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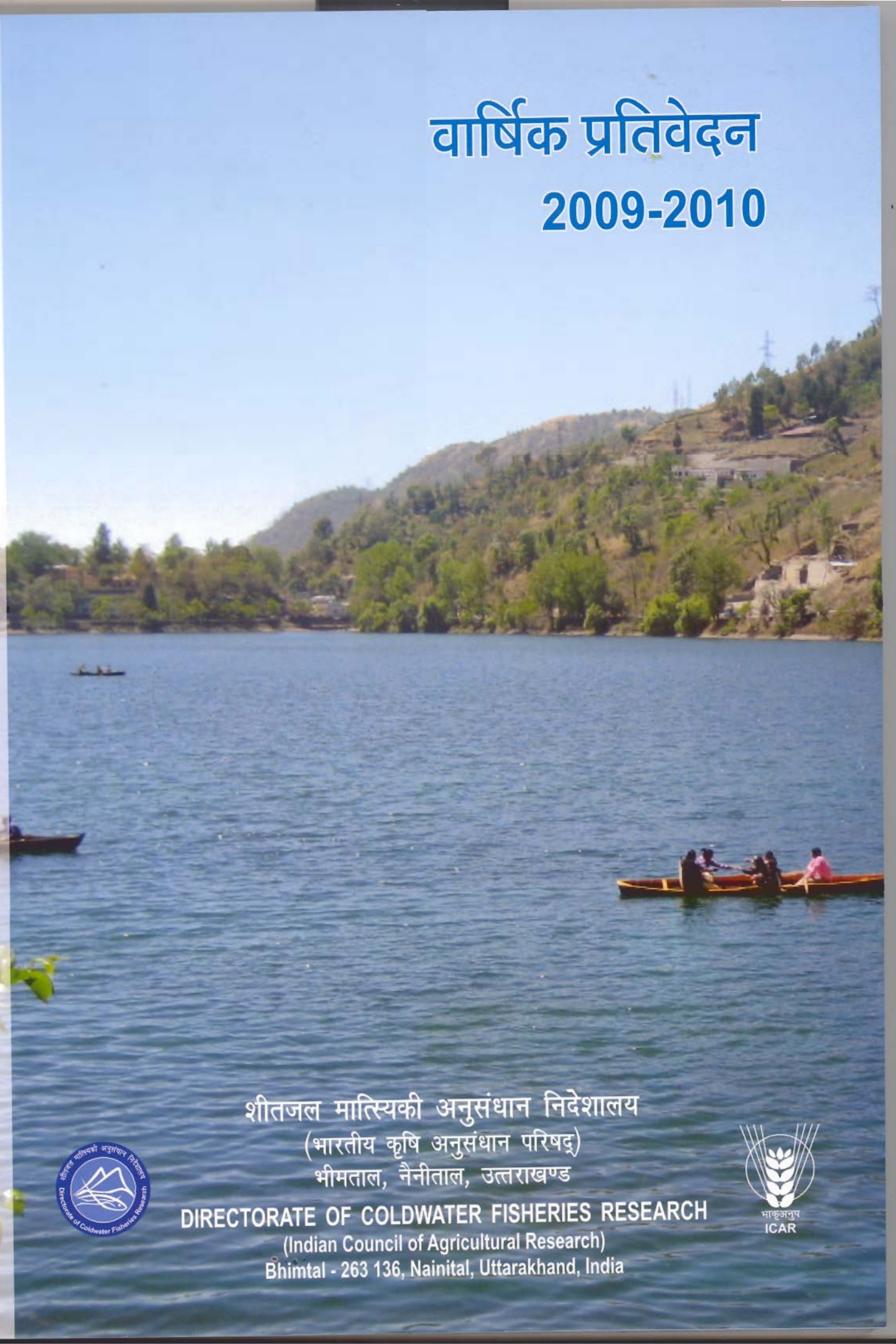
2009-2010

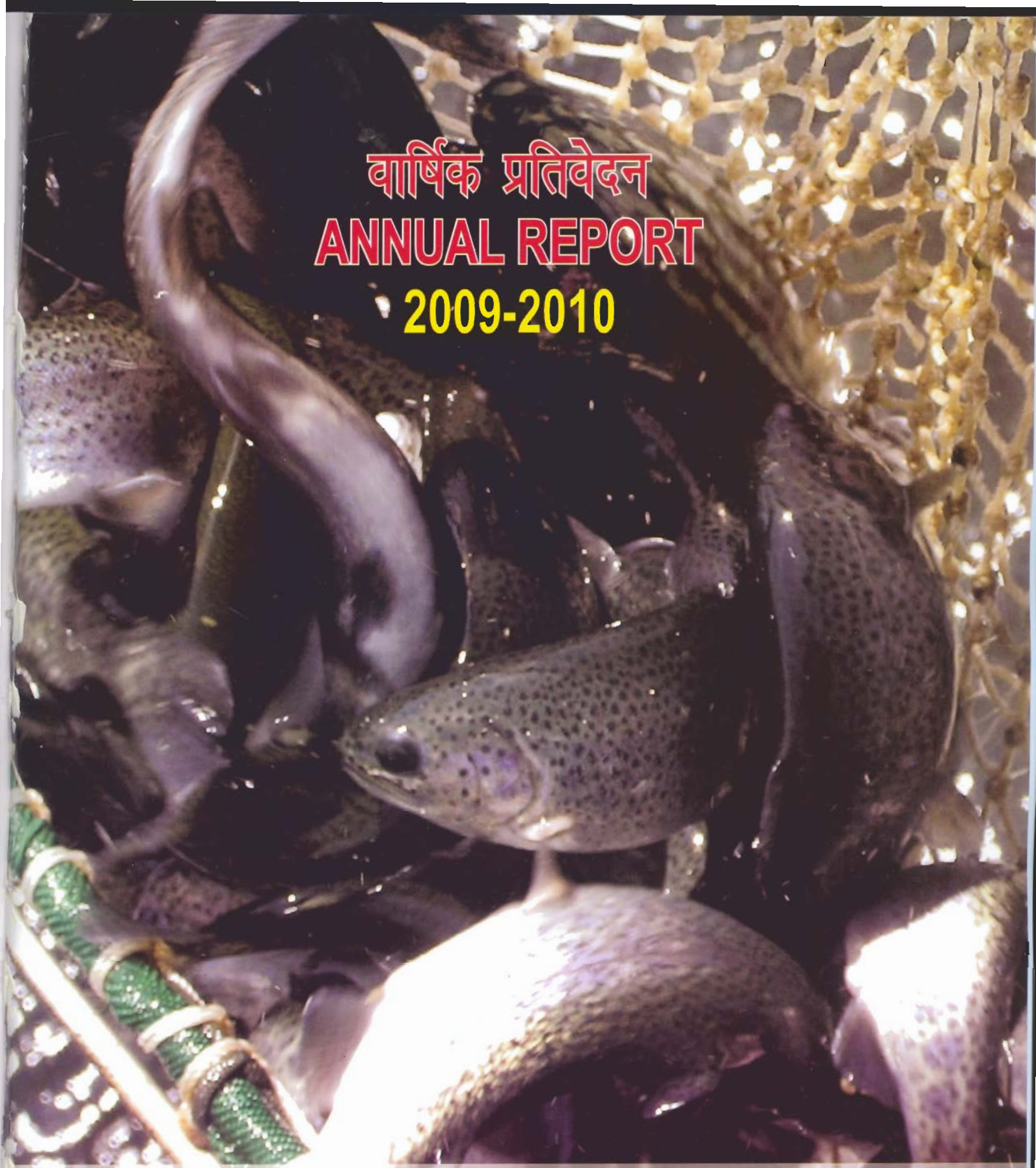


ANNUAL REPORT 2009-2010

शीतजल मात्स्यिकी अनुसंधान निदेशालय
(भारतीय कृषि अनुसंधान परिषद्)
भीमताल, नैनीताल, उत्तराखण्ड

DIRECTORATE OF COLDWATER FISHERIES RESEARCH
(Indian Council of Agricultural Research)
Bhimtal - 263 136, Nainital, Uttarakhand, India

भाकृअनुप
ICAR



वार्षिक प्रतिवेदन
ANNUAL REPORT
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Cover Page
View of Bhimtal Lake, Nainital

Back Cover
View of Bhagirathi River near Harsil, Uttarakhand

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PREFACE

The coldwater fishery of the country is in its transition phase with an aim to uplift the socio-economic condition of the underprivileged population in the hills. In order to fulfill the objective of developing situation and need specific technologies for the benefit of hill community, the Directorate of Coldwater Fisheries Research has successfully completed one year working in a collaborative mode with the five hill states and other fisheries institutes. We have tried to rejuvenate the research programme under exploration of some new species other than snow trout, golden mahseer and exotic trout. In order to conserve and propagate the golden mahseer, model hatchery systems were installed in the North East zones of the country for the availability of seeds. The propagation of trout farming in the model of Himachal Pradesh and Jammu & Kashmir was tried in Sikkim and Arunachal Pradesh. The artificial breeding of chocolate mahseer was successfully carried out in Arunachal Pradesh.

With the intensification of culture system occurrence of disease is an unavoidable problem. For better understanding of causes of disease occurrence, our scientists surveyed various natural resources as well as different culture system both in the government and private sector in the coldwater region of the country. The causes of disease occurrence in indigenous snow trout and exotic trout are under investigation. In recent years, scientists from various disciplines particularly in microbiology, biotechnology, genetics and aquaculture have joined the Directorate which has given impetus to our research activities in the area of fish genomics and fish health. To explore these new areas of fish genomics and proteomics in coldwater fishes, a state of art laboratory was established. We have also received projects from NAIP (ICAR), Department of Biotechnology, Department of Science and Technology, New Delhi and extremely thankful to all of them for showing confidence in us. In near future, the Directorate will show its ability to share with the national growth.

Institute had organized successfully one Workshop on climate change and a Symposium at ABACA, Nameri, Assam during the year. We have successfully conducted several training programmes/short courses for the scientists, fisheries officers and farmers with the financial help from NFDB and ICAR. Our scientists also participated in several national training, workshop, seminars and received several awards and honours. It was the constant efforts of scientists and all staff members of this Directorate which has made possible for such progress and achievements. The continuous support, guidance and encouragement received from Dr. S. Ayyappan, Secretary DARE & Director General, ICAR, Dr. Mangala Rai, Ex. Secretary DARE & Ex. Director General, ICAR, Dr. Arvind Kumar, DDG (Fy), Dr. V.V. Sugunan, ADG (Inland Fisheries) are recorded with sincere thanks and gratitude.

Thanks are also due to Dr. A. Barat, Sr. Scientist, Sri. Ashok K Nayak, Scientist (SS) and Dr. S. Ali, Scientist for bringing out the annual report. The effort made by Dr. Prem Kumar and Dr. S. Ali for Hindi version of the report and other assistance rendered by Smt. Susheela Tewari, PA to Director is also recorded with appreciation.

Date : 01 June, 2010

P.C. Mahanta
DIRECTOR

CONTENTS

सारांश

ग्यारहवीं पंचवर्षीय योजना में संस्थान का पुनः नामकरण कर इसे शीतजल मात्स्यिकी अनुसंधान निदेशालय का दर्जा दिया गया। इसके तहत निदेशालय द्वारा जम्मू कश्मीर से अरुणाचल प्रदेश तक फैले विस्तृत पर्वतीय संसाधनों के दोहन के लिए क्षेत्रीय स्थिति तथा तंत्र अनुकूल तकनीकों का विकास करना है। राष्ट्रीय शीतजल मात्स्यिकी अनुसंधान केंद्र का उद्भव 24 सितंबर 1987 में हुआ। संस्थान ने मैनपावर तथा मूलभूत सुविधाओं की कमी के बावजूद शीतजल अनुसंधान के क्षेत्र में कई उपलब्धियाँ हासिल की। इन्हीं तथ्यों को ध्यान में रख कर ही संस्थान का पुनः नामकरण किया गया जिससे संस्थान प्रदेश सरकारों तथा विश्वविद्यालयों के साथ अनुसंधान में भागीदारी कर सके।

गत् वर्ष में निदेशालय द्वारा दो मुख्य घटक क्रमशः प्राकृतिक जल मात्स्यिकी (open water fisheries) तथा जलकृषि के अंतर्गत दस संस्था पोषित प्रयोजनों, दो नैप (NAIP कॉम्पोनेंट 3–4) पोषित प्रयोजनाएं भा. कृ. अनु. प. की मेगा सीड प्रयोजनाएं पाँच पर्वतीय राज्यों के साथ आउटरिच कार्यक्रम, मात्स्यिकी संस्थान के साथ तीन आउटरिच कार्यक्रम एवं दो वाह्य निधि प्रयोजना जो की डी.बी.टी एवं डी.एस.टी द्वारा पोषित हैं, को सुचारु रूप से चलाया गया है।

भौगोलिक सूचना तंत्र (GIS) का उपयोग कर नैनीताल जिले में तालुका स्तर पर झील, नदियाँ, सड़क, बाज़ार, बीज उत्पादन केंद्र तथा जल एवं मृदा की गुणवत्ता के विभिन्न तत्वों के आधार पर 'थीम मैप' बनाये गए। स्थानिक एवं अस्थानिक डाटा GIS सॉफ्टवेयर द्वारा ऐकीकृत किए गए एवं जलकृषि के लिए योग्य क्षेत्र को दर्शाया गया। मल्टी क्राईटेरिया आंकलन (multi criteria evaluation) तकनीक द्वारा मृदा एवं जल संबंधी पैरामीटर के आधार पर जलकृषि के लिए सुयोग्य क्षेत्रों को अंकित किया गया। नैनीताल जिले में जलकृषि विकास के लिए एक ग्राफ़िकल यूज़र इंटरफ़ेस (GUI) जो की निर्णय समर्थन प्रणाली (Decision Support System) पर आधारित है का विकास भी प्रयासरत है।

शाइज़ोथोरक्स रिचर्डसोनई (*Schizothorax richardsonii*) के आयु एवं लम्बाई के दो विभिन्न आकड़ों का उपयोग कर नॉन लिनियर सांख्यिकी द्वारा विभिन्न जलीय परिवेशों में इनकी अधिकतम लम्बाई का आंकलन किया गया। विशलेषन के फलस्वरूप यह पाया गया की चंपावत से पकड़ी गयी असेला की अधिकतम लम्बाई 25 सेंटीमीटर तथा कुमाऊँ की अन्य नदियों से पकड़ी गयी असेला की अधिकतम लम्बाई 29 सेंटीमीटर थी। इससे यह निष्कर्ष निकाला जा सकता है की कुमाऊँ की अन्य नदियों में पायी जाने वाली असेला की वृद्धि चंपावत से बेहतर है। हालॉकि, दोनों परिवेशों में असेला की लम्बाई भारतीय एवं विदेशी शोध साहित्य में प्रकाशित लम्बाई से काफी कम पायी गई।

