



CIFRI NEWSLETTER

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Novel Approaches in Aquaculture Research to Boost Fish Production From Inland Waters

The country has immense inland fishery resources in the form of rivers, lakes, reservoirs, irrigation tanks, ponds, estuaries, backwaters, etc. These resources remain largely undeveloped. The goal of inland fishery research during three decades has been to improve the productivity and fish production of these inland water resources. Considerable information has been collected on the biology of economic fishes of open waters; catch structure and composition and fishing effort with a view to evaluate the dynamics of exploited fish stocks. Significant progress was made in raising fish production of the order of 5 tonnes/ha and 2 tonnes/ha respectively in fresh and brackishwater aquaculture.

New light on population dynamics

In capture fisheries the recent focus has been on study of the population parameters of the exploited fish stocks



The Calcutta University has honoured Dr. A. V. Natarajan, Director of CIFRI by inviting him to deliver the first D. N. Ganguly memorial lecture. This lecture was organised by the D. N. Ganguly Academy of Biosphere, Department of Zoology, University of Calcutta. Dr. Natarajan spoke on "Recent trends in inland fisheries researches in India". A gist of the lecture delivered by Dr. Natarajan on 18th December 1981 is presented here.

placing due emphasis on management of fishing effort with a view to getting optimum fish harvest. A breakthrough has been made in dissecting out the year classes without resorting to age census by hard parts. This has facilitated the development of appropriate population models relevant to tropical fish stocks. The detailed studies carried out on fish stocks of lagoons have shown that stock abundance is inversely related to recruitment and this model explains population oscillations and yield fluctuations that have been frequently observed in this country. Systems approach to population analysis is fast catching up and may throw considerable light in eco-system analysis and management of fish stocks.

Breakthrough in Reservoir Fisheries

In reservoir research, the emphasis has been to study the ecological principles, trophic structure and functions, and

ecological energetics placing due emphasis on eco-system oriented approach to manipulation of stocks with a view to getting optimum and sustained fish harvest. Considerable success has been achieved following this approach. The fish production has mounted from 200 tonnes to 1000 tonnes per year in four years in Govindsagar and similarly from 90 tonnes to 300 tonnes per year in Bhavanisagar.

Fish Genetics Bureau

Natural fisheries are vulnerable to environmental changes. Many of our inland waters like rivers, estuaries, etc. receive large-scale discharge of industrial effluents, chemicals, heavy metals and many of them are mutagenic as well as carcinogenic. Experimental studies are underway to evaluate the genetic damage from such effluents. The CIFRI will soon have a Bureau of Fish Genetic Resources which will examine these aspects of stock structure and genetic damage, if any, on fish stocks from man-made causes.

Aquaculture both fresh and brackishwater continues to remain main area of research. The recent emphasis has been on genetic selection, hybridization, induced breeding, hatcheries, nutritional bioenergetics, nutritional biochemistry, feed formulation, environmental monitoring, fish diseases and microbiology. These new trends of research are expected to provide strong research



Dr. Natarajan delivering D. N. Ganguly Memorial Lecture.

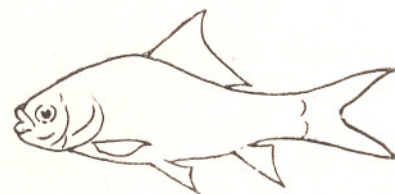
support for enhanced production of fish and fish seed from both fresh and brackishwater aquaculture.

