 1980 and was sponsored jointly by CIFRI, North Eastern Council and the Fisheries Department of Manipur. The Takmu lake had a very heavy infestation of weeds, mainly water hyacinth. The dense mat of weed upto one meter in height and several meters across covered the lake throughout the year.

After examining the pros and cons of different methods of eradication it was decided that the use of chemical weedicide 2, 4-D was the most suitable method. The other methods would create sanitary, environmental and public health problems apart from prohibitive costs. This chemical weedicide kills the weeds *in situ* and the nutrients derived from the dead weeds fertilise the water to make it more productive.

2, 4-D sodium salt (80% a. i.) was chosen because of its low price and efficiency on the succulent broad-leaved water hyacinth.

Paraquat herbicide (gramaxone) was used to kill the grass grown over the weed mat. A commercial wetting agent (Dedanol) had to be mixed with the herbicidal spray solution to facilitate adhesion and spread of the solution on waxy and hairy leaf surface of other weeds.

2, 4-D sodium salt at a dose of 10 kg/ha could achieve a total kill of at least 90% of the plants. Spray volume was fixed at 1,000 litres per hectare. The effectively treated water hyacinth died in the course of 6-8 weeks and then gradually decomposed, disintegrated, sank or scattered. The grasses when they were sparse simply scattered and disappeared as the mat was killed.

However, dense growth of grass (more than 40% of foliage) needed to be treated with paraquat herbicide.

The personnel were split into many spraying units of four and each unit moved in a boat. The spray which was adjusted to fine droplet delivery could normally reach a distance of 10-15 m. Where the weed mats were more extensive, the spraying operatives had to walk over the frame of bamboo poles laid over the weed mat. During the two years of field operations, 3.5 tonnes of 2, 4-D sodium salt, 300 litres of paraquat herbicide, 160 kg of wetting agent and one tonne of urea were the main chemicals used. The cost of labour, chemicals and field contingencies worked out to be Rs. 2,06,865.10 for clearing 400 ha (Rs. 517.15/ha). A sum of Rs. 18,030.05 was spent on equipments.

☐ Water hyacinth is the most devastating among the aquatic weeds in the North Eastern Region. It menacingly covers over 90 percent of the surface area of 0.12 million hectares of beels and lakes of immediate fishery importance in the region. The density of infestation is equally alarming, i. e., 20-100 kg/sq. m.

☐ Water hyacinth is not a weed when considering its tremendous potentials. One tonne of its biomass contains about 10 kg of protein and an average infestation of this weed per ha represents a standing crop of 4 tonne protein. An infestation of about 400 t/ha is estimated to contain mineral nutrients equivalent to inorganic fertilizers worth Rs. 6000/-. There is more. Water hyacinth has great scope in paper industry, biogas production, pollution abatement measures and even as a good substratum for mushroom farming.



HILSA — HAS IT COME TO STAY IN RESERVOIRS ?

Hilsa is once again in the news. Young and grown up hilsa have started appearing in the commercial catches of Vallabh Sagar (Ukai) Reservoir on river Tapi. The young ones were stocked in the reservoir during October, 1979. The scientists working under the Ukai Centre of All India Coordinated Project on Reservoir Fisheries have every reason to be proud of this remarkable achievement. Ukai is one of the seven centres under the Coordinated Project.

Hilsa catches from Indian rivers are known to be dwindling due to the dams and weirs across the rivers which prevent the breeding migration of this fish. In Narmada, the present annual landings amount to 150 tonnes and it is apprehended that the proposed new project at Navagram may affect the hilsa fishery. The Gujarat State Fisheries scientists, therefore, explored the possibilities of rearing and breeding hilsa

in reservoir.

Taking a cue from the success of CIFRI research team, these scientists artificially bred *Hilsa ilisha* by stripping live gravid fishes from the river and reared them in nylon hapas till they attained a size of 20-25 mm in 17 days. Five thousand such young hilsa were stocked in the reservoir in October, 1979. After 17 months, one of the two fishermen cooperative societies operating in

the reservoir reported the catch of two hilsa specimens weighing about 500 g each. Two months later, one more specimen of 600 g got entangled in the surface gill-nets of the State Fisheries Department. This turned out to be a gravid female with 8.5 lakhs eggs. Not only that. Two months later, a hilsa fingerling was caught from the lentic sector of the reservoir confirming the natural breeding of this species in reservoir. Yes, hilsa is an inthing in Ukai reservoir. It has come to stay.