विभिन्न आयु की सुनहरी महासीर (*Tor putitora*) का भीमताल स्थित दो तालाबों (1200 masl) में अक्टूबर 2005 से संवर्धन किया गया। सभी ब्रूड स्टॉक के लिए जल की गुणवत्ता से संबंधित पैरामीटर को समान रखा गया। फरवरी से जून तक चार वर्षीय ब्रूड स्टॉक को मिथाइल टेस्टोस्टोरोन (MT @ 50 mg/kg) युक्त आहार दिया गया। इस अध्ययन से यह पता चलता है की प्राकृतिक स्त्रोत से पकड़ी गयी फिंगरलिंग मछलियों को तालाबों में प्रजनन के लिए संवर्धित किया जा सकता है। तालाबों का रख-रखाव भी आसान है।

केज कल्चर के अंतर्गत असेला तथा महासीर के दो विभिन्न आयु वर्ग की मछलियों को पाला गया। इन मछलियों को फिशमील तथा सोयाबीन के प्रोटीन स्त्रोत एवं 30 व 35% की दर से आहार में प्रोटीन की मात्रा

मिलाकर खिलाया गया। पानी का तापमान जो की अत्यधिक महत्वपूर्ण है, दिन में दो बार मापा गया। प्रयोग के अंत में उत्पादन को प्रभावित करने वाले प्रमुख घटक मुख्यतः जीवन-मृत्यु दर, शारीरिक भार, शारीरिक लम्बाई, कुल लम्बाई, मत्स्य परिमाण, कुल भार ग्रहण, प्रतिशत भार ग्रहण, विशेष विकास दर एवं आहार परिवर्तन अनुपात का आंकलन किया गया।

शीतजल मतस्यों के ऊत्तक, अंडों एवं जलीय वातावरण से रोगजनक फफूँद पृथक किए गए। चंपावत मत्स्य फार्म, उत्तराखंड राज्य के बैरंगना ट्राउट फार्म, पतलीकुल स्थित हिमाचल ट्राउट फार्म से जमा किए गए मछलियों एवं जल के नमूनों से रोगजनक फफूँद को पृथक किया गया। यह फफूँद चलते पानी की अपेक्षा स्थिर पानी में अधिक मात्रा में पाये गए। सतरंगी ट्राउट की मांसपेशियाँ, फिन तथा गलफड़ों में फफूँदी का संक्रमण पाया गया। इन फफूंदों की पहचान सपरोलीगनिया पैरासिटिका (*Saprolegnia parasitica*) और सपरोलीगनिया डिकलिना (*Saprolegnia diclina*) के रूप में की गई जो की कपास रूपी, लंबे पतले जूस्पोरंजिया (zoosporangia) तथा नाशपाती के आकार में प्राथमिक जूस्पोरंजिया के रूप में विकसित होते हैं। यह फफूँद कम तापमान पर उग्र रूप धारण कर लेती है। काफल (*Myrica esculenta*) की छाल, गेंदा (*Calendula officinalis*) की पत्तियाँ, हरड़ (*Myrobulus indicus*) के घोल में असेला तथा ट्राउट के रोग ग्रस्त अंडों में प्रभावी रूप से रोग नियंत्रण करने की क्षमता पायी गयी।

हंगरी से आयातित कॉमन कार्प तथा स्वदेशी कॉमन कार्प का संवर्धन मोनो एवं पोलिकल्चर पद्धितियों के द्वारा चंपावत मत्स्य केंद्र में किया गया। हंगरी कार्प की एक साल में 269 ग्राम की वृद्धि हुई जबकि पुराना स्ट्रेन सिर्फ 146 ग्राम ही बढ़ा। जल प्रयोजन एवं प्रबंधन के अंतर्गत वर्षा जल संचयन ताल का निर्माण किया गया तथा एक सस्तो ग्रिट फ़िल्टर का निर्माण किया गया। यह ग्रिट फ़िल्टर पानी की गंदगी को 70% कम करने में सक्षम है। इस के अलावा यह पानी में 1–1.5 पीपीएम तक आक्सीजन की मात्रा में वृद्धि कर अमोनियम को 0.62–0.30 पीपीएम तथा नाइट्राइट को 0.046–0.017 पीपीएम तक कम कर देता है।

निदेशालय में चलाई जा रही परियोजना "कुमाऊँ हिमालय के जलकृषि प्रणाली में चॉकलेट महासीर की योग्यता" के अंतर्गत चॉकलेट महासीर के फ्राई एवं फिंगरलिंग में होने वाली वृद्धि का अध्ययन किया गया। इसकी प्रारम्भिक लम्बाई एवं भार क्रमशः 28.1 मिलीमीटर एवं 0.21 ग्राम थी। एक वर्ष के प्रयोग के दौरान इसकी लम्बाई एवं भार क्रमशः 82.9 मिलीमीटर एवं 14.6 ग्राम की वृद्धि हुई। विभिन्न भौगोलिक स्थानों से पकड़ी गई असेला की आरएपीडी (RAPD) तथा माइटोकोन्ड्रियल जीनोम नामक मारकर द्वारा विशेष लक्षणात्मक गुणों का वर्णन किया गया। मेगा सीड प्रयोजना के अंतर्गत 20,000 महासीर फिंगरलिंग का उत्पादन किया गया। जो मध्य प्रदेश मत्स्य संघ तथा महराकोट मत्स्य फार्म देहरादून को में बेची गईं।

उत्तरपूर्वी पर्वतीय क्षेत्रों में जलकृषि, संरक्षण एवं शीतजलीय मत्स्यों में उपस्थित सूक्ष्म जीवों के प्रयोग की जैव संभावनाएँ जैसे कई कार्यक्रम चलाए गये। निदेशालय ने विभिन्न मात्स्यिकी अनुसंधान संस्थान जो की भा. कृ. अनु. प. के मात्स्यिकी अनुभाग के अंतर्गत हैं, के साथ मिलकर तीन आउटरीच कार्यक्रम शुरू किया है। यह कार्यक्रम इस प्रकार हैं (1) मत्स्य आहार (2) मत्स्य पोषक तत्वों का आंकलन एवं आहार घटक के रूप में उपयोग (3) मत्स्य आनुवंशिकता। मत्स्य आहार के अंतर्गत महासीर के बीजों के विकास एवं अस्तित्वता में वृद्धि, चॉकलेट महासीर के लिए ग्रो आउट आहार का विकास, एवं सतरंगी ट्राउट के प्रचलित आहार की उत्कृष्टता बढ़ाने एवं आहार प्रक्रिया को प्रभावी बनाने की दिशा में कार्य किए गए। मछलियों के पोषक तत्वों के आंकलन के लिए उत्तराखण्ड एवं अरुणाचल प्रदेश

से मछलियों के नमूनों को जमा किया गया। जिला नैनीताल के कुछ क्षेत्रों में चिकित्सीय एवं महामारी से संबंधित सर्वेक्षणं किया गया। मत्स्य पोषक तत्वों का आंकलन एवं आहार घटक के रूप में उपयोग के अंतर्गत, मछलियों के नमूनों में नमी की मात्रा, प्रोटीन, चर्बी की मात्रा, शर्करा, मिनरल एवं अमीनो एसिड की मात्रा का आंकलन किया गया। मत्स्य आनुवंशिकता के अध्ययन के अंतर्गत महासीर के नमूनों के लिए कुछ भौगोलिक रूप से पृथक स्थान का चयन किया गया। साइटोक्रोम बी (Cyto-b) जीन क्रम माइटोकोन्ड्रियल डी एन ए के द्वारा महासीर के संरचना एवं आनुवंशिकता का आंकलन भी किया गया। सुनहरी महासीर के विशेष साइटोक्रोम बी क्रम (307 bp) निकाले गए एवं NCBI जीन बैंक में अधिकृत कराए गए।

उत्तर पश्चिमी हिमालय क्षेत्रों में सुरक्षित जीविकोपार्जन हेतु टिकाऊ कृषि पद्धति एवं इससे जुड़े उद्यम् को विकसित करने के लिए नैप (NAIP) के घटक–3 के अंतर्गत कार्यक्रम शुरू किए गए। इसके अलावा नैप (NAIP) के घटक–4 के अंतर्गत निदेशालय द्वारा 'अजैविक तनाव प्रतिरोधक के लिए एलील एवं जीन की जैव संभावनाएँ' जैसे कार्यक्रम भी शुरू किए गए। प्रारंभ में स्नो ट्राउट एवं विदेशी ट्राउट मछलियों के नमूने, पश्चिमी, उत्तर पश्चिमी एवं मध्य हिमालय के मध्यम ऊँचाई एवं अधिकतम ऊँचाई वाले क्षेत्रों से जमा किए गए। मछलियों को विभिन्न तापमान पर रख कर उनके शारीरिक क्रिया पर होने वाले प्रभाव का भी अध्ययन किया गया। प्रारम्भिक शोध में तापमान के तनाव का असर गुलूकोज एवं ट्राइग्लीसाईड के आंकलन के द्वारा किया गया। स्नो ट्राउट, भूरी ट्राउट एवं सतरंगी ट्राउट मछलियों की शीतरोधक क्षमता से संबंधित कुछ जीन को पी सी आर द्वारा प्रवर्धित किया गया एवं उनके जिगर, स्प्लीन, मस्तिष्क, हृदय, चमड़ी एवं फिन ऊतकों के सी–डीएनए के अनुक्रमों का अध्ययन किया गया।

निदेशालय द्वारा वाह्य निधि प्रयोजना का भी निष्पादन किया गया। इनमें 'भारतीय स्नो ट्राउट में माइक्रो सेटेलाइट मारकर का वर्णन एवं विकास' प्रयोजना जैव प्रोधौगिकी विभाग, नई दिल्ली द्वारा प्रायोजित है। इस प्रयोजना में शाइज़ोथोरक्स रिचर्डसोनई की आंशिक जीनोमिक लाईब्रेरी का निर्माण किया गया है। इसके अलावा 500 सकारात्मक क्लोन से 50 माइक्रोसेटेलाइट मारकर का विकास भी प्रयासरत है। यह माइक्रोसेटेलाइट मारकर विभिन्न मत्स्य प्रजातियों एवं स्नो ट्राउट के आनुवंशिक विविधता एवं लिंकेज मैपिंग में काफी सहायक सिद्ध होंगे। इसी वर्ष विज्ञान एवं प्रोधौगिकी विभाग, नई दिल्ली द्वारा प्रायोजित प्रयोजना 'शाइज़ोथोरक्स रिचर्डसोनई के चयनात्मक प्रजनन हेतु जीनोम स्केल माइनिंग करना' भी शुरू किया गया। राष्ट्रीय शीतजल मात्सियकी अनुसंधान केन्द्र के निदेशालय के रूप में पुनः नामकरणं के पश्चात् पाँच पर्वतीय राज्य अरुणाचल प्रदेश, हिमाचल प्रदेश, जम्मू कश्मीर, सिक्किम एवं उत्तराखण्ड के साथ मिलकर पर्वतीय क्षेत्रों की प्राकृतिक सम्पदा को मूल रूप से बनाए रखने के साथ इसके सुविचारित उपयोग के लिए कार्यक्रम बनाये गए।

शी.मा.अनु.नि. ने विश्व पर्यावरण दिवस (5 जून 2009) के अवसर पर ग्लोबल वार्मिंग से उत्पन्न चुनौतियों को उजागर करने के लिए ''शीतजल मात्स्यिकी पर जलवायु परिवर्तन के प्रभावः इसके परिप्रेक्ष्य, रूपरेखा और प्राथमिकता'' के विषय पर एक राष्ट्रीय कार्यशाला का आयोजन किया। पर्वतीय मत्सियकी संसंधानों के महत्व को सामने रखते हुए निदेशालय ने 2–4 अक्टूबर 2009 को ''शीतजल मात्स्यिकी प्रबंधन के नवीन आयाम एवं दृष्टिकोण'' के विषय पर एक राष्ट्रीय गोष्ठी का भी आयोजन किया। यह गोष्ठी तेज़पुर असम में स्थित नमेरी राष्ट्रीय पार्क के इको कैंप में आयोजित की गई।

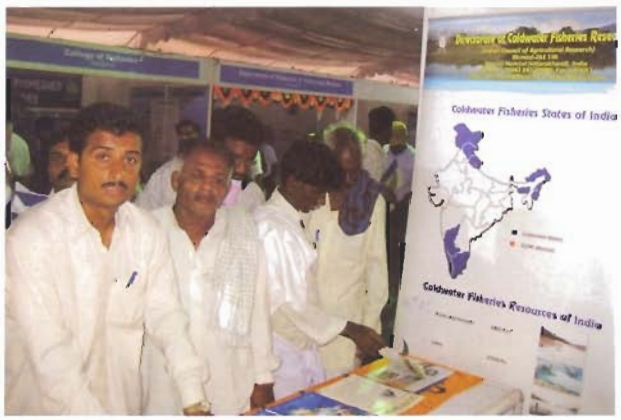
निदेशालय ने सफलतापूर्वक दो प्रशिक्षण का भी आयोजन किया। इन में भा.कृ.अनु.प. द्वारा प्रायोजित अल्पअवधीय प्रशिक्षण पाठ्यक्रम ''शीतजल मत्स्य में

मालिकुयलर तकनीक का उपयोग'' 14.23 जुलाई, 2009 के दौरान आयोजित किया गया। इसी क्रम में 1–7 सितंबर, 2009 के दौरान निदेशालय ने राष्ट्रीय मात्स्यिकी विकास बोर्ड, हैदराबाद द्वारा प्रायोजित प्रशिक्षण कार्यक्रम ''ऊपरी हिमालय में प्रमुख शीतजल मत्स्य के संवर्धन की तकनीक'' का आयोजन किया।

निदेशालय ने आर.ए.सी (RAC), ऐस.आर.सी (SRC), आइ.एम.सी (IMC), क्यू.आर.टी (QRT) एवं राज्य भाषा से संबंधित गोष्ठी का आयोजन भी किया। इन गोष्ठियों में विभिन्न प्रकार के कार्यसूचियों पर विचार किया गया एवं निदेशालय के विभिन्न शोध कार्य, प्रबंधन इत्यादि को सुचारू रूप से चलाने के लिए दिशा निर्देश दिये गए।

निदेशालय भारत की सांस्कृतिक विभिन्नता का प्रतिबिंब है एवं इसके सभी कर्मचारी और वैज्ञानिक गण सांप्रदायिक सद्भावना का परिचय देते हुए विभिन्न राष्ट्रीय पर्वों में हर्षोउल्लास के साथ सम्मिलित हुए।

Dr. S. Ayyappan, Ex-DDG (Fisheries) during the inauguration of new building complex at Champawat



Farmers visiting the DCFR stall during exhibition in Indian Fish Festival organized by NFDB at Hyderabad

Exhibition during farmer's meet at Champawat

Visitors at the stall in the exhibition during farmer's meet at Champawat

EXECUTIVE SUMMARY

The present Directorate of Coldwater Fisheries Research was reconstituted during XI Five Year Plan, to develop location, situation and system specific technologies by utilizing and augmenting resources in all the Himalayan states from Jammu & Kashmir to Arunachal Pradesh. Previously, National Research Center on Coldwater Fisheries (NRCCWF) was established as an independent Research Center on 24 September 1987 during the VII Five Year Plan. Since its inception, the NRCCWF in spite of constraints in terms of manpower and infrastructure has made significant contribution for proper appraisal of coldwater fishery resources and evolve suitable technologies to propagate important coldwater fish species in hills. But to exploit greater potential of coldwater fisheries in different Himalayan states, NRCCWF has been constituted as Directorate of Coldwater Fisheries Research (DCFR). During the year under report 10 institutional projects under two major components (Open water Fisheries and Aquaculture), two NAIP (component-3 and 4), ICAR Mega Seed Project, Outreach activity with five hill states, three outreach activities with Fisheries Institutes under ICAR and two externally funded projects (DBT and DST) were conducted.