New systems

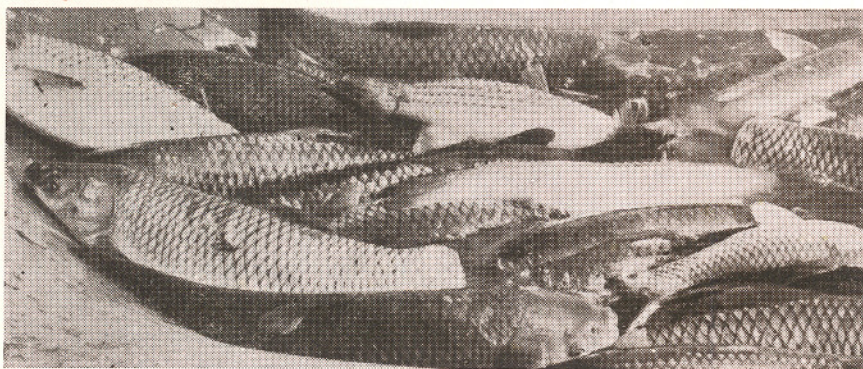
New systems of aquaculture are also emerging such as cage culture, pen culture, fish culture in running waters, raceways, and recirculatory system, paddy-cum-fish culture, sewage-fed fish culture and so on. All these hold immense promise for raising fish yield in aquaculture systems. Recent research trends also place enormous emphasis on controlled breeding and culture of penaeid and palaemonid shrimps. Some of the above systems of culture concern intensive fish culture for commercial-scale fish production while the integrated fish farming and sewage-fed fish farming emphasise on reduction of the cost of production.

2 million tonnes from inland waters

These new trends of research are expected to provide support in the management of capture and culture fishery waters and improve the total annual inland fish production in this country from the present 9 lakh tonnes to 2 million tonnes. Inland fisheries has fish production potential of the order of 9 million tonnes and it is hoped that the present trends of research will facilitate in accomplishing these targets.



New habitat for grass carp



Weed-choked bherries in West Bengal have been identified as a suitable environment for the growth of grass carp. In an experimental culture conducted by CIFRI in the brackishwater impoundments during the low saline phase, grass carp registered a record growth of 3.225 kg in just 100 days. The fishes could flourish well on weeds, *Ruppia maritima* and *Najas minor*, which were unconventional as a feed for grass carp. The fishes having an initial wt. of 225 g and stocked @ 333/ha gained a weight @ 32.2g/

'Columnaris' detected in rohu

A case of columnaris has been detected from the Indian major carp *Labeo rohita* by the CIFRI scientists working at FARTC. 'Columnaris' is a widely known

day. This is undoubtedly a spectacular growth-rate for grass carp from saline, and for that matter, even from freshwaters.

The weed-infested bherries of West Bengal are usually kept fallow or an unremunerative type of aquaculture is practised in them during the low saline period. The present experiment has evoked considerable interest among the local fish farmers' community who now consider grass carp as a boon in the production basket.

bacterial disease that infects salmonids and many species of warm-water fishes, affecting the skin, fin and gills with varying morbidity and lethality. This chronic

to subacute infection is caused by a long thin gram negative bacterium presumptively identified as *Flexibacter columnaris*. Grey to yellowish lesions appear first on the fin and then progress towards the head. It may cause extensive losses to stock within 1-2 days of the appearance of initial disease signs. The disease is attributed to the injuries during netting, rough handling and to diverse environmental conditions

At the Fish Pathology Laboratory of FARTC, Dhauli, the bacterium was successfully isolated in pure culture from skin lesions of the affected fishes. The infection was successfully controlled by treatment with Streptopenicillin administration.

Myxosporidiasis :

The pathoanatomical studies in the Districts of Cuttack and Puri also suggested the enzootic nature of renal myxosporidiasis in Indian major carps. Vacuolar degeneration of cytoplasm with pycnotic nuclei were observed in most of the renal tubules. Dilatations of the lymphatic spaces in the kidney were also noticed.

Successful Gynogenesis in carps

The scientists working in the Fish Genetics and Hybridisation Laboratory at FARTC have been successful in inducing gynogenesis in the Indian major carp viz. rohu. Earlier, the attempts on artificial gynogenesis in common carp eggs proved successful. Artificial gynogenesis based on inactivation of sperm and diploidization of maternal chromosome is used for producing gynogenetic populations. Here the spermatozoan enters and activates the egg but degenerates without its nucleus fusing with that of the egg.

