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INTRODUCTION

Conservation of fish biodiversity is not a simple task in a vast and diverse country like ours where even there is no public awareness on the matter as yet. Our utterly inadequate number of scientific and technical manpower for this purpose could register conspicuous achievements both in the laboratory and in the field absolutely due to their devotion and sincere effort. The linkage with other relevant organisations remained useful in strengthening the effort with meaningful outcome. The Bureau would take the lead on the matter when approved manpower comes in position and the departmental infrastructure building is completed in near future.

I take this opportunity of offering compliments to the Scientific and Technical personnel for their achievements which are included in the report, Library personnel for their technical assistance and all other categories of officers and staff for their useful support in the Bureau's effort.

P. DAS
DIRECTOR

प्रतिवेदन का हिन्दी सारांश
१९९५-१९९६

भूमिका

संक्षिप्त इतिहास

हमारे देश के अन्तर्स्थलीय एवं समुद्री मत्स्य विकास सम्बन्धी राष्ट्रीय कार्यक्रमों के अन्तर्गत यह सुनिश्चित किया गया है कि मछली उत्पादन में केवल वृद्धि ही पर्याप्त नहीं है अपितु प्रकृति प्रदत्त विभिन्न मत्स्य प्रजातियों एवं उनमें पायी जाने वाली विभिन्नता का संरक्षण भी अत्यन्त आवश्यक है। भारत सरकार द्वारा इसके महत्व को ध्यान में रखते हुए कुछ समय पूर्व राष्ट्रीय मत्स्य आनुवंशिक संसाधन ब्यूरो की स्थापना का अनुमोदन किया गया। भारतीय कृषि अनुसंधान परिषद के अन्तर्गत ब्यूरो ने पिछले कुछ वर्षों से अपना कार्य भी आरम्भ कर दिया है। ब्यूरो का स्थायी मुख्यालय मई १९९४ में इलाहाबाद से लखनऊ स्थानान्तरित किया गया तथा ५२ एकड़ भूमि पर तेलीबाग लखनऊ में ब्यूरो का भवन एवं मत्स्य फार्म निर्माणाधीन है।

उद्देश्य

राष्ट्र के समस्त मत्स्य आनुवंशिक संसाधनों के विषय तथा ज्ञान का एकत्रीकरण एवं वर्गीकरण (कैटलागिंग), मत्स्य आनुवंशिक संसाधनों का संरक्षण, संस्थानों के सहयोग से मत्स्य आनुवंशिक संसाधनों का रखरखाव और लुप्तप्राय (एन्डैन्जर्ड) प्रजातियों का संरक्षण तथा भारतीय जल संसाधनों के लिए विदेशी प्रजातियों का चयन एवं नियंत्रण।

संगठन

ब्यूरो के कार्य के सुचारु रूप से क्रियान्वयन हेतु ब्यूरो के संगठनात्मक ढांचे में निम्नलिखित चार केन्द्रों का प्रस्ताव है।

१. मृदु जलीय संसाधन केन्द्र
२. शीतल जलीय संसाधन केन्द्र
३. क्षार जलीय संसाधन केन्द्र
४. समुद्र जलीय संसाधन केन्द्र

उपरोक्त चारों केन्द्रों पर सम्बन्धित मत्स्य प्रजातियों के संरक्षण एवं शोध कार्य होंगे। इसके अतिरिक्त मुख्यालय पर स्थित निम्न चार सम्भाग (सेक्सन) संरक्षण एवं शोधक्षेत्र में कार्यरत हैं।

१. कोशिकानुवंशिकी
२. जीव रसायन आनुवंशिकी

३. जीव विज्ञान
४. संरक्षण एवं प्रबन्ध

१.१ एफ.बी. ६ : भारतीय मत्स्य आनुवंशिक संसाधन का डाटा बैंक विकसित करना

१ भारत के मत्स्य जर्मप्लाज्म संसाधन की सूचना एकत्र करना

क) **चेक लिस्ट** : भारतीय मत्स्य जर्मप्लाज्म संसाधन की सम्पूर्ण जानकारी रखने हेतु विभिन्न परिस्थितिकी जैसे कि शीत जल, मृदु जल, क्षारीय जल तथा समुद्री जल की २२०० फिनफिस का ड्राफ्ट चेक लिस्ट संशोधित सिनोनिम के साथ संशोधित किया गया है जिसमें उनके वर्गीकरण, आवासीय स्थल एवं वितरण की जानकारी दी गयी है।

इसका वर्गीकरण विशेषज्ञों की राय के अनुरूप पुनः अपडेट किया जा रहा है। डा. ए.जी. के. मेनन के सुझाव के अनुसार लिस्ट को ''बायोडाइवर्सिटी आफ इण्डिया'' के नाम से प्रकाशित किया जा सकता है। यह मत्स्य अनुसंधान में लगे वैज्ञानिक, अनुसंधान कर्मी एवं विद्यार्थियों के लिये रेडीरेकनर की तरह प्रयुक्त होगी।

ख) **कैटलाग** : भारत के मत्स्य जर्मप्लाज्म संसाधन पर विस्तृत कैटलाग में करीब १५० फिनफिस के वर्गीकरण, पहचान, आवासीय वातावरण, उपलब्धता, जैवज्ञान, जीवन चक्र, मत्स्य पैदावार, आनुवंशिकी, लैंगिकता, मत्स्य पालन, तथा संरक्षण सम्बन्धी जानकारी को जोड़ कर नवीनतम किया गया है। आसानी से खोजने एवं कार्य करने की सुविधा हेतु इन सभी जानकारियों को पुनः कम्प्यूटर डाटा वेस में स्थानान्तरित किया गया है। इसी कैटलाग में लगाने के लिये गंगा नदी की ५० मछलियों के चित्र लिये गये हैं।

२ भारतीय मछलियों की लुप्तोन्मुख स्थिति

पानी के कुछ प्रभाग में फिनफिस की वर्तमान स्थिति सुनिश्चित करने के लिए इलाहाबाद के लैंडिंग सेन्टर (गंगा नदी) फरक्का बैराज एवं हिमालय के कुमाऊ क्षेत्र की नदियों का सर्वेक्षण किया गया। कुछ क्षेत्र के सत्यापन के आधार पर एवं शोधकर्ता, मत्स्य प्रभाग के अधिकारियों, एन्गलर्स एवं काली नदी, पूर्वी राम गंगा, सरयू नदी, कोसी नदी के मछुआरों के कथनानुसार स्थानीय मछलियों, बोटिया अल्मोरी, पहाड़ों में आहार एवं खेल में प्रयुक्त होने वाली मछली टार टार, टार प्यूटीटोरा, साइजोथोरैक्स रिचर्डसोनी, बैरोलियस वेन्डेलिसिस, लेबियो डेरो, लेबियो डायोचिलस तथा उष्णीय पहाड़ी मछलियों, ग्लिप्टोर्स्टनम पेक्टिनोप्टैरम स्यूडोइकेन्सिस सलकेटस की स्थिति में भारी कमी आयी है।

इलाहाबाद लैंडिग सेंटर तथा फरक्का बैराज से प्राप्त टेनुआलोसा इलिसा के आंकड़ों को विश्लेषित किया जा रहा है एवं इसकी आख्या शीघ्र ही प्रस्तुत की जायेगी।

३ विदेशी मछलियों का भारतीय जल श्रोतों में नियंत्रित प्रतिस्थापना हेतु अध्ययन

विदेशी मछलियों के प्रभावी पुनर्उत्पादन प्रबन्ध के लिए दीप्तमानिता एवं तापमान पी/टी के प्रभाव का अध्ययन किया गया एवं गोनैड के विकास एवं विभेदन में इसके महत्व को देखा गया। हमारे अध्ययन के अनुसार तिलापिया एवं कामन कार्प में लिंग के विभाजन एवं पुनर्उत्पादन पर वातावरणीय प्रभाव पुनर्उत्पादन का प्रबन्ध एवं स्पीसीज में उनके उद्दीपनों के प्रतिउत्तर का आधार देता है। हमारे प्रयोग के अध्ययन की कुछ प्रमुखता नीचे दी गयी है।

(i) १७ अल्फामेथाइल टेस्टोस्टीरान खिलाने से एकलिंगी (नर समुदाय) उत्पादन का अध्ययन : नियंत्रित प्रयोगशाला परिस्थिति में ओरियोक्रोमिस मोजैम्बिकस के प्रजनन द्वारा नर को परिवर्तित करने के प्रयोग को मानकीकृत किया गया है। नर लिंग हारमोन १७ अल्फा मिथाइल टेस्टोस्टीरान का प्रभाव विभिन्न मात्राओं में ५ से ४० मि.ग्रा./कि.ग्रा. भोजन में परिक्षित किया गया। इस अध्ययन में यह पता चलता है कि सबसे ज्यादा ४० मि.ग्रा./कि.ग्रा. १७ एम टी भोजन में देने से नर समुदाय का उत्पादन ८४ प्रतिशत होता है। प्रयुक्त मछलियों के समूह में शारीरिक विभिन्नता के साथ १०० प्रतिशत लिंग परिवर्तित समुदाय की अनुपस्थिति से वातावरणीय तत्वों के प्रभाव में जैसे दीप्त मानिता एवं तापमान एवं ३५ मि.ग्रा. १७ एम टी/कि.ग्रा. स्टेरायड की मात्रा को भोजन में बदल बदल कर एक लिंगी नर समुदाय में प्रयोग की योजना बनायी गयी।

(ii) दीर्घ दीप्तमानिता से प्रभावित मछली को १७ एम.टी. भोजन में देने पर : हमारे शोध परिणाम दिखाते हैं कि ७ दिन के पैदा हुए नये बच्चों को ६० दिन की दीप्तिमानिता १६ एल. ८ डी. में रखते हुए ३५ मि.ग्रा./कि.ग्रा./१७ एम.टी. भोजन में खिलाने पर उनमें अच्छा विकास होता है एवं १०० प्रतिशत नर समुदाय की प्राप्ति होती है।

ओरियोक्रोमिस मोजाम्बिकस का औसत गीला वजन साधारण, १७ एम टी के साथ तथा ६० दीर्घ दीप्तिकाल अवस्था (१६ एलः८डी) में १७ एम टी के प्रयोग से आरम्भिक गीला वजन ०.०१२±०.००३ ग्रा. से बढ़कर १.२३±०.२८ ग्रा. हो जाता है।

सबसे ज्यादा ध्यान देने योग्य बात यह है कि लम्बी दीप्तिमानिता अवस्था १६ एल : ८ डी में उनका विकास दर अनुपात सबसे ज्यादा था (पी > ०.००१) इस मछली को दीर्घ दीप्तमानिता अवस्था १६एल : ८डी से गुजारने पर एवं १७ एम.टी. खिलाने पर जीवित रहने का अनुपात ६७% से ६८.१% हो जाता है चूंकि एन्ड्रोगोनाइज किया हुआ तिलापिया का नया बच्चा नियन्त्रित दीप्तमानिता की अवस्था में सम्पूर्ण नर लिंगी नहीं बन पाता है।

अतः गोनैड के विकास एवं इसकी विभिन्नता पर वातावरण, दीप्तमानिता एवं तापमान के प्रभाव का अध्ययन करने को सोचा गया।

(iii) तिलापिया के जननांग विकास एवं रूपान्तरण पर दीप्तमानिता एवं तापमान का प्रभावः गोनैड के विकास एवं इसकी विभिन्नता पर प्रयोग के दौरान यह देखा गया कि तापमान एवं

दीप्तिमानिता पोटेंशियल प्रोक्जीमेंट फैक्टर की तरह कार्य करता है। तिलापिया पर प्रयोग के अध्ययन ने यह सिद्ध किया है कि निम्न ताप एवं स्कोटोफेज में गोनाड के विकास एवं इसके विभेदीकरण पर प्रभाव पड़ता है। निम्न ताप एवं स्कोटोफेज पर इन मछलियों का भोजन एवं सामुदायिक व्यवहार साधारण की तुलना तक कम हो गया था। आंकड़ों के अध्ययन के अनुसार प्रयोगिक मछलियां विभिन्न दीप्ति काल के दौरान लिंग अनुपात में अपेक्षित मेण्डल अनुपात से काफी भिन्नता दिखाई देती हैं। चूँकि इन्डोजिनस हार्मोन जैसे लिंग स्टेरायड, थायरायड हार्मोन एवं मेलाटोनिन का परिणाम वातावरण से बहुत प्रभावित होता है, अतः थायरायड हार्मोन एवं मेलाटोनिन का प्रभाव देखने का निश्चय किया गया।

(iv) तिलापिया के प्रभावित लैंगिग परिवर्तन में १७ एम.टी. पर थायरायड हार्मोन का प्रभाव : एक्वेरियम में सिन्थेटिक थायराक्सिन (टी–४) एवं ट्राइआइडोथाइरानिन (टी–३) के ०.२५ मि.ग्रा. एवं ०.५० म्यू/एल मात्रा के साथ लम्बी दीप्तिमानिता १६एल : ८डी. की क्रिया १७ अल्फा एम.टी. खिलाने के साथ लिंग परिवर्तन का प्रयोग किया गया। प्रयोग से नये जन्मे बच्चों के फिन में केवल जल्दी विभेदन के अलावा लिंग अनुपात एवं विकास में कोई अन्तर दिखायी नहीं दिया। हमारे प्रयोग के अनुसार केवल थायरायड हार्मोन के प्रभाव से समूह के लिंग अनुपात में १:१ के अतिरिक्त कोई बदलाव नहीं दिखाई देता है जबकि सिन्थेटिक थायरायड हार्मोन की उपस्थिति एवं लम्बी दीप्तिमानिता में १७ एम.टी. खिलाने से १०० प्रतिशत नर समूह देता तथा लिंग विभेद के दौरान थायरायड हार्मोन की कोई विशेष भूमिका नहीं रहती है। प्राप्त तथ्यों से पता चलता है कि मेलाटोनिन का प्रवाह दीप्तमानिता से जल्दी प्रभावित हो जाता है और प्रजनन पर सीधे प्रभाव डालता है।

(v) तिलापिया के १७ एम.टी. से प्रभावित गोनैड के प्रवधन पर मेलाटोनिन का प्रभाव : इस प्रयोग में लम्बी दीप्तमानिता (१६एल : ८डी.) के दौरान ३५ एम.जी./के.जी. १७ एम.टी. की मात्रा खिलाने के एक लिंगी (सभी नर) उत्पादन की विधि को सिन्थेटिक मेलाटोनिन की ०.२५ एम.जी./एल. तथा ०.५० एम.जी./एल मात्रा से पुनः क्रिया कराया गया। सबसे विशेष तथ्य यह सामने आया कि मेलाटोनिन के प्रभाव में १०० प्रतिशत नर का उत्पादन प्राप्त नहीं हो सका। परिणाम ने यह इंगित किया कि इस हार्मोन की क्रिया गोनैड के विकास के साथ गोनैड के विभेदन पर भी है।

(vi) कामन कार्प (साइप्रिनस कार्पियो–कम्यूनिस) के साथ लिंग परिवर्तन का प्रयोग : चूंकि कामनकार्प, साइप्रिनस कार्पियो–कम्यूनिस के तुरन्त पैदा हुए बच्चों को ६० दिन तक ३००–४०० एम. जी./के.जी. १७ एम.टी. भोजन के साथ मिलाकर दिया गया। एक्वेरियम में कुछ बच्चे ही जीवित रह सके जिससे कोई भी निष्कर्ष नहीं निकल सका।

अब तक किये अध्ययन के अनुसार १७ एम.टी. (३५ एम.जी./कि.ग्राम भोजन में) को लम्बी दीप्तमानिता (१६एल. : ८डी.) की क्रिया को कराने से १०० प्रतिशत नर उत्पादन होता है जबकि ओरियोक्रोमिस मोजौम्बिकस में १०० प्रतिशत विकास की दर तथा जीवंतता होती है जो कि मत्स्य पालन में अच्छा उपयोग हो सकता है।

तिलापिया की तरह ट्रापिकल मछलियों में पीनियल मेलाटोनिन हार्मोन का लिंग विभेदन की

प्रक्रिया में शामिल होना बताता है कि मछलियों की लिंग विभेदन में पीनियल मेलाटोनिन क्रिया पर और अनुसंधान आवश्यक है।

१.२ एफ–बी २ : चयनित उच्च जल क्षेत्रों में महाशीर संरक्षण

उत्तर प्रदेश के कुमायूं मण्डल के पर्वतीय भाग से बहने वाली शारदा एवं उसकी सहायक नदी, लधिया में महाशीर संरक्षण हेतु एक उचित कार्य योजना तैयार की जा रही है जिसका प्रमुख घटक निम्नवत है।

पर्वतीय नदियों पर अध्ययन

संयुक्त राष्ट्र मत्स्य एवं वन्यजीव सेवा प्रपत्र के आधार पर महाशीर के प्राकृतिक वासस्थान का प्राथमिक सर्वेक्षण चलथी पुल से नीचे किया गया तथा बिसौरिया नाला क्षेत्र से मृदा एवं जल के नमूने एकत्रित किये गये ताकि महाशीर मछली की वर्षा ऋतु में बड़ी संख्या में होने वाली असमय मृत्यु के कारणों का पता लगाया जा सके।

मृदा एवं जल के नमूनों का वैज्ञानिक विश्लेषण किया गया तथा उसका पी.एच. विद्युत संचालक शक्ति तथा विभिन्न घटकों जैसे कैल्शियम, सोडियम, पोटैशियम, कार्बन, क्ले तथा सिल्ट एवं बालू की प्रतिशत मात्रा का आंकलन किया गया। प्राप्त आंकड़ों से यह निष्कर्ष निकाला गया कि वर्षा काल में चट्टानों की विभिन्न सतहों से होने वाले जल रिसाव के कारण चट्टानों को बांधने वाले पदार्थ अत्यन्त क्षीण हो जाते हैं जिसके कारण चट्टानों का नाश होने लगता है तथा यह मृदा में परिवर्तित हो जाती है।

महाशीर की वर्तमान स्थिति

लधिया तथा शारदा के कुछ भाग में महाशीर की उपलब्धता के आंकलन हेतु निकटवर्ती गांव तथा मत्स्य दोहन क्षेत्र से आंकड़े एकत्रित किये गये। टोर प्यूटीटोरा तथा टोर टोर का प्रति प्रयत्न पकड़ (कैच पर यूनिट एफर्ट) लधिया तथा शारदा नदियों में ०.२–०.६ ग्राम पाया गया जबकि कुल मत्स्य आखेट का प्रति प्रयत्न पकड़ ५–१२ ग्राम था।

महाशीर पुर्नस्थापना

पर्वतीय क्षेत्र में महाशीर के पुर्नस्थापना के उद्देश्य से राष्ट्रीय शील जल मत्स्य अनुसंधान केन्द्र हलद्वानी, उ.प्र. तथा मत्स्य विभाग, उ.प्र. के सहयोग से एक कार्ययोजना तैयार की गयी जिसके अन्तर्गत लधिया कोसी तथा शारदा नदी में खैरना से कोसी एवं कातरमल जिला नैनीताल एवं अलमोड़ा का सर्वेक्षण किया गया तथा महाशीर पुर्नस्थापना हेतु निम्न स्थानों का चयन किया गया।

१ कोसी नदी में कोसी से कातरमल
२ कोसी नदी में खैरना पुल के निकट नैनीताल–अल्मोड़ा मार्ग पर

३ लधिया नदी में चलथी पुल से नीचे
४ शारदा नदी में ब्रह्मदेव ग्राम के निकट

महाशीर अंगुलिका में मार्कर टैग लगाने का कार्य : प्राकृतिक परिवेश में महाशीर मछली के व्यवहारिक अध्ययन हेतु अंगुलिकाओं के पहचान के लिये विभिन्न प्रकार के जीव रंग का प्रयोग किया गया जैसे एलीजरीन रेड, एलिशियन ब्लू, एनिलीन ब्लू, बिस्मार्क ब्राउन तथा सिलवर नाइट्रेट। किन्तु स्थानीय उपलब्ध वस्तुओं से तैयार किया गया टैग सबसे ज्यादा कारगर साबित हुआ। यह प्रयोगशाला में तिलापिया तथा पुंटियस मछली पर लगाया गया तथा लगाने के चार माह बाद भी मछलियों पर कोई दुष्प्रभाव डाले बिना भली भांति लगा रहा।