In open water fisheries, theme maps on Taluka level were prepared for lakes, streams, rivers, road network, markets, hatcheries and different soil & water quality parameters of Nainital district. Spatial and non-spatial data were integrated using GIS software to locate suitable areas for aquaculture. Based on the soil and water quality parameters, the output maps for the aquaculture suitable sites assessed using multi-criteria evaluation techniques. A graphical user interface (GUI) of GIS based decision support system for aquaculture development in the Nainital district is under process.

Two different datasets on length-at-age of *S. richardsonii* was considered to estimate the maximum size of this fish species in different aquatic environments by using nonlinear statistical models. The results revealed that the maximum estimated lengths of *S. richardsonii* were approximately 25 cm and 29 cm in the aquatic environments of farm condition at Champawat and Rivers of Kumaon respectively. The growth in wild aquatic environment of Kumaon Rivers is faster than the farm condition at Champawat and has to attain comparatively larger size at the end. However, the maximum expected sizes of *S. richardsonii* in both environments are significantly smaller than the reported maximum sizes in India and abroad.

The fish stocks of *Tor putitora* of different age group initially collected from wild are being reared in pond environment in 2 hired ponds at Bhimtal (1200 m asl) since October 2005. The variables related to water quality were identical for all the brood stock. The fish feed fortified with MT@50 mg/kg of feed was offered to brood stock of the age of 4 years

Release of fish seed in Bhimtal lake

daily during February to June and were found to be matured and ready to spawn. The present studies clearly indicate that stock collected from wild (lake) or fingerlings reared in hatchery/pond can be grown in ponds for breeding purpose. The pond management practices are simple.

In cage culture, rearing of indigenous coldwater fishes namely, snow trout and golden mahseer was adopted. Fishes of two different size groups were reared using feeds having two different protein sources (fish meal and soyabean meal) and two different levels of protein (30% and 35%). Water quality parameters were monitored at fortnightly intervals inside the cages as well as that of lake water. Water temperature being crucial was recorded twice daily. Various production parameters were evaluated namely, survival, body weight, total length, fish biomass, net weight gain, percentage weight gain, specific growth rate and feed conversion ratio, at the end of experiment.

Attempt has been made to isolate the pathogenic fungus from water, body tissue and eggs of cold-water fish. Water samples were collected from Experimental Fish Farm, Champawat, State Fish Farm Bairangna and Farmers ponds, in Uttarakhand and State Trout Farm, Patlikuhal in Himachal Pradesh. Fungal infection was more prominent in the ponds of stagnant water than the running water raceways. Infection was observed in the muscles of the rainbow trout, fins and gills of the carp. The pathogenic fungi were identified as *Saprolegnia parasitica* and *Saprolegnia diclina* with cotton like appearance, elongated zoosporangia and pear shaped primary sporangium. Temperature had a significant effect on the development of fungal infection. Most epizootics occurred when temperatures were below the optimal temperature range for that species of fish. Bark of Kaphal (*Myrica*

Hon'ble Education Minister, Uttarakhand and VC, GBPUA&T visiting the DCFR stall in Kisan Mela

esculenta) tree, marigold (*Calendula officinalis*) leaves and extract of Harad (*Myrobolus indicus*) were tested in the infected eggs of snow trout and rainbow trout and found to be effective to control the infection.

Growth performance of Hungarian stock was evaluated under monoculture and polyculture system at Champawat field station in comparison with existing stock of common carp. The highest growth was recorded for Hungarian stock (269gm.) and lowest for existing strain (146gm.)

Under the study on water budgeting and management, rainwater harvesting cum fish farming pond has been constructed and stocked with carp species. A low cost grit filter has been designed. This filter is efficient to remove 70% physical impurities (Clay + algae cells) with 1-1.5 ppm improvement in D.O .The inlet flow rate is 32 lpm. After inoculation of nitrifying bacteria, reduction in ammonium level from 0.6 to 0.3 ppm and nitrite level from 0.046 to 0.017 ppm has been recorded. Initially, the water requirement based on the biomass and operational ponds was estimated. One water re-circulatory unit was also designed.

The details of the growth performance of fry and fingerlings of *Neolissochilus hexagonolepis* were recorded in the project entitled, "Performance of chocolate mahseer in freshwater aquaculture system in Kumaon Himalaya". The initial average length and weight was 28.1 mm and 0.21 gm respectively. The gross increment in length and weight was about 82.9 mm and 14.6gm respectively after a culture period of 1 year. It is found out from the study that the chocolate mahseer shows optimum growth during the temperature range of 19°C to 23°C.

Molecular genetic characterization of Indian Snow Trout (*Schizothorax richardsonii*) from different geographical locations was tried using molecular markers like RAPD and mitochondrial genome.

Under ICAR Mega Seed project, 20,000 seed of golden mahseer produced under this project at DCFR sold for Rs. 30,000 to M.P Matsya Mahasangh (Sah.) Maryadit, Bhopal. 2,000 seed were sold to Meharkoat Fish Farm, Dehradun at Rs. 2,200.00

In North East Hill region programme several activities were performed for aquaculture development, conservation and documentation of bioprospecting bacterial micro flora from selected coldwater fishes.

Inaguration of Table tennis facilities at DCFR

The Directorate has initiated three outreach activities with different Fisheries Institute under Fisheries Division, ICAR, New Delhi. These are 1) Fish Feed, 2) Nutrient Profiling and evaluation of fish as a dietary component, and 3) Fish Genetic Stock. Three different activities were performed under "Fish Feed" for enhancement of larval growth and survival of mahseer, development of grow out feed of chocolate mahseer, and up-scaling of existing grow-out feeds and feeding practices in rainbow trout. Clinico epidemiological survey was made in some localities in Nainital District and fish samples were collected from different areas of Uttarakhand and Arunachal Pradesh. Moisture content, protein, crude fat, carbohydrate minerals and some amino acids were estimated in fish samples under "Nutrient Profiling and evaluation of fish as a dietary component". Under "Fish Genetic Stock", some geographically isolated areas were defined for sampling of *Tor putitora* and some samples were also collected for morphological and genetic assessment using mtDNA amplicons of Cytochrome b gene sequences. Cytochrome b Gene sequences (307bp) specific to Golden mahseer, has been achieved and deposited in NCBI GENBANK.

In NAIP under Component 3, work has been initiated for enhancement of livelihood security through sustainable farming system and related farm enterprises in North-West Himalayas.

Another NAIP (Component-4) entitled, "Bioprospecting of Genes and allele mining for abiotic stress tolerance" has been initiated during the year in the Directorate. Initially, sampling of snow trout and exotic trout species were carried out from different mid and high altitude areas of Western, North-Eastern and Central Himalayas. It has also been tried to study the physiological activities after challenging

the fishes to different temperatures. Hyperglycemia has been observed through glucose and triglyceride estimation in temperature stress condition under a preliminary experiment. PCR amplification of some known genes related to cold tolerance has also been tried on first strand cDNA of liver, spleen, skin, brain, heart and fin tissues of snow trout, rainbow trout and brown trout.

The Directorate has conducted externally funded project entitled, "Development and characterization of microsatellite markers in Indian Snow Trout, *Schizothorax richardsonii*" funded by Department of Biotechnology, New Delhi. A partial genomic library of *Schizothorax richardsonii* has been constructed under this project. In this library, isolation of at least 50 microsatellite markers from 500 positive clones is in process. These microsatellite markers will be useful for genetic variability and linkage mapping of number of coldwater fishes including snow trout. During the year another project (funded by Department of Science and Technology) was initiated, "Genome- Scale mining of *Schizothorax richardsonii* fish species for formulation of selective breeding programme".

After the renaming of NRCCWF to DCFR, the directorate has initiated a programme "Sustainable utilization of mountain fishery resources- a partnership mode" with five hill states, Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir, Sikkim and Uttarakhand.

In order to address the challenges posed by global warming, the DCFR organized National workshop on "Impact of climate change on coldwater fisheries resources: perspective, framework and priorities" on the occasion of World's Environment Day on 5th June 2009. Keeping in view the importance of Hill fisheries resources, DCFR has organized another National Symposium on

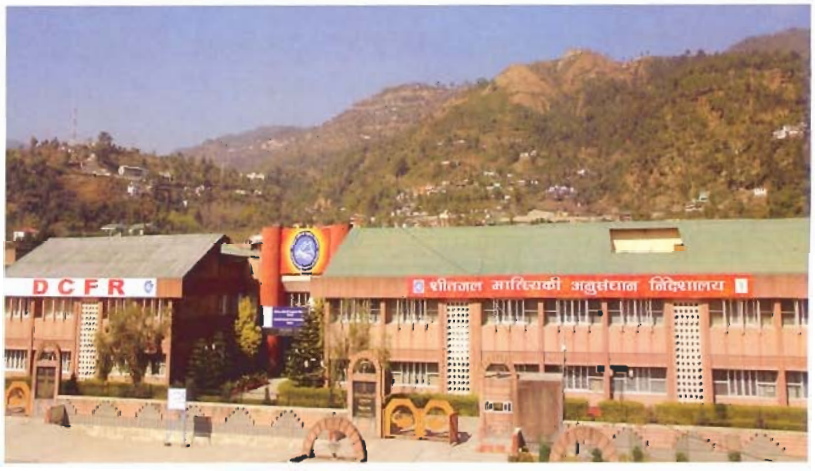
Visit of Dr. S.N. Dwivedi at DCFR stall during ILDEX, 2009

"Coldwater Fisheries Management: New Strategies & Approaches" at Eco-Camp, Nameri National Park, Tezpur, Assam during 2-4 October, 2009.

The Directorate has also successfully conducted two training programs. The ICAR sponsored short course on "Application of Molecular Techniques in Coldwater Fishes" was organized during 14-23 July, 2009 to address the priority areas for increasing productivity with the emerging tools in molecular biology and biotechnology. Another training program on "Grow out Technologies of important Coldwater Fishes in Upland Himalayas" was organized during 1-7 September 2009 sponsored by NFDB, Hyderabad.

Other than the research activities, the Directorate also has organized several meetings, like, RAC, SRC, Institute Management Committee, QRT, IJSC and official language. The respective committees discussed the various agenda items and provided guidelines for the proper management and smooth functioning of the institute and research activities. The Directorate family is representative of diverse cultures of the country and each member participated in celebration of various national days, events and genuine spirit of communal harmony.

INTRODUCTION



Coldwater fisheries have a great potential in generating rural income and providing food security to the economically underprivileged population residing in Indian uplands. To utilize the available resources and opportunities in the coldwater fisheries sector the involvement of Indian Council of Agricultural Research in this sector started during late sixties which, subsequently culminated in the creation of National Research Center on Coldwater Fisheries as an independent Research Center on 24 September 1987 during the VII Five Year Plan. This is the only national facility in the country to take up the research investigation on capture and culture aspects with a focus on exotic and indigenous coldwater fish species. Since its inception, the NRCCWF in spite of constraints in terms of manpower and infrastructure has made significant contribution for proper appraisal of coldwater fishery resources and evolve suitable technologies to propagate important coldwater fish species in hills.

Keeping in view the ever expanding activities of NRCCWF and the greater potential of coldwater fisheries in different Himalayan states, in a significant decision during the XI plan, it has been made **Directorate of Coldwater Fisheries Research (DCFR)**, to develop location, situation and system specific technologies by utilizing and augmenting resources in all the Himalayan states from Jammu & Kashmir to Arunachal Pradesh.

The DCFR is on its glorious path of virtually actualizing its vision by imparting boon of quality research in sustainable coldwater fisheries production, management and conservation.

Location

The headquarters of DCFR is located at Bhimtal at an altitude of 1470 masl in the district of Nainital of Uttarakhand state. It is about 25 km away from the famous tourist place of Nainital. The nearest railway station is Kathgodam, which is about 280 km from Delhi. The nearest airport is Indira Gandhi International Airport, New Delhi. The experimental field station of the Institute at Chirapani in Champawat district of Uttarakhand State is about 150 km from Bhimtal.

This Directorate is now emerging as the nodal facility in the country where research investigations are undertaken both on capture and culture aspects with a focus on exotic and coldwater species.

Management

A high powered Research Advisory Committee (RAC) guides this Directorate in the research in thrust areas and on new initiatives. The RAC also evaluates

and monitors the progress of research activities of this Directorate. The Management Committee (IMC) constitutes and mandated by Indian Council of Agricultural Research under the Chairmanship of the Director, supervises at this Institute. A number of Internal committees such as Staff Research Council (SRC), Official Language Committee and Institute Joint Staff Council (IJSC) are in place of decentralized management.

Mandate

- To conduct basic, strategic and applied research in coldwater fisheries and aquaculture
- To develop stock management models and culture technologies for major coldwater fish species
- To create awareness and provide training and consultancy

Organizational set-up

Infrastructure

Building and Farm

The Institute is now functioning from its own new complex constructed at Bhimtal Industrial area. A pilot scale mahseer seed production unit is also operating at Bhimtal on the land belonging to State Fisheries Department, Uttarakhand, which in addition to the mahseer hatchery houses, a laboratory which provides back up facilities to seed production activities of the Directorate. The Directorate has an experimental fish farm facility at Chhirapani in Champawat district of Uttarakhand State which has trout hatchery, cemented raceways for nursery and brood stock rearing and few tanks for conducting yard trials on various culture aspects of the indigenous and exotic fish species.