The remarkable phenomenon coupled with the recent strides in breeding and rearing of this migratory species in confined waters suggest that a long standing fear over the conservation of this species is getting withered away. □

Continued from Page 2

Obviously enriched by the nutrients from decomposing weed biomass, the plankton increased remarkably. At least 500% increase in plankton was recorded. The decaying vegetation was also directly fed upon by fish particularly by common carp which were found browsing upon decaying weed masses. After the decrease of weeds, common carp catch per man day (5 hrs) in-

creased by 400%. Average growth of common carp was 1.0 kg an year compared to the previously reported 0.5. Encouraged by the lucrative fishery, fishermen preferred to pay license and fish from Takmu lake rather than to avail the free fishing facility of Loktak lake. Clearance of weeds also facilitated the aquatic vegetable *Trapa bispinosa* to stage a biological comeback. *Trapa* had been the traditional native vegetable crop of the area

yielding the much valued edible fruits and shoots before the infestation by water hyacinth.

From a wider social and national perspective, the success of the project has been appreciated by the State Government and numerous private fishery cooperative enterprises in Manipur and other states afflicted by a similar problem. States of N. E. Region are at present formulating a plan to adopt this technology in a massive scale. □

INLAND FISHERIES — A SIGNIFICANT ECONOMIC COMPONENT IN IRD

At the instance of Ministry of Rural Reconstruction a three days Seminar on Fishery (Inland) as an Economic Programme for IRD was held at CIFRI, Barrackpore during September 28-30, 1981. Dr. A. V. Natarajan, Director, CIFRI, acted as Course Director and was ably assisted by Dr. K. L. Sehgal and Shri S. Paul as Associate Directors. The Seminar was attended by 47 participants from ten states and the Union Territory of Pondicherry.

Objectives

Recognising the immense development potential of inland fisheries in raising income and standard of living of vulnerable sections of the population the Seminar was to subserve the following objectives :—

- i) to enable the assisted beneficiaries to achieve substantially higher income and attain a standard of living which could be considered well above the poverty line ;
- ii) to assist the beneficiaries in taking up productive enterprises, suitable in local conditions ; and
- iii) develop and strengthen the skills at district levels for identifying, formulating and implementing projects with potential benefits to the poorer sections.

Deliberations

The Seminar spanned into six technical sessions viz., Fresh-water Aquaculture, Brackish-water Aquaculture, Reservoir Fisheries, Fish culture Integrated with Agriculture and Livestock. Strategies for Rural Aquaculture and Operational problems identified by participants from each state. The Seminar was inaugurated by Shri B. C. Sharma, Secretary, Fisheries, Govt. of West Bengal and the presidential address was delivered by Dr. A. V. Natarajan, the Course Director for the Seminar. Scientists of CIFRI and renowned experts from Govt. of West Bengal made significant contribution by their animated erudition and down to earth approach in dealing with operational problems confronting inland fisheries sector.

Recommendations

A Task Force headed by Dr. A. V. Natarajan comprised Dr. P. V. Dehadrai, Senior Scientist, Sarvashri M. Ahmed, Director, State Fisheries Assam, J. C. Roy, CRO, Orissa, one representative from each participating state and Shri S. Paul who acted as a member secretary.

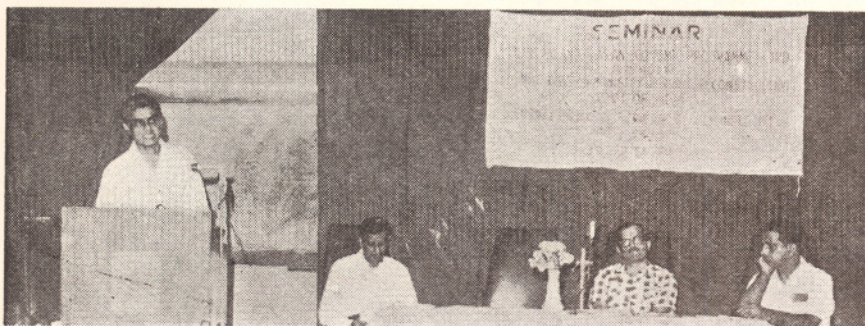
Some of the major recommendations of the Task Force are as follows :