ऊतकीय अध्ययन : लुप्तप्राय महाशीर मछली के मस्तिष्क तथा जनन ग्रंथि ने मौसम के अनुसार होने वाले परिवर्तन को जानने के लिये हिमाचल प्रदेश से पकड़ी गई मछलियों के ऊतक लिये गये। ऊतक को बोइन्स घोल में २४ घंटे तक रखा गया तथा तत्पश्चात् स्वच्छ जल से धोया गया ताकि पिकरिक अल्म पूर्णतया निकल जाय। इसके बाद ऊतक को अलकोहल के विभिन्न प्रतिशत मात्रा में निर्जलीकरण किया गया तथा जाइलीन में धोने के बाद पैराफीन मोम में ६०° सेल्सियस पर रखा गया। मस्तिष्क के ऊतक का अग्रपश्च–काट काट कर एल्डिहाइड फयसिन तथा मैलोरी ट्रिपल में रंगा गया। जनन ग्रंथि के अनुप्रस्थ–काट को हेमेटौक्सलीन–इयोसीन से स्टेन किया गया। इसका विस्तृत अध्ययन प्रगति पर है।

जन जागृति कार्यक्रम : लधिया तथा शारदा के जलागम क्षेत्र में स्थानीय ''महासीर संरक्षण समिति'' की मदद से एक जन जागृति कार्यक्रम का आयोजन किया गया। इस कार्यक्रम के प्रभाव से इस क्षेत्र में अवैध विधि से मत्स्य आखेट में कमी आयी है। महासीर संरक्षण समिति के पदाधिकारियों तथा सदस्यों को ब्यूरो की तरफ से परिचय पत्र प्रदान किया गया तथा इस अवसर पर ''महाशीर बचाओ'' स्टीकर भी जारी किया गया।

१.३ बी जी/१० : प्राकृतिक प्रदत्त व्यवसायिक महत्व की और लुप्तप्राय मछलियों का आनुवंशकीय अध्ययन

टेनुआलोसा इलीशा ''हिल्सा'' फरक्का से लाये गये टेनुआलोसा इलीसा सैम्पुल में पहले अध्ययन किये गये दो आईसो इन्जाइम के साथ १२ और एन्जाइम अध्ययन किये गये। हिल्सा में पी जी एम और जी पी आई एन्जाम में रोहू की अपेक्षा और एक्स डी एच में कामन कार्प के अपेक्षा विभिन्न बैन्ड पैटर्न देखी गई।

टौर पुटीटोरा : लुप्तप्राय टौर पुटीटोरा सैम्पुल ब्यास नदी (हिमाचल प्रदेश) से एकत्रित किये गये। समविद्युत विभव केन्द्रीकरण (आईसो इलेक्ट्रिक फोकसिंग) विधि द्वारा आंख के लेंस प्रोटीन अध्ययन करने पर ४० बैन्ड प्राप्त हुए। ५३ सैम्पुल में १७ मछलियों में विभिन्न बैन्ड पैटर्न पाया गया।

भारतीय कार्प

भारतीय कार्प में एल डी एच और जी पी आई एन्जाइम आनुवंशिक चिन्हक पाये गये। जी पी आई और ए ए टी एन्जाइम के प्रयोग से रोहू मृगल संकर की पहचान की गयी। वायु श्वासी मछली कई वायु श्वासी मछली में आनुवंशकीय अध्ययन किए गए। क्लेरियस बैट्रेक्स और हैन्ट्रोप्न्यूइस्ट फोसिलिस में एम ई एम डी एच, जी ६ पी डी, ६ पी जी डी, एस ओ डी एन्जाईम पैटर्न एक तरह ही पाया गया और एस ओ डी तथा ६ पी जी डी के लिए चन्ना पंकटेटस और एनाबस टैसटूडिनस में भिन्न थे। समविद्युत विभव केन्द्रीकरण विधि द्वारा चन्ना पंकटेटस के आंख के प्रोटीन का अध्ययन करने पर ३७.५ प्रतिशत मछलियों में पोलीमार्फिजम पाया गया।

लुप्तप्राय समुद्री कैट फिस

टैकीसूरस स्पीशीस के वर्गीकरण के लिए सात आईसोएन्जाईम से टै. मैकूलेटस और टै. सबरोस्ट्रेटस के आनुवंशकीय अध्ययन किये गये। ए ए टी आईसोएन्जाईम में साफ साफ स्पीशीज प्रमुख बैन्डस पैटर्न देखा गया। इन दोनों जातियों में इस्ट्रेसआईसो एन्जाम बैन्ड को चार खण्ड में विभाजित किया जा सकता है। स्पीसीज मुख्यतः बैन्ड खण्ड नं. २ में देखी गयी। धीमी गति की एम डी एच और एम ई पी के बैन्ड पैटर्न में दोनों कैट फिस में आनुवंशकीय भिन्नता पायी गयी। अतः इस विधि द्वारा इन दोनों स्पीशीस का आनुवंशिक चरित्र चित्रण किया जा सकता है।

नये आनुवंशिक चरित्र का विकास

इसके लिए माइटोकोन्ड्रियल डी एन ए हिमोग्लोबिन का समविद्युत विभव केन्द्रीकरण, ट्रान्सफैरिन, एन्जाम और ग्रेडीएन्ट जैल इलैक्ट्रोफोरिस का प्रयोग किया गया।

माइटोकोन्ड्रियल डी.एन.ए.

पशुओं में अध्ययन करने के लिए माइटोकोन्ड्रीएल डीएनए का आरएफएलपी पैटर्न एक शक्तिशाली साधन बन गया है। इस विधि की प्रामाणिकता के लिए दो तरीके अल्ट्रासेन्ट्रीफ्यूगेशन और एलकली लाइसिस प्रयोग में लाये गये। कामन कार्प माइटोकोन्ड्रिएल डी एन ए को हिन्ड–३ एन्जाम के काटने से चार मुख्य अंश प्राप्त हुए जो ७.८, ५.७, ३.५ और २.६ के.बी. के थे। ईको आर–१ के साथ काटने से ४.८, ४.१, २.० और १.० के खण्ड मिले।

हीमोग्लोबिन का समविद्युत विभव केन्द्रीकरण

इस तकनीक से सामान्य पेज की तुलना में हीमोग्लोबिन में अधिक बैन्ड पाये गये। इस अध्ययन से यह प्रमाणित होता है कि विभिन्न समुदायों के बीच तुलनात्मक अध्ययन के लिए इस विधि द्वारा आनुवंशिक चरित्र चित्रण किया जा सकता है।

अन्य अध्ययन

समविद्युत विभव केन्द्रीकरण से कुछ एन्जाम जैसे जी पी आई और पी जी एम में अधिक बैन्ड पाये गये।

नान मीनिमम इनवैसिव सैम्पलिंग

श्लेष्मा और अन्य कोशाओं के सैम्पुल द्वारा मछली को बिना हानि पहुंचाये, आईसो एन्जाम अध्ययन द्वारा यह प्रमाणित किया गया कि ऐसे सैम्पुल से भी मूल्यवान ब्रूड स्टौक का आनुवंशिक चरित्र चित्रण किया जा सकता है और लीवर बाइओपसी सुई द्वारा निकाले गये ६–८ माईक्रो ग्राम मांसपेशी से ८ एन्जाम पैटर्न अध्ययन किये गये।

१.४ सी.एम. ८ : चुने हुए लुप्तप्राय और व्यवसायिक महत्व के प्रकृति में पाये जाने वाले प्रजाति के जीन बैंक तकनीक का विकास

हिल्सा शुक्राणु हिम परिरक्षण में दूसरे मछलियों की तुलना में काफी अन्तर देखा गया। हिल्सा में प्राप्त सीमन की मात्रा अन्य मछलियों की अपेक्षा कम है। सीमन का पीएच ८.४–८.६ है। सीमन की मात्रा तथा गाढ़ापन दिन के समय पर भी निर्भर करता है जैसाकि पैक्ड सैल वोल्यूम (पीसीवी) से ज्ञात होता है। पी सी वी, मध्यान्ह से पूर्व ७०–६२ प्रतिशत की तुलना में मध्यान्ह के पश्चात ४८–६२ प्रतिशत तक घट जाता है।

प्रमुख लवणों का शुक्राणु पर अलग अलग तथा मिश्रण में प्रभाव

पौटेशियम क्लोराइड की मात्रा १४०० से १७५० मि.ग्रा./१०० मिलि तक शुक्राणु निष्क्रिय रहते हैं तथा जल मिलाने पर सक्रिय किये जा सकते हैं परन्तु १७५० मिग्रा/१०० मिलि से ऊपर सक्रिय नहीं किए जा सकते। इसी प्रकार सोडियम बाई कार्बोनेट की मात्रा १०० से ४०० मिग्रा/१०० मिलि रहने पर शुक्राणु निष्क्रिय रहते हैं तथा जल मिलाने पर सक्रिय हो जाते हैं। पी एच ८.०–८.६ तक शुक्राणुओं में महत्वपूर्ण सक्रियता देखी गई।

मिश्रित प्रभाव : पौटेशियम क्लोराइड के साथ सोडियम क्लोराइड ५०० मिग्रा/१०० मिलि से अधिक होने पर शुक्राणुओं में निष्कृयता अधिक होती है।

पौटाशियम क्लोराइड, सोडियम क्लोराइड तथा सोडियम बाइकार्बोनेट मिश्रण में सोडियम क्लोराइड २५०मिग्रा/१०० मिलि सोडियम बाईकार्बोनेट २०० मिग्रा/१०० मिलि तथा कैल्शियम क्लोराइड २०मिग्रा/१०० मिलि मिश्रण में होने से पौटाशियम क्लोराइड की उपयुक्त मात्रा एक तिहाई कम की जा सकती है।

एडिटीब्स में १० प्रतिशत अंडपीतक मिश्रित से २०० मिग्रा/१०० मिलि सोडियम क्लोराइड में शुक्राणुओं की सक्रियता अधिक पायी गयी।

१.५ सी एम ४ : भारतीय मुख्य कार्प एवं लुप्तप्राय मछलियों के एक्स सीटू संरक्षण हेतु अन्डों का शीतकालीकरण का विकास

एन्ड्रोजैनिसिस की विधि से हिम परिरक्षित शुक्राणु द्वारा विशेष प्रजाति को संयोजित करना सम्भव हो जायेगा जो लुप्त हो चुका है अतः कामन कार्प और कतला–रोहू संकर मछलियों को हिम परिरक्षित शुक्राणु द्वारा संयोजित करने के प्रयास किये गये।

एन्ड्रोजैनिसिस (कामन कार्प)

मादा कामन कार्प में नर मिरर कार्प और लाल कामन कार्प की अपेक्षा एन्ड्रोजैनिसिस अध्ययन किये गये। शुक्राणु हिम परिरक्षण में प्रयोग किये गये तथा ४ आर्टीफिशल डाईलुएंस का प्रयोग किया गया जिससे अण्डे सूखने से बचे रहे और अल्ट्रा वाइलेट तरंगों से बराबर प्रदीपन मिले। इनमें ट्रिस ग्लाईसीन (पी एच ८.१) सबसे ज्यादा असरदार रहा। ४१.६ और ४४.१ सैकेन्ड संसेचन के पश्चात गर्म झटका देने पर सबसे अधिक एन्ड्रोजिनिक मछलियां प्राप्त हुईं। इस अध्ययन से पहली बार हिम परिरक्षित शुक्राणु द्वारा एन्ड्रोजिनेटिक मछलियां प्राप्त हुई।

एन्ड्रोजैनिसिस (कतला) रोहू संकर

भारतीय मुख्य कार्प में भी एन्ड्रोजेनेटिक प्राणी बनाने हेतु कई तरह के ओवेरियन फ्लूइड और अलग अलग दूरी पर यू वी रेडिएशन दिये गये। पर जीवित हैचलिंग नहीं मिले। कामन कार्प के अध्ययन से तुलना करने पर यह अनुमान लगाया गया कि मुख्य कार्प रेडिएशन से ज्यादा संवेदनशील है और उनमें कम मात्रा में रेडियेशन की जरूरत है।

कटला में टेट्रापोलाइडी

टेट्रापोलाइडी बनने के लिए अन्डों को संसेचित करने के पश्चात गर्म झटका दिया जाता है। अण्डों को संसेचित करने के १६.३० मिनट के बाद गर्म झटका देने से सर्वाधिक जीवित प्राणी प्राप्त हुए। गर्म झटका ६ सेकेन्ड के लिये ४१° सेल्सियस पर दिया गया था। लारवे को टेट्रापोलाइडी के लिए आनुवंशिक सत्यापन करना सम्भव न हो सका क्योंकि लारवे आवश्यक माप तक आने से पहले ही मर गये थे।

हिमपरिरक्षण अध्ययन

इन अध्ययन में आर्टीमिया सीस्ट को सीधे लीक्विड नाइट्रोजन में बिना हिमपरिरक्षक मिलाये डाल दिया गया। सैम्पुल को शीघ्र गर्म या धीरे धीरे गर्म होने दिया गया। इन दोनों अध्ययनों में हैंचिंग प्रतिशतता में कोई अन्तर नहीं पाया गया। हिम परिरक्षक का अध्ययन करने के लिये २०डिग्री सेल्सियस पर ४८ घन्टों के भ्रूण पर प्रयोग किया गया। अध्ययन किये गये हिम परिरक्षण हैं : १. डी एम एस ओ

१५ प्रतिशत वाल्यूम/वाल्यूम, दो : एक मिश्रण डीएमएसओ ग्लीस्रौल और मिथनौल २० प्रतिशत वाल्यूम/वाल्यूम भ्रूणों को ५–६ डिग्री सेल्सियस पर लवण हिमपरिरक्षण के विस्तारक में २५ मिनट के लिये रखा गया। उसके बाद सामान्य हिम परिरक्षण को डाल कर एक घन्टे रखने के पश्चात १० प्रतिशत यूवी हिम परिरक्षण में ३ घन्टे के लिये रखा गया। उसके बाद लारवों को ५–६ डिग्री सेल्सियस पर रखा गया। लारवे डीएमएसओ में ज्यादा समय के लिये जिन्दा रहे।

१.६ सी जी ११ : लुप्तप्राय एवं व्यावसायिक महत्व की मछलियों में गुणसूत्रों एवं प्रदूषण से उत्पन्न होने वाली आनुवंशिक विषाक्तता का अध्ययन

एन.ओ.आर. बैंडिंग, हिमांचल प्रदेश से प्राप्त महासीर एवं साइजोथोरेक्स रिचर्डसोनी में कोशीका आनुवंशिकीय अध्ययन किया गया। इन मछलियों में गुणसूत्रों की संख्या क्रमशः २ एन = १०० और २एन = ६८ पायी गयी। महासीर में एन ओ आर दो गुण सूत्र जोड़ों पर पाया गया।

सिस्टर क्रोमेटिड एक्सचेंज (एससीई) अध्ययन

मछलियों में जल प्रदूषण से होने वाली संभाव्य आनुवंशिक विषाक्तता जानने हेतु एस सी ई का अध्ययन सौरी (चन्ना पंक्टेटस) में किया गया जिसमें बेस अनालाग बी आर डी यू का प्रयोग किया गया। इसके अलावा माईक्रो नुक्लीआय परिक्षण में कुछ रक्त क़ोशिका में सूक्ष्म न्यूक्लीआय पाये गये।

बी आर डी यू प्रतिकृति (रेप्लीकेंशन बैंडिंग)

इस अध्ययन में बेस अनालाग बी आर डी यू का प्रयोग किया गया। जिसके परिणाम स्वरूप गुणसूत्रों पर हल्के और गाढ़े बैंड्स पाये गये।

सी बैंडिंग

इस अध्ययन में रोहू मछलियों के आठ गुणसूत्र जोड़ों पर सेंट्रोमेरीक सी बैंड्स पाये गये। इसके अलावा एक गुणसूत्र जोड़े पर अन्तर्विस्ट (इन्टर केलरी) बैंड्स पाये गये।

अतः पात्र (इन विट्रो) कोलचीसीन प्रयोग से गुणसूत्र पाने की तकनीक

इस तकनीक में नैन और बाम मछलियों में अतः पात्र कोलचीसीन का प्रयोग करके मेटाफेज विस्तार किये गये। इस तकनीक से उत्कृष्ट आकार के गुणसूत्र प्राप्त हुए हैं। जिससे इनका अध्ययन अधिक सरल हो जाता है।

रेसट्रिक्शन एन्डोन्यूक्लिएस बैंडिंग

इस अध्ययन में तीन एन्जाईम का बैंडिंग हेतु प्रयोग सौरी मछलियों में किया गया परन्तु बैंड्स नहीं पाये गये।

अल्पकालीन पुर्णरक्त कोशिका पालन

कोशिका से गुणसूत्रों को पाने हेतु पूर्ण रक्त कोशिका पालन इग्लस एम ई एम माध्यम में किया गया। इसके लिये रक्त नमूना माँगुर मछली के पुच्छीय शिरा से निकाला गया। इस अध्ययन का परिणाम काफी उत्साहजनक निकला है।

७ पुस्तकालय एवं सूचना सेवायें

७.१ पुस्तकालय सेवायें : ब्यूरो का पुस्तकालय समस्त वैज्ञानिकों के लिये आवश्यक वैज्ञानिक सूचनायें एवं विभिन्न प्रकार के लेखों, बिब्लियोग्राफी के भण्डारण का स्रोत है। रा.म.आ.सं. ब्यूरो के पुस्तकालय में इस वर्ष तक १३६८ पुस्तकें, ४४१० से अधिक पत्र वैज्ञानिक पत्रिकाएं, ११०१ विविध प्रकार के प्रकाशन, १५६२ पुनर्मुद्रित प्रतियां तथा १२५ मानचित्रों का संयोजन किया गया है जिससे ब्यूरो के शोध.प्रोजेक्ट्स को अधिक से अधिक वैज्ञानिक कृतियां उपलब्ध करायी जा सकी हैं। इस वर्ष पुस्तकालय ने अपने भण्डारण में ८० नयी पुस्तकें, १२७ प्रकाशन, ३६ पुनर्मुद्रित प्रतियां तथा ३ मानचित्रों का समावेश किया।

७.२ विनिमय सेवायें : पुस्तकालय अपने सदस्यों के लिए ६१ अग्रणी देशों एवं विदेशी पत्रिकाओं को खरीदता है। देशी एवं विदेशी वैज्ञानिक पत्रिकाओं तथा पत्र पत्रिकाओं को विनिमय के माध्यम से अथवा निःशुल्क प्राप्त करता है। ब्यूरों में वार्षिक प्रतिवेदन और विभागीय प्रकाशनों को विभिन्न अनुसंधान संगठनों, विभिन्न विश्वविद्यालयों, उद्यमियों, मत्स्य पालकों को निःशुल्क भेजे ताकि ब्यूरो के अनुसंधान की प्रगति के विषय में दूसरे वैज्ञानिक संस्थानों, विश्वविद्यालयों एवं विभिन्न विभाग अनिभिज्ञ हो सकें।

७.३ सूचना सेवायें : ब्यूरो ने इस वर्ष अपने वैज्ञानिकों, तकनीकी अधिकारियों तथा बाहरी विभागों को ७०० वैज्ञानिक रचनाओं की पुनर्मुद्रित प्रतिलिपयों को उपलब्ध कराया। इसके अतिरिक्त मत्स्य आनुवंशिकी पर चुनी हुई बिब्लियोग्राफी को सी डी एस/आई एस आई एस पैकेज पर संकलन किया गया। ब्यूरो के पुस्तकालय का यह अनुभाग रेप्रोग्राफी सेवाओं के लिये एक सक्रिय खण्ड है।

७.४ तकनीकी रिपोर्ट : ब्यूरो की अनुसंधानात्मक प्रगति से सम्बन्धित ३६ रिवियू तथा शोध पत्रों को विभिन्न राष्ट्रीय तथा अन्तर्राष्ट्रीय पत्रिकाओं में प्रकाशन हेतु पत्राचार किया। ऐसी प्रकाशित अनुसंधानात्मक प्रगति से भा.कृ.आ.प. को ज्ञात कराया। वैज्ञानिक समस्याओं और प्रश्नों का उत्तर भी इसी अनुभाग द्वारा प्रस्तुत किया गया। इस अनुभाग ने ब्यूरो के वैज्ञानिकों द्वारा सेमिनार, संगोष्ठी, सम्मेलन आदि से सम्बन्धित कार्य भी किये।

७.५ रेप्रोग्राफी सेवायें : पुस्तकालय का यह अनुभाग विभागीय प्रकाशनों का त्वरित रेप्रोग्राफी सेवायें बनाये रखता है। इसके साथ साइक्लोस्टाइलिंग, काम्ब बॉइडिंग तथा इलेक्ट्रोडेटा बाइडिंग सुविधायें भी संस्थान को समय समय पर उपलब्ध कराता है।

3. INTRODUCTION

3.1 Brief History

In view of the national programme for improvement and expansion of both inland and marine fisheries of the country, it has been recognised that enhancement of fish production alone is not enough and conservation of the diversity of the natural fish population is a necessary prerequisite. Appreciating this, the Government of India approved establishment of the Bureau at the end of Sixth Five Year Plan.