Genetic inactivation of rohu milt was achieved by exposure to ultraviolet rays. Eggs were fertilised by the genetically inactive sperm. Later, the restoration of diploidy was achieved through cold shock at 12° C or heat shock at 39° C. In case of common carp, the cold shock was given at 4° C. The embryos could develop successfully.

This achievement is a major breakthrough in genetic selection work on Indian major carps. Gynogenesis facilitates production of offsprings of purely maternal inheritance. This is an important tool in fish genetic research to produce inbred lines with a high degree of homozygosity of characters aimed at improving productivity of fish.

EXTENSION SCENE

Janata Krishi Mela

The Institute participated in the Janata Krishi Mela at Akuni (Bandipur) from 25-31 December 1981. CIFRI exhibits in the form of charts, posters, lighted panels etc., depicting the achievements of CIFRI attracted a steady stream of 5,000 visitors. The films on composite fish culture and induced breeding were screened at the mela on 30-12-81. About 1,500 people watched the film with great enthusiasm.

CIFRI on the Air

The Calcutta Station of All India Radio covered the activities of CIFRI. On the daily programme *Prayatahiki* broadcast on 3.11.81 the research activities of CIFRI were highlighted for the benefit of fish farmers in Bengal.

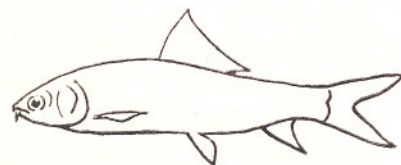
Talks delivered :

S/Sri P. K. Pandit and B. K. Banerjee, Scientists delivered lectures on "Air-breathing fish culture" and "Fish diseases and their control" respectively for the benefit of trainee fish farmers at Bangalpur, U. C. High School Bagnam. The training programme was arranged by the Gandhi Peace Foundation on 15-12-1981.

Shri U. Bhowmick, Scientist delivered two lectures viz. "The concept principles and objectives of fisheries extension and different techniques and communication systems followed in fisheries extension to the Fisheries Extension Officers of West Bengal Fisheries Department on 23.12.81. The extension scientist also led two group discussions with fish farmers one on problems encountered in composite fish culture and magur culture and the other on fish diseases and their control.

Demonstration

A demonstration programme 'on fish diseases and their control' was arranged at the village Alipur under Chandithala Block-11, in the District Hooghly on 4-11-81. More than 30 fish farmers were benefitted by the demonstration.



NEWS ROUNDUP

The Chinese weave together silk and fish

The Chinese and foreign scientists at the Canton Institute of Geography have rediscovered a traditional method of raising fish and silkworms together to ensure high yields of both. The peasants plant mulberry trees which provide the leaves on which the silkworm feed, around fish ponds. The silkworms feed chrysalides (the nonsilk part of the cocoons) and droppings are fed to the fish in ponds. The fish droppings, in turn, are used as fertilizer for mulberry trees.

Within pond, grass carp that eat the silkworm chrysalides and droppings are raised near the surface. Lower down in the water fish called bigheads and silver carp eat plankton, which thrive on droppings of the grass carp. The big heads and silver carp, in their turn, provide droppings along with leftover chrysalides nourish dace, common carp and cuttlefish that inhabit the bottom most layer of the pond.

There is more. The excrement of the last three species decomposes in the bottom silt into ammonia, phosphorus, potassium and other elements that are vital to the growth of the plants. The peasants regularly dredge the

silt and use it to fertilize mulberry trees and sugar cane. And the cycle runs indefinitely - with the plants and fish sustaining and thriving on one another.

—Wall Street Journal,
December 3, 1981

Pollution control

An adult salmon has been found in the main rivers between Chetese Bridge and Chetese Weir - the farthest upstream a record since 1833. The fish, a mature female weighing four kilogram and 78 cm. long must have travelled 76 miles upriver, ascending five lock weirs before it was found dead. Equally significant, two sea trouts have been taken on rod and line, one a 1.4 kg female caught 94 miles from the sea in the river Colu, which Thames Water Authority biologists say had already spawned. This is first migratory salmonoid known to have done so for at least 150 years. The other one a male was caught near Teddington lock.