- i) The devolution of ownership of water bodies should vest with department of fisheries only as against the existing diffusion of ownership among several state departments.
- ii) The tenure of lease should be at least for 12 years as against leases for short duration which do not meet the criteria of bankability.
- iii) The amount of subsidy should be raised upto Rs. 5000/- from a present level of Rs. 3000/-. The involvement of District Fisheries Officers should be more intense to ensure proper utilization.
- iv) Closer cooperation among departments of agriculture, irrigation and fisheries is very essential to meet the water requirements of fishery sector. The aquaculture should be treated at par with agriculture with regard to sharing of waters.
- v) The district level marketing co-operatives should be set up for the timely supply of fishery requisites as also their distribution to blocks through fishery extension officers.
- vi) The IRD funds should be made available for the development of hatcheries at district levels without linking the same with matching grants in block general fund.
- vii) In view of the low level of assets of fishermen the bank loan should be invariably under-written by the respective State Governments as is being done by the State of Tamil Nadu.

Dr. A. V. Natarajan, the Course Director in his concluding remarks reposed full confidence and trust in the management cadre of the State Governments for accelerating the pace of fishery development through integrating it with IRD programme. On his part, he assured the states with regard to appropriate research support for rural development.



While delivering the inaugural address Shri B. C. Sharma, Secretary, Department of Fisheries, Govt. of West Bengal advocated closer linkages between research and development. He was quite optimistic with regard to the role of fisheries in raising the living standards of rural poor.



Dr. A. V. Natarajan, the Course Director of the Seminar keenly felt the need for integrating fisheries in poverty eradication programmes. He was of the view that location-specific approach in harmony with natural endowments in each region will go a long way in development.



Fortyseven state/district level functionaries from ten states and one union territory, scientists of CIFRI and other experts participated in the three days Seminar. Most of the state-level participants discussed at length the difficulties encountered by them at the implementation stage of the rural development programmes.



With a view to giving adequate representation to each participating state, a broad-based Task Force was constituted. Varied and diverse view points were considered by the Task Force to formulate the recommendations.

CIFRI'S TWIN BREAKTHROUGH

☐ DERRIS PLANT IN NONSALINE SOIL

☐ GROWTH RETARDANT TO INCREASE

ROTENONE

It has been possible to increase the 'rotenone content in the root of the derris plant, *Derris trifoliata* var. *uliginosa* with the use of a growth retardant hormone. Earlier, this halophytic plant was successfully acclimatised in the completely non-saline soil at CIFRI campus Barrackpore.

The insecticide 'rotenone' ($C_{23}H_{22}O_6$) is extremely toxic to fish by way of inhibiting cellular respiration. Powdered derris plant was first used as fish toxicant in Michigan in 1834. Since then, it had gained rapid popularity for reclamation of ponds and tanks. A concentration of about 0.5 ppm rotenone is advocated in ideal pond conditions. However, it pays to add a little excess amount to provide a margin for ensuring the desired results. The effect of rotenone seldom persists in the environment over two weeks.

In West Bengal, derris plant is often met with in the char islands (salinity about 19‰) of Sundarbans area. However this plant was successfully transplanted and acclimatised to the soil at CIFRI campus (soil salinity about 0.01% by salinizing the soil with NaCl application. The plants thrived well at a salinity (artificially provided) less than 4.5‰.

After having failed to increase the rotenone content with the application of growth promoting substances, an unconventional idea of employing growth retardant cycocel was tried and that clicked in an instantaneous success. The plant recorded an increase in rotenone content from 2.2% to 3.5%.

The achievements viz., transplantation to non-saline soil and the increase in rotenone content are two big leaps towards the goal of a dependable alternative for 'mahua oilcake', the conventional but scarce fish toxicant.



SIMLA WORKSHOP ON RESERVOIRS



Pandit Sukh Ram, Hon'ble Minister, Dr. Natarajan, Director, CIFRI and Dr. G. P. Dube engaged in a discussion

Mr. S. D. Tripathi proposing a vote of thanks to the chair and the participants



The sixth workshop of All India Coordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs was held at Simla on 25th and 26th November 1980. While inaugurating a function preceding the Workshop, Shri Sukh Ram the Hon'ble Minister for Agriculture, Himachal Pradesh stressed the need for further development of fisheries and increasing the fish yield from reservoirs. He further said that fish production from reservoirs could be increased upto 3,000 tonnes if suitable steps were taken.