The National Bureau of Fish Genetic Resources was thus sanctioned in December 1983 under the Indian Council of Agricultural Research.

The infrastructure consisting of building and the farm complexes are under construction in a 52 acre plot on the Ring Road, Telibagh, Lucknow.

3.2 Mandate

* Collectioin, classification and evaluation of information on fish genetic resources of the country;
* Cataloguing of genotypes;
* Maintenance and preservation of fish genetic material in co-ordination with other agencies and conservation of endangered fish species; and
* Monitoring the introduction of exotic fish species in Indian waters.

3.3 Organisation

The organisation set up of the Bureau was structured for meeting the objectives. Four centres have been approved in order to take up work on different resources. These are : (i) Freshwater Fish Genetic Resource Centre, located at the headquarters of the Bureau (ii) Brackishwater Fish Genetic Resource Centre to be located at the headquarters of the Central Institute of Brackishwater Aquacultute (iii) Marine Fish Genetic Resource Centre is being set up at the Central Marine Fisheries Research Institute at Cochin (iv) Coldwater Fish Genetic Resource Centre willl be located at the headquarters of the National Research Centre for Coldwater Fishereies.

The following subject matter sections have been set up at the headquarters of the Bureau at Lucknow :

i) Cytogenetics

ii) Biochemical Genetics

iii) Biology

iv) Conservation and Management.

The Section of Sl.No. (i) and (ii) would be under the Genetic Characterization Division while the other Sections would be under the Conservation Biology Division.

3.4 Staff Position

The overall staff position as on 31st March 1995 is given below :

Sl. No.	Category of Posts	Post sanctioned (No.)	Post created (No.)	Staff in position	Posts vacant (out of created posts)
1.	Research Management (Director)	01	01	01	-
2.	Scientific	40	40	15	25
3.	Technical	35	18	18	-
4.	Administrative	15	09	08	01
5.	Auxiliary	02	02	02	-
6.	Supporting	29	13	13	-
	Total :	122	83	57	26

3.5 Finance

Allocation of fund and expenditure incurred during the year 1995-96.

	Budget-Allocation (Rs. in Lakhs)	Expenditure (Rs. in Lakhs)
Plan	401.50	401.48
Non-plan	38.50	38.50
Total	440.00	439.98

4. RESEARCH ACHIEVEMENTS

4.1 FB-9 : To Develop Data Bank of Fish Genetic Resources of India

D. Kapoor, P.C. Mahanta, A.K. Pandey, S.P.Singh, O.P. Pandey, A.K.Singh, R.Dayal, S.M. Srivastava, R.S. Patiyal, K.D. Joshi, Ajay Kr. Singh and S.K.Paul

(1) Compilation of Information on Fish Germplasm Resources of India

A) Checklist : In order to have complete information about fish germplasm resources of India, a draft checklist containing information about systematics, habitat and distribution of 2,200 finfishes of India inhabiting different ecosystems like cold-water, warmwater, brackishwater and marine water has been revised and synonyms checked. It is being further updated in the light of discussions held with the experts in the field of Systematics. As suggested by Dr.A.G.K.Menon, the list may be published as "Fish Biodiversity of India". This would serve as a ready rockoner for the scientists, researchers and students engaged in Fishery research.

B) Catalogue : The detailed Catalogue on Fish Germplasm Resources of India has been updated further by adding more information about taxonomy, morphology, morphometric characters, distribution, habitats, bionomics, life-history, food and feeding, fishery, aquaculture, cytogenetics, biochemical genetics and conservation status of about 150 finfishes. Further, the information was transferred to the computer (data base) for easy retrieval. Photographs of 50 fishes of river Ganga were also procured for their inclusion in the upcoming Catalogue.

(2) Threatened Status of Indian Fishes

In order to assess the present status of finfishes in certain water stretches, surveys were conducted at Allahabad landing centre (Ganga river), Farakka Barrage and rivers of Kumaun Himalayas. On the basis of verifications in some sites and views of the researchers, fishery officials, anglers and fishermen in Kali, East Ramganga, Saryu and Kosi rivers reveal that the endemic species (*Botia almorhae*), upland food and sport fishes (*Tor tor*, *Tor putitora*, *Schizothorax richardsonii*, *Barilius bendelisis*, *Labeo dero*, *Labeo dyocheillus*) and the typical hill-stream fishes (*Glyptosturnum pectinopterum*, *Pseudoechenesis sulcatus*) are under severe depletion.

The data collected at Allahabad landing centre and Farakka barrage on (*Tenualosa ilisha*) have been analysed and report will follow shortly.

(3) Studies on exotic fish species for their controlled introduction to the Indian waters

For the effective reproductive management in exotic fish, effects of photoperiod and temperature (P/T) have been investigated. It has been observed to have bearing in gonadal development and differentiations. Our observations on environmental impacts on sex differentiation and reproductive physiology in tilapia and common carp provide basis for responses of their stimuli in species perpetuation and reproductive management. Observations of some of our experiments are highlighted as below :

(i) Observations on monosex production (male population) by feeding 17α-methyltestosterone

Breeding of *Oreochromis mossambicus* under controlled laboratory conditions were standardized for conducting the expriments on sex reversal. Response of male sex hormone 17α– methyl testosterone was tested in different doses which ranged from 5-40 mg/kg feed. The observations depicted that male population production was directly dose-dependant fetching upto 84% male production with the highest dose 40 mg 17α–MT per kg of feed for sixty days. In the absence of 100% sex reversed population (male) with some physical abnormalities in the treated group of fishes, it was planned to conduct the monosex male production experiments under the influence of environmental factors *viz.*, photoperiod and temprature and under altered steroid dose of 35 mg 17α– MT/kg feed.

ii) Feeding of 17α– methyltestosterone under the effect of long photoperiods

Our results demonstrate that feeding of 17α- methyltestosterone - incorporated diet in the dose of 35 mg/kg feed to 7day old swim-up hatchlings under long photoperiod (16L : 8D) for sixty days showed excellent growth and survival besides 100% male population. Mean wet weight of *Oreochromis mossambicus* increased from the initial wet weight 0.012 ± 0.003 g to 1.23 ± 0.25 g, 2.38 ± 0.63g and 5.63g ±0.28g under normal, 17α methyl testostenone alone and under 17α-MT long photopriod (16L: 8D) treatments, respectivly, during sixty days period. Further, the growth rate percentage was observed highest in 17α-MT treatment under long photopriod (16L : 8D) which was highly significant ($P< 0.001$). The survival rate also enhanced from 67% to 98-100% in case of individuals fed with 17α-MT under long photopriod (16L : 8D). Since androgenizing tilapia hatchlings under controlled photoperiod fetched absolute monosex population (male tilapia), it was thought to investigate the environmental (photoperiod and temperature) effects alone on gonadal development and differentiation.

iii) Effect of photoperiod and temperature on gonadal manipulation in tilapia

During the course of experiment, temperature and photoperiod were observed as potential proximate factors in gonadal development and differentiation. Experimental observations have confirmed that low temperature and scotophase inhibited gonadal development and differentation in tilapia. The feeding and territorial behaviour of these fishes under low temperature and scotophase were reduced as compared to the normals. Analysis of data revealed a sharp deviation in sex ratio of fishes under experimental groups under different photothermal regimes against expected Mendelian ratio.

Since endogenous hormonal *viz.*, sex steroids, thyroid hormones and melatonin output are greatly enfluenced by environmental cues, it was considered to be important to observe the effects of thyroid hormones and melatonin on 17α–methyltestosterone which induced sex-reversal in tilapia.

iv) Effect of thyroid hormones on 17α-methyltestosterone induced gonadal manipulation in tilapia.

The sex reversal experiment by feeding 17α– methyltestosterone (35mg/kg feed) under long photoperiod (16L:8D) was run together with synthetic thyroxine(T4) and tritodothyrorime (T3) in the doses of 0.25 µg/and 0.50µg/l in aquarium water. The observation did not delineate any significant change in sex ratio and growth, except an early fin differentiation of the hatchlings. In our experiments, the sex ratio of the only thyroid hormone treated group indicated no change in 1:1 expected sex ratio. However, feeding of 17α-MT under long photoperiod and the presence of synthetic thyriod hormones could bring about 100% male population, suggesting no significat role of thyroid hormones during sex differentiation. Further, considering the available literature that melatonin secretion is readily influenced by photoperiod and has got direct influences on reproduction, another experiments was conducted to clinch the effect of melatonin on sex differentiation.

v) Effect of melatonin on 17α- methyltestosterone induced gonadal manipulation in tilapia

In this experiment, the worked out method of production of monosex (all- male) by feeding 17α- methyltestosterone in the dose of 35 mg/kg feed under long photoperiod (16L: 8D) was again repeated under the influence of synthetic melatonin in the dose of 0.25µg/l and 0.50µg/l. It was interesting to observe that 100% masculinization could not be achieved under influence of melatonin. The results pointed out possibilities of involvement of this hormone in gonadal differentiation beside its role in gonadal development.

vi) Sex reversal experiments with common carp (*Cyprinus carpio* var *communis*)

The hatchlings of common carp, *Cyprinus carpio* var *communis*, were treated with 17α methyltestosterone-incorporated diet with doses ranging from 300-400mg/kg feed for sixty days under the laboratory conditions. Since only a few specimens survived, no conclusive observation could be made.

Observations made so far are suggestive that combining 17α- methyltestosterone (in the dose of 35mg/kg feed) treatment with long photoperiod (16 L:8D) may give consistent results of 100% masculinization besides 100% enhanced growth and survival in *Oreochromis mossambicus* which may have promising applications in aquaculture (Fig 1). Further, clue indicating possible involvement of pineal melatonin hormone in sex differentiation in tropical fish like tilapia opens avenues for further researches on the role of pineal melatonin in sex-determination of fishes.

4.2 FB-2 : Conservation of Mahseer in Selected Upland Waters

P.C. Mahanta, D. Kapoor, A.K.Pandey, S.P. Singh, P. Punia, R. Dayal, S.M.Srivastava, R.S.patiyal, K.D.Joshi, Ajay K. Singh and S.K.Paul

With a view to develop an

Fig. 1. Growth studies on sex reversed *Oreochromis mossambicus.*

appropriate integrated strategy for *in situ* conservation of mahseer in upland waters, a workable programme is under investigations in selected rivers and streams of Kumaun Hills (U.P.). The major components of the programme under observations are as follows :

Studies on the upland rivers

A preliminary habitat inventory survey of Ladhiya river downwards Chalthi bridge was conducted following the format of U.S. Fish and Wildlife Service. Soil and water samples were also collected from the eroded banks of Ladhiya and Bisouria (a seasonal stream of first order) confluence in U.P. hills to ascertain the causative factors responsible for the mass mortality of fishes in the river during heavy rains (Fig 2).

The soil samples were processed for recording the data on pH, electrical conductivity, and contents of Ca, Na, K, carbon, clay, silt and sand. Similarly, water samples were also analysed for pH, electrical conductivity and total dissolved solids (TDS). The rock samples were processed *as per* standard methods. Studies of the rock and soil samples revealed that most of the

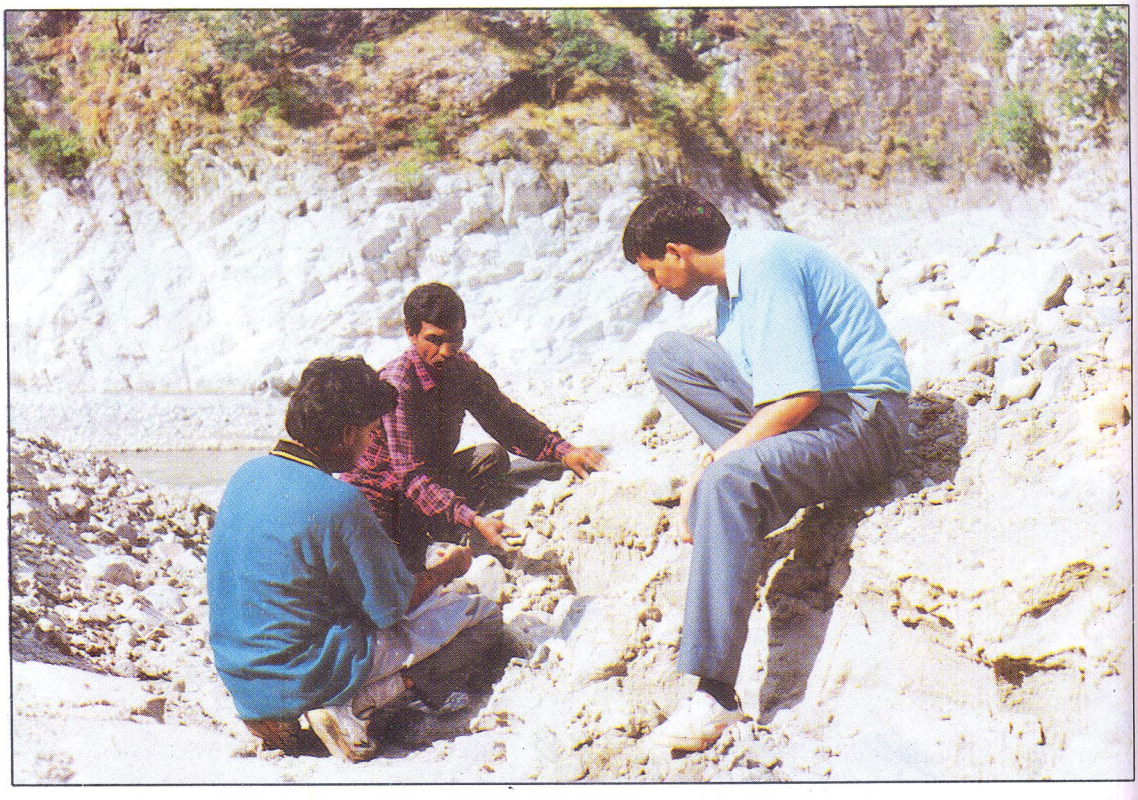

Fig. 2. Scientists of NBFGR collecting soil samples and surveying the riparian zone of Ladhiya river.

minerals were flaky and platy in nature and have a weak cleavage surface through which water percolates inside the rock mass causing the transformation of rock into soil. The cementing material which holds the sediment pressure in the boulders is negligible. Hence, the rocks and soil surface is very sensitive and prone to erosion.

Present status of mahseer

Data have been collected to estimate some parameters of fish catch from Ladhiya and some stretches of Sharda rivers through enquiry from the adjoining villages and actual fishing grounds. The data collected were analysed statistically. The catch per unit effort (CPUE) for mahseer (*Tor putitora* and *Tor tor*) in Ladhiya and Sharda river ranged from 0.2-0.9g, respectively, while CPUE for total catch was recorded from 5-12g.

Restoration by ranching

With the objective to restore the depleted stocks of mahseer in upland waters, a collaborative programme has been chalked out with the National Research Centre on Coldwater Fisheries and U.P. State Fisheries Department.

Meanwhile Ladhiya and Sharda rivers, a stretch of Kosi river from Khairna to Kosi, Katarmal (in Nainital and Almora districts) was surveyed to locate the suitable ranching sites for mahseer fingerlings. The following sites were identified in the above rivers for the proposed ranching programmes :

(i) Kosi-Katarmal in Kosi river,

(ii) Near Khairna Bridge (Nainital-Almora Highway) in Kosi river,

(iii) Downwards to Chalthi Bridge in Ladhiya river, and

Fig. 3. Tagging of fish for behavioural studies.

(iv) Near Baramdeo village in Sharda river.

Marker/tag for mahseer fingerlings

Aiming at recording the behaviour of released fish into the natural environment, trials were conducted on the Indian major carp fingerlings using various biological markers like alizerin red S, alcian blue, aniline blue, bismark brown and silver nitrate, under the laboratory conditions. It was found that the retaintivity of these markers was temporary. Hence, a tag was fabricated at the NBFGR with the indigenously available infant feeding tubes and garment tags and was successfully tried on the fingerlings of Indian major carps, *Oreochromis mossambicus* and *Puntius* spp. Fingerlings did not exhibit any symptoms of distress and performed well even after four months of tagging under the laboratory conditions (Fig 3, 4).

Fig. 4. Fish tagged with indegenous tag developed by NBFGR.

Histological studies

In order to record the seasonal changes in brain (hypothalamus and pituitary) and gonads of the endangered mahseer (*Tor putitora*), tissues were extirpated from the specimens collected from Himachal Pradesh. The tissues were fixed, washed thoroughly, dehydrated cleared in xylene and embedded. Sections were cut and stained. Further studies is in progress.

Mass awareness programmes

Small scale mass awareness programmes were organized with the "Mahseer Conservation Committees" in the Ladhiya and Sharda catchments. As a result of the continuous such activities in the area, the destructive fishing incidences like poisoning and dynamiting have been drastically reduced.

An appealing sticker with a slogan "Save Mahseer"has been printed for the mass awareness programmes. Identity cards have also been printed for distribution among the local "Mahseer Conservation Committee" officials and members to recognize the committees for effective conservation drive.

4.3-BG/10 : Genetic profile of prioritised endangered species and wild strains of commercially important species.

A.G.Ponniah, A.Gopalakrishnan, K.K.Lal, V.Mohindra, P.K.Sahoo, S.K.Srivastava, Rama Shanker, B.K.Rao,

In order to determine the natural genetic variation in the commercially important and threatened species, the following species have been screened with already standardized genetic markers. The study has helped to enlarge the data base on genotypes of Indian fishes.

Genetic characterisation

Tenualosa ilisha

In addition to the two earlier investigated isozymes, twelve more enzymes have been screened in *T. ilisha* samples from Farakka. In the screening of LDH, a total of four loci were present within the muscle. Muscle and liver shared two loci. Unlike rohu, one more loci of PGM was present while in GPI only one locus activity could be detected.The two loci of F1-6PDH were better resolved by TCED/D buffer. In major carps only one XDH locus could be scored, whereas in hilsa, two loci were present. An additional locus of SOD is present in the gill tissue. For esterase more bands were resolved in the liver tissue.

Tor putitora

Samples of endangered *Tor putitora* were collected from Beas river of Himachal Pradesh. Analysis of eye lens proteins by

isoelectric focussing revealed 40 distinct bands (Fig 5). In a sample of 53, variable band pattern was observed in 17 individuals.