This evidence of Thames becoming sweeter reflects both credit and success on Thames Water Authority's continuous effects to clean the river.

—IAWPC Newsletter.

Visitors

□ S/Sri Tian Chensha, Lu Young Ke and Shan Jian of the China Lead Centre of UNDP Project visited the Institute during 17-18 December 1981. The work and achievements of the Institute were explained to them.

□ Dr. J. A. Beardmore, Professor of Genetics University College of Swanson, Singleton park, U. K. visited the Institute on 3-11-81.

□ Sri A. K. M. Ashan and Sri A. S. M. Kamaluddin, Consultants of National Committee on Rural Training, Bangladesh were at CIFRI from 9-16 November 1981.

□ A batch of 40 trainees from U. G. T. C., Lumbucherra, Tripura visited the Institute on 8-12-81.

□ S/Sri S. L. Dey and A. K. Ghosal of Basanti Development Project visited the Institute on 28-11-81 and held discussions on fisheries development with the scientists of CIFRI.

CIFRI SCIENTISTS TO UNDERTAKE MORE CHALLENGING TASKS IN 82

The annual Staff Research Council Meeting was held at Barrackpore during 21-22 Dec. 1982. The meeting was chaired by Dr. A. V. Natarajan, Director, CIFRI, who highly commended the work done by scientists particularly relating to phenomenal growth of grass carp in Bherries. attempts to increase rotenone content of derris plant and encouraging results achieved in fish culture in jute-retted waters. However he attached paramount importance to diversification in research and unequivocally spelt out certain priority areas such as breeding operations in respect of penaeid prawns, *Lates calcarifer*, *Mystus seenghala*, *Wallago attu* and *Pangasius pangasius* and sex reversal studies in respect to tilapia and grass carp. Further he keenly felt the need for elevating existing status of capture fisheries.

During the two day deliberations, Heads of Divisions, officers-in-charge and project leaders appraised the chairman of the progress achieved in research project programme during the year 1981. The chairman evinced keen interest in the project proposals for 1982 and lent his general approval subjected to some modifications with regard to certain projects.

Stress on Information

With a view to rendering efficient and better services to scientists of CIFRI and also outside individuals/organisations, Information Division has been streamlined so as to make it an effective instrument for liaison between scientists and watersheds in the march of science and technical knowledge.

The upgrading of skills by keeping pace with the recent scientific development is a condition precedent for relentless pursuit of excellence in science and technology. In harmony with this principle some major programmes would be taken up in 1982 pertaining to:—

1. Selective Dissemination of Information (S. D. I.)
2. Construction of Central Information File (C. I. F.)

Dr. A. V. Natarajan, the chairman in his concluding remarks sounded a note of cautious optimism and expressed his confidence in the scientific capabilities of workers who could take up challenging assignments.

Symposium/ Training

- Sri B. B. Ghosh, Scientist has attended the symposium on "Water Resources Conservation,

Pollution and Abatement" held by the Department of Civil Engineering, University of Roorkee from 11-13 December 1981. He presented a paper entitled "Observations on environmental pollution caused by zinc-borne waste disposed from rayon industries into the Hooghly estuary". The paper was co-authored by Sri M. M. Bagchi.

- Dr. H. C. Joshi, Scientist-S-1 attended the 19th Pesticide Residue Analysis Course sponsored by the Directorate of Plant Protection Quarantine & Storage, Ministry of Agriculture and Irrigation, Government of India, Faridabad at the Central Plant Protection Training Institute, Hyderabad-30 from 1-10-'81 to 31-12-'81 and obtained first position in the examination. He also delivered a lecture on 'pesticides in aquatic environments'.

- Shri U. Bhowmick attended the National Seminar on "Challenges in Extension in 80s" held at IARI, New Delhi from 26-28 November 1981.