The minister assured all help if Himachal Pradesh Agricultural University were to set up a research cell for the development of fisheries in the State. He informed that State Government intended to construct a cold storage plant at Calcutta to stock fish in order to ensure remunerative price. Later, Shri H. R. Kalia the Vice-Chancellor of Himachal Pradesh Agricultural University inaugurated the workshop.

Dr. A. V. Natarajan, Director, Central Inland Fisheries Research Institute, in his key-note address said that the research and management gaps in reservoir fisheries

were sought to be bridged through the All India Co-ordinated Project. He emphasised that by scientific management the yield from reservoirs in the country could easily be augmented to two lakh tonnes and this would generate an income of Rs. 100 crores and an employment potential of 70,000.

Shri B. C. Negi, H i m a c h a l Pradesh Production Commissioner in his Presidential address dis-

closed that the State Government proposed to spend Rs. 2 crores on the development of fisheries in the next plan as compared to Rs 35 lakhs previously. Earlier, Shri G. C. Negi, Director of Animal Husbandry welcomed the delegates and scientists who participated in the workshop.

The workshop recommended suspension of the stocking programme for mirror carp and sugg-

ested that the silver carp be monitored in regard to its recruitment and stock accretion. The workshop also outlined new programmes for implementation in the reservoir under the Project's fold. A suggestion has been made to observe closed season for Govind-sagar lake from June 15 to August 15 with a view to improving stock structure of economic fish for ensuring better yield.

ON THE ANVIL - 4

Beel Fisheries Investigations

CIFRI has rediscovered yet another underutilised resource - the beels. Beel (also called *mans*) is a highly d y n a m i c natural aquatic ecosystem generally a cut off river basin with great potential for fishery development. In the State of Assam alone 760 beels are available covering an area of 0.12 million a c r e s. The paucity of scientific literature on the dynamics of beel ecosystem is an ample testimony to the lack of attention on these water bodies. As a pioneering effort to bridge the gap in the knowledge of beel ecosystem and to evolve a suitable strategy for beel fishery development, a comprehensive research project has been taken up by CIFRI. A scientific appraisal of the fish production potential forms a vital part of the programme. The Dhir beel in Assam, Kulia beel in Kalyani (W. Bengal) and the *mans* at Gandak basin (Muzaffarpur, Bihar) have b e e n selected under the present investigations.

The nutrient-rich beel base leads to an enormous growth of aquatic vegetation. In a derelict b e e l, the decay of this macrovegetation coupled with the

enhanced evapo-transpiration hastens the process of its natural 'death'. Such an unhealthy condition in an unattended beel doesn't p e r m i t the production of the much desired plankton for fish growth. Instead, the nutrients released are utilised for the repeated growth of macrovegetation. Recent investigations carried out by CIFRI suggest that the fish yield from the b e e l s can be increased by s e v e r a l folds with meagre investment through proper ecological manipulations.

Limnological studies have been given due stress in order to e v o l v e management measures for rapid fishery development. The energy reserves and its pathways at different levels are b e i n g investigated for evolving a suitable s t o c k i n g policy. Attention is also being paid to know how best a beel ecosystem can be remodelled to obtain a maximum sustained yield. An induced break in the conventional macrovegetation-d e t r i t u s-macrovegetation cycle is predicted which is expected to show greater promise in the yield.

Experiments are also being conducted on the lines of increasing fish yield by adopting pen culture in the marginal areas of beels. Recent findings indicate that pen culture in beels would be profitable as fishes depend on natural food in pens to a very large extent.

The scientists now engaged in beel fisheries investigations are S/Shri Y. S. Yadav, M. Choudhary and V. Kolekar at Gauhati, Shri S. B. Saha Dr. V. Pathak and Shri B. Roy at Kalyani and Dr. M. L. Bhowmick, Dr. S. P. Rai, S/Shri V. R. Chitransi, H. P. Singh and D. Kapoor at Muzaffarpur. ☐

Pen culture in beels – promising results :



Pen culture experiments in beels show encouraging results. In an experiment conducted by CIFRI Centre at Gauhati, common carp recorded an average weight of 200 g in five months in pens. Fingerlings (av. wt. 7 g) were stocked @ 10 nos/sq. m in pens erected in the marginal areas of Dighali beel. They were fed with rice bran and oil cake for the first three months of the experi-

ment. Thereafter the supplementary feeding was stopped and the fishes fared well on natural food. Fish production obtained at the end of five months rearing was 32 kg/20 sq. m. area. Popularisation of pen culture can considerably enhance fish production, as is evident from this experiment, in Assam and neighbouring states where beels occupy substantial areas.