Support Services

Project Implementation and Monitoring Cell

A separate cell called the Project Implementation and Monitoring Cell monitors the implementation and progress of research project programmes being conducted by the Directorate. This cell annually organizes the meeting of SRC to evaluate the progress made in each research project and accordingly approves the work programmes for the current year. The new proposals are also approved by the SRC after thorough evaluation of the objectives, practical utility, manpower support and financial involvement. The cell is also responsible for maintaining records of project reports through RPF system.

Technical Cell

The technical cell has been given the responsibilities of dealing with all technical matters within and outside matters of the ICAR system. The cell takes care of the training programmes, deputation, participation of scientists in seminars, symposia, workshop, meetings etc. and organizing conferences.

Library Section

The library of the Directorate subscribes for about 19 foreign and 11 Indian Journals during the year.

Visit of Dr. M. Mahadevappa Former Chairman ASRB in Library

The current holding of the library includes more than 2000 books and 3000 other publications. It provides services to the scientists and other staff members of the institute apart from scholars, researchers, students and other local organizations interested in scientific literature on coldwater fisheries and other allied subjects. The library also provided facilities to access free online download of publications, articles of many international journals through www.cera.jccc.in. The library section is further continuing its efforts in collection, processing and disseminating scientific/ technical information to the potential users.

ARIS Cell

The ARIS Cell of this Directorate provides the VSAT Internet facilities to scientist/staff of this institute. The Internet facilities were also available at Library, Director cell and VIP rooms in Guesthouse. In ARIS Cell, computer and Internet facilities were provided to other research scholars and M.Sc./Ph.D. students working under various project/programmes. The LAN connectivity of more than 50 computers was monitored by the Cell. One mail & messaging solution (mail server) was successfully installed at the Directorate under the name of **mail.dcfr.res.in**. Individual user ids and passwords for all scientists and officers were created for proper use of the mail server in email communications. The VSAT internet connectivity has also been installed at the Experimental Fish Farm & Field Centre of this Institute at Champawat by ARIS Cell. Now the field centre is well equipped with internet connectivity with webmail facilities.

The website of this institute is being updated from time to time as per instructions of the ICAR. The site contains the information about manpower, institute mandate, project programmes and achievements, tenders & job announcements etc. The DCFR's website has been uploaded with the new domain name **http://www.dcfr.res.in**.

Demonstration of ARIS activities to students

Laboratory Facilities

The Directorate has well equipped Aquaculture, Health and Management, Nutrition, Genetics & Breeding and Transfer of Technology laboratories. In addition to these it has wet laboratory equipped with flow through troughs for installing physiological experiments and nutrient trials. One trout feed mill also installed at main campus of Institute to meet routine requirements of fish feeds.

Visit of Dr. C.D. Mayee Chairman ASRB to Nutrition Lab

Extension Wing

The extension wing carries out the various extension activities of the institute such as transfer of technology programmes, organizing the exhibitions, training programmes and other activities related to farmers.

IPR Cell

The Directorate has constituted IPR (Intellectual Property Rights) Cell. It is responsible for providing informations about ICAR guidelines on IPR issues. Trainings to the concerned scientists have also been given regarding IPR issues. The ITMC has also been constituted under the chairmanship of Director for dealing with patents and other intellectual property rights to recognize technologies developed at the Institute and their safe transfer.

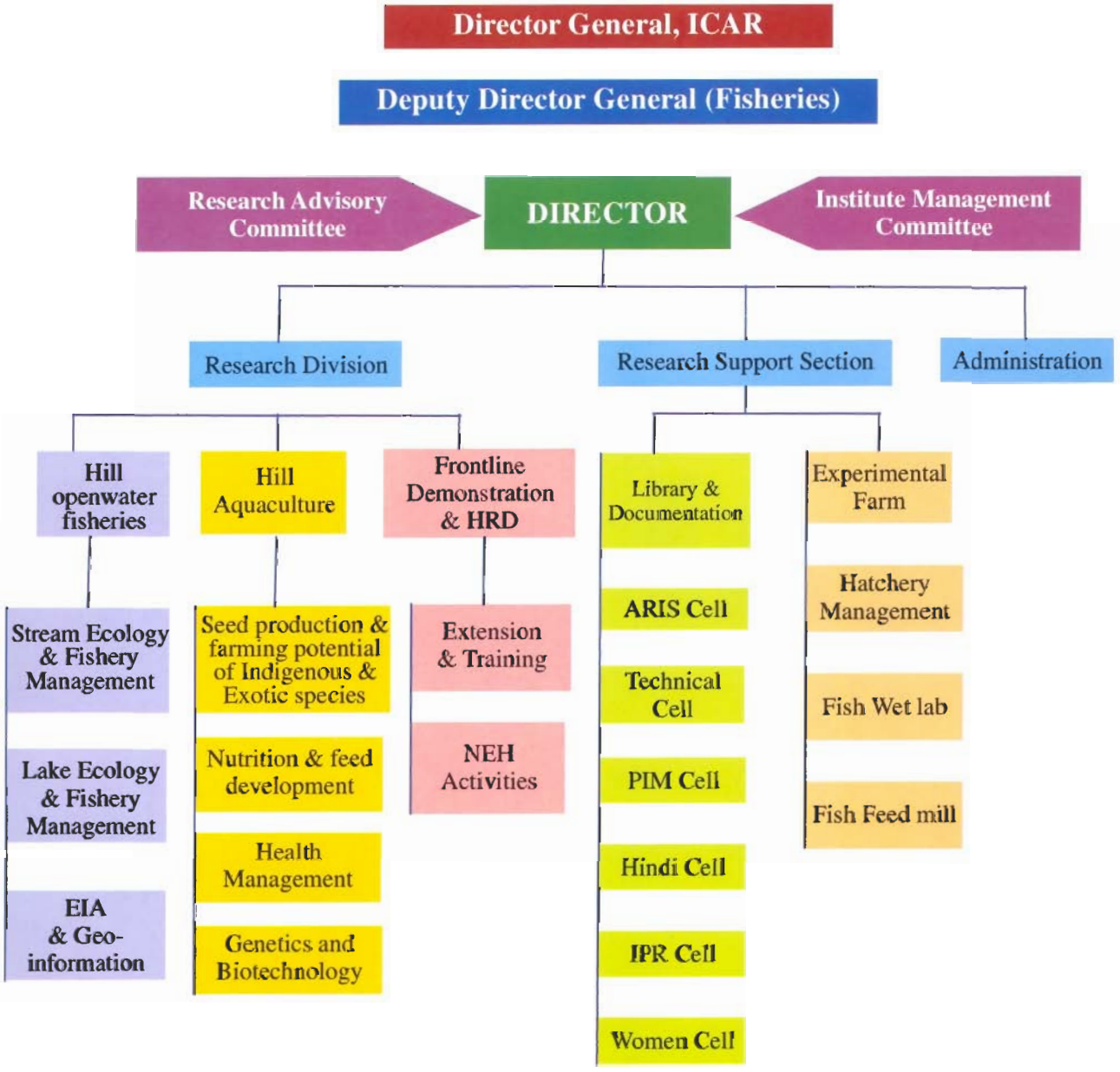
Academic Council

The academic council was constituted under the chairmanship of the Director. It is responsible to arrange administrative facilities to Ph.D. scholars and Postgraduate students from different Universities and State Agricultural Universities under MoU with the institute to carry out the dissertation work. The Academic council also looks for national and international linkages with repute educational institutes and universities.

Staff strength as on 31.03.2010

Category	Sanctioned	Filled	Vacant
Director (RMP)	01	01	-
Scientific	30	13	17
Technical	14	14	-
Administrative	11	10	01
Supporting	14	13	01
Total	70	51	19

ORGANOGRAM

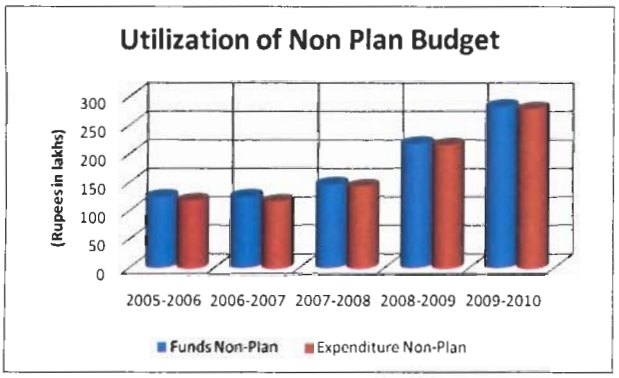

Director General, ICAR
Deputy Director General (Fisheries)
Research Advisory Committee
DIRECTOR
Institute Management Committee
Research Division
Research Support Section
Administration
Hill openwater fisheries
Hill Aquaculture
Frontline Demonstration & HRD
Stream Ecology & Fishery Management
Lake Ecology & Fishery Management
EIA & Geo-information
Seed production & farming potential of Indigenous & Exotic species
Nutrition & feed development
Health Management
Genetics and Biotechnology
Extension & Training
NEH Activities
Library & Documentation
ARIS Cell
Technical Cell
PIM Cell
Hindi Cell
IPR Cell
Women Cell
Experimental Farm
Hatchery Management
Fish Wet lab
Fish Feed mill

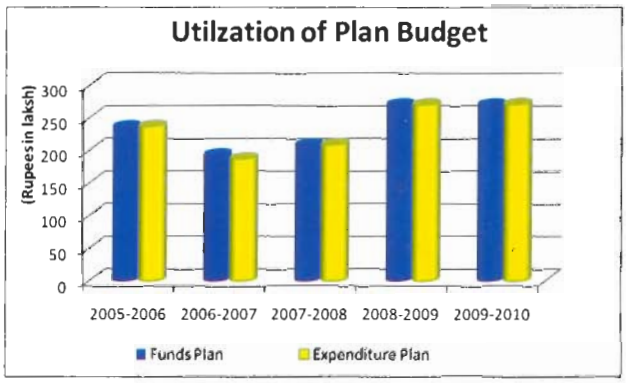
BUDGET 2009-2010

Financial Statement Abstract

(Rupees in Lakhs)

Year	Funds Non-Plan	Expenditure Non-Plan	Funds Plan	Expenditure Plan
2005-2006	124.03	117.68	235.98	235.90
2006-2007	124.50	116.21	192.91	186.26
2007-2008	146.00	142.40	208.00	207.65
2008-2009	217.30	214.91	270.00	269.23
2009-2010	282.32	278.23	270.00	269.95





Budget Statement for the Year 2009-2010

(Rupees in Lakhs)

Head of Accounts	Budget (R.E.)		Expenditure	
	Plan	Non-Plan	Plan	Non-Plan
Pay & Allowances	-	255.00	-	254.93
Traveling Expenses	10.00	1.85	10.00	1.85
HRD	3.00	0	2.00	-
Other Charges including Equipment	180.00	13.79	179.98	9.77
Information Technology	5.00	0	4.98	-
(a) Major Works	70.00	0	70.00	-
(b) Repair & Maintenance	0	11.68	0	11.68
Other Items Fellowship/ Scholarship/Awards including furniture for New Complex	2.00	0	2.00	-
Total	270.00	282.32	269.95	278.23

LIST OF ONGOING PROJECTS

Title of the project	Project leader and associates	Year of start	Likely year of completion
Development of GIS based decision support system for aquaculture in selected coldwater region	Sh. Ashok K. Nayak Dr. Prem Kumar	2007	2010
Modelling of Length-weight Relationship and Growth pattern of selected Important Coldwater Fish species	Dr. N. Okendro Singh Dr. Debajit Sarma	2008	2011
Studies on induced maturation and seed production of Himalayan mahseer, *Tor putitora* and *Schizothorax richardsonii* in pond environment	Dr. B.C. Tyagi Dr. Prem Kumar	2005	2010
Culture of fishes in floating cages in subtropical Himalayan lake- Bhimtal	Dr. Y. Basade Dr. M. Mohan Dr. B.C. Tyagi	2005	2010
Investigations on coldwater fish pathogens and their environment	Dr. Amit Pande Dr. N.N. Pandey Sh. Sumanta K. Mallik	2008	2012
Evaluation of growth performance of different strains of Common Carp	Dr. N.N. Pandey Dr. Prem Kumar Dr. S.K. Srivastava	2008	2013
Study on water budgeting and water management for coldwater aquaculture system	Dr. N.N. Pandey Dr. Prem Kumar	2008	2011
Performance studies of chocolate mahseer (*Neolissochilus hexagonolepis*) in freshwater aquaculture system in Kumaon Himalaya	Dr. D. Sarma Dr. N. Okendro Singh	2008	2012
Genetic characterization of important snow trout fish species	Dr. G.K. Sivaraman Dr. A. Barat	2008	2011
Seed production in agricultural crops and fisheries	Dr. Madan Mohan Dr. D. Sarma Dr. Prem Kumar	2006	2010
Fisheries Research and Development in NEH region	Dr. B. C. Tyagi		

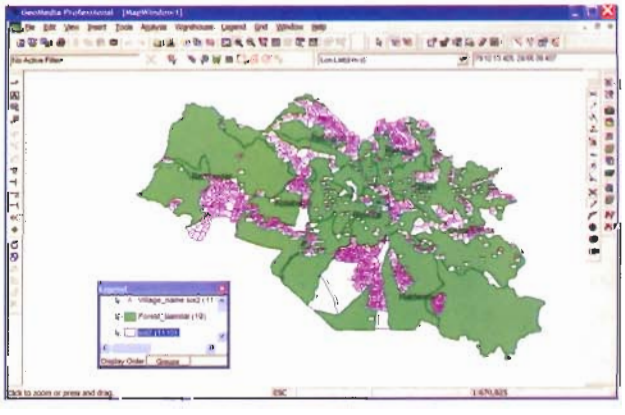
Network Project on Fish Germplasm Exploration, Cataloguing and Conservation	Mr. Ashok K. Nayak Dr. Prem Kumar Dr. P.C. Mahanta	2006	2010
Outreach Activities (Fisheries Division ICAR)		2008	2012
Fish Feed	Dr. Yasmeen Basade Dr. D. Sarma Dr. N.N. Pandey		
Nutrient Profiling and Evaluation of Fish as a dietary component	Dr. Debajit Sarma Dr. N.N. Pandey		
Fish Genetic Stocks	Dr. A. Barat Dr. G.K. Sivaraman Dr. Prem Kumar		
Outreach Activities Sustainable utilization of mountain fishery resources: A partnership mode	DCFR Five Hill States	2008	2012
NAIP			
Enhancement of livelihood security through sustainable farming system and related farm enterprises in North-West Himalayas	Dr. Prem Kumar	2009	2012
Bioprospecting of Genes and allele mining for abiotic stress tolerance	Dr. A. Barat Dr. G.K. Sivaraman Dr. S. Ali	2009	2012
Externally Funded Project			
DBT			
Development and characterization of microsatellite markers in *Schizothorax richardsonii*	Dr. A. Barat	2008	2011
Studies on the diversity and phylogeny of Bagrid catfishes of the genus *Mystus scopoli* of northeast India using classical and RAPD techniques	Dr. A. Darshan Singh (DBT Postdoctoral Fellow) Dr. P.C. Mahanta (Supervisor)	2009	
DST			
Genome Scale mining phylogenetic marker of *Schizothorax richardsonii* fish species for Formulation of Selective Breeding Programme	Dr. G.K. Sivaraman (Up to 25th March, 2010) Dr. Shahnawaz Ali (From 26th March, 2010) Dr. A. Barat	2009	2012