- Sri K. C. Roy, Assistant Administrative Officer underwent a refresher Course for Section Officers/Administrative Officers conducted from October 5 to November 13 1981, by the Department of Personnel and Administrative Reforms, New Delhi.

KAKINADA WORKSHOP

Call for Intensified Research and Extension in Brackish-water Aquaculture

The IV workshop of All India Coordinated Research Project on Brackishwater Prawn and Fish Culture was held at Kakinada during 24-25 October, 1981. Organised jointly by the Central Inland Fisheries Research Institute and the Andhra Pradesh Agricultural University, the workshop was inaugurated by Shri G. N. Mitra, Retired Joint Commissioner (Fisheries), Govt. of India. While welcoming the delegates, Dr. A. V. Natarajan, Director and Project Coordinator, Brackishwater Prawn and Fish Culture Project, CIFRI, stressed the growing importance of brackish-water aquaculture in the country.

Need for more seed

He pointed out the need to develop techniques for production of seed and culture of commercially important brackishwater fishes and prawns. Dr. Appa Rao, Director of Research, Andhra Pradesh Agricultural University appealed to the scientific community to disseminate the scientific know-how to the fish farmers in order to enable them to adopt scientific brackishwater aquaculture.

Dissemination of scientific know-how stressed

He detailed out the steps



Dr. (Mrs.) Rajyalekshmi, Professor of Fisheries APAU extending a vote of thanks to the Workshop participants.

Delegates at the Brackishwater Aquaculture Farm of APAU, at Kakinada



taken up in Andhra Pradesh towards this end and he hoped that holding of the workshop at Kakinda would benefit everyone in general and those in Andhra Pradesh in particular.

Twin objectives

Shri Mitra, while inaugurating the workshop expressed the view that the development of brackishwater areas in the country under productive programmes is highly relevant today in the context of the twin objectives viz., providing employment in the backward areas and earning foreign exchange for the country. He also appealed to the elite gathering to evaluate the result obtained from different centres of the projects critically and frame the future programme of work. Dr. Rajyalakshmi, Professor of Fisheries, Andhra Pradesh Agricultural University, proposed a vote of thanks.

Technical sessions

The technical sessions that followed, discussed the work programme and achievements of the project centres at Kakdwip, Kakinda, Madras and Vytilla (Cochin). This was followed by a comprehensive report on the progress achieved under the Project. The report was presented by Shri K. K. Ghosh on a suggestion from Dr. A. V. Natarajan, the Project Coordinator and Director of CIFRI.

Progress reviewed

Later Dr. Natarajan reviewed the overall progress made in the execution of the project. He remarked about the necessity for uniform sampling and management procedures. Dr. Natarajan reminded the scientists of the vital role of seed production in the development and popularisation of new technologies. The programme for the coming years would take into consideration all these aspects along with the proper analysis of operational costs involved. He was of the view that economics was an index which gives an idea of the state of the industry (culture system).

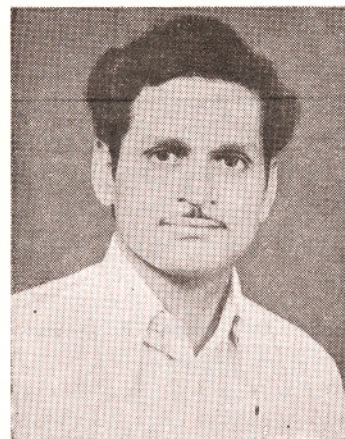
Programme for 1982

While finalising the project programme for 1982, monoculture of *P. monodon* and *P. indicus* were given the due importance. Separate experiments would be undertaken to culture prawns along with fishes like *Chanos chanos* and *Etroplus suratensis*. The management measures to be adopted, stocking rates, etc. were laid down. Prawns *P. monodon* and *P. indicus* would be stocked @ 20,000/ha in monoculture as well as mixed culture with fishes. Juveniles would be 50-60 mm in size. The stocking rate recommended for fishes were 500/ha for *Chanos chanos*, 300/ha (for *E. suratensis*) and 300/ha when both the fishes were stocked.