EXTENSION SCENE

Highlights :

☐ A demonstration programme was arranged at Chanditala on composite fish culture for 21 FAO/UNDP sponsored Senior Aquaculturists on 17. 10. 1981.

☐ Six officers from Laos were trained in various freshwater aquaculture practices under the

auspices of Extension Section from 2-10 September, 1981.

☐ Culture techniques of carps and air-breathing fishes were demonstrated to seven officers of State Fisheries Department, Govt. of Assam and eight fish farmers during 16-19 September, 1981 at Barrackpore.

☐ CIFRI exhibits depicting new vistas in inland aquaculture were displayed in the exhibition organised on the occasion of World Food Day by Ministry of Education and Social Welfare, Govt. of India at Jadavpur University campus, Calcutta.

Extracts from ICAR Biannual Report on Lab to Land Programme at CIFRI

□ Twentyfive million carp seed were raised by adopted farm families under the guidance of extension scientists.

□ Fish production ranging from 1500 kg in five months to 5290 kg in 10 months were obtained by farmers in 'Lab to Land' centres against the country's average fish production of about 600 kg/ha/yr by traditional culture method. The income from fish farming was increased by 2-4 times through composite fish culture.

□ By adopting fish farming on scientific lines under the guidance of the CIFRI scientists, the income of farm families was increased by 4-6 times in fish-cum-duck farming and fish-cum-pig farming; two times in air-breathing fish culture and 2-3 times in brackish-water fish farming. This significant rise in income in comparison to the traditional practices has enthused the farmers to continue the scientific fish culture on their own.

Training

UNDP-SPONSORED TRAINEES AT CIFRI

A 21 members team of Senior Aquaculturists representing thirteen countries were at FARTC, Dhauli under a training programme on Composite fish culture. During the programme initiated on 16 September, 1981 the participants were acquainted with both

laboratory and field aspects of composite fish culture technology developed at CIFRI. This batch of trainees comprised Senior Aquaculturists from Bangladesh, Brunei, Burma, China, Philippines, Indonesia, Malaysia, Pakistan, Papua New Guinea, Sri Lanka, Thailand and India. In addition to the programme at FARTC, the Aquaculturists were also exposed to the on campus and off campus activities of KVK/TTC, Dhauli and fish culture practices at pond culture station of CIFRI at Cuttack. They also visited some nearby villages to get familiarised with the fish farmers and the resource inventory survey conducted by KVK/TTC.

The visiting members of the team evinced keen interest in the researches being conducted at FARTC and also in the 'Lab to Land' Programme of the Centre. The Training Programme was in tune with one major objective of FARTC; i.e., to help the developing countries to develop appropriate technologies in freshwater fish farming. The Centre has already acquired the required physical facilities and scientific expertise to impart such international training programmes. FARTC of CIFRI has already acquired the status of 'Lead Centre' under the Global Aquaculture Development and Coordination Programme of FAO.

News Roundup

A new algicide to eradicate *Euglena* :

Euglena blooms in fish ponds obstructing sunlight can be destroyed by dried leaves of *Adhatovasisca*. This was tested successfully by the Rural Development Wing of the Regional Research Laboratory, Jammu. The method was reported to be quite harmless.

—Fishing Chimes

Mass cultivation of brine shrimps :

A technique for mass cultivation of the brine shrimp, *Artemia salina* in salt pans has been developed by the National Institute of Oceanography, Goa. The extensive salt pans all along the Indian coast offer excellent scope for brine shrimp culture in a mass scale. *Artemia* is considered as the only suitable live food for larval stages of cultivable prawns. The market value of the brine shrimp cysts is as high as 500/- per kg

—PTI Science Service

Water Pollution Research Conference :

The eleventh conference of the International Association on Water Pollution Research, Cape Town will be held on 29th March—2nd April, 1982. Details are available from Secretary, IAWPR, Chichester House, 278 High Holborn, London WC1, England.