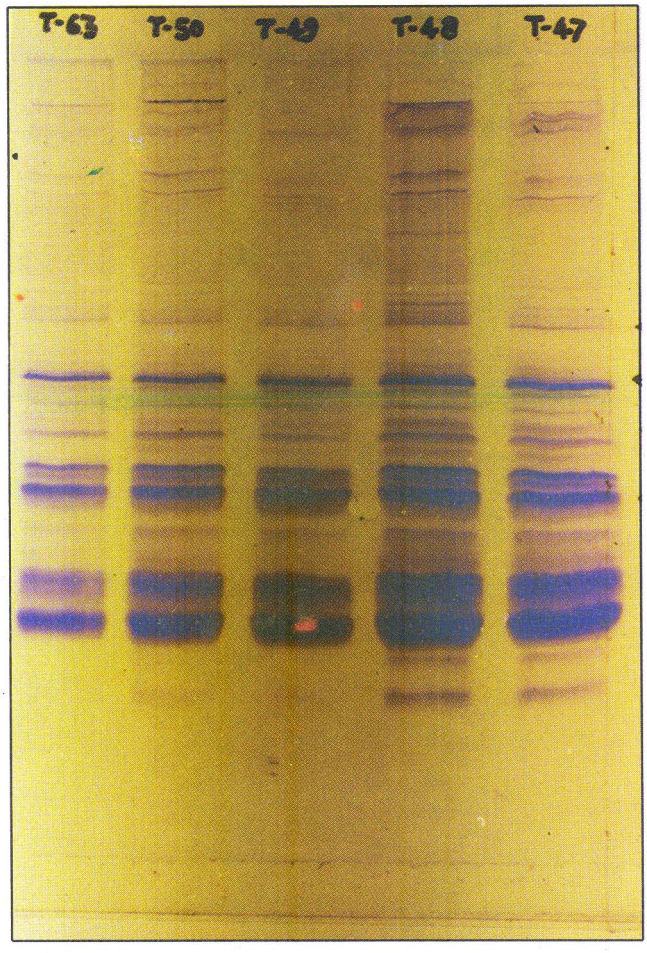

Fig. 5. Intra population differences in eye lens proteins of *Tor putitora.*

Indian major carps

Additional genetic markers, LDH and GPI were observed to show species specificity in Indian major carps. Suspected hybrids collected locally were screened with the genetic markers and based on the band pattern of GPI and AAT were confirmed to be rohu and mrigal hybrids.

Air-breathing fishes

In the air-breathing fishes, *Clarias batrachus, Heteropneustes fossilis, Channa punctatas* and *Anabas testudineus*, the earlier work of genetic screening has been further extended. *C. batrachus* and *H. fossilis* have the same pattern for ME, MDH, G6PD, 6PGD and SOD. For SOD and 6PGD *C. punctatas* and *A.testudienus* have similar pattern. For other enzymes like LDH, XDH,GPI, α GPD, ICD and EST, the band pattern differed in all the species. Only PGM exhibited a conservative single locus in all the four species by PAGE.

Isoelectric focussing (IEF) of eye lens of *Channa punctatus*, obtained from local populations, were carried out. The IEF profiles revealed polymorphism in 37.5% of individuals sampled (N=48).

Threatened marine catfishes

There are uncertainties regarding the classification of *Tachysurus* spp. Fishes of this group are threatened, as such there is an urgent need to genetically chazracterise and place them at right position in the classification of fishes. *T. maculatus* and *T. subrostratus* have been genetically screened

with the seven isozymes, i.e. AAT, EST, LDH, MDH, MEP, ODH and SOD.

Clear cut species specific band patterns were obtained for AAT with two loci in liver and one locus in muscle. In both species, esterase could be grouped into four zones, with each zone having 1 to 3 bands. Screening with two different substrates α napthyl acetate and B-napthyl acetate in combination or alone and staining at two different pH (pH 7.3 and 8.0), however, did not reveal any differences. Species-specificity was observed in Zone II esterase of both species with band of *T. maculatus* exhibited faster migration. Typical tetrameric pattern of LDH was observed in both species. Interspecies difference in LDH pattern were not striking with only the slowest LDH band exhibited slightly slower migration in *T. maculatus*.

In both the screened catfishes, clearcut species specific differences were observed in the slower migrating loci of MDH. In *T. maculatus* five bands were observed while in *T. subrostratus* six bands were seen. Three loci were observed in MEP of both species with the slowest loci exhibiting clear-cut species specificity. More number of ODH bands could be resolved using the trisglycine buffer. Liver extracts of *T. maculatus* expressed a total number of five bands and in *T. subrostatus* three bands.

Thus, study has indicated that both the species are genetically distinct species and AAT, EST, MDH, MEP, and ODH can be useful genetic marker to differentiate the species.

Development of new genetic markers

In order to develop new genetic markers, studies have been done on mitochondrial DNA, isoelectric focussing of haemoglobin, transferrin, enzymes and gradient gel electrophoresis.

Mitochondrial DNA

Restriction fragment length polymorphism (RFLP) of mitochondrial DNA (mt DNA) has become a powerful tool in the study of animal populations. A study was undertaken to standardize the technique using the ultracentrifugation method. Several variation of the method using different homogenising buffers, centrifugation protocols, different concentrations of SDS to lyse mitochondria failed to remove the inconsistency in the appearance of the second band containing mitochondrial DNA. Most of the times only a single band containing nuclear DNA was observed.

In the alkali lysis method, out of the various variables tested, the combination of 0.2m sucrose in TE as homogenising buffer, sucrose cushion for purifying mitochondria, lysis of mitochondria for 5 min on ice, then extraction with phenol and twice with chloroform- IAA and then precipitation with ethanol proved to be best. This method

standardized was found to avoid nuclear contamination and provided a sufficiently pure mitochondrial DNA for restriction banding pattern with EtBr staining.

Restriction of mitochondrial DNA of common carp with HindIII revealed four major fragments of size 7.8, 5.7, 3.5 and 2.9 kb. With EcoR I four major fragments of approximately 4.8, 4.1, 2.0, 1.0 kb were obtained. With EcoR I the small fragments might not have been detected with EtBr staining.

Isoelectric focussing of Haemoglobin

Normal PAGE electrophoresis of haemoglobin reveals only one band. All the three major carps were found to share one common band. Preliminary investigations revealed that by using IEF, more clear bands could be resolved. Therefore, haemoglobin IEF of nine species viz., tilapia, common carp, puntius, channa, shingi, magur, anabas, rohu and mrigal were screened (Fig 6). Each of the species exhibited many bands and species specific pattern were observed in all the species with the three major carps exhibiting different pattern. The studies indicate that haemoglobin IEF will serve as a good genetic marker for scoring intrapopulation differences also.

Other studies

Isoelectric focussing of some enzymes of hilsa were carried out to determine if additional loci could be scored. Only GPI enzyme was resolved into more number of bands. Enzymes like SORDH and GPI which were not resolved in hilsa using normal PAGE were subjected to

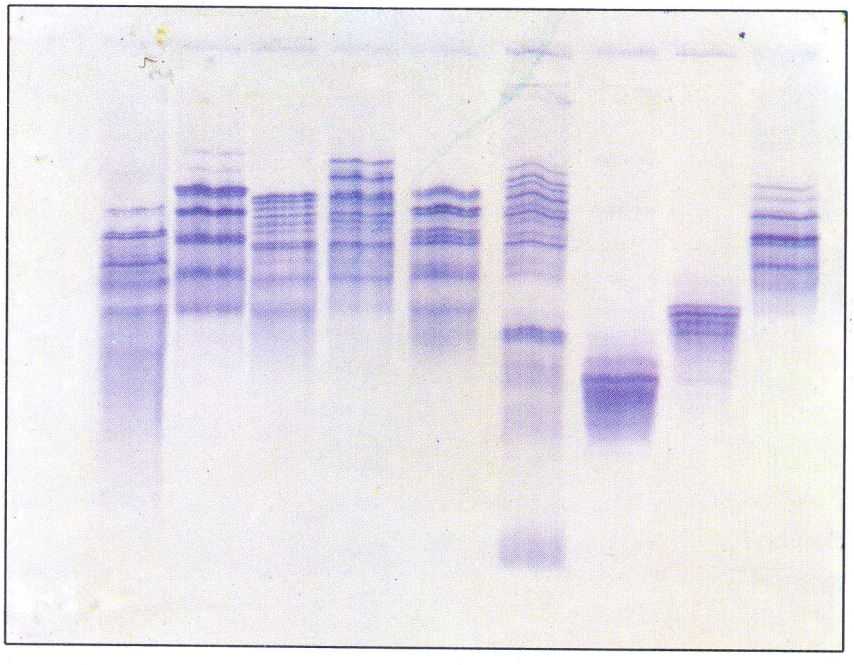

Fig. 6. Species specific ultrathin isoelectric focussing pattern of Haemoglobin proteins. (*L-R*)
1. *O. mossambicus*, 2. *L. rohita*, 3. *C. mrigala*, 4. *P. sophore*, 5. *C. carpio*, 6. *C. striatus*, 7. *H. fossilis*, 8. *C. batrachus*, 9. *A testudineus*.

gradient gel electrophoresis. But no further improvement in resolution could be achieved. In airbreathing fishes, PGM resolved into additional bands with IEF.

Non/Minimum invasive sampling

Utility of the tissues which are non-conventional but can be sampled without or with minimum harm to specimen for biochemical genetic analyses have been screened. Mucus and tissues like barbels, fins, gills, serum, oocytes have been screened in place of conventional tissues like liver and muscle in *Clarias batrachus*. Scorable levels of enzymatic activity have been recorded by PAGE electrophoresis. The enzymes included AAT, esterase, 6PGD, G6PDH, GPI, SORDH, LDH, XDH, GPDH, SOD and ACP. Similar work has been done in *Heteropneustes fossilis*.

Such attempts indicate that sampling of mucus and other tissues which does not involve any harm to fish can contribute towards determining genetic make up of valuable broodstock of fish without inflicting gross injuries to the fish.

Biopsy of the white muscle was successfully attempted using human liver biopsy needle by which approximately 6-8mg of muscle tissue can be extracted. This is sufficient to get minimum of 0.03ml of extract for conservative estimate by assay of 8 enzymes.

4.4 CM 8 : Development of Sperm Banking Technique for Selected Endangered and Wild Strains of Commercial Fishes

Kuldeep K. Lal, A.G. Ponniah, A. Gopalakrishnan, P.K. Sahoo, S.K. Srivastava and Rajesh Dayal

Cryopreservation of sperms of *Tenualosa ilisha*

The work on cryopreservation of hilsa spermatozoa was further extended to optimize the various parameters by studying the characteristics of milt and sperm behavior in response to individual as well as synergesic effects of certain cations, anions and pH range. Preliminary investigations revealed that phenomenon associated with hilsa spermatozoa crypreservation was quite different from that of other fish species.

(1) Milt characteristics :

Milt was collected from live hilsa specimens and analysed for various milt characterstics.

A) Milt volume : Hilsa gives relatively low milt volume. Maximum output recorded was 1013 µl (fish wt. 350 gms). Body size does not appear to have distinct correlation with milt volume.

Milt volume may depend on time of the day, more amount and better flow have

been observed in afternoon hours. However, while sampling natural populations, many specimens gave low milt volume which could be the recently spent ones.

B) Packed cell volume : PCV value, an indicative of sperm density, ranges from 70-92% in forenoon, which decreases drastically to 48 to 62% in the afternoon The reason for low PCV may be attributed to thinning of milt at the spawning hours. Hilsa appears to breed in late noon hours. This inference gets further support from the observation that the earliest of the running ripe/spent female was observed at 15.15 hours during the period of entire sampling.

C) pH : pH of the milt ranged between 8.4 and 8.6.

D) Duration of sperm motility : Maximum observed time from collection was 40-50 sec but mostly it ranged between 30 to 40 sec.

II. Effects of cations, anions etc

The study was carried out keeping in view the earlier observation of very high potassium chloride (1500mg/100ml) required to keep the sperms inactive which is desired for cryopreservation. This amount was found to be relatively higher than that used for other fishes. This higher osmolality due to high salt composition may have harmful effects on the sperm during freezing.

A) Individual effects

1. Potassium (potassium chloride) : This confirms the previous finding that sperms were inactive between 1400 to 1750mg/100ml of milt and could be activated, however, beyond 1600mg/100ml the duration of motility of sperm declines.

2. Sodium (sodium chloride) : It does not appear to have any inhibitory affect. However, beyond 1000 mg/100 ml, the sperms could not be activated.

3. Calcium chloride : Activates the sperms in the range tested, from 0 to 100 mg/100 ml.

4. Magnesium chloride and magnesium sulphate : They have similar effect as calcium chloride on the spermatozoa.

5. Sodium bicarbonate : It appears to have strong influence. Sperms were active upto 100mg/100ml and from 100 to 400mg/100ml, inactive but activable. However, above 400mg/100ml sperms couldnot be activated. The role of sodium bicarbonate could be explained in maintaining higher pH.

6. pH : Sperms were inactive and exhibited vigorous activity when pH of the medium was increased to 8.0 to 8.9. This is in contrary to earlier

report on rainbow trout that pH less than 7.8 was required to keep sperms inactive. Similar effect was observed if pH was maintained by tris or $NaHCO_3$. $NaHCO_3$ 200mg/100ml (pH 8.9) was used as diluent. When sperms were directly collected in the solution, centrifuged after 1 hour and pellet resuspended, the sperms exhibited high motility on activation.

B) Synergesic effects

From the above results, two independent factors exhibiting deactivating effect on sperm viz. KCl 1500mg/100ml and $NaHCO_3$ 100mg/100ml were selected. Combined effect of these two factors with other salts was also examined. The combinations tested include :

1. KCl with varying NaCl concentration: KCl with NaCl above 500mg/100ml showed decline in motility.
2. KCl with $CaCl_2$, $MgSO_4$ and $MgCl_2$ did not exhibit any change in results.
3. KCl, NaCl with $NaHCO_3$: In this combination, $NaHCO_3$ at 200mg/100 ml could effectively allow reduction in the required amount of KCl to one third viz., 500mg/100ml along with 250mg/100ml NaCl and 20mg/100ml $CaCl_2$.

(3) Additives

Effect of various additives Tris, NaH_2PO_4, BSA, mannitol, Glucose and hen's egg yolk (2,10,20%) was tested in combination with (i) extender having KCl 1500mg,NaCl 250-500mg,$CaCl_2$ 20mg, $NaHCO_3$ 20mg/100ml (based on earlier work) and (ii) Extender $NaHCO_3$ 200mg/100ml.

Motility was best observed with $NaHCO_3$. With egg yolk 10%,other combinations did not exhibit much difference.

(4) Effect of different Cryoprotectants

Cryoprotectants tested were DMSO, glyerol, methanol and equal proportions of the three. Except methanol, other three cryoprotectants did not exhibit any harmful effect on motility between 5-15% concentration range tested. A considerable reduction in duration and level of mortility had been observed when methnol was used as cryoprotectant.

(5) Cryopreservation

Spermatozoa of hilsa were frozen to test the effect of certain critical conditions involved in post thaw motility (Fig 7).

- Methanol as cryoprotectant gives coagulation even at 5% level.
- Extender with egg yolk has been found superior than the extender without egg yolk as observed in our earlier observations.
- Equilibration time tested (0-45 min),

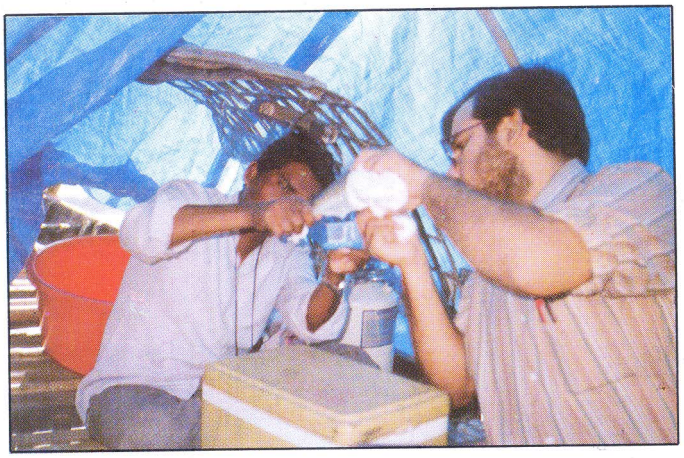

Fig. 7. Milt of endangered *Tenualosa ilisha* being collected for cryopreservation experiments at Farraka.

motility declines after 25 min with DMSO but no effect in glycerol combination could be observed.

Promising factors selected have to be tested with various combinations of freezing and thawing rates through precise control.

(6) Upscaling of cryopreservation technique

A portable hatchery unit, based on the design of circular hatchery, was fabricated with locally available materials and tested. The hatchery was provided circular motion to eggs through controlled flow of water and continuous exchange. The hatching units were fabricated in two sizes (1) large to hold around 8000 eggs and (ii)small for 200-300 eggs. The hatchery units can be dismantled and assembled when needed at the site conveniently and can be put in series to increase the capacity as per local need.

Advantage of such a system over static system had been confirmed especially in the experiments during end season, when survival in the static system obtained was nil against 40-45% hatching in the circulatory system.

The cryopreservation experiments have fertilizability as an essential component. The experiments have been normally conducted in static system but circulatory water exchange improved the hatchability in major carps.

4.5 CM/4 : Methodology development for cryopreservation of eggs and embryos of Indian major carps and endangered species for *ex situ* conservation

A.G. Ponniah, A.Gopalakrishnan, Kuldeep K. Lal, Peyush Punia, Vindhya Mohindra, P.K. Sahoo, A. Barat, S.K.Srivastava, Rama Shanker and B.K.Rao

By the technique of androgenesis, it is possible to constitute the whole genome from the male gamete only and thus it is possible to revive even the extinct species from its cryopreserved milt. There is an urgent need to develop and standardize the technique of androgenesis by which an extinct species of fish could be retrieved

from cryopreserved milt. Studies have been undertaken to retrieve the species of common carp and catla x rohu hybrid from cryopreserved milt of these species for standardising the techniques.

Androgenesis (common carp)

Androgenesis experiments were carried out with female scale carp against male mirror carp and blond red common carp. The inactivation of egg genome was done by two UV- tube lights (15w) placed at a distance of 5cm for 2min. In the earlier trials the eggs of common carp stuck to the container used for UV exposure, there was a possibility that all the eggs might not have received adequate UV rays. Therefore, initially four artificial diluents used for sperm cryopreservation were tested to prevent drying of eggs and that eggs would get a even exposure to UV. Since satisfactory hatchlings could not be obtained in controls, tris glycine (pH.8.1.) was tested as an egg physiological media at 1:1 ratio which was found effective. In the diploid controls three times more hatchlings could be obtained when diluent was used compared to controls without diluent. While the number of hatchling in all diploid controls was 47%, in haploid control it was only 1.7% indicating that UV irradiation had effectively destroyed the egg genome. In halploid control, the larvae that hatched out exhibited typical haploid larval body shape. Experiments were carried out to determine the optimum time of heat shock after fertilization (TAF) for inducing diploidy. The eggs were heat shocked at 41°C for 90 sec. The rearing water temperature was 20°C at which the published time 't'_o for common carp is 29.4 min. ('t'_o is the arbitrary unit for embryonic age equivalent to the average time taken, for one mitotic division). The 't_o' values tested were 1.3, 1.4, 1.5, 1.6 and 1.7 corresponding TAF of 38.2, 41.6, 44.1 and 47.6 min. Though putative androgenetic individuals were obtained at all the tested TAF, the maximum number was observed at 't' 1.4 and 1.5 and minimum at 1.3. For the first time, cryopreserved milt was used successfully in one of the trials with production of putative androgenetic individuals. The hatching percentage was similar to that of other trials and there was no change in trend regarding TAF with cryopreserved milt.