STAFF NEWS

Doctorate for L. H. Rao

Shri L. H. Rao, S-1 at the Kakinada Centre of CIFRI was awarded the degree of Doctor of Philosophy in Zoology by the Andhra University for his "Studies on taxonomy of the fishes and on the biology of *Heteropneustes fossilis* (Block, 1974) of Lake Kolleru in Andhra Pradesh".



STAFF NEWS

Promotions

Name	From	To	W. e. f.
Shri B. Majhi	Supporting Grade III	IV	2. 11. 1981
„ Khemchand Balmiki	I	II	do
„ Dhaneswar Das	„	„	do
„ A. K. Biswas	„	„	do
„ Fakji Parida	„	„	do
„ Giridhari Das	„	„	do
„ Dharendra Bhujan	„	„	do
„ Khetra Mohan Sahoo	„	„	do
„ Rajkrishore Behera	„	„	do
„ Raghunath Swain	„	„	do
„ Shyama Bhoi	„	„	do
„ S. Parida	„	„	do
„ Lakshmidhar Sahoo	„	„	do
„ Sitaram Bahadur	„	„	do
„ Suraj Bahadur	„	„	do
„ K. Kaliannan	„	„	do
„ M. V. Krishnan	„	„	do
„ A. E. Raju	„	„	do
„ Hiralal Bose	„	„	do
„ Parameswar	„	„	do
„ Jainandan Mallah	„	„	do
„ B. Hazarika	„	„	do
„ Manindra Nath Biswas	„	„	do
„ Shyamlal Dhanuk	„	„	do
„ Kishori Mohan Das	„	„	do
„ Ashok Kumar Biswas	„	„	do
„ Biswanath Mondal	„	„	do
„ Vibhuti Kumar Jena	„	„	do

Transfers

The following transfers were made during November - December, 1981.

Name	Designation	From	To
Shri S. D. Tripathi	S-3	Barrackpore	Dhuli
Dr. C. R. Das	S-2	Cuttack	Bhubaneswar
Dr. N. K. Thakur	S-2	TTC (Dhuli)	FARTC (Dhuli)
Shri S. K. Wishard	S-1	Allahabad	Gauhati
„ D. S. Murthi	JFS	Cuttack (on study leave)	Tadepalligudem
„ S. N. Sar	SRA	Barrackpore	Digha
„ K. S. Banerjee	T-II-3	Barrackpore	Bilaspur
„ R. K. Panda	Jr. Clerk	Dhuli	Cuttack
„ Wilson Guria	do	Ranchi (CFCSP)	Barrackpore

Induction to ARS Cadre :

Shri S. L. Kar was inducted to ARS Cadre in 'S' grade with effect from 7-4-1978.

Resignation

Shri Mrinal Kanti Bala, Junior Clerk was relieved of his duties in ICAR Service to join as Assistant Cashier-cum-Godown Keeper in United Commercial Bank, New Delhi on 9. 11. 1981.

Farewell to Dr. Dehadrai

On the eve of his taking over as Fishery Development Commissioner, Ministry of Food and Agriculture, Government of India, Dr. P. V. Dehadrai, Project Coordinator, Air breathing Fish Culture was accorded a warm send-off by the CIFRI Staff on 7-11-1981. All members of CIFRI Staff at Barrackpore turned up at the auditorium to bid farewell to Dr. Dehadrai. Speaking on the occasion, Dr. A. V. Natarajan, Director said that there could not be a better indicator of the fact that P V D reigned the hearts. While recalling Dr. Dehadrai's contributions to the growth and achievements of CIFRI for the last one decade, he pointed out that members of CIFRI family were proud of this recognition to one of their top scientists. He was confident that under the stewardship of a dynamic person like Dr. Dehadrai, the fisheries development in the country was bound to achieve the necessary pace.