—ICLARM Newsletter

VISITORS

Narayanan Adviser, Planning Commission at Gauhati Unit



Mr. T. Narayanan, Adviser (Animal Husbandry and Veterinary), Planning Commission, Govt. of India paid a visit to the Air-breathing Fish Culture Unit of CIFRI at Gauhati on 11.6.1981. The Scientists at the Unit apprised him of the recent advances made by CIFRI in air-breathing fish culture practices. He was impressed with the tremendous scope of air-breathing fish culture in augmenting fish production from derelict waters. Mr. Narayanan accompanied by Mr. M. Ahmed, Director of Fisheries, Assam also witnessed netting demonstration in the experimental ponds at the centre.



Mr. Narayanan, Adviser, Planning Commission (3rd from left), Mr. M. Ahmed, Director of Fisheries, Assam (2nd from left), and Dr. S. C. Pathak, Officer-in-charge, Gauhati unit, CIFRI at the CIFRI campus Gauhati.

A fish haul from experimental pond shown to Mr. Narayanan.

STAFF NEWS

FAO Assignment for Bhowmick

Shri R. M. Bhowmick, Chief Training Organizer (Scientist-3) of KVK/TTC, Kausalyagang has been appointed as Senior Adviser in Fisheries at FAO. He was relieved of his duties at CIFRI on 23rd October, 1981 to take up his assignment on deputation in Sri Lanka. The KVK/TTC will be looked after by Dr. V. R. P. Sinha, Head, FARTC, Dhauli.



Ph. D. M. sc. degree to Mrs. Sivakami

Mrs. S. Sivakami, Scientist-1 at the Bangalore Research Centre of CIFRI has been awarded Ph. D degree in Zoology based on the thesis submitted to the University of Kerala. Her thesis entitled

'Studies on the Cyprinid fishes of the genus *Rashora* of Kerala' pertains mainly to the biochemical aspects of *Rashora daniconius*.

Retirement

Shri Chandra Bahadur, Fieldman retired from the services of CIFRI on 30. 9. 1981. Members of CIFRI family wish him a happy retired life.

Bali and Paul Raj Relieved :

The resignation of Shri V. K. Bali, S-1, Coldwater Fisheries Unit, Harwan, Srinagar has been accepted and he is relieved of the services of ICAR w. e. f. 30.9.1981. Shri Bali has joined the M. P. State Fisheries as Dy. Director.

Dr. S. Paul Raj Scientist-1, Fish Nutrition Laboratory, FARTC, Dhauli has joined the Centre of Advanced Studies in Mariculture at Central Marine Fisheries Research Institute, Cochin as Scientist-2.

Congratulations Roy :

Shri P. K. Roy, Supporting Staff Grade-1 at the Cuttack Centre of CIFRI passed the Secondary School Certificate Examination conducted by the Board of Secondary Examination, Govt. of Orissa, in 1981.

Promotion

Shri S. N. Sadhukhan T-2 is promoted to the grade T-1-3.

Transfers

Name	Designation	From	To
Shri A. V. P. Rao	S-2	Kakinada	Madras
„ S. N. Sar	SRA	Barrackpore	Digha
„ K. R. Deb	Driver	Kakdwip	Calcutta
„ B. K. Halder	Messenger	„	„
„ J. K. Patra	Peon	„	„

LIBRARY

New arrivals

Books :

Current references in fish research, Vol. I, II, III, IV & V

Ramanujam, S., E. A. Siddiq, V. L. Chopra & S. K. Sinha *ed.*

Science and agriculture : M. S. Swaminathan and the movement for self reliance. ICAR, New Delhi.

Brijgopal, and K. P. Sharma

Water-Hyacinth (*Eichhornia crassipes*)—the most troublesome weed of the world. Hindustan Publishers, Delhi.

Forstuer, U. G., T. W. Wittmann

Metal pollution in the aquatic environment : Second revised edition.

Lange, D. L., K. L. Kappen & E. D. Schutze *ed.*

Water and plant life : Problems and modern approaches.

Kunleyside, Miles H. K.

Diversity and adaptation in fish behaviour.

Brown, E. Even and John B. Gratzek

Fish farming handbook : Food, Bait, Tropicals and Goldfish.

Korringa, P.

Farming marine fishes and shrimps – a multidisciplinary treatise (Developments in Aquaculture and Fisheries Science, 4, 1979).

Kuperman, B. I.

Tapeworms of the Genus *Triaenophorus*, parasites of fishes

Panse, V. G. & P. V. Sukhatme

Statistical methods for agricultural workers.

White, M. J. D.

Animal cytology and evolution, 3rd Edition.