RESEARCH ACHIEVEMENTS

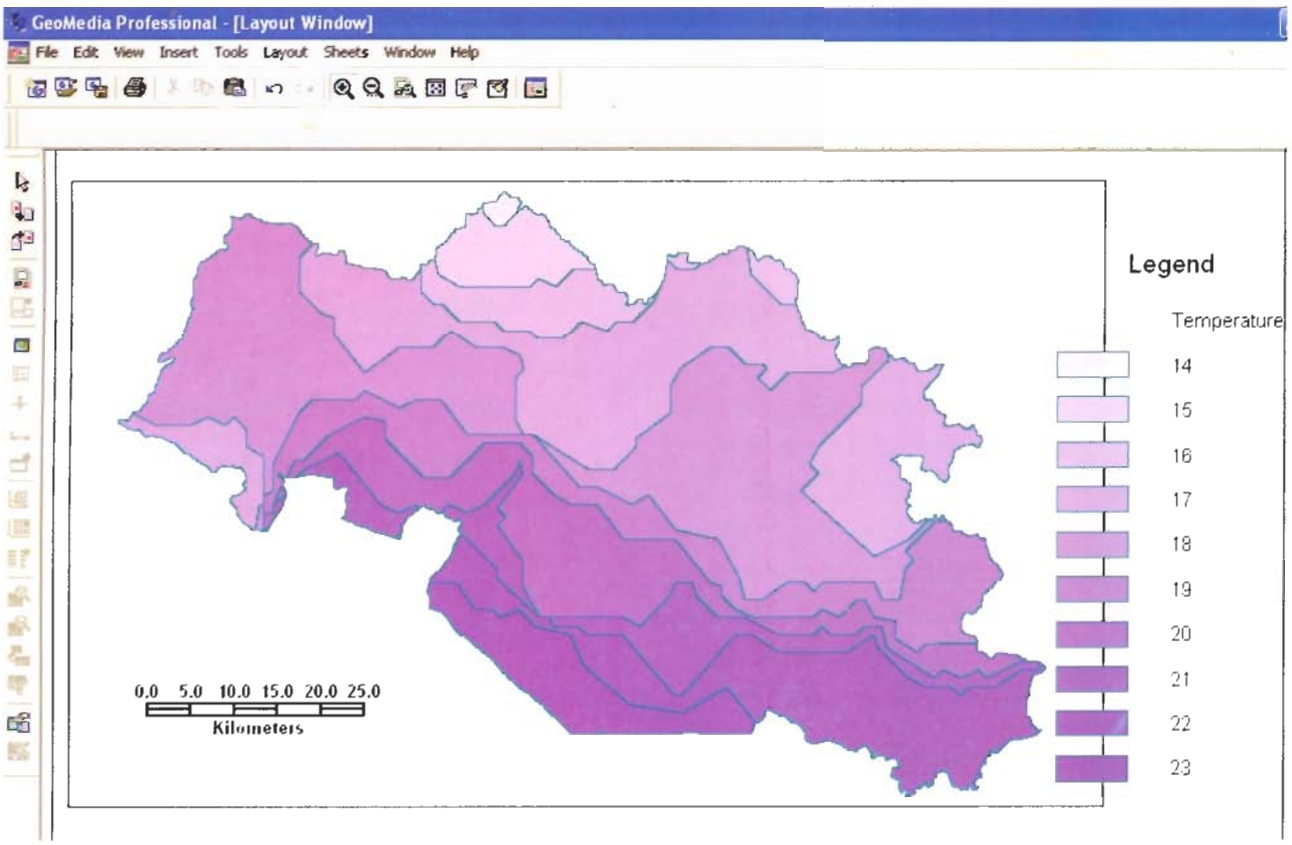
Open Water Fisheries

Project Title	Development of GIS based decision support system for aquaculture in selected coldwater region
Personnel	Ashok K. Nayak, Prem Kumar, P.C. Mahanta, R.S. Haldar, A.K. Saxena

- The Kumaon region of the Uttarakhand state is an ideal region for having different types of aquaculture resources based on low, medium and high altitude ranges. The region is already having the fishponds in different altitudinal ranges and it will be a useful tool to find out the suitable site for aquaculture development in the region depending on different criteria.
- The different parameters like large water bodies, stream and rivers, road network, markets, hatcheries etc. are digitized based on the toposheets of the Nainital district having numbers 53/O3, 53O/6, 53O/7, 53O/8, 53O/10, 53O/11, 53O/12 & 53O/15 on Geomedia professional 6.0 software. Thematic maps on villages and forest cover of Nainital district were prepared based on the digital open series map data of Survey of India, Dehradun. Primary and secondary data on different water quality parameters such as temperature, pH, dissolved oxygen, carbon dioxide, alkalinity, hardness, phosphate and nitrate of different sampling stations were added into the software for further analysis. Soil texture, slope and other soil parameters were also prepared in the GIS software. The aquatic zones of Nainital district were categorized based on the altitude and water availability, water quality parameters.
- The Analytical Hierarchy Process (AHP) model is used to assess the importance of different water quality parameters. Using the interpolation techniques in the Geomedia Grid software, the thematic maps were prepared on different water quality parameters for developing water quality suitable maps of Nainital district for aquaculture.
- Based on the soil and water quality parameters, the thematic maps for the aquaculture suitable sites are being assessed and a graphical user interface of GIS based decision support system for aquaculture development in the Nainital district is being developed.



Forest cover of the study area



Distribution of average temperature in Nainital District

A Detailed Study of Sarda Sagar Reservoir

- The reservoirs in the Uttarakhand are located in-between 28° 25' to 29° 55' N latitude and 78° 18' to 79" 55' E longitude. The important reservoirs of the Tarai region are Tumaria, Haripura, Baur, Baigul, Dhaura, Nanaksagar and Sarda Sagar located in Bhabar and Tarai belts of the state.
- Sarda Sagar is one of the reservoirs, located in-between 28° 40' to 28° 50' N latitude and 80° 3' to 80° 12' E longitude that falls geographically, in Uttarakhand and Uttar Pradesh. The reservoir was selected for the study since no investigation has been made on the limnology and fisheries.
- The present study is an attempt to gather base-line data on limnology and fisheries of Sarda Sagar reservoir.
- The morphology of the reservoir has been changed due to sedimentation during the course of time, when it was impounded and period of study. Remote sensing data were used for this study. A total of 45.23 Mm^3 volume of sedimentation occurred in-between the 183.704m and 190.504m elevation. *The total sedimentation was calculated as 11.72 % and average rate of sedimentation in Sarda Sagar was calculated as 0.26% per year during 1962 to 2006-07.*

- Thematic maps of distribution of physico-chemical parameters of soil such as sand, silt, clay, organic matter, pH, nitrogen and phosphorus were prepared using interpolation technique.
- Thematic maps of distribution of physico-chemical parameters of water such as temperature, transparency, conductivity, total dissolved solids, pH, dissolved oxygen, free carbon dioxide, total alkalinity (carbonate and bicarbonate) and hardness were prepared based on average mean point data using interpolation technique.
- Thematic map for nutrients such as nitrate nitrogen, phosphate and dissolved silicate were also prepared.

Modeling for level of Productivity of Reservoir

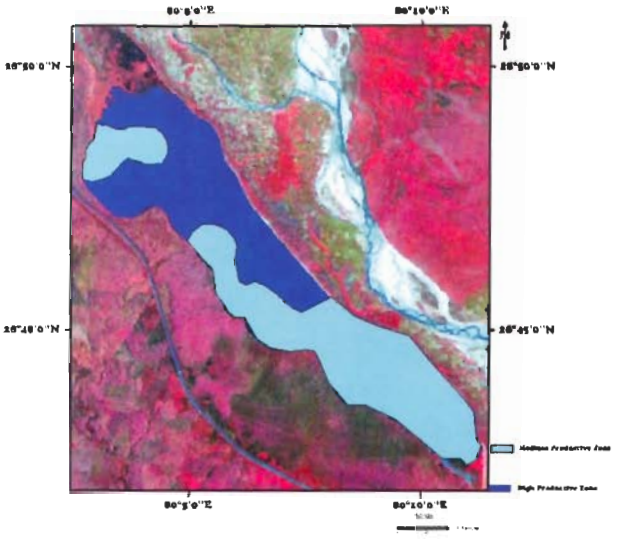
- A modeling was carried out based on criteria (in table hereunder) of optimum range of all physico-chemical properties of the reservoir water and modeling intern output of the productive zone of the Sarda Sagar.

Based on these criteria an area of 2481 hectares falls in medium productive and 2109 hectare of area was found as high productive zone, which is shown in the figure hereunder.

Thematic maps of distribution of all major phytoplankton and zooplankton groups found in water were prepared using interpolation technique.

- **Production Potential:** Based on the survey and

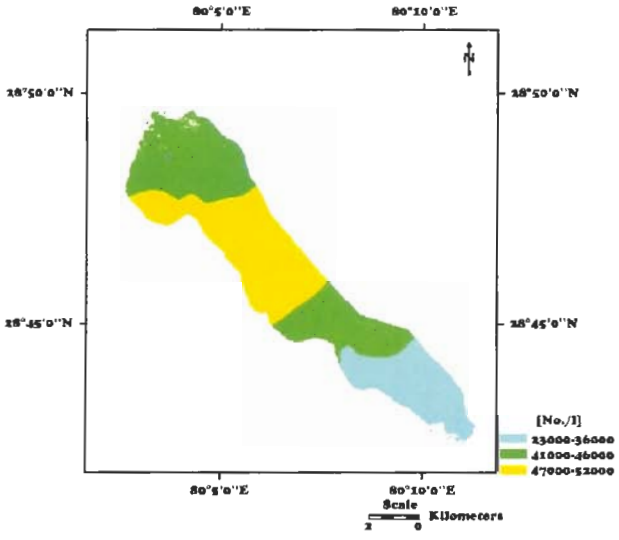
Productive Zone of Reservoir Based on Water Quality Parameters



Parameters	Productivity		
	Low	Medium	High
pH	<6.0	6.0-8.5	>8.5
Alkalinity (mg/l)	<40	40-90	>90
Nitrates (mg/l)	Negligible	Up to 0.2	0.2-0.5
Phosphate (mg/l)	Negligible	Up to 0.1	0.1-0.2
Specific Conductivity (m mhos)	-	Up to 200	>200
Temperature (°C)	18	18-22	>22
Total dissolved solids mg/l	-	-	>50
Hardness mg/l	-	-	>70

(References : Sreenivasan (1978), Jhingran (1988), Sugunan (1990, 1995))

Annual distribution of Cyanophyceae



model the production potential was calculated as 65 kg/ha in Sarda Sagar reservoir. The projected production of the reservoir is 1170 tons/year in Uttarakhand since they fall in same geographical area.

Project Title	Modelling of Length-Weight Relationship and Growth Pattern of Selected Important Coldwater Fish Species
Personnel	N.Okendro Singh, D. Sarma

- Continue efforts are made to collect primary and secondary data on length-weight and age-at-length (or weight) of important coldwater fish species from different sources.
- Two different datasets on length-at-age of *S. richardsonii* was considered to develop suitable models for estimating its maximum size. Each dataset was observed from different aquatic environments. Joshi *et al.* (2005) observed lengths of one to five-year old of *S. richardsonii* at farm environment of Champawat by rearing the above fish species from hatchling stage up to five years during September 1997-August 2002. The fish was regularly sampled for observation of gain in length, weight and survival. In the above study, *S. richardsonii* attained an average length of 8.4, 12.1. 15.6, 18.2 and 20.4 cm during the rearing period of first 5 years respectively. Also, Mohan (2006) estimated length-at-age in this species from Kumaun River from one to five years old by operculum method.
- Different nonlinear models were fitted to the dataset observed by Joshi *et al.* (2005) using Nonlinear Regression option on the SPSS 12.0 Version. Different sets of initial parameter values have been tried so that a global convergence criterion is met for fitting of nonlinear models. The global convergence criteria have been met for all the models considered. The estimates of parameters, R^2, RMSE, MSE, MAE, run test statistic (|Z|) value and Shapiro-Wilk test p-value for the said models are presented in Table 1. Gompertz and Richards models show almost equal performance but better than other models

when the criterion of RMSE, MSE and MAE is used to identify the best-fit model since R^2 values are approximately same in all the cases. Further, independence assumption about residuals is satisfied since the run test |Z| values (1.200 and 0.109 given in Table 1) are well below the critical value 1.96 of normal distribution at 5% level of significance. Also, the significance values of Shapiro-Wilk test for residuals clearly indicate that residuals are normally distributed. Moreover, Richards model is adjudged to be the best fit. The asymptotic length of *S. richardsonii* estimated by the Richards model is approximately 25 cm. However, the maximum length estimated by von-Bertalanffy model is on an average 20% approx. larger than other models whereas the remaining models yield more or less same estimated values, on farm condition at Champawat. In the similar fashion, the above models have been fitted to the dataset observed by Mohan (2006). The estimates of parameters, R^2, RMSE, MSE, MAE, run test statistic (|Z|) value and Shapiro-Wilk test p-value for the said models are given in Table 2. Richards model is found to be the best-fit model when the above criteria is used to identify the best model. Further, independence as well as normality assumptions about residuals is satisfied since the run test |Z| value 1.200 is well below the critical value 1.96 and the significance value of Shapiro-Wilk test for residuals is 0.676. The maximum estimated length of *S. richardsonii* given by the Richards model is approximately 29 cm as shown in Table 2. As observed on farm condition of Champawat, a similar trend on estimated maximum length between von-Bertalanffy and other models is also found in case of Kumaun Rivers. However, the maximum length of fish estimated by different models on farm condition is comparatively smaller than its corresponding estimated values in the Kumaun River irrespective of the models. In other words, approx. 12-17% larger in the maximum length of *S. richardsonii* is expected in the Kumaun River than on farm condition at Champawat. It is, therefore, concluded that the Richards growth model may be considered as the best model fitted to growth of *S. richardsonii* in the above aquatic conditions. Thus, we summarize that in the aquatic environment of Kumaun Rivers, we can expect the maximum size of approximately 29 cm in length of *S. richardsonii*, which is more than the maximum expected size of approximately 25 cm in the aquatic environment on farm condition at Champawat. Moreover, the growth in wild aquatic environment of Kumaun Rivers is faster than on farm condition and has to attain the larger size at the end as demonstrated in Fig. 1. However, the maximum expected sizes of *S. richardsonii* in both environments are significantly smaller than the reported maximum sizes in India and abroad.