Androgenesis (catla x rohu hybrid)

Similar to common carp, for Indian major carps also physiological media are required for UV inactivation. Four ovarian fluids OV I,OV II,OV III and OV IV, composed of NaCl-KCl-tris glycine with and without BSA and tyrosine were tested with *Labeo rohita* eggs. The eggs were held in the ovarian fluids for 3min. and ovarian fluid was decanted thereafter. The eggs were fertilized with the normal milt. Maximum twitching larvae count was obtained with OVII in both the trials. In the second trial OVIII and OVIV were added, however, survival was poor. Since in the earlier

androgenetic experiments, there were no genetic markers, the androgenetic nature of hatchlings could not be confirmed. In the present experiment, rohu eggs were crossed with catla milt so that if the hatchling produced were truly androgenetic all of them would be catla and can be easily screened. The timings followed were 60 sec,90 sec and 120 sec. To cut down the UV intensity , the distance of the eggs from UV source was increased from 5cm to10cm with one tube against 2 tubes used earlier.

However, viable hatchlings could not be obtained. Comparing the results with common carp experiments, it appears that Indian major carps are more sensitive to irradiation and trial with even lower intensity may be required. Moreover, quality of eggs which decreases towards end of the season may also have interacted with the sensitivity of eggs to UV irradiation, as indicated by the less number of hatchlings observed in the control.

Tetraploidy in catla

As a part of work on androgenesis, experiment was conducted to work out the effective time after fertilization for heat shock. Onset of furrow for first division was observed between 12th to 19th min. after fertilization for *Catla catla*. TAF for heat shock was selected 7.30, 10.30, 14.30, 16.30, 18.30, 19.30 and 22.30 min. Maximum number of survival was observed when heat shock was subjected at 16.30min after fertilization. The heat shock was given for 90 sec at 41°c. The larvae were to be analysed for tetraploidy, but due to mortality before they grew to desirable size for chromosome analysis and the ploidy could not be ascertained.

Cryopreservation experiments

In continuation with work on marine crustaceans, Artemia cyst were kept in cryomicrofuge tubes and directly immersed in liquid nitrogen without the addition of any chemical diluent or cryoprotectant. Samples were thawed rapidly by dipping in water or slowly thawed by keeping in vapor phase for 10 minutes before bringing them to room temperature. No difference in hatching was observed between the two thawing methods and the mean percentage of hatching was 91.9%. The hatching of cryopreserved cysts did not differ significantly from the control fresh cysts even after 65 days of storage.

Common carp was bred through stripping and eggs allowed to develop. At ambient temperature of 20°C, 48 hours old embryo used to test the effect of cryoprotectants. The embryos were checked for their heart beat under the microscope. Initial screening exhibits that at sudden exposure to DMSO above 15%V/V, embryo did not survive. The protocol as given below was followed with cryoprotectants (1) DMSO(15%v/v). (2) 2:2:1 mixture DMSO, glycerol and methanol(20%v/v) The developing (10 nos) embryos in plastic boxes

were kept in a extender used for milt cryopreservation in refrigerator so that temperature is maintained around 5 to 6°C for approx. 25min. Then normal cryoprotectant (cooled) 10%v/v was added and left for 1 hour. Again 10%v/v cryoprotectant was added and left for 3 hour. The larvae were shifted to lower temperature (5 to 6°C). The two step exposure, embryos could survive for more time in DMSO. The embryos were checked after 5 and 20 hours at 5°C. With DMSO alone, only 2 embryos survived after 5 hours and no survival after 20 hours could be observed. With cryoprotectant mixture, all the embryos survived after 5 hours and 60% survived after 20 hours. The embryos were taken out after 20 hours and allowed to develop. All the surviving embryos produced viable hatchlings.

4.6 CG 11 : Chromosomal Profile of Endangered Species and Fishes of Economic Importance with Special Reference to Genotoxic Effect of Pollutants.

N.S.Nagpure, A.K.Pandey, Peyuish Punia and A.Barat.

The investigations were aimed to :

(i) study the karyological details, (ii) to identify and catalogue chromosomal variations and (iii) study the genotoxic effect of different pollutants.

NOR Banding

38 Specimens of *Tor putitora* and 10 specimens of *Schizothorax richardsonii* had been collected from Himachal Pradesh. The kidney and gill tissues were processed for chromosome preparation using routine colchicine-citrate-air drying technique. The slides were then stained for NORs following silver staining method of Howell and Black (1980). The diploid number of chromosomes was found to be 2n =100 in *T. putitora* and 2n= 98 in *S. richardsonii*. As regards the location of NORs is concerned in *T. putitora*, the NORs were found to be localized on terminal end of two pairs of chromosomes and in *S. richardsonii* the NORs were observed on one pair of large sized chromosome, however, heteromorphism in the size of NOR has been observed between the chromosomes.

Sister Chromatid Exchange (SCE)

Under this study 9 specimens of *Channa punctatus* procured from local market have been sacrificed. The specimen were injected intraperitoneally with bromodeoxyuridine (BrdU) at different doses of 50-500µg/gm body wt of fish. The slides were stained with Hoechst 33258(50µg/ml) and then exposed to mecury-vapour lamp followed by incubation in 2 X SSC for 2hr at 60°C. The slides were finally stained with 2% Giemsa. Micronuclei test (MNT) have also been conducted using peripheral blood smear upon screening of slides, no SCE could be observed, however, few micronuclei have been detected in some slides.

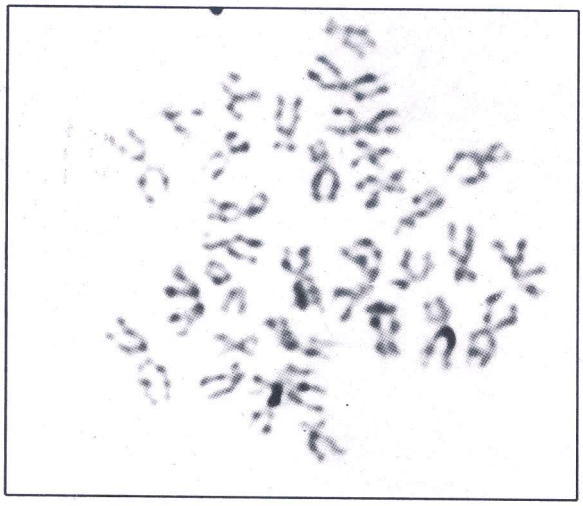

Fig. 8. Replication banding pattern in chromosomes of *Channa punctatus.*

BrdU Replication Banding

Structural bands like G and R do not work well in fish, therefore, replication banding could be a very useful tool in fish chromosome characterisation. For BrdU replication banding, the modification of *in vivo* technique of Delany and Bloom (1984) was followed. Six BrdU live specimens of *Channa punctatus* were injected with Brdu 50-500µg/g body wt of the fish. The slides were stained following modified FPG method (Perry and Wolf, 1974). Out of 6 specimens, replication banding could be found only in one specimen, with one to four dark bands appeared on most of the chromosomes. The light bands are areas of late replication which corresponds to G or Q bands. As regards the dose of BrdU, best results were obtained by injecting BrdU at the dose of 500µg/g body wt. of fish. Thus, these results confirm the existence of replication banding in *C. punctatus*. The diploid number in these species ascertained was 2n=32 and the NORs were found to be localized on the largest pair of submethocentric chromosome (No. 11) (Fig 8).

C Banding

To study C banding pattern, four specimens of *Labeo rohita* have been sacrificed. The kidney and gill tissues were processed for chromosome preparation using routine colchicine citrate-air drying technique. For C banding, barium hydroxide saline Giemsa technique (Sumner, 1972) was employed with some modifications. Better C banding effects have been obtained in 2.5% and 5% barium hydroxide for 3 min. duration. The C bands were present as small-sized bands located in the centromere region of eight pairs of chromosomes. In addition to this, intercalary C bands have been observed in one pair of telocentric chromosomes (Fig 9).

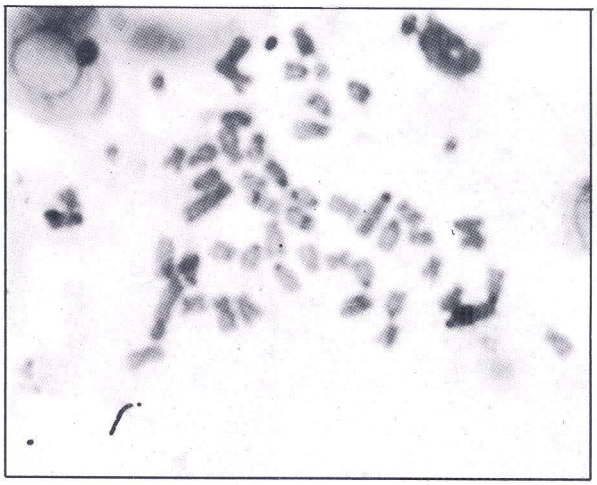

Fig. 9. Somatic metaphase chromosomes of *Labeo rohita* showing C-banding.

In vitro Colchinization Technique for Chromosome Preparation

The conventional technique of chromosome preparation has two drawbacks. Firstly there is usually variation in degree of condensation of chromosomes and secondly for larger fish (>20cms.) large amount of colchicine is needed. To overcome these limitations modification of PHA direct technique (Gold *et al.* 1990) has been used involving 3 specimens of *Cirrhina mrigala* and one specimen of *Mastacembelus armatus* have been sacrificed. The kidney and gill tissues were dissected out and placed in different petridishes containing 7-8ml of Minimum Essential Medium (Eagle). To each petridish 1-2 drops of 0.05% colchicine was added. After one hour the tissues were processed following routine citrate flame drying-Giemsa technique. About 20-25 metaphase spreads have been observed in all slides and the quality of metaphase spreads was much better than conventional method, thereby increasing its suitability for studying different banding patterns. Since this method does not involve *in vivo* colchinization, it is very useful under field conditions.

Restriction Endonuclease Banding

Under this study, 2 specimens of *C. punctatus* have been sacrificed for chromosome preparation. For studying the banding pattern, three enzymes viz Eco RI, Bam HI, Hind III have been used in different concentrations and different time durations of enzyme treatment. The slides were stained with 2% Giemsa and screened for presence of banding effects. No distinct banding pattern could be observed.

Short Term whole Blood Cell Culture

Cell culture greatly improves the quality of metaphase spreads. Few trials on short term whole blood cell culture have been undertaken using Minimum Essential Medium (Eagle) fortified with 10% foetal bovine serum. Blood was drawn from caudal vein of *Clarius batrachus* with the help of heparinized syringe. After innoculation, the culture tubes were placed in CO_2 incubator. After 72 hrs, the culture was harvested. The results were found to be encouraging (Fig 10).

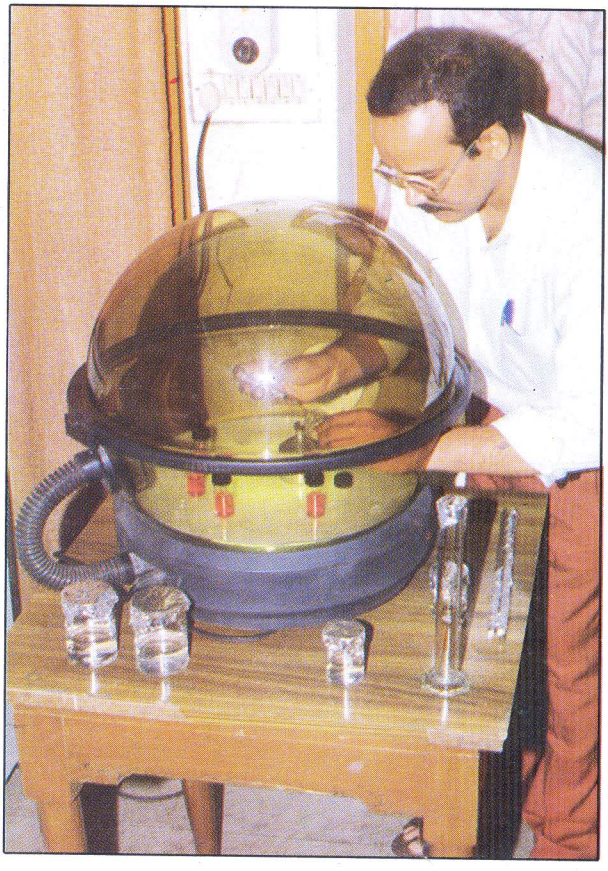

Fig. 10. Dr. N.S. Nagpure, inoculating the blood cells of *L. rohita* in the tissue culture laboratory.

5. COLLABORATION

5.1 National

1. Central Inland Capture Fisheries Research Institute, Barrackpore, West Bengal.
2. Central Marine Fisheries Research Institute, Cochin, Kerala.
3. National Research Centre on Coldwater Fisheries, Haldwani.
4. Department of Fisheries, Govt. of Uttar Pradesh, Lucknow.
5. Department of Fisheries, Govt. of Himachal Pradesh, Bilaspur.
6. Zoological Survey of India, Madras, Tamil Nadu.
7. Nature Conservators, Muzaffarnagar, U.P.
8. Department of Biotechnology, Ministry of Science & Technology, New Delhi.
9. Industrial Toxicology Research Centre, Lucknow.
10. Central Institute for Medicinal & Aromatic Plants, Lucknow.
11. Central Drug Research Institute, Lucknow.

6. MANPOWER DEVELOPMENT

6.1 : Scientific and Technical

The following personnel had undertaken study tour/undergone training in their respective fields :

Shri Sanjeev Kumar Srivastava, Scientist had undergone the training course on 'Use of Geographic Information System and Remote Sensing Techniques in Management of Land and Water Resources' held during May 16-27, 1995 at IARI, New Delhi.

Dr. A.K. Singh, Asstt. Farm Manager (T-6) had undergone the short term training course on 'Recent advances on fresh water aquaculture' at CIFA, Kausalyagang, Via. Bhubaneshwar during 30 May to 8 June, 1995.

Mrs. S.Das, Librarian (Technical Officer) had undergone training course on'CDS/ISIS' during 29 May to 8 June, 1995 jointly organised at the Computer Centre, Lucknow University, Lucknow.

Shri Sanjeev Kumar Srivastava, Scientist had undergone the training programme on 'Nutrient Management in

Aquaculture' during 9 to 15 July, 1995 organised by the Soil Testing Laboratory, Institute of Agriculture (Palli Siksha Bhavan), Vishva Bharati which was sponsored by Asian Fisheries Forum, Indian Branch and co-sponsored by Department of Science & Technology, Govt. of West Bengal & NABARD.

Dr. K.D. Joshi, T-5, Sarvashri R.S. Patiyal, T-5, Ajay Kumar Singh, T-2, & S.K. Paul, T-2 had successfully passed the P.G.Diploma Programme in Ecology and Environment (1993-94 Session) in April 1995 conducted by the Indian Institute of Ecology & Environment, New Delhi.

Dr. A. Barat, Technical officer (Cytogenetic Lab.) is undergoing the P.G. Diploma Programme in Ecology & Environment (1995-96 Session) conducted by the Indian Institute of Ecology & Environment, New Delhi.

Dr. A.G. Ponniah, Principal Scientist & Head, Genetic Characterisation Division had undergone the Hands-on Training course on 'DNA Fingerprinting' during January 17 to February 4, 1996 at Centre for Cellular and Molecular Biology, Hyderabad.

Mrs. S.Das, Librarian (Technical Officer) had undergone the programme on 'Total quality Management in Library and Information Services' conducted by the Indian Institute of Management, Lucknow during Feb. 14-16, 1996.

Dr. S.K.Srivastava, Sr. Lab. Technicion (T-4) had undergone the 'Computer training Course on E-Mail' during March 11-15, 1996 which was organised by the ICAR and conducted at M/S CMC Ltd., Delhi.

Shri Sanjeev Kumar Srivastava, Scientists and Dr. S. K. Srivastava, Sr. Lab. Technician (T-4) had undergone the Computer training Course on 'Microsoft Windows' during March 18-22, 1996 which was organised by the ICAR and conducted at M/S CMC Ltd., Delhi.

6.2 Honours and Awards

Dr.P.Das, Director was awarded with the prestigeous Gold Medal of the Society of Biosciences, Muzaffarnagar for his contributions in the field of endangered and commercial fish genetic resources conservation of the county. The award was presented at the 'National Symposium on Recent Advances in Bio-Sciences' held during Nov. 3-5, 1995 at

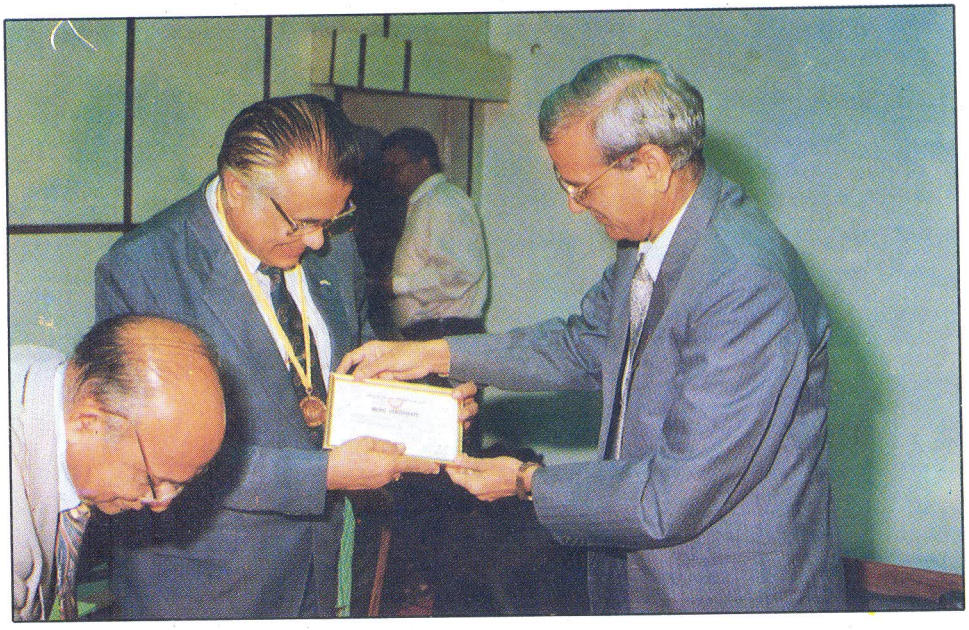

Fig. 11. Dr. P. Das, Director receiving the Gold Medal and Citation from Prof. V.C. Sharma, Vice Chancellor of M.D. University, Rohtak, Haryana on 5th Nov. 1995. Dr. V.P. Agarwal, Secretary General of Society of Bio-Sciencies is also seen.

Maharshi Dayanand University, Rohtak, Haryana (Fig 11).

Dr. P. Das, Director was nominated as a member of the Editorial Board of the 'Indian Journal of Fisheries' being published by the Central Marine Fisheries Research Institute, Cochin.

Dr. A.G.Ponniah, Principal Scientist was elected Fellow of the Bioved Research Society (FBRS) of Allahabad.

Dr. A.K. Pandey, Scientist (Senior Scale) was elected Fellow of the Academy

Fig. 12. Dr. A.K. Pandey, receiving the fellow award of the Academy of Environmental Biology from Dr. C.S.Rangachari, Special Secretary, Govt. of Andhra Pradesh.

of Environmental Biology (FAEB), Muzaffarnagar during its Sixteenth Annual Session (November 23-25, 1995) at Andhra Pradesh Agricultural University, Hyderabad (Fig. 12).

Dr. A.K. Pandey, Scientist (Senior Scale) received Scientist of the Year Award of the Bioved Research Society during the Inaugural Session of the National Symposium on Prospects and Problems of Technology Transfer and Rural Reality (February 17-18, 1996) at Allahabad.