Bloom.....Smiles and flowers

First incumbent

Creation of the post of Fishery Development Commissioner as well as the appointment of a scientist of Dr. Dehadrai's stature to it is the ample testimony for the growing awareness of fisheries at the Centre.

Dr. Dehadrai had endeared himself to all by his amiable temperament, individualised humour and quick witticism. CIFRI fraternity, though missing him for his disarming smile, reassuring pat on shoulder and his infectious enthusiasm, hope that he will continue to favour them with his counsel.

ON THE ANVIL—5

Fish genetics and hybridisation

□ Engineering the genetic resources of culturable fishes to our advantage is highly relevant in present-day search for viable and more profitable fishery management procedures. Perhaps a breakthrough is evading us for want of a much needed fillip in this sector. Results of arbitrary and sporadic attempts hitherto made on Indian species of cultivable fishes assure promises. Systematic work on these lines have been initiated at the Freshwater Aquaculture Research and Training Centre of CIFRI at Dhauli by adopting the latest techniques in fish genetic research. The team of scientists at the fish genetics and hybridisation laboratory have taken up the gauntlet under the following lines :

□ Elucidation of cytogenetic features and accordingly the selective breeding is designed to establish maximum possible homozygosity of desired characters. The fishes thus obtained with superior strains are to be incorporated in culture practices.

□ Selective breeding and hybridization of Indian and exotic species would lead to improved stocks. Investigations are underway to identify specific markers like protein and isoenzyme which would help in fool-proof selection of desired strains. Obviously the characters looked into in the offsprings are better growth-rate, diversified feeding habits, desirable morphometric features, paternal character of natural breeding in ponds, resistance to diseases and an easy acclimatisation to the local environment.

□ A faster selection of desired traits through the production of gynogenetic, androgenetic and polyploid populations are given adequate attention

at the fish genetics laboratory of CIFRI. Exclusion of paternal or maternal genome from a genetic constitution of a fish through gynogenetic or androgenetic path drives the population to monosex nature. Manifestation of desirable or undesirable characters in such cases tends to become prominent. Thus, selection of desired population becomes easier. Further these monosex varieties become safe to test their efficiency on native aquatic fauna and flora.

□ Based on this point, functional sex reversal of tilapia through oral hormone administration at fry stage before gonadal differentiation is yet another investigation undertaken by the Institute. Thus, free introduction of such population averts the threat to Indigenous fishes.

□ CIFRI has also undertaken genetic characterisation studies on *Catla catla*, *Cyprinus carpio* and *Hilsa ilisha*. Establishing the genetic identity of these species or the subspecies would lead to definite conclusions with regard to their biological and behavioural features. This understanding is essential for determining their suitable environment, proper exploitation and the conservation of species like *Hilsa*.

□ CIFRI has already attained notable success in many of these experiments.

□ Ten scientists at present are engaged in the above investigations : R. K. Jana, George John, P. V. G. K. Reddy, S. D. Gupta, G. V. Kowtal and V. R. P. Sinha at FARTC, Dhauli and S. K. Mukhopadhyay, B. Venkatesh, P. K. Mukhopadhyay and Apurba Ghosh at the Barrackpore / Khardah Centre of CIFRI.

LIBRARY

Journals :

(Accession List)