Table 1- Summary statistics for fitting of various growth models on *S. richardsonii* data collected from Champawat Farm, DCFR

	Logistic	Gompertz	Von-Bertalanffy	Richards
Parameter estimates				
L_{Max}	23.108 (0.506)	25.294 (0.495)	31.597 (2.225)	25.495 (2.686)
K	0.634 (0.031)	0.407 (0.016)	0.183 (0.025)	0.394 (0.171)
t_0	1.868 (0.079)	1.241 (0.046)	-0.674 (0.112)	1.184 (0.740)
b	-	-	-	-0.060 (0.753)
Model adequacy				
R^2	0.999	0.999	0.999	0.999
RMSE	0.093	0.054	0.087	0.053
MSE	0.021	0.007	0.019	0.014
MAE	0.084	0.046	0.068	0.046
Residual analysis				
Run test $(\|Z\|)$	0.109	1.200	0.109	1.200
Shapiro-Wilk test p-value	0.123	0.964	0.908	0.823

Figures in parentheses are the corresponding asymptotic standard errors.

Table 2- Summary statistics for fitting of various growth models on *S. richardsonii* data collected from Kumaon River

	Logistic	Gompertz	Von-Bertalanffy	Richards
Parameter estimates				
L_{Max}	27.846 (0.193)	30.266 (0.245)	36.294 (1.892)	29.013 (0.350)
K	0.490 (0.008)	0.325 (0.005)	0.162 (0.017)	0.396 (0.023)
t_0	1.425 (0.028)	0.636 (0.020)	-1.592 (0.128)	1.048 (0.111)
b	-	-	-	0.430 (0.138)
Model adequacy				
R^2	0.999	0.999	0.999	0.999
RMSE	0.023	0.018	0.058	0.005
MSE	0.001	0.001	0.008	0.001
MAE	0.022	0.016	0.054	0.006
Residual analysis				
Run test $(\|Z\|)$	0.109	0.109	0.109	1.200
Shapiro-Wilk test p-value	0.761	0.095	0.522	0.676

Figures in parentheses are the corresponding asymptotic standard errors.

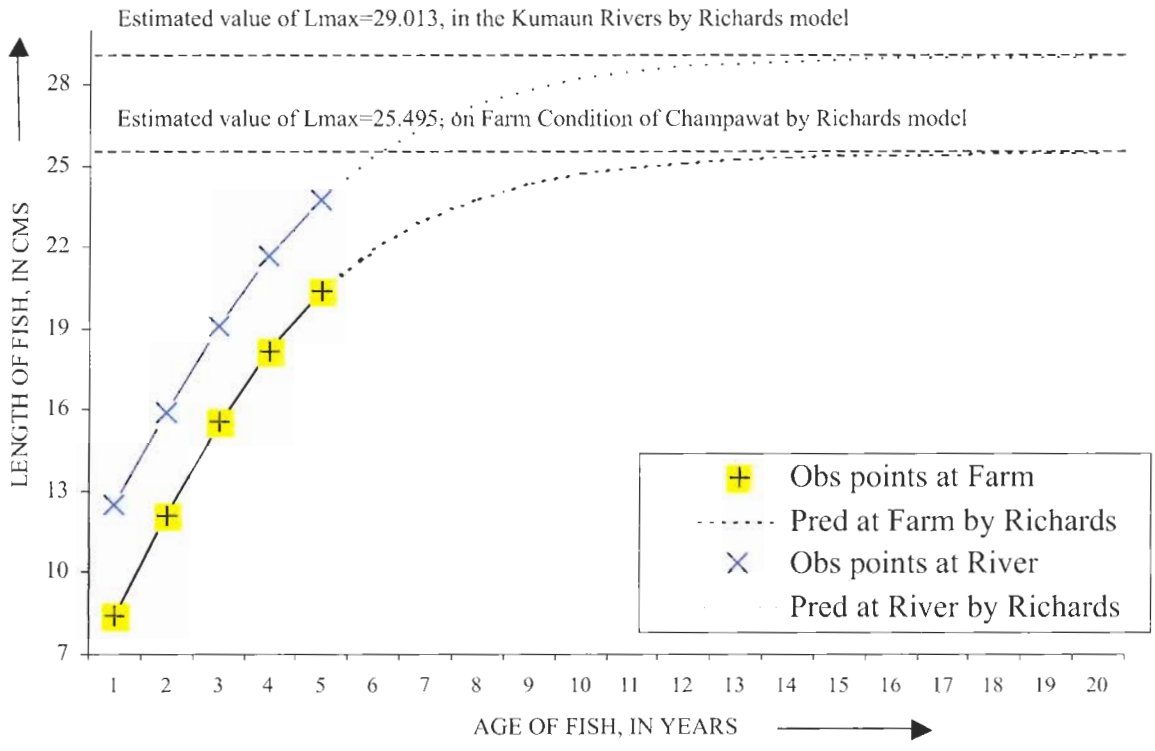


Fig. 1: Graphical display of observed and best-predicted growth in length of *S. richardsonii* from Champawat Farm, DCFR and Kumaun River (Richards model is adjudged to be best fit)

- An attempt to develop statistically sound and valid length-weight relationship of *Schizothoraichthys curvifrons* considering its different stages of life, different seasons and sex has been made using the data collected from secondary sources. The combined data for sex (1=male and 2=female) and four seasons namely, 1-Spring (March-May), 2-Summer (June-August), 3-Autumn (September-November) and 4-Winter (December-February) of *S. curvifrons* has been analyzed by ANCOVA (Syntax method of SPSS), Regression (linear and nonlinear) method with the help of SPSS 12.0 version available at Directorate of Coldwater Fisheries Research, Bhimtal. In the present study, only 288 observations out of 350 specimens taken on length-weight data of *S. curvifrons* have been used which includes first five stages of life viz., immature, maturing, late maturing, mature and ripe of this fish species respectively.
- Difference in various stages is found significant and they are classified into two major stages regarding length-weight relationship of this fish species. Similarly, there are only two seasons, which influence the above parameters of the fish. Sex differences within the major two seasons of two distinct stages are not significantly different. Therefore, four regression lines are fitted at the end. Further, the failure of the criterion of R-square values to identify the best model is demonstrated.

- We have collected primary data on length-weight of *Tor putitora* and so far 224 fish specimens of the above fish species has been collected from various sources viz., local fish market (Ramnagar), river sites at Sunderkhal and Marchula of Kosi River, Uttarakhand (INDIA). The fish specimens were collected from the above river sites through experimental fishing with drag net, cast net, etc. Fish samples were also collected and recorded from the local fishermen as and when they were available at the selected river sites. The collected primary data on length-weight of *Tor putitora* were categorized into four different stages namely, (i) Fry: 0.00-4.00 cm; (ii) Fingerling: 4.00-10.00 cm; (iii) Juvenile: 10.00-20.00 cm. The above data is ready for statistical analyses and will proceed for development of suitable allometric models.

Aquaculture

Project Title	**Studies on induced maturation and seed Production of Himalayan Mahseer, *Tor putitora* and *Schizothorax richardsonii* in pond environment.**
Personnel	**B.C. Tyagi, Prem Kumar**

The fish stocks of *Tor putitora* of different age group initially collected from wild in 2005, reared in pond environment in 2 hired ponds at Bhimtal (1200 m asl) @ 1 fish / m. The fish feed fortified with MT@50 mg/kg of feed was offered to brood stock of the age of 4 years daily during February to June. Few prospective fish specimen were marked and treated with ova prime plus carp PG extracts in 1:3 ratio @ 0.2-0.4 ml / kg body weight of fish on every 20 days during 15 February to June. During this period average water temperature was recorded 18.8 °C TO 27.0°C and average sunshine hours were 11.2 hrs. The dissolved oxygen and pH were 6.0-7.6 mg/l and 8.2-84 respectively. The ponds were fertilized regularly with raw cattle dung + urea on 10th day interval and treated with lime also @ 300 kg/ha on 7 day basis.

The treated stock of four years age and untreated stock of 5 years were found matured and ready to spawn. Like 2009, the selected females having 460 -710 g weights were stripped and fertilized with milt obtained from 12 matured males having 390-540 g weight. The fecundity was recorded 5200/kg body weight. The fertilization percentage was recorded 50-63% .The breeding occurred at 26.0°C. The fertilized eggs were reared in hatchery successfully for further development.

The present study conducted during 2005 to October 2009 clearly indicate that stock collected from wild (lake) or fingerlings reared in hatchery/pond can be grown in ponds for breeding purpose. The pond management practices are simple. However optimum water quality (Water temperature 17-26°C, dissolved oxygen 5-8 mg/l, Ph 8-8.4, CO_2 nil-1.4mg/l) regular fertilization and liming on every 7-10 day interval and feeding of fish daily on a balance diet @ 2-3% of body weight allow the stock to grow to the size of 456-760 gin 4-5 years. Maturity occurs in fifth year. Stocking density by weight is important and should not exceed 1500-1700 kg/ha. Presence

of natural food in pond and occasional flow of water in ponds helping getting prime maturity. Spawning of matured fish is possible with or without Ova prime in late April-June and august- September.

With these findings in the said project is completed.

Similarly the fish stock of snow-trout (*S. richardsonii*) being reared in 3 nursery ponds (15m²) at Champawat but their inducement and spawning programme could not be taken up.

Project Title	**Culture of fishes in floating cages in subtropical Himalayan lake-Bhimtal**
Personnel	Yasmeen Basade, B.C. Tyagi, Madan Mohan (up to July, 2009)

For cage culture, cages made up of HDPE knotless webbing of 4-15 mm mesh size measuring 3m x 3m x 3m each were suspended at a suitable site in lake Bhimtal. The cages were installed in a raft type frame made of angle iron and floated on 200l capacity synthetic sealed barrels. The layout design constituted four units of four such cages each. In one unit of four cages, each of the cages is provided with central pulley system for lifting. While all the other cages, in other three units, have chains in four corners for lifting. Working wooden platform is provided along the sides of each unit of four cages.

In these cages rearing of indigenous coldwater fishes namely, snow trout (*Schizothorax richardsonii*) and Himalayan golden mahseer (*Tor putitora*) was taken up. Fishes of two different size groups were reared using feeds having two different protein sources (fish meal and soybean meal) and two different levels of protein (30% and 35%). Water quality parameters were monitored at fortnightly intervals inside the cages as well as that of lake water. Water temperature being crucial was recorded twice daily. On conclusion of the trials various production parameters were evaluated namely, survival, final body weight, final total length, final fish biomass, net weight gain, percentage weight gain, specific growth rate and feed conversion ratio. The results obtained during the twelve months rearing period are presented here.

1. Feed preparation and analysis

Experimental feeds were formulated with varying protein levels (30 and 35% crude protein) using two different sources of protein namely, fish meal and solvent extracted soybean meal. The other ingredients used for feed preparation included groundnut oil cake, rice bran, wheat flour, vegetable oil and vitamin and mineral mixture. The feeds were prepared in the pellet form with the single screw extruder in small batches as per requirements. The prepared feeds after extrusion were dried in hot air oven, packed in poly-bags and transported to the cage experiment site. The chemical composition of the four experimental feeds was analyzed in terms of dry matter, crude protein, fat, ash, fibre, NFE and gross energy contents.

2. Rearing of snow trout in cages

Snow trout (*Schizothorax richardsonii*) fingerlings of two different size groups 12-15g (105-118mm) and 20-25g (125-130mm) were stocked separately in cages at a density of 100 numbers per cage keeping replicates. Feeding was done with the two soybean meal based experimental diets having 30 and 35% dietary protein levels. Each of the feed

was given to duplicate group of fishes in each size group.

The results of trial conducted on smaller sized fingerlings showed that after a rearing period of twelve months the percentage survival was almost similar for both the dietary treatments 90.5-91%. The values for growth performance of fish assessed in terms of final mean weight (and final mean total length), net weight gain, per cent weight gain and specific growth rate (SGR) were recorded. The data suggested that the growth performance of fish in terms of final weight, net weight gain, per cent weight gain and SGR was significantly ($P<0.05$) higher in fish fed with feed having 30% dietary protein level. The feed conversion ratio (FCR) was observed to be significantly ($P<0.05$) better in fish fed with feed having 30% dietary protein level. Fish production was consequently higher in fish fed with feed having 30% dietary protein level compared to fish fed with 35% dietary protein level.

The trial conducted on bigger sized snow trout (20-25g) brought forth that after a rearing period of 12 months the survivability was higher to the order of 96.0±1.00% in fish fed 30% dietary protein level compared to fish fed with 35% dietary protein level in which the survivability was 93.50±0.50%. The growth parameters namely, final mean body weight, final mean total length, net weight gain, per cent weight gain and SGR were significantly ($P<0.05$) higher in fish fed with feed having 30% dietary protein level than those fed with 35% dietary protein level. Feed conversion ratio (FCR) was significantly ($P<0.05$) better in fish fed with feed having 30% dietary protein level compared to those fed with 35% dietary protein level. Fish production as a result was comparatively greater in fish fed with feed having 30% dietary protein levels than those fed with 35% dietary protein level.

Photo 1: Rearing of snow trout in cages

Photo 2: Tray feeding of snow trout with experimental diets in cages.

3. Rearing of Himalayan golden mahseer in cages

Himalayan golden mahseer (*Tor putitora*) advanced fingerlings 40-45g (156-171mm) were stocked in cages at a stocking density of 100 numbers per cage and fed with the four experimental diets having two levels of protein (30 and 35%) and two sources of protein (fish meal and soybean meal). After a rearing period of 12 months the rate of survival ranged from 93.00±1.00% to 95.50±0.05% and was higher in fish fed with soybean meal based feed having 30% dietary protein level. The values for final mean body weight, final mean total length, net weight

gain, percent weight gain, SGR and final biomass were higher in fish fed with soybean meal based diets compared to those fed with fish meal base diet being significantly higher in fish fed with feed having 30% dietary protein level. Feed conversion ratio (FCR) was better for soybean meal based diets than for the fish- meal based diets. FCR was significantly ($P<0.05$) lower in treatment group fed with soybean meal based diet having 30% dietary protein level. The fish production per cage per year was consequently highest ($P<0.05$) in case of fish fed with soybean meal based diet having 30% dietary protein level than all other treatment groups. The above trial indicates that golden mahseer fingerlings can be cultured in cages using feed having a protein content of 30% and soybean meal as the major protein source.