7. TRANSFER OF TECHNOLOGY

7.1 Advisory Services

Aquaculturists and enterpreneures visited the Bureau during the year for getting expert advice on their problems pertaining to construction of new ponds and renovation of the existing ponds,water quality management,weeds and disease control, eradication of weed fishes, management of nursery ponds, stocking ponds and brood stock ponds etc. They were also aquainted with the importance and latest methods of monoculture, polyculture and integrated fish farming. Use of synthetic drugs for excellent results in fish breeding and better survival was imparted to the fish breeders.They were also advised about the use of agricultural wastes in aquaculture for obtaining optimum production.

7.2 Other Activities

Talks delivered from AIR, Lucknow and Programmes telecasted through Doordarshan, Lucknow.

- Dr.P.Das, Director delivered a talk on 'Matsya beej utpadan kaise ?' on 3 June 1995.
- Dr.P.Das, Director delivered a talk on 'Matsya palako ko samayaik sujhav' on 28 September 1995.
- Dr.P.Das, Director interacted in the 'Chaupal' Programme of Doordarshan on the topic 'Es maah ke matsya palan karya' on 20 April 1995.
- Dr.P.Das, Director interacted in the 'Chaupal' Programme of Doordarshan on the topic "Vyavasaya ke roop mein matsya palan" on 8 September 1995.

Lectures Delivered

- Shri. P.C.Mahanta, Sr. Scientist, delivered a lecture on "Genetics in Aquaculture" at CIFE, Chinat, Lucknow to the progressive farmers, Bankers, U.P.State Fisheries Deptt. officials, Insurance Company Personnels and students.
- Shri Sanjeev Kr. Srivastava delivered a lecture at the workshop on 'Pond Nutrition' at Institute of Agriculture (Palli Siksha Bhavan), Vishva

Bharati, Santiniketan on 15th July 1995 (Fig. 13).

Training Imparted

- CIFE, Bombay trainees visited the Bureau on 7 July 1995 and they were appraised of the research activities going-on in the various divisions.
- Trainees of G.B.Pant University of Agriculture & Technology, Pantnagar (U.P.) visited the Bureau on 29 September 1995 and they were appraised of the various research activities of the Bureau (Fig 14).

Mass Awareness Programme

- Mass awareness programmes on small scale with photo exhibition were organised in the catchment areas of Ladhiya and Sharda rivers in U.P. which was attended by local people, students, teachers, members of non-governmental organisations and fishermen.

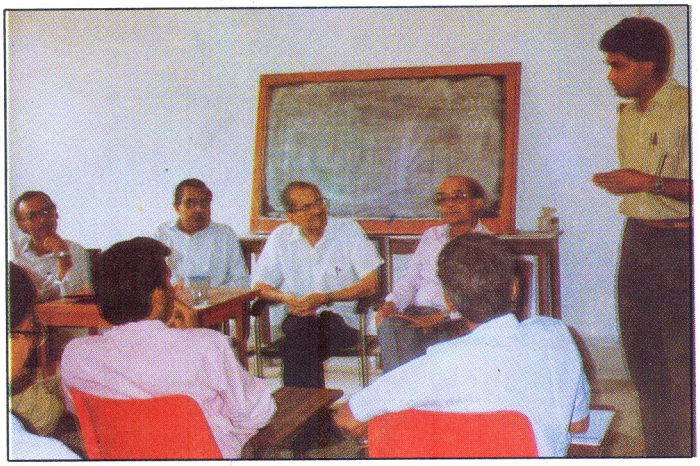

Fig. 13. Shri Sanjeev Kumar Srivastava delivering lecture at Workshop on Pond Nutrition at Vishva Bharati.

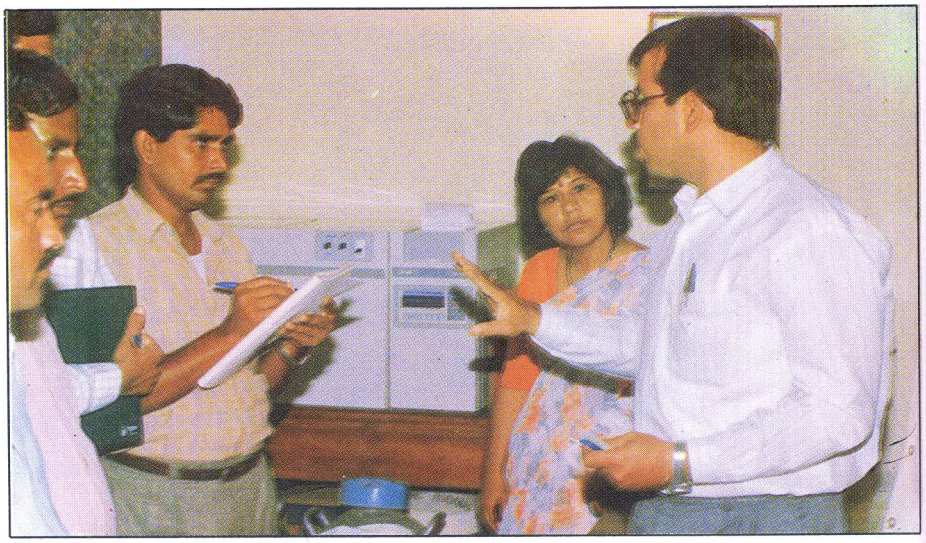

Fig. 14. Dr. K.K. Lal, explaining about the technique of fish spermatozoa cryopreservation to the trainees from G. B. Pant University.

8. LIBRARY AND INFORMATION SERVICES

8.1 Library Services

The objective of the library of this Bureau is to provide a comprehensive information services to the entire scientific group. The library supports NBFGR research projects by providing literature-based information, primary documents and bibliographic data. It has now built up a good collection of 1368 books, over 4410 volumes of journals and serials, 1101 publications, 1592 reprints and photocopies and 124 maps and charts to meet the needs of its users.

80 new books, 127 publications, 36 reprints and 3 maps were acquired during the year under report. The library subscribes 55 National and International journals and receives 59 Journals and serials in exchange/ as gratis. The total expenditure incurred by the library during the year was Rs.6,95,755.00.

8.2 Exchange Services

The library maintained exchange relationship with 61 leading National and International Research Institutes, R and D Organisations, Agricultural Universities and Academic Universities by mailing Annual Reports, reprints of scientific papers and departmental publications as a part of resource sharing and exchanging of information.

The library continued free mailing of Bureau's publication to various Research Institutes, Organisation, Universities, State Fisheries Deptts, FFDAs, Enterpreneurs and Fish Farmers to keep them abreast about the provided services to the scientific personnel Research Scholors individuals through inter library loan services and reading room facilities.

8.3 Information Services

Current awareness tools, bibliographic search service, document supply and reference services including selected databases are offered by the library to its users. The library supplied 700 photocopies of scientific papers to NBFGR scientists, technical staff and to externals on request. A database of selected bibliography on Fish Genetics is under preparation using CDS/ISIS package.

8.4 Technical Reports

Technical reports on the progress of research activities of the Bureau were compiled and sent to ICAR.39 review and research papers and abstracts of the Director and scientists were communicated to various National and International journals and Symposia/ Seminars/Conferences for presentation and publication.

Technical queries regarding the activities of the Bureau from various quarters of

the country and abroad were attended to by the Section. Bio-data sheets in respect of the scientists were compiled and mailed to 12 organisations for inclusion in different year-books and directories.

8.5 Reprography Services

The Section maintained active reprography services by producing departmental publications. The Section also provided cyclostyling, comb binding and electro-data binding facilities for departmental publications.

8.6 General Publication

Working paper brought out on :

- 8th Meeting of the Management Committee, 25 May, 1995.
- Brain Storming Meeting for finalising Live Fish Genetic Resource Centre, held on 1st June, 1995.
- Perspective Plan, 1995-2020, NBFGR, Lucknow. *1st Draft.*
- Meeting of Research Advisory Committee, 28-29 August, 1995.
- Meeting of the Staff Research Council, 31st August & 1st September 1995.
- Research Project Proposal for 1996-99 for Department of Biotechnology, Government of India, Ministry of Science & Technology, New Delhi.
- Annual Report for 1993-94.
- Annual Report for 1994-95.
- Deputation Report : Participation at the First Asian Australasian Fish Genetics Workshop in Malayasia during 15-16 November, 1995.
- Background information for Quinquennial Review Team 1989-1993.
- Perspective Plan 1995-2020. (*Revised Copy*).
- First Meeting of the Quinquennial Review Team at the NBFGR, 17-18 January, 1996.
- Guidelines for the QRTs.
- 9th Meeting of the Management Committee, 25 January, 1996.
- Deputation Report : participation at the Workshop on Health & Quarantine Guidelines for Responsible Movement (Introduction and Transfer of Aquatic Organisms) in Bangkok, held on 28 January, 1996.
- Proceedings of the First Meeting of the Quinquennial Review Team at the NBFGR, Lucknow.
- First draft of QRT Report (1989-93) for NBFGR, Lucknow.

9. CONFERENCES, SYMPOSIA ETC.

9.1 Important Meetings/Events

The following meetings were organised by the Bureau during April 1995 to March 1996 :

- Meeting of the Management Committee, held on 25 May, 1995.
- Brain Storming Meeting for finalising Live Fish Genetic Resource Centre, held on 1st June, 1995.
- Meeting of the Research Advisory Committee held on 28-29 August, 1995.
- Meeting of the Staff Research Council held on 31st August & 1st September, 1995.
- First Meeting of the Quinquennial Review Team held on 17-18 January 1996 (Fig. 15).
- Meeting of the Management Committee held on 24 January, 1996 (Fig. 16).

Fig. 15. A view of NBFGR Management Committee meeting (L-R) : Shri K.D. Pandey, Director of Fisheries, U.P., Dr. K. Radhadrishnan, ADG (Fy.), ICAR, Dr. P. Das, Director NBFGR, Sushree Sushila Jakhar, Advocate, Prof. C. S. Singh, Dean Faculty of Fisheries, G. B. Pant Agric. Univ., Pantnagar.

- Second Phase of QRT Meeting was held on 25-26 March, 1996.

- Construction of Bureau's infrastructure at Canal Road, Telebagh, Lucknow is in rapid progress.

Fig. 16. Members of the QRT discussing during the meeting. (L-R) : Dr. P. Das, Director, NBFGR; Prof. T. P. Singh, Chairman of QRT, Centre for Advanced Studies in Zoology, Banaras Hindu University, Varanasi; Dr. M.Y. Kamal, ADG (Fy.), ICAR & Dr. A.G.K. Menon, Emeritus Scientist, ZSI, Madras.

9.2 Participation

The Scientists and Technical staff of the Bureau participated in the following Conference/Symposia/Meetings etc.

Seminar/Symp-osia/Workshop	Organised by	Title of the paper & author(s)	Name of the participant
1) Seminar on Game Fish Conservation for Food and Sport, 6-7 May, 1995.	The Environment & Angler's club, New Delhi.	Endangered fishes and their food chain : Criteria for determination and rehabilitation. (Lecture delivered by P.Das)	Dr. P.Das
2) National Workshop on Natural Conservation, 5-7 June, 1995.	Deptt. of Botany, K.S. Saket P.G. College, Ayodhya, U.P.	Detection of environmental mutagen by sister chromatid exchange - O.P.Pandey N.S. Nagpure & Ajay Kr. Singh	Dr.O.P.Pandey
3) Planning Workshop to Develop Strategies for Collaboratives Research and Training in Application of Genetics to Increase Sustainable Aquaculture Production & Special Session on Fish Biodiversity and Strategies for Fish Genetics Research, 24-27 June, 1995.	ICLARM, Philippines, held at Hotel Krishna Oberoi, Hyderabad.	Fish biodiversity : genetic resources for aquaculture-Regional overview for South and West Asia (Country paper) - P. Das Management of *ex-situ* and *in-situ* conservation of fish Genetic Resources. - P.Das	Dr.P.Das Dr. A.K.Pandey Dr. A.Barat Dr. K.D.Joshi Dr. S.K. Srivastava

4)	4th Workshop on Conservation and Rehabilitation of Mahseer, 4-5 Aug., 1995.	The Tata Electric Co. Ltd.,Lonavla, Maharastra.	Conservation of Himalayan mahseer - P.Das	Dr.P.Das
			Ex-situ conservation of endangered mahseer. - A.G.Ponniah	Dr.A.G.Ponniah
5)	Workshop on Development of Fisheries Through Institutional Financing, 14th Sep., 1995.	NABARD,Lucknow held at Bankers Institute of Rural Development(BIRD), Lucknow.	—	Dr.P.Das
6)	National Symposium on Recent Advances in Biosciences, 3-5 November,1995.	Society of Biosciences held at M.D. University, Rohtak.	Lecture delivered on-Fish biodiversity conservation in India for sustainable production. - P.Das	Dr.P.Das
			Reproductive containment and the pineal gland in teleosts. - A.K.Singh - A.K.Pandey	Dr.A.K.Singh
			Breeding of Indian major carps with the synthetic hormone drug ovaprim in Uttar Pradesh. - W.S.Lakra *et al.*	Dr.A.K.Pandey
			Scope of chromosome banding in identification of intraspecific variations. - O.P.Pandey & - N.S.Nagpure	
			Recycling of waste water fish culture. -O.P.Pandey *et al.*	Dr.A.K.Pandey

7)	First Asian Australasian Fish Genetics Workshop, 15-16, November, 1995.	Institute of Advanced Studies, University of Malaya, Kuala-Lampur,Malaysia.	Response to selection for high directional growth rate in 2 cichlide and performance of a carp hybrid in Indian composite fish culture. - P.Das	Dr.P.Das
8)	National Symposium on Chemopollutants and Sustainable Ecosystems, 23-25 November, 1995.	The Academy of Environmental Biology, Muzaffarnagar(India), held at Andhra Pradesh Agricultural University, Hyderabad.	Culture environments for *in-vitro* maintenance of fish cell lines. - A.K.Singh & A.K.Pandey	Dr.A.K.Pandey
			Histopathological alterations in gill and kidney of an estuarine mullet, *Liza parsia* induced by sublethal exposure to lead. - A.K.Pandey *et al.*	Dr.A.K.Pandey
9)	XX All India Conference of IASLIC, 26-29December,1995	Lucknow University, Lucknow.	—	Mrs.Sukla Das Mr. P. Chithamparam
10)	Workshop on Health and Quarantine for Responsible Movement of Aquatic Organisms, 28 Jan., 1996.	Network of Aquaculture Centres in Asia-Pacific, Deptt. Fisheries Compound, Kasetsart Univ. Campus, Ladyao, Bangkok.	Health and quarantine for aquatic organisms in India. - P.Das	Dr. P. Das
11)	National Symposium on Islands Ecosystem and Sustainable Development, 8-9 February,1896.	Andaman Science Association and Science & Technology, A&N Administration, Port Blair.	Conservation of fish genetic resources for sustainable development of fishes. - P.Das	—

12)	International Symposium on Water/ Air Transitions in Biology, 14-18 Feb., 1996.	Department of Zoology, Banaras Hindu University, Varanasi, U.P.	Fish genetic and biodiversity conservation for sustainable production. - P.Das	—
13)	Indo-British Workshop on Bioversity, 15-17 February, 1996	Tropical Botanic Garden and Research Institute, Thiruvanthapuram, Kerala.	Fish genetic resources in India and their economic potential. - P.Das	—
14)	National Symposium on Prospects and Problems of Technology: Transfer and Rural Reality, 17-18 February,1996.	Bioved Research Society, Allahabad, U.P.	Gene bank technology for increased aquaculture production. - A.G.Ponniah	Dr.A.G.Ponniah
			Control and management of mollusc infestation in fish - A.K.Singh, P.C.Mahanta & S.M.Srivastava	Dr. A.K.Singh
			Endocrine regulation of calcium in fishes : An overview - A.K.Pandey	Dr. A.K.Pandey
			Variation in karyomorphology of some native fishes. - O.P.Pandey *et al.*	Dr. O.P.Pandey
			Genetics of disease resistance in fishes. - O.P.Pandey *et al.*	-do-
			Monosex (male) produc-	Dr.A.K.Pandey

			tion technique of tilapia. - A.K.Singh & A.K.Pandey	
			Demonstration on conserving aqua-environment through pond culture. - A.K.Singh *et al*	Dr.A.K.Singh
			Utilization of animal excreta for uplifting rural economy - O.P.Pandey *et al.*	Dr.O.P.Pandey
			Prospects and problems of aquaculture technology for fishery development in Kumaun hills. - K.D.Joshi	Dr.K.D.Joshi
			Altitudinal distribution of fishes in Kali river, U.P. - K.D.Joshi	Dr.K.D.Joshi
15)	Symposium-cum-Workshop on Aquaculture and Allied Technologies : A New Horizon in Rural Prosperity, 28-29 Feb.1996	Fish Farmers Development Agency, Deoria, U.P.	—	Dr.O.P.Pandey Dr.A.K.Pandey
16)	Workshop of the Indo-Norwegian Project of Selective Breeding of Rohu, 21-22 March, 1996.	Central Institute of Freshwater Aquaculture, Bhubaneshwar, Orissa.	Present status of fresh water fish genetic resources of India. - P.Das	Dr.P.Das

10. VISITORS

The following distinguished personalities visited the Bureau during 1995-96 (Figs.17-27).

Agrawal, V.P.(Dr.)	Retd. Principal, D.A.V. College & Secretary General, Society of Bio-sciences, Muzaffarnagar, U.P.
Alagarswami, K.(Dr.)	Director, CIBA, Madras.
Agarwal, Anil(Dr.)	Sr.Scientist (FY), ICAR, New Delhi.
Bhadula, S.K.(Dr.)	Dy.Director-General, UPCAR,Lucknow.
Chatterjee, K. (Prof.)	Professor, Dept. of Zoology, NEHU, Shillong, Meghalaya.
Chennubhotla,V.S.K.(Dr.)	Principal Scientist & OIC of CMFRI Res. Centre, Visakhapatnam.
Dalela, R.C.(Dr.)	Head, Dept. of Zoology, DAV (PG) College, Muzaffarnagar, U.P.
Dehadrai, P.V. (Dr.)	Dy. Director General (FY), ICAR, New Delhi.
Furtado, Jose I Dos R.(Prof.)	World Bank, NW Washington, USA.
Jakhar, Sushree Sushila	Member, Management Committee, Sikar, Rajasthan.
Kamal, M.Y. (Dr.)	Asstt. Director General (FY), ICAR, New Delhi.
Khuda-Bukhsh, A.R. (Prof.)	Professor, Dept. of Zoology, Univ. of Kalyani, Kalyani, W.B.
Menon, A.G.K.(Dr.)	Emeretus Scientist, ZSI, Madras.
Pandey, K.D.(Shri)	Director of Fisheries, U.P., Lucknow.
Paroda, R.S.(Dr.)	Director-General, ICAR, New Delhi. (Visited the site for permanent infrastructure).

Radhakrishnan, K. (Dr.)	Asstt. Director-General (Marine Fisheries), ICAR, New Delhi.
Raina, H.S. (Dr.)	Project Director, NRC on Coldwater Fisheries, Haldawani, U.P.
Rishi, K.K.(Prof.)	Professor, Dept. of Zoology, Kurukshetra University, Kurukshetra, Haryana.
Singh, C.S.(Prof.)	Dean, Faculty of Fisheries, G.B. Pant University of Agriculture and Technology, U.P.
Singh, H.R.(Prof.)	Head, Dept. of Zoology, Univ. of Allahabad, Allahabad.
Singh, R.P.(Shri)	Member, Management Committee, Sheikhapura, Bihar.
Singh, T.P.(Prof.)	Professor, Fish Endocrinology Lab.,Centre for Advanced Studies in Zoology, BHU, Varanasi.
Singh, V.D. (Dr.)	World Bank Consultant, New Delhi.
Sinha, M. (Dr.)	Director, CICFRI, Barrackpore.
Subramaniam, T. (Prof.)	Professor, Dept. of Zoology, Univ. of Madras, Madras.
Thakur, N.K. (Dr.)	Director, CIFE, Bombay.
Tripathi, Y.R. (Dr.)	Retd. Director of Fisheries, U.P., Lucknow.
Tripathi, S.C. (Dr.)	Project Officer, UPCAR, Lucknow.
Verma, R.B. (Dr.)	MD, UP Fisheries Development Corp., Lucknow.
Verma, S.R. (Prof.)	Professor, Dept. of Zoology, D.A.V. (P.G.) College, Muzaffarnagar, U.P.
Warsi, A.S. (Dr.)	Director of Research, C.S.A. Agricultural Univ., Kanpur, U.P.