Love, Milton S. and Cregor M. Cailliet *ed.*

Readings in ichthyology.

- Poznanin, L. P.
Ichthyology. (Translated from Russian)
- Anderson, Lee G.
The economics of fisheries management.
- Carlander, Kenneth D.
Handbook of freshwater fishery biology, Volume one : Life history data on freshwater fishes of the United States and Canada, Exclusive of the Perciformes, 3rd edition.
- Bardach, John E., John H. Ryther and William O. McLarney
Aquaculture : The farming and husbandry of freshwater and marine organisms.
- Kinne, Otto *ed.*
Diseases of marine animals, Vol. I : General aspects, Protozoa to Gastropoda.
- Nikolskii, George V.
Theory of fish population dynamics - as the biological background for rational exploitation and management of fishery resources.
- Edmondson, W. T. *ed.*
Freshwater biology, 2nd edition
- Sims, R. W. *ed.*
Animal identification-A reference guide, Vol. 2 : Land and freshwater animals. (not insects)
- Stickney, Robert R.
Principles of warmwater aquaculture
- Hutchinson, G. Evelyn
A treatise on limnology, Vol. II : Introduction to lake biology and the limnoplankton Vol. III : Limnological botany.
- Crampton, E. W. and L. E. Harris
Applied animal nutrition : The use of feedstuffs in the formulation of livestock rations.
- Natarajan, R.
Researches in estuarine biology : Proceedings of symposium on estuarine biology. Held at Annamalai University.
- Golt Ermon, H. L., R. S. Chymo and M. A. M. Ghnstad
Methods for physical and chemical analysis of freshwaters : IBP Handbook No. 8. Second edition.
- Snedecor, George W. and William G. Cochran
Statistical methods. Sixth Edition.
- McLaren, A. Douglas and George H. Peter *ed.*
Soil Biochemistry. Vol. 1, 2, 3 & 4
- Sopher, Charles D. and Jack V. Baird
Soils and Soil management.

Journals :
(Accession List)

1. Australian Journal of Biological Sciences, **34** (1), 1981.
2. Australian Journal of Marine & Freshwater Research, **32** (1), 1981.
3. Australian Journal of Zoology, **29** (1), 1981.
4. Agricultural Situation in India, **35** (9), Dec., 1981.
5. Aquatic Sciences & Fisheries Abstracts. Part 1 : Biological Sciences, **11** (1-8), 1981.
6. Aquaculture, **24** (3 & 4) & **25** (2-4), 1981.
7. Asian Aquaculture, **4** (4), April, 1981.
8. Biological Abstracts, **71** (4-12), Feb.-June, 1981.
9. Bulletin of National Fisheries University of Busan, **19** (2), Dec., 1979 & **20** (1 & 2), 1980.
10. Bulletin of the Department of Marine Sciences, **11** (1), June, 1980.
11. Bulletin of Marine Science, **30** (4) & **31** (1 & 2), 1980 & 1981.
12. Bulletin of the Zoological Survey of India, **2** (2 & 3), 1980 & **3** (1-3), 1981.
13. California Fish & Game, **67** (1-3), 1981.
14. Canada Fisheries & Marine Service, Technical Report, Nos. 995, 1000, 1006 & 1009, 1981.
15. Canadian Bulletin of Fisheries & Aquatic Sciences, Nos. 207 & 208, 1980.
16. Canadian Journal of Fisheries & Aquatic Sciences, **38** (5-7), 1981.
17. Current Science, **50** (12-18), June-Sept., 1981.
18. Doklady Biological Sciences, **250** (1-6), **251** (1-6) & **252** (1-6), & **253** (1-6) Jan.-Aug., 1980.
19. Environment International : A Journal of Science, Technology, Health, Monitoring and Policy, **4** (2-6), 1980.
20. Environmental Biology of Fishes, **5** (4), 1980.
21. Estuaries : Journal of the Estuarine Research Federation, **3** (4), December, 1980.
22. Extension Bulletin (Asian Pacific Council), 103, 155, 157 & 158, 1980-'81.
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Edited by :

B. N. Saigal, V. V. Sugunan, V. K. Unnithan, (Mrs.) G. K. Vinci and S. Paul.

Published by :

The Director, Central Inland Fisheries Research Institute, Barrackpore.

Printed by :

ROMAN PRINTERS (S. S. I. Regd. Unit) 37 Andul Road Howrah 711 109 West Bengal.