In another trial golden mahseer yearlings of about 100-120g (200-240mm) were reared in cages. The fishes were stocked at a density of 100 numbers per cage and fed with two soybean meal based experimental diets having 30% and 35% dietary protein levels. After a rearing period of 12 months the growth performance, feed efficiency and production of fish was assessed. The rate of survival was greater in fish fed with 30% protein diet ($98.50\pm0.50\%$) compared to those fed with 35% protein diet ($96.50\pm1.50\%$). The final mean body weight and the corresponding final mean total length, net weight gain, percent weight gain and specific growth rate indicated that growth performance of fish was higher when 30% dietary protein was given. Similarly, feed conversion ratio (FCR) was better in fish fed with 30% protein diet compared to those fed with 35% protein diet. The growth performance and FCR were better in fish fed with 30% protein diet compared to fish fed with 35% protein diet. Suggesting that a soybean meal based 30% protein diet is suitable for the yearlings of Himalayan golden mahseer.

4. Physico-chemical characteristics of water

The major water quality parameters dissolved oxygen, free carbon dioxide, total alkalinity, conductivity, TDS, total hardness, ammonia, nitrate, nitrite, phosphate, etc. were assessed inside and outside the cages. The water quality characteristics were more or less similar inside and outside the cages suggesting that there was free flow of water across the cages.

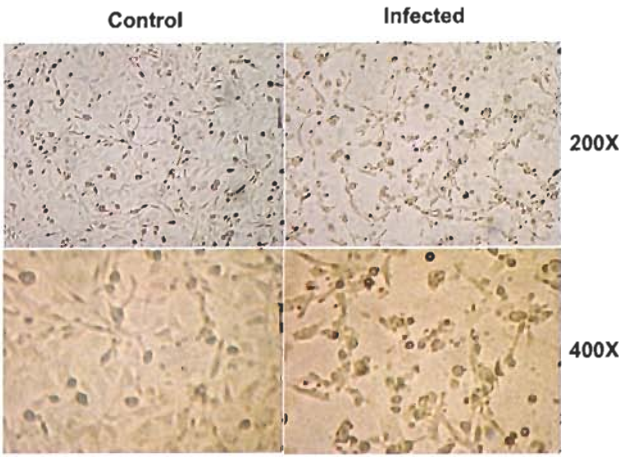
Photo 3: Rearing of golden mahseer in cages

Photo 4: A view of golden mahseer yearlings being reared in cages

Project Title	Investigations on coldwater fish pathogens and their environment
Personnel	Amit Pande, N. N. Pandey, Sumanta Kumar Mallik

Fish Cell Culture Facility has been upgraded in the Institute. The laboratory procured three cell lines namely BF-2, FHM and RTG-2 from National Centre for Cell Science Pune in March 2009. For the past one year the laboratory has been maintaining these cells satisfactorily.

Research on Diagnostic Virology, a specialized field within Fish Pathology, has been initiated in the Institute. Samples were collected from suspected rainbow and brown trout from the Institute's Fish Farm at Chirapani, Champawat and State Fisheries Farm Bairangana (Chamoli) as well as from different fish farms of Himachal Pradesh. The samples obtained from different fish farms have been processed and stored at -80°C till further use. Virus isolation was attempted from rainbow, brown and snow trout. Out of 26 samples of rainbow trout tested 15 showed cytopathic effect in BF2 cells. Cytopathic effect could be visualized in two out of four samples of brown trout and *Schizothorax*. The agent was proved to be virus as it was filterable. RT-PCR is being standardized and the diagnosis on the basis of RT-PCR has been difficult in the absence of a positive control. In this regard, Dr James Winton, Chief Fish Health Section, Western Fisheries Research Center, Seattle (USA) also an OIE expert on infectious hematopoietic necrosis (IHN), a rhabdoviral disease of trout and salmon, has been consulted. He has shown his interest in having collaboration with our lab and has been kind enough to send two hyperimmune serum samples. One hyperimmune serum is directed against infectious hematopoietic necrosis virus (IHNV) and the other against infectious pancreatic necrosis virus (IPNV). These sera are to be used for virus neutralization assays in order to confirm their presence in farms from where the disease has been observed.



RBT079 through 0.22 filter
Isolation of a filterable agent from diseased rainbow trout

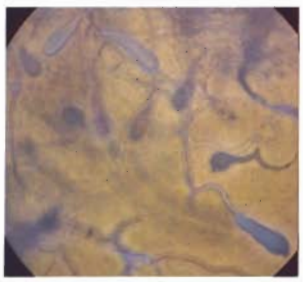
Study on pathogenic fungi is being now conducted at the Field Centre, DCFR, Champawat during the period August- December 2009. Fungal infection was more prominent in the ponds of stagnant water than the running water raceways. Hatchery water was also prone for the fungal infection. The muscles of the rainbow trout, fins and gills of the carp and scale of the carp are susceptible for the infection. Intensity of the infection in cold-water fish species decreases with the downfall of the water temperature. The pathogenic fungi in the present study were identified as *Saprolegnia parasitica* and *Saprolegnia diclina* with cotton like appearance, elongated zoosporangia and pear shaped primary sporangium. Temperature has a significant effect on the development of fungal infection. Most epizootics occurred when temperatures were below the optimal temperature range for that species of fish. But, in the case of trout egg incubation, it was observed that

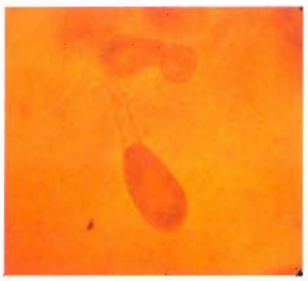
the high temperature increases the chances of infection. The dead eggs were more susceptible to the fungal attack during incubation. Snow trout is more susceptible than the rainbow trout. Infection occurred most prominently in trout even at low temperature but not in carps. In the snow trout, fungus was present as an ulcerative mycosis that converted into a deep necrotic lesion involving the muscle.

Water samples collected from fish farm Champwat

Hemp seeds used as bait for isolation of *Saprolegnia*

Plate showing colony growth of *Saprolegnia* on hemp seeds after3 days of incubation





Mature zoosporangium of *Saprolegnia*

Field visits were conducted by a team of scientists who visited the state trout farm Bairangana in Chamoli District, DCFR Field Station Champawat, Fish Farms of HP and Arunachal Pradesh for disease surveillance as well as to collect the samples of moribund and infected fish. Isolation of various fish pathogens was attempted. The investigations are under progress.

Evidence of polythene as a factor of fish kill was observed in a private rainbow trout farm at Patlikuhal (Mandi district) owned by G. Balbir Singh Yark, autopsy of a table sized rainbow trout showing abnormal swimming behaviour was conducted. The intestine was found enlarged and swelled heavily. The gut content analysis showed presence of polythene. The polythene measured 55 cm in length. Improper feeding might have stimulated the trout to swallow up the polythene. This was an intriguing case study of fish kill due to polythene nuisance.

Autopsy showing swollen intestine of rainbow trout (left) and ingested polythene (right)

In fish seed farm Kangra, 1-2% of the carp stock (Common carp and Mrigal) was found with symptoms of extended belly and protruding eyes. Besides collection of the diseased samples, it was advised to segregate the health stock from diseased one. Application of antibiotic Chlorotetracycline in fish feed @ 55 mg/Kg body weight for 10 days, Oxytetracycline @ 70mg/Kg body weight for 10 days and treating water body with 1ppm potassium permanganate ($KMnO_4$) was also recommended.

Common carp showing symptoms of protruding eyes

Fishkill in Upper Siang river of Arunachal Pradesh were attended in January-February. Incidents of mass mortality of indigenous fish, *Schizothorax plagiostomus* were reported in different stretches of tributaries of Upper Siang River, Arunachal Pradesh during month of December 2009 to January, 2010. Local newspapers of the state coined the incident as outbreak of mysterious fish diseases. The outbreak was only confined to the *Schizothorax plagiostomus* whereas other fishes in the water bodies remained unaffected. As there was death of a single variety of fish, depletion of oxygen, presence of toxic substances, heavy metals and poisoning of water bodies could not be the possible reasons for mass mortality. The gross morphological observation of moribund specimens showed healthy symptoms. There were no lesions, ulcer, haemorrhage, tail rot or fin rot in the body, except infected tissue mass at lower jaw of the fish. The tissue in lower jaw had turned white and with degenerating condition. Autopsy of the specimens revealed absence of food in gut content. The infection at lower jaw might have forced the fishes to remain in the state of hunger.

a b c d

Oral lesion in *Schizothorax* (a to c) and enlarged spleen (d)

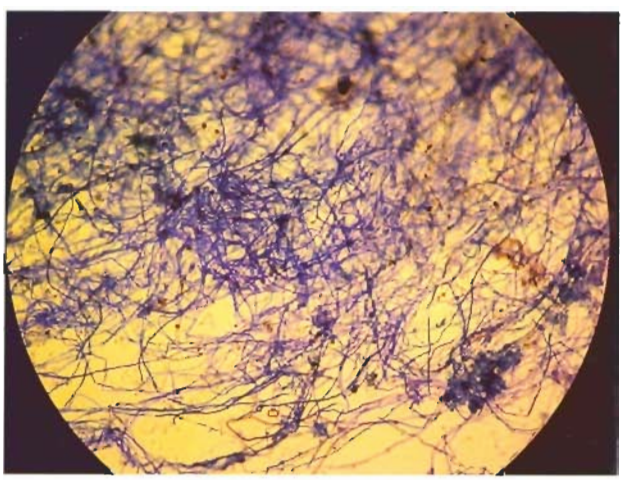
Setting up of a Diagnostic Bacteriology Laboratory too is being given priority to study the important bacterial diseases of coldwater fish species. The lab had been earmarked, occupied and useful chemical and consumables have been obtained. Bio-chemical characterization of pathogenic bacteria isolated from infected fish is in the process of standardization.

Parasite studied rainbow trout fry kill at coldwater fish farm Champawat. A symptom of whirling movement followed by mortality of rainbow trout fry was observed in coldwater fish farm, Champawat in the year 2009. Death of more than 80% of fry was recorded in the incident. The symptoms shown by infected rainbow trout fry revealed the occurrence of rainbow trout fry disease, which is generally caused by *Myxobolous cerebralis*. Though presence of *Myxobolous cerebralis* could not be detected, but presence of Triactinomyxon (TAM), the infective spore of *Myxobolous cerebralis* is recorded in *Schizothorax richardsonii*. It is reported that this infective stage in encysted stage can survive in the mud and water for several years during unfavorable condition. So source of water might have contaminated the hatchery tanks leading to mass mortality of rainbow trout fry.

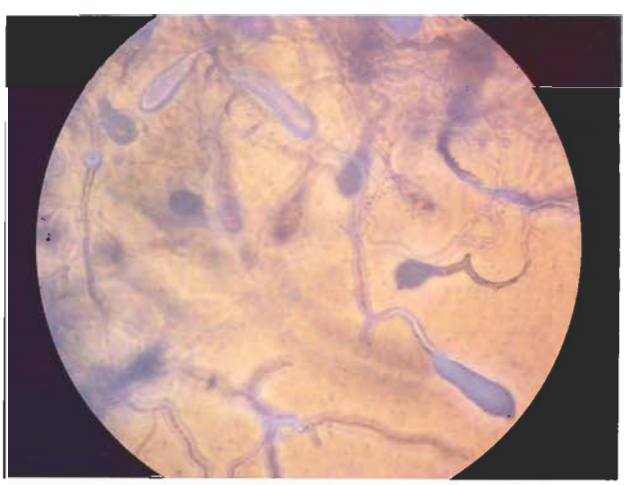
Isolation of pathogenic fungi from coldwater fish and their environment

Attempt has been made to isolate the pathogenic fungus from water, body tissue and eggs of cold-water fish. Samples were collected from Experimental fish farm, Champawat and State fish farm Bairangna, District Chamoli (Uttarakhand). The pathogenic fungi were identified as *Saprolegnia parasitica* and *Saprolegnia diclina* with cotton like appearance, elongated zoosporangia and pear shaped primary sporangium. Temperature has a significant effect on the development of fungal infection. Most epizootics occur when temperatures was below the optimal temperature range for that species of fish. The dead eggs of trout were more susceptible to the fungal attack during incubation.

Snow trout is more susceptible than the rainbow trout. Infection occurred most prominently in trout even at low temperature but not in carps. In the snow trout, fungus was present as an ulcerative mycosis that converted into a deep necrotic lesion involving the muscle.



Mycelia of *Saprolegnia*

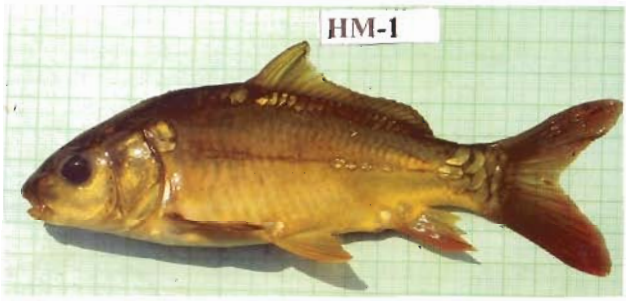


Zoosporangia of *Saprolegnia*

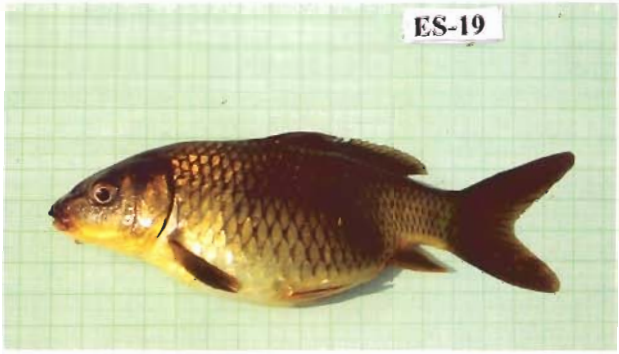
Project Title	Evaluation of growth performance of different strains of Common Carp
Personnel	N.N. Pandey, Prem Kumar, S.K. Srivastava

Better growth performance of Hungarian strain of common carp in field conditions.