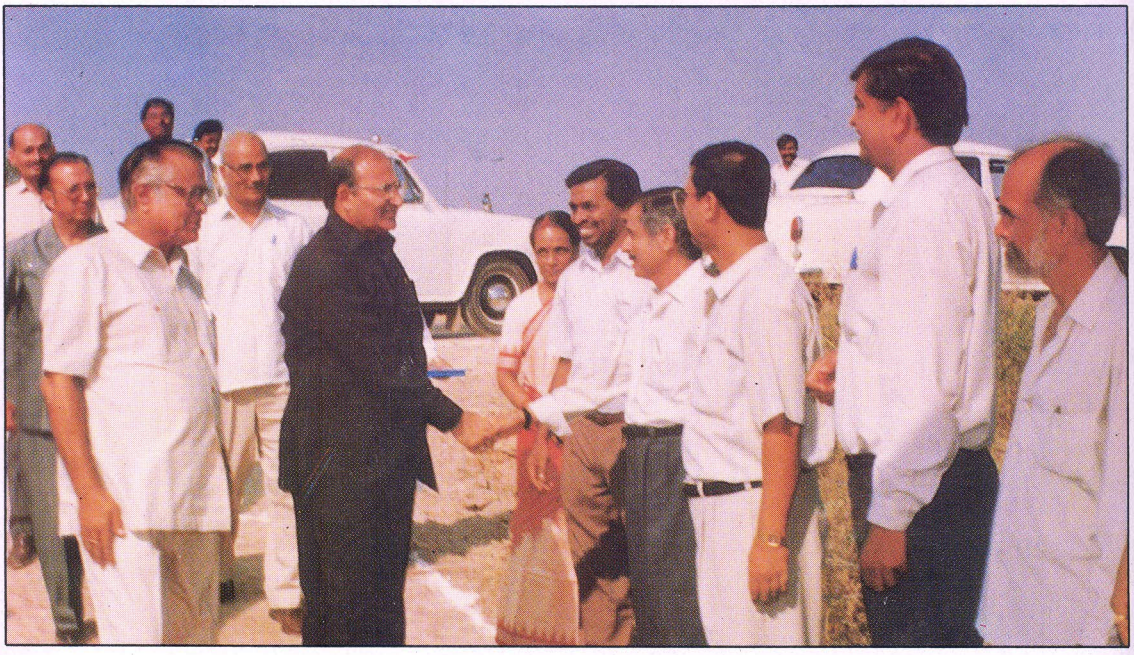

Fig. 17. Director General, ICAR, Dr. R.S. Paroda meeting scientists and staff of the NBFGR during his first visit at NBFGR site on 14.10.1995.

Fig. 18. Dr. R.S. Paroda, Director General, ICAR, New Delhi, looking at the model of the NBFGR complex. Dr. P. Das, Director, NBFGR, explaining the infrastructure model of the NBFGR.

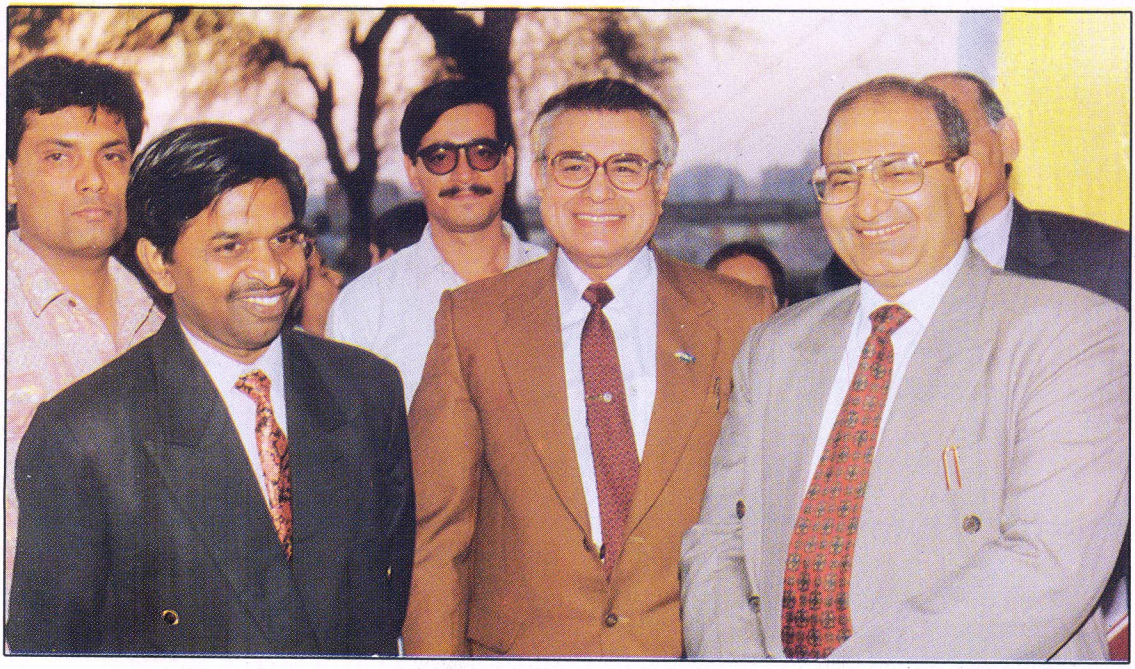

Fig. 19. Dr. R.S. Paroda, DG, ICAR, at the NBFGR complex on 22.02.1996. (R-L) : Dr. R.S. Paroda, Dr. P. Das, Shri Peyush Punia, Dr. A.G. Ponniah, Shri Sanjeev Kumar Srivastava

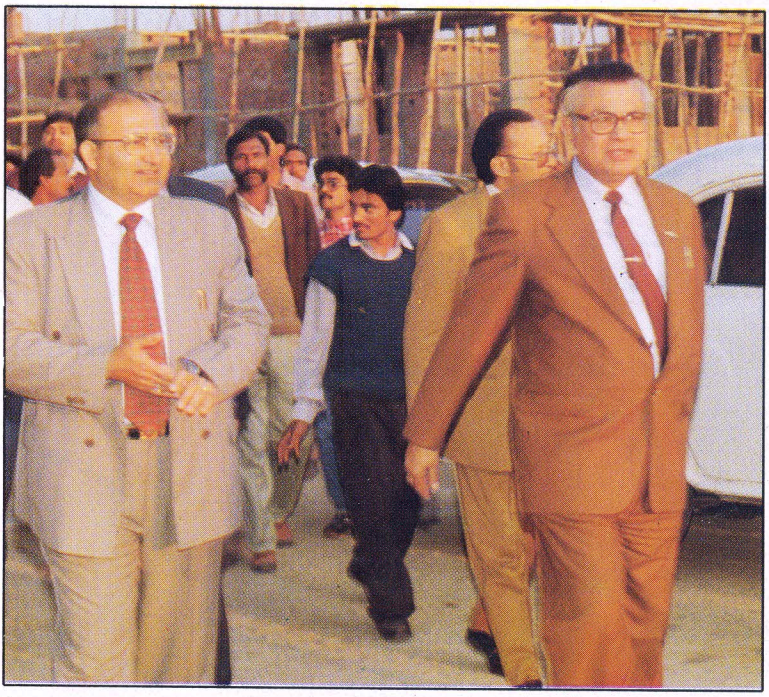

Fig. 20. Dr. R.S. Paroda, DG, ICAR, visiting upcoming NBFGR complex at Telibagh, Lucknow.

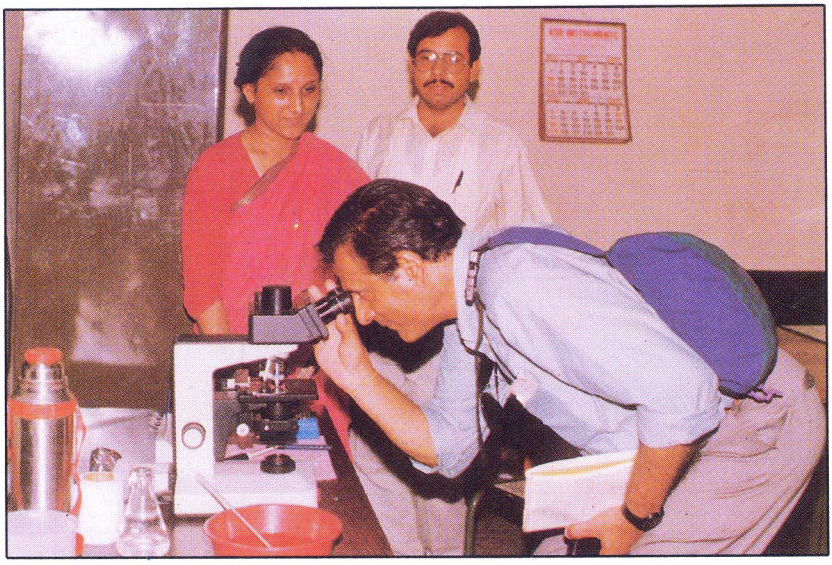

Fig. 21. Prof. Jose I Dos R Furtado, FAO Environmental Consultant, observing the motility of the cryopreserved sperms.

Fig. 22. Shri P.C. Mahanta explaining to the members of the RAC about NBFGR's efforts on the conservation of the endangered mahseer.

Fig. 23. Dr. P.V. Dehadrai, DDG (Fy.), ICAR, New Delhi is being briefed by Dr. A.G. Ponniah on NBFGR's work on genetic characterisation in Fish Biochemical Genetics laboratory.

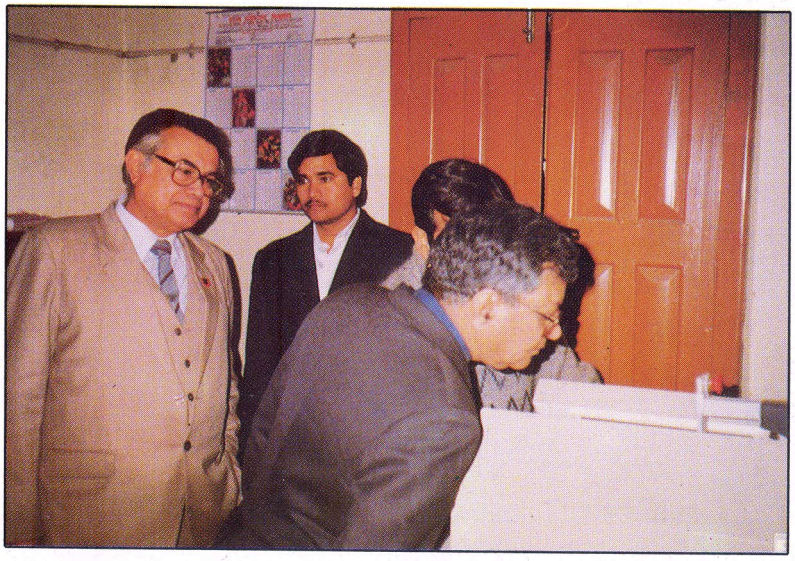

Fig. 24. Dr. P.V. Dehadrai, examining the gel showing genetic variation.

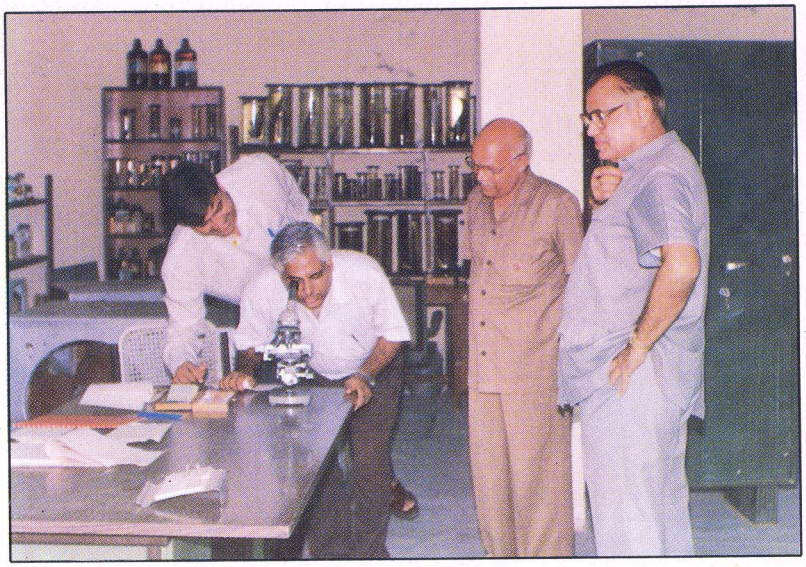

Fig. 25. Examining work on conservation biology of endangerdd fish. (L-R) : Dr. A.K. Pandey, Dr. Gopal Ji Srivastava, Dr. R.C. Dalela and Dr. P. Das.

Fig. 26. Dr. P. Das, Director, NBFGR, explaining the increased growth in sex inverted male population in tilapia, *Oreochromis mossambicus*, to the Dr. Y.R. Tripathi, Ex-Director, U.P. Fisheries and Dr. V.P. Agarwal, Retd. Principal, DAV College, Muzaffarnagar.

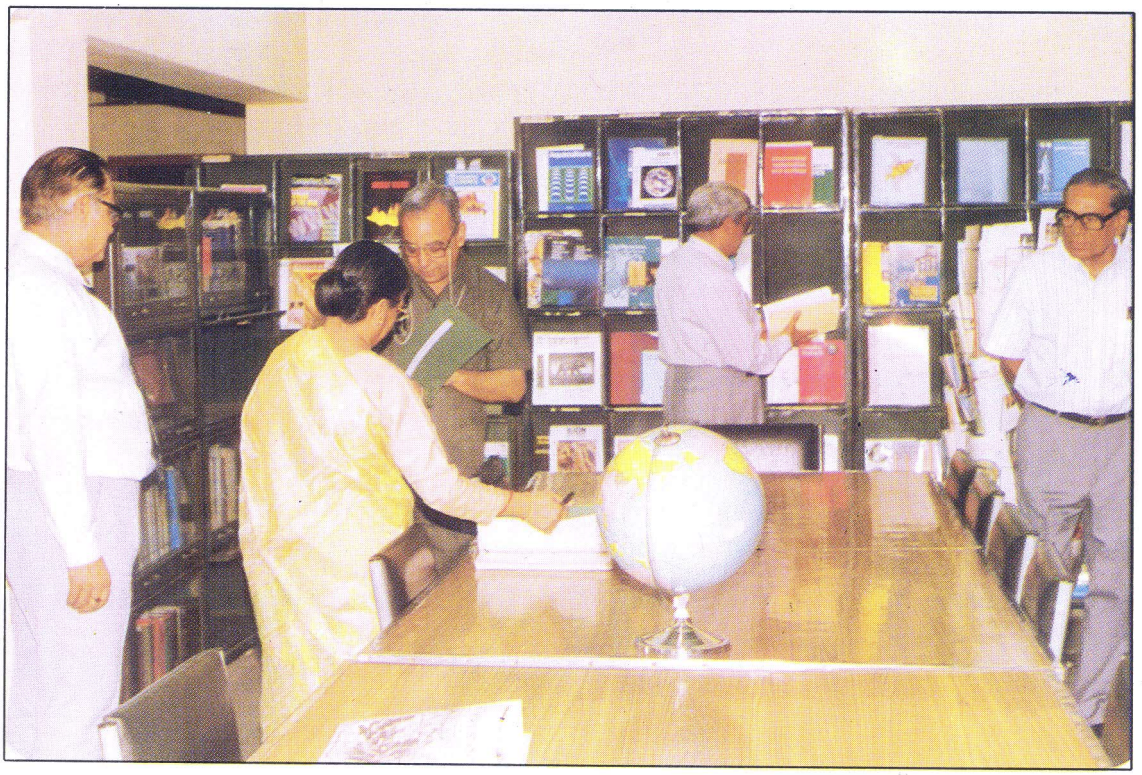

Fig. 27. QRT members visit to NBFGR Library. (L-R) : Dr. P. Das, Mrs. S. Das, Dr. T.P. Singh, Dr. K.K. Rishi and Dr. A.G.K. Menon.

11. SCIENTIFIC PUBLICATIONS 1995-96

Agarwal, S.K., Sushil Kumar & A.K.Pandey, 1996.

Fish toxicants from selected traditional plants for their application in aquaculture. (Abstract). *In* National Symposium on Prospects & Problems of Technology Transfer and Rural Reality, 17 - 18th February, 1996. Abstract, organised by Bioved Research Society, Allahabad, pp 103-104.

Das, P., 1995.

Ex-situ management of fish germplasm resources. *In* Complex Carbohydrates and Advances in Biosciences, ed. by V.P.Agrawal & Ors, pub. by Society of Biosciences, Muzaffarnagar, India, pp. 511 - 520.

Das. P., 1995,

Response to selection for high directional growth rate in 2 Cichlidae and performance of a carp hybrid in Indian composite fish culture. *In* First Asian - Australian Fish Genetics Workshop, 15-16 November 1995. Programme & Abstracts, org. by Institute of Advanced Studies, University of Malaya, Kuala Lumpur, Malaysia.

Das, P. & A.Barat, 1995.

Application of genetics in fisheries can help blue revolution in India. *In* Perspectives in Cytology and Genetics, eds. by G.K.Manna & S.C.Roy, Vol 8 (1995) : 25-33.

Das, P. avam K.D. Joshi, 1995.

Bharatiya looptapraya matsya prajatiya. (In Hindi). *In* Jalkrishi, ed. by S.A.H. Abidi & Ors. New Delhi, Mahasagar Vikas Vibhag, 1995, pp. 211-224.

Das, P., 1996.

Biotechnology in aquaculture and germplasm conservation in India. *In* Ethnobiology in Human Welfare : Proceedings of IV International Congress of Ethnobiology held at Lucknow, India, during 17-21 November, 1996 : 274-279.

Das, P., 1996.

Conservation of Himalayan mahseer. *Fishing Chimes*, 15(10): 13-15.

John, George, A.G.Ponniah, W.S.Lakra, A.Gopalakrishnan & A. Barat, 1993.

Preliminary attempts to cryopreserve embryos of *Cyprinus carpio* (L) and *Labeo rohita* (Ham). *J Inland Fish. Soc. India*, 25(1) : 55-57.

Joshi, K.D., 1996.

Prospects and problems of aquaculture technology for fishery development in Kumaun hills. (Abstract). *In* National Symposium on Prospects and Problems of Technology Transfer

and Rural Reality, 17-18 February, 1996. Abstract, Org. by Bioved Research Society, Allahabad, pp.94-95.

Joshi, K.D., P.C.Mahanta, S.M.Srivastava & R.S.Patiyal, 1996.

Altitudinal distribution of fishes in Kali river, U.P. (Abstract). *In* National Symposium on Prospects and Problems of Technology Transfer and Rural Reality, 17 -18 Feb., 1996. Abstract, Org. by Bioved Research Society, Allahabad, p. 94.

Lakra, W.S., A.Mishra, R.Dayal & A.K.Pandey 1995.

Breeding of Indian major carps with the synthetic hormone drug ovaprim in Uttar Pradesh. (Abstract). *In* Abstract Book : National Symposium on Recent Advances in Biosciences, November, 3-5 , 1995, Org. by Dept. of Biosciences, M.D. Univ., Rohtak (Haryana), p. 50.

Mahanta, P.C., A.K.Singh & S.M. Srivastava, 1996.

Control and management of mollusc infestation in fish pond. (Abstract). *In* National Symposium on Prospects and Problems of Technology Transfer and Rural Reality, 17-18 February, 1996. Abstract, Org. by Bioved Research Society, Allahabad, p. 80.