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2. Aquatic Sciences & Fisheries Abstracts, Part I : Biological Sciences, **11** (9-11), 1981
3. Aquaculture, **26** (1, 2), 1981
4. Canada Fisheries & Marine Service, Technical Report, Nos, 1016 & 1021, 1981
5. Canadian Bulletin of Fisheries & Aquatic Sciences, No. 209, 1981
6. Current Science, **50** (19-23), 1981
7. Estuaries : Journal of the Estuarine Research Federation, **4** (2) 1981
8. Extension Bulletin (Asian Pacific Council), Nos. 146, 159 & 160, 1981
9. Fishery News, Nos. 3532, 3536, 3538 & 3540, 1981
10. Fish Farming International, **8** (2) 1981
11. Fishing Chimes, **1** (7), 1981
12. Indian Farming, **31** (6), 1981
13. Indian Journal of Biochemistry, **18** (4), 1981
14. Indian Journal of Environmental Health, **23** (4), 1981
15. Indian Journal of Animal Sciences. **51** (9-10), 1981
16. Indian Journal of Experimental Biology, **19** (1-12), 1981
17. Indian Journal of Agricultural Economics, **36** (3), 1981
18. Indian Journal of Extension Education, **17** (1-4), 1981
19. Indian Journal of Marine Sciences, **10** (1-4), 1981
20. Indian Journal of Ecology. **8** (1), 1981
21. Journal of Experimental Biology, 90-93, 1981
22. Journal of Experimental Marine Biology & Ecology, **56** (1), 1981
23. Journal of Fish Biology, **19** (1-5), 1981
24. Journal of the Indian Society of Soil Science **29** (3), 1981
25. Journal of Scientific and Industrial Research, **40** (1-10), 1981
26. Journal of the American Society for Information Science, **32** (3 & 4), 1981
27. Journal of Zoology, **193** (1-3), 1981
28. Pesticide Biochemistry and Physiology, **16** (1), 1981
29. Proceedings of the California Academy of Sciences, **42** (11-13), 1981
30. Proceedings of the Indian Science Congress Association, **68th** (1), 1981
31. Proceedings of the Indian National Science Academy, **47** (4), 1981
32. Sankhya : The Indian Journal of Statistics, **43A** (1 & 2) & **43B** (1 & 2), 1981
33. Science & Culture, **47** (6 & 7) 1981
34. Seafood Export Journal, **13** (6-11), 1981
35. Tulane studies in Zoology & Botany, **22** (2), 1981
36. UNCSCO Journal of Information Science, Librarianship & Archives, **2** (4), 1980
37. Washington State University, College of Agriculture & Cooperative Extension, Extension Bulletin Nos. 815-874, 1981
38. Yearbook of Fishery Statistics, **49**, 1979

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New additions

Books :

Fisher, R. A. & Frank Yates

Statistical tables for biological, agricultural and medical research. *6th ed.*

Bose, P. R. and V. N. Vashist

Rural development and technology : A status report-cum-bibliography.

Bhatnagar O. P.

Research methods and measurements in behavioural sciences.

Gupta, R. K. Subhas Chandra, K. D., Koranne, Y. K., Arora & C. Sastry *eds.*

Proceedings of the National Symposium on soil conservation & water management in 1980's (March 12-13, 1980). *Part-I*

Mani, M. S. *ed.*

Ecology and Biogeography in India.

Berg, Leo S.

Classification of fishes both recent and fossil (English and Russian).

Gupta, O. P.

Aquatic weeds : their means and control - a text book and manual.

Raychaudhuri, S. P. & D. S. Gupta *eds.*

Environmental pollution and toxicology : Proceedings of International symposium held under the auspices of Haryana Agricultural University and Indian National Science Academy, November 28-30, 1977.

Lydekker, Richard, J. T., Cunningham G. A. Boulenger and J. Arthur Thomson

Reptiles amphibians fishes and lower chordata.

Sorgeloos, Patrick, Robert P. McCourt, Patrick Labens, Ludmila Spectorova and Azwar N. Khalaf

European Mariculture Society Special Publication No. 5 : Updated bibliography on the brine Shrimp *Artemia*.

Pillay, T. V. R. and Wm. A. Dill *eds.*

Advances in aquaculture - Papers presented at the FAO Technical Conference on Aquaculture, Kyoto, Japan, 26 May - 2 June 1976.

Weatherley, A. H.

Growth and ecology of fish populations.

Barrington, E. J. W. and C. Barker Jorgensen

Perspectives in endocrinology - Hormones in the lives of lower vertebrates.

Nikolsky, G. V.

The ecology of fishes.

LIBRARY

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