Pandey, A.K., 1996.

Endocrine regulation of calcium in fishes : an overview. *In* National Symposium on Prospects and Problems of Technology Transfer and Rural Reality, 17-18 February, 1996. Invited Lectures, org. by the Bioved Research Society, Allahabad, p. 79.

Pandey, A.K. & V.E.Sabarathnam, 1996.

Transfer of fisheries technologies in adopted and non-adopted villages of Puri District, Orissa. *In* National Symposium on Prospects and Problems of Technology Transfer and Rural Reality, 17-18 February, 1996. Invited lectures, Org. by the Bioved Research Society, Allahabad, pp. 13-14.

Pandey, A.K., K.C.George & M.Peer Mohamed, 1995.

Histopathological alterations in gill and kidney of an estuarine mullet, *Liza parsia*

induced by sublethal exposure to lead. (Abstract). *In* 16th Annual Session of the Academy of Environmental Biology, Abstracts Compendium (Abstracts Proceedings), Org. by the Academy of Environmental Biology, Muzaffarnagar, India at A.P. Agricultural University, Rajendranagar, Hyderabad, p. 124.

Pandey, A.K., M.Peer Mohamed, K.C.George and Shyam Lal, 1993.

Histopathological changes in gill, kidney and liver of an estuarine mullet, *Liza parsia* induced by sublethal exposure to DDT. *J. Indian Fish. Assoc.*, 23: 41-49 (appeared in 1996).

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Variation in karyomorphology of some native fishes (Abstract). *In* National Symposium on Prospects and Problems of Technology Transfer and Rural Reality, 17-18 February, 1996. Abstract, Org. by Bioved Research Society, Allahabad, p. 96.

Pandey, O.P., A.K. Singh, N.S.Nagpure, S.K.Paul & A.K. Pandey, 1995.

Recycling of waste water for fish culture. (Abstract). *In* Abstract Book : National Symposium on Recent Advances in Biosciences, November 3-5, 1995, Org. by Dept. of Biosciences, M.D. Univ., Rohtak (Haryana)., p. 17.

Pandey, O.P. & N.S.Nagpure, 1995.

Scope of chromosome banding in identification of intra- specific variations. (Abstract). *In* Abstract Book: National Symp. on Recent Advances in Biosciences, November 3-5, 1995, Org. by Dept. of Biosciences, M.D.Univ., Rohtak (Haryana), p. 33.

Pandey, O.P., N.S.Nagpure & A.K.Pandey, 1996.

Genetic engineering for fish stock improvemennt. (Abstract). *In* 13th National Symposium on Life Sciences, 30 - 31st December 1995 & 1st January 1996 at Ch. Charan Singh Univ., Meerut, U.P., Abstract of Papers, Org. by Ch. Charan Singh Univ. & Indian Soc. of Life Sciences, pp. 78-79.

Pandey, O.P., N.S.Nagpure, S.K.Srivastava & A.K.Pandey, 1996.

Genetics of disease resistance in fishes.(Abstract). *In* National Symposium on

Prospects and Problems of Technology Transfer and Rural Reality, 17-18 Feb., 1996. Abstract, organised by Bioved Research Society, Allahabad, pp. 57-58.

Pandey, O.P., N.S. Nagpure, Ajay Kr. Singh, S.K.Paul, R.Dayal, S.M.Srivastava & A.K. Pandey, 1996.

Utilization of animal excreta for uplifting the rural economy.(Abstract). *In* National Symposium on Prospects and Problems of Technology Transfer and Rural Reality, 17-18 Feb., 1996. Abstract, Org. by Bioved Research Society, Allahabad, pp. 95-96.

Ponniah, A.G., 1996.

Gene bank technology for increased aquaculture production. (Abstract). *In* National Symposium on Prospects and Problems of Technology, Transfer and Rural Reality, 17-18 Feb., 1996. Abstract, organised by Bioved Research Society., Allahabad, p. 62.

Ponniah, A.G., S.K.Srivastava, K.K.Lal & A.Gopalakrishnan, 1995.

Preliminary investigations on androgenesis in *Cyprinus carpio. Nat. Acad. Sci. Letters*, 18(3 & 4) : 77-80.

Singh, A.K., 1994.

Environmental and genetic implications during gonadal manipulation in fishes. *In* Environment and Applied Biology : Proc. of the Conf. on Environ & App. Biol., held at Bareilly College, Bareilly on 7 Feb. 1993,Organised by the Society of Biosciences, Muzaffarnagar, 1994 : 255-262.

Singh, A.K. & A.K. Pandey, 1996.

Monosex (male) production technique of tilapia, *Oreochromis mossambicus* for excellent growth, survival and aquacultural production. (Abstract). *In* National Symposium on Prospects and Problems of Technology Transfer and Rural Reality, 17-18 Feb., 1996, Abstract, Org. by Bioved Research Society, Allahabad. pp. 56-57.

Singh, A.K. & A.K.Pandey, 1995.

Culture environments for in vitro maintenance of fish cell lines. (Abstract). *In* 16th

Annual Session of the Academy of Environmental Biology. Abstracts Compendium (Abstracts Proceedings), Org. by the Academy of Environmental Biology, Muzaffarnager, India at A.P. Agricultural University, Rajendranagar, Hyderabad, p. 30.

Singh, A.K. & A.K.Pandey, 1995.

Reproductive containment and the pineal gland in teleosts. *In* Abstracts Book : National Symposium on Recent Advances in Biosciences, Nov. 3-5, 1995, Org. by Dept. of Biosciences, M.D.Univ., Rohtak, Haryana, p. 50.

Singh, A.K., P.C.Mahanta, S.M.Srivastava & R.S.Patiyal, 1996.

Demonstration on conserving aquaenvironment through pond culture.(Abstract). *In* National Symposium on Prospects and Problems of Technology Transfer and Rural Reality, 17-18 Feb., 1996. Abstract, Org. by Bioved Res. Soc., Allahabad, p. 78-79.

Srivastava, Sanjeev Kr. & A.G.Ponniah, 1996.

Application of GIS and remote sensing to study fish habitat in freshwater bodies. (Abstract). *In* National Symposium on Prospects & Problems of Technology Transfer and Rural Reality, 17-18 Feb.,1996. Abstract, Org. by Bioved Research Society, Allahabad, p. 97.

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Measures to reduce permeability of soil for fish farm. (Abstract). *In* National Symposium on Prospects & Problems of Technology Transfer and Rural Reality, 17-18 Feb., 1996. Abstract, Org. by Bioved Research Society, Allahabad, p. 98.

12. PERSONNEL

12.1 List of personnel

RESEARCH MANAGEMENT

1.	**Dr. P. Das**	- **Director**

SCIENTIFIC

1.	Dr. L.B. Singh	- Principal Scientist (upto June 1994)
2.	Dr. A.G. Ponniah	- Principal Scientist
3.	Dr. George John	- Principal Scientist (on deputation in the Deptt. of Biotechnology)
4.	Dr. D. Kapoor	- Senior Scientist
5.	Shri P.C. Mahanta	- Senior Scientist
6.	Dr. O.P. Pandey	- Scientist (Senior Scale)
7.	Dr. A.K. Pandey	- Scientist (Senior Scale)
8.	Shri S.P. Singh	- Scientist (Senior Scale)
9.	Dr. A. Gopalakrishnan	- Scientist (Senior Scale)
10.	Dr. N.S. Nagpure	- Scientist
11.	Shri Peyush Punia	- Scientist
12.	Dr. Kuldeep Kumar Lal	- Scientist
13.	Dr. (Mrs.) Vindhya Mohindra	- Scientist
14.	Shri Sanjeev Kumar Srivastava	- Scientist
15.	Dr. (Mrs.) P.K. Sahoo	- Scientist

TECHNICAL

1.	Dr. A.K. Singh	- Asstt. Farm Manager (T-6)
2.	Smt. Sukla Das	- Librarian (T-5)
3.	Shri A.K. Mishra	- Electrical Foreman (T-5)
4.	Dr. A. Barat	- Senior Laboratory Technician (Cytogenetics) (T-5)
5.	Shri Babu Ram	- Farm Engineering Assistant (T-5)

6.	Shri Rajesh Dayal	- Field Surveyor (T-4)
7.	Shri S.M. Srivastava	- Field Surveyor (T-4)
8.	Shri R.S. Patiyal	- Farm Assistant (T-4)
9.	Dr. K.D. Joshi	- Senior Laboratory Technician (Fish Biology) (T-4)
10.	Dr. S.K. Srivastava	- Senior Laboratory Technician (Biochemical Genetics) (T-4)
11.	Shri P. Chithamparam	- Library Assistant (T-4)
12.	Shri Ajay Kumar Singh	- Junior Survey Assistant (T-2)
13.	Shri S.K. Paul	- Junior Survey Assistant (T-2)
14.	Shri B.K. Rao	- Sample Sorter (T-2)
15.	Shri R.K. Shukla	- Sample Sorter (T-2)
16.	Shri Ved Prakash	- Library Attendant (T-2)
17.	Shri R.S. Sah	- Dark Room Assistant (T-2)
18.	Shri B.N. Pathak	- Gestetnar Operator (T-1)

ADMINISTRATIVE

1.	Shri R.C. Srivastava	- Assistant Finance & Accounts Officer
2.	Shri A. Sah	- Superintendent
3.	Shri R.C.P. Sinha	- Stenographer
4.	Shri Panchoo Lal	- Assistant
5.	Smt. Chanda Tiwari	- Senir Clerk
6.	Shri Mohan Tiwari	- Senior Clerk
7.	Shri Navin Kumar	- Junior Clerk
8.	Miss Kaneez Fatima	- Junior Clerk (from 6.5.95)

AUXILIARY

1.	Shri Samerjit Singh	- Driver
2.	Shri Om Prakash	- Driver

SUPPORTING

1. Shri Sree Ram - Fieldman, SSG-IV
2. Shri Madan Lal - Fisherman, SSG-III
3. Shri Raj Bahadur - Laboratory Attendant, SSG-III
4. Shri Shri Swapan Debnath - Laboratory Attendant, SSG-II
5. Shri K.K. Singh - Fieldman, SSG-II
6. Shri Ram Baran - Fisherman, SSG-II
7. Shri Laxchman Prasad - Fisherman, SSG-II
8. Shri Dukhi Shyam Deo - Fisherman, SSG-II
9. Shri Inderjit Singh - Messenger, SSG-II
10. Shri Anil Kumar - Safaiwala, SSG-II
11. Shri Prahlad Kumar - Safaiwala, SSG-II
12. Shri Chhote Lal - Fisherman, SSG-I
13. Shri Vinay Kumar Srivastava - Laboratory Attendant, SSG-I

12.2 APPOINTMENTS

1. Miss Kaneez Fatima, Junior Clerk joined NBFGR on 6.5.95.

12.3 PROMOTION

Sl. No.	Name	Designation	Date of Promotion
1.	Shri Raj Bahadur	Lab. Attendant SSG-II	1.6.95 Lab. Attendant, SSG-III
2.	Shri Prahalad Kumar	Safaiwala SSG-I	27.10.95 Safaiwala, SSG-II

12.4 TRANSFER FROM OTHER INSTITUTES TO NBFGR, LUCKNOW

1. Dr. (Mrs.) Rehana Abidi, Scientist (Senior Scale) joined at the Bureau on the forenoon of 18.12.95 from CIFE, Bombay.

12.5 STUDY LEAVE GRANTED

1. Shri S.P. Singh, Scientist (Senior Scale) was relieved in the afternoon of 30.12.95 for proceeding on study leave for 3 years w.e.f. 1.1.96 to 31.12.98 for doing the Ph.D. work at Department of Mathematics, University of Allahabad, Allahabad (U.P.).
2. Shri Peyush Punia, Scientist was relieved in the afternoon of 30.3.96 for proceeding on study leave for 2 years w.e.f. 1.4.96 to 31.3.98 for doing the Ph.D. work at Kitasato University, Japan.

13. MANAGEMENT COMMITTEE

List of members of the Management Committee of NBFGR, Lucknow.

1.	Dr. P. Das Director NBFGR, Lucknow.	Chairman
2.	Dr. K. Radhakrishna Asstt. Director General (Fisheries) ICAR, New Delhi.	Member
3.	Shri K.D. Pandey Director of Fisheries	Member
4.	Shri A.M. Faruqui Director of Fisheries Govt. of M.P., Bhopal.	Member
5.	Sushree Sushila Jakhar, Advocate Dassa ki Dhani, Sikar, Rajasthan	Member
6.	Shri Rajeshwar Prasad Singh Shekpur, Bihar.	Member
7.	Prof. C.S. Singh Head, Department of Fisheries GBPAU, Pantnagar.	Member

8.	The Financial Adviser DARE, New Delhi.	Member
9.	Dr. A.G. Ponniah Principal Scientist NBFGR, Lucknow.	Member
10.	Dr. D. Kapoor Senior Scientist NBFGR, Lucknow.	Member-Secretary
11.	Shri P.C. Mahanta Senior Scientist NBFGR, Lucknow.	Member
12.	Dr. A.K. Pandey Scientist (Sr. Scale) NBFGR, Lucknow.	Member

14. STAFF WELFARE ACTIVITIES

14.1 Institute Joint Staff Council

The Institute Joint Staff Council with the below mentioned members existed at the Bureau and considered the matters of common interest concerning the staff.

Official side

1.	Dr. P. Das Director	- Chairman
2.	Dr. D. Kapoor Senior Scientist	- Member
3.	Shri P.C. Mahanta Senior Scientist	- Member
4.	Dr. A.K. Pandey Scientist (Sr. Scale)	- Member

5.	Shri R.C. Srivastava Asstt. Finance & Accounts Officer	- Member-Secretary
6.	Shri A.K. Mishra Electrical Foreman (T-5)	- Member
7.	Shri A. Sah Superintendent	- Member

Staff side

1.	Shri Panchoo Lal Assistant	- Secretary
2.	Shri Mohan Tiwari Senior Clerk	- Member
3.	Shri S.K. Paul T-2	- Member
4.	Shri Ved Prakash T-2	- Member
5.	Shri Raj Bahadur Lab. Attendant, SSG-III	- Member
6.	Shri Ram Baran Fisherman, SSG-II	- Member

Appendix-1

Statement showing the total number of employees and member of Scheduled Castes and Scheduled Tribes amongst them as on 31.3.96.

Group/Class		Total No. employees	SC	%SC	ST	%ST
GROUP 'A' (CLASS-I)						
1.	Director	1	-	-	-	-
2.	Principal Scientist	2	-	-	-	-
3.	Senior Scientist	2	-	-	-	-
4.	Scientist (Sr. Scale)	5	-	-	-	-
5.	Scientist	6	-	-	-	-
6.	Asstt. Farm Manager, T-6	1	-	-	-	-
	Total :	17	-	-	-	-

GROUP 'B' (CLASS-II)

Group/Class		Total No. employees	SC	%SC	ST	%ST
1.	Asstt. Finance & Accounts Officer	1	-	-	-	-
2.	Technical Officer (T-5)	4	1	25	-	-
3.	Superintendent	1	-	-	1	100
4.	Technical (T-4)	6	-	-	1	16.66
	Total :	12	1		2	-

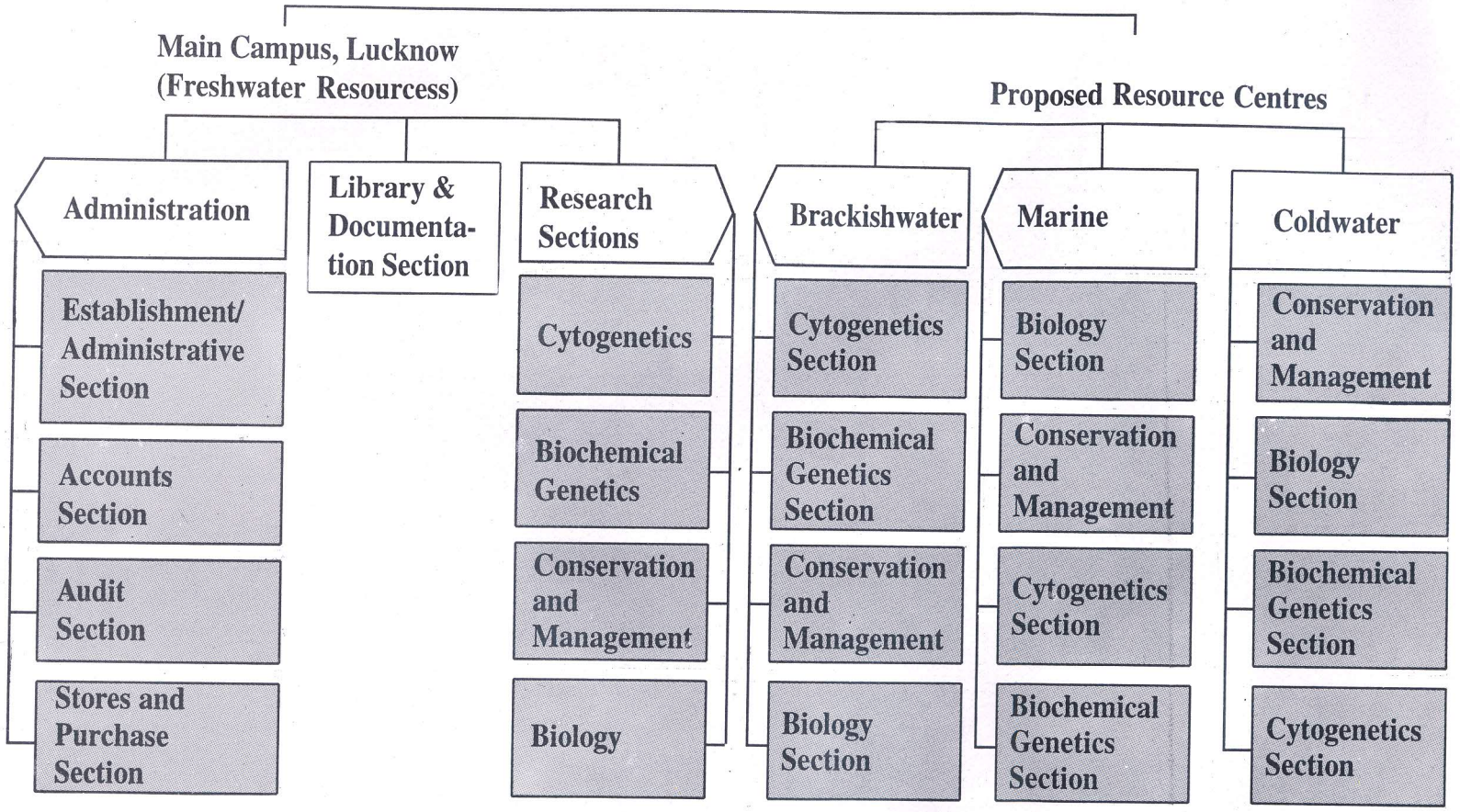
GROUP 'C' (CLASS-III)

Group/Class		Total No. employees	SC	%SC	ST	%ST
1.	Technical T-2	6	1	16.66	1	16.66
2.	Technical T-1	1	-	-	-	-
3.	Stenographer	1	-	-	-	-
4.	Assistant	1	1	100	-	-
5.	Senior Clerk	2	-	-	-	-
6.	Junior Clerk	2	1	50	-	-
7.	Driver	2	1	50	-	-
	Total :	15	4		1	

GROUP 'D' (CLASS-IV)

Group/Class		Total No. employees	SC	%SC	ST	%ST
1.	Fisherman	5	1	20	1	20
2.	Laboratory Attendant	3	-	-	-	-
3.	Fieldman	2	1	50	-	-
4.	Messenger	1	-	-	-	-
5.	Safaiwala	2	2	100	-	-
	Total :	13	4		1	

Appendix-II Organisational Chart



The Research Sections would be elevated to Research Division when adequate number of scientists will come in position during the IX Plan period.