The Institute has already imported two Hungarian strains (Ropsa scaly carp and Felsosomogy mirror carp) at field center, Champawat. Growth performance of these Hungarian strains and existed local strain of scale carp (Bangkok strain) was evaluated in field condition at Champawat. Highest growth was recorded in hungarian mirror carp (352gm.) under poly culture system followed by Hugarian scale carp (304gm.). The growth of the existing strain was low (187gm.) in polyculture. Brooders of each strain (40nos, each) were reared in separate tank and sex-wise segregated during Feb. month. Early maturity was observed in mirror carp than the scale carp. Existing scale carps have been bred (at 15-17°C) during second week of March. Breeding programme of the Hungarian strains is in progress at Champawat center.



Felsosomogy mirror carp



Scale carp (Bangkok strain)

Ropsa scaly carp

Felsosomogy mirror carp

Mature female of Ropsa scaly carp

Haul of Hungarian mirror carp

Mature male of Ropsa scaly carp

Breeding of Hungarian strains of common carp

Project Title	Study on water budgeting and water management for coldwater Aquaculture system
Personnel	N.N. Pandey, Prem Kumar

Development of Low cost grit filter for carp rearing at Field Center, Champawat.

Semi-intensive carp culture practices are popular in the mid hills. When the temperature rises during April to June months there are frequent incidences of shooting up the algal production in the ponds resulting in mortality of fish due to sudden depletion of dissolved oxygen during night time. Addition to it, there is problem of water scarcity if the water could be replaced with the fresh one. Therefore, there was a need to develop a low cost filter that can be used for water purification. In this line, continuous efforts were made in order to design a low cost grit filter. This filter is efficient to remove 70% physical impurities (Clay + algae cells) with 1-1.5 ppm improvement in D.O (after ventury system). The inlet flow rate is 32 lpm. After inoculation of nitrifying bacteria, this small filter is efficient to reduce the ammonium level from 0.6 to 0.3 ppm and nitrite level from 0.046 to 0.017 ppm was recorded.

Incubation of nitrosomonas & Nitrobecter

Incubated pebbles

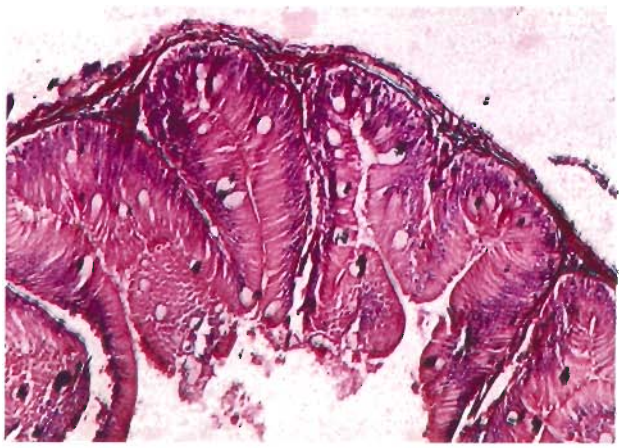
Low cost grit filter

Project Title	**Performance of Chocolate mahseer (*Neolissochilus hexagonolepis*) in fresh water aquaculture system in Kumaon Himalaya.**
Personnel	Debajit Sarma, B.C. Tyagi, N.O. Singh

The chocolate mahseer (*Neolissochilus hexagonolepis)* is a very important fish in terms of its sports and food value. This fish may be considered as a new candidate species of hill aquaculture in Western Himalayan region. The consignment of chocolate mahseer fry was transported from Arunachal Pradesh to DCFR, Bhimtal. The fishes were stocked in the (5m X 2m X 1m) Mahseer hatchery complex of Directorate of Coldwater Fisheries Research. The increment in fish length and weight was about 82.9 mm and 14.6gm respectively after a culture period of one year. The length – weight relationships of chocolate mahseer shows the b value for the fish was isometric. Thus the fish growth follows the isometric growth and coincides with the slope of that of an ideal fish. The feed has been given at the rate of 10% body weight regularly two times a day. Gut content study revealed that the fry of chocolate mahseer are carni-omnivore while the advanced fingerlings are herbi- omnivore. RGL values increased with the increase in length of the fish. Feeding intensity was found to increase in lower size groups (0.439 gm - 5.9 gm) and certain significant variations were observed in respect to the feeding intensity in the higher size groups (9.1 gm – 19.7 gm) i.e. during fingerling stage. The fish showed optimum growth during the temperature range of 19 °C to 23 °C. The routine analysis of physico-chemical parameters was recorded (DO, pH, Total alkalinity, Free CO_2, Total hardness, Nitrate, Phosphate, Chloride, Iron, Ammonium).

The morphological and functional development of chocolate mahseer different organs (gut, brain & eye) are observed using the histological process in which the live fish is dissected and the organs were fixed in Bouin's solution and then the histological slides were prepared. Histological study is carried out to gather more information about the developmental stages of different organs from fry stage to adult stage.

Culture of chocolate mahseer



Transverse section of intestine

Project Title	Assessment of growth parameters of a principal upland fish, *Schizothorax richardsonii* (Gray) in different rearing conditions
Personnel	K.D. Joshi, S.K. Srivastava, S. Ali

- A new project was started on *Schizothorax richardsonii* since September 2009. Under which a total of 150 fry (70-100 mm. in length) with corresponding weight of 2.6-5.3 g collected from the Saryu river near Rameswar were stocked in nursery pond (10 x 3x 1.25 m) at Chhirapani Fish Farm, Champawat located at 1620 msl. The stocking density in the pond was 5 fry /m^2.
- The continuous water flow in the ponds was maintained at the rate of 15-30 l/minutes. The fry were fed on a laboratory compounded wet artificial diet consisting 32 % crude protein @ 5 % of body weight.
- The stocked juveniles attained an average length of 95-120 mm, with corresponding weight of 8.2 to 15.0g, up to March 2010. The cumulative survival was 92.6 % during the study period.
- The water quality parameters in the rearing ponds during experiment varied as- water temperature 5.2 – 23.7 ^{0}C; pH 7.6 – 8.6; dissolved oxygen 7.9 –10.0 mg./l; free carbon dioxide 1.0 –2.4 mg/l and total alkalinity 18.0 – 44.0 mg./l.
- In order to standardize the breeding of *asela*, snow trout for seed production, artificial breeding of the captive brood stock of was done successfully at Champawat farm.
- A total of 8 farm raised females in 3+ years age with average body weight 175±15 gm and 11 males with 62±5 gm body weight, respectively were successfully bred during 15 Sept- 5 Oct' 09 at an ambient water temperature between 16-20^{0}C.
- The average fecundity was observed as 10560-22120 eggs/kg body weights with 2320-5524 eggs/female. The fertilization rate varied from 45-60 % with incubation period of 110-150 hours at 16-18^{0}C water temperatures.
- The hatching rate was between 65 to 82%. The average length of sac fry was recorded between 7.3-8.8 mm. Absorption of yolk sac was completed within 112-140 hours at the temperature of 16-18^{0}C.
- About 5000 early fry were produced.

Project Title	Genetic characterization of important snow trout fish species
Personnel	G. K. Sivaraman, A. Barat, R.S. Haldar, P.C. Mahanta

Eleven random primers were employed to screen for RAPD markers in the most commonly available coldwater fish species of Uttarakhand region, viz., *Tor putitora*, *Schizothorax richardsonii*, *Raiamas bola* and *Garra* species. The sizes of the amplified products were from 200 to 5,000 bp in all the fish species with all the primers employed.

Total 188 bands were scored with the 11 primers employed, with the average numbers of bands scored being 3.54 ± 0.72, 5.18 ± 0.69, 3.64 ± 0.58 and 4.73 ± 0.78 in *Tor putitora*, *S. richardsonii*, *R. bola* and *Garra* species respectively. The maximum numbers of scorable bands were obtained with primer OPA-03 primer in *Tor putitora* (08 ± 0.71), *Schizothorax richardsonii* (08 ± 0.71), *Raiamas bola* (07 ± 0.71)

and *Garra* species (05 ± 0.71), and minimum numbers (1 to 3) of amplified fragments were observed with primer OPA 05. Higher proportions of polymorphic bands were produced by OPY02 (7.5%) and NUSZG4 (5.75%) primers among these fish species. The highest genetic distances were observed between *T. putitora* and *R. bola* (0.60), followed by *T. putitora* with *Garra* species (0.52), and the least genetic distance was observed between the *S. richardsonii* and *Garra* species (0.36), followed by *T. putitora* and *S. richardsonii* (0.43). The phylogenetic tree was constructed using TDRAW V1.4 software package, which revealed the *T. putitora* with *S. richardsonii* and *Garra* species with *R. bola* forming a separate monophyly.

Isolation of genomic DNA from the Formaldehyde fixed tissue

We standardized a simple and inexpensive method to extract DNA from preserved fish specimen. The procedure was tested on fresh, dried, and preserved sample from 4 different species. Depending on the origin and size of the scale as well as on the storage method, the amount of DNA obtained was approximately 50 to 700 ng per sample.

Solutions

Solutions utilized in this study are as follow: STE (Sodium chloride – Tris-EDTA) extraction buffer–, 0.1M NaCl, 10 mM Tris-HCl (pH 8.0), 1 mM EDTA (pH 8.0); Extraction buffer 'S'–2% SDS, 100 mM Tris-HCl (pH 8.0), 50mM EDTA (pH 8.0), 100 mM NaCl; Chloroform-isoamylalcohol 24: 1 (v/v); TE buffer–10 mM Tris-HCl (pH 8.0), 1 mM EDTA; 5M Sodium acetate; Ethanol; PBS (phosphate-buffered Saline)- 137mM NaCl, 2.7 mM KCL, 10mM Na_2HPO_4, 2 mM KH_2PO_4; 10% formaldehyde fixed tissue sample were used in two treatment combinations to isolate genomic DNA.

DNA Isolation

Both STE and buffer 'PBS' were used as extraction buffer. Total genomic DNA was extracted from the formaldehyde fixed tissue of different species of Genus with proteinase-K and phenol-chloroform method, which removes proteins and other cellular components from the nucleic acids and pure genomic DNA was obtained. All experiments were carried out in three replications.

Procedure for STE Buffer

Approximately 50 mg of small pieces of muscle/ fin tissue were taken in 1.5 ml eppendorf tube with 0.5 ml STE buffer and kept in incubation at room temperature for over night. The tissue sample was homogenized on next day in Lyses buffer (contains 10 mg SDS) with the help of a micro pestle. 10µl (per sample) of Proteinase K was added to the Lysis buffer. The homogenized tissue were then transferred to the 50ml tubes and kept for overnight incubation at 37^0 C in water bath. After taking out the sample from the water bath 1 ml of incubation buffer was added in each tube for proper lysis of the samples.2 ml Tris-saturated phenol (pH 8.0) was added in each tubes and was mixed (by repeatedly inverting tubes) for 10 min. Then 2 ml Chloroform: Isoamyl alcohol (24:1 v/v) was added to each tube and again mixed slowly for 10 min. Sample tubes were centrifuged at 10, 000 rpm for 10 min at 4°C, supernatant was pipette out, avoiding interface white layer. 2 ml of chloroform: Isoamyl alcohol (24:1) was added to supernatant in each tube, and was mixed slowly for 10 min. The sample tubes were then centrifuged at 10,000 rpm for 10 min at 4°C. Clear supernatant was pipette out and 1/10 volume of 3M sodium acetate (pH 5.2) and 2.5 times ice-cold absolute

ethanol were added to the supernatant. Slowly mixing of the tube was done and then tubes were kept on the -20°C for one hour. The samples were centrifuged at 10,000 rpm for 10 min at 4°C and supernatant was taken out and pellet was dissolved in 2ml 70% ethanol was added to each tube and centrifuged at 10,000 rpm for 10 min at 4°C. Ethanol was discarded and the pellet was air dried for 10-15 minutes. After drying, TE (pH 8.0) was added and pellets were dislodged from the tube walls. Isolated DNA was kept at 4°C for overnight. 1µl of RNAase was added in each sample tube and samples were kept at 37°C in water bath for 2 hours. And then stored at 4°C.

Procedure for PBS Buffer

50 mg fin sample from each sample was taken out of the 4% formaldehyde, dried by wiping with a paper towel, and then placed into a 1.5-ml Eppendof tube containing 500 µl PBS buffer, Left the tubes at room temperature for pre incubation for whole night. Next day 6 µl of Proteinase K was added to each tube, followed by incubation at 55°C for 1 hour. Then the tubes were centrifuged at 14,000 rpm for 10 minutes in 4°C and the supernatant was transferred into a new 1.5-ml tube. Added absolute ethanol and kept the tubes in –20 for 4-5 hrs. Pallet was comes out. Ethanol was discarded and the pellet was air dried for 10-15 minutes. After drying, TE (pH 8.0) was added and pellets were dislodged from the tube walls. Isolated DNA was kept at 4°C for overnight. 1µl of RNAase was added in each sample tube and samples were kept at 37°C in water bath for 2 hours. And then stored at 4°C.

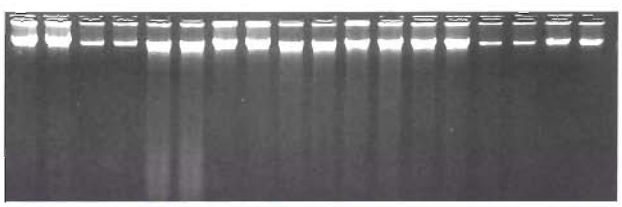
Determination of quality and quantity of isolated DNA using Agarose gel electrophoresis

0.4 mg agarose was dissolved in 5o ml of 1X TBE. Agarose solution was boiled for few seconds until the agarose gel dissolved. 1µl of Ethidium bromide is added before it gets cooled. The above agarose solution was cooled down to approximately 50°C, and then it was poured in the casting plate with already adjusted gel comb. It was then left for solidification at room temperature for nearly 30 minutes. Cold 1 X TBE as gel running buffer was used.4µl of DNA solution with Bromophenol blue was loaded in the wells along with known quality of DNA in adjacent wells. It was run at 70 V for 15 to 20 min and the DNA band was observed with ultraviolet transilluminator.

Gel image documentation

DNA can be visualized in the gel with Ethedium bromide. It is entrapped into the grooves of double stranded DNA and fluoresces in UV light. The high concentration of DNA in a band on a gel will fluoresce brightly a back ground of diffuse Ethedium bromide in the gel matrix. The image was stored in Gel documentation system (Alpha Innotech Imager).

Tor putitora *Schizothorax richardsonii* *Schistura sp.*



Genomic DNA of different fish species preserved in formaldehyde

Thus our method can be potentially useful for DNA extraction from fish fin and muscle collected from archived museum samples. This might have great potential for the study of extinct fish species and for examination of population and community changes of fish in the recent past.

Project Title	**ICAR Mega Seed Project** Seed Production in Agricultural Crops and Fisheries
Personnel	Debajit Sarma

1. Seed production of Golden mahseer in 2009-10 was 0.72-lakh spawn and 0.65 lakh fry compared to 103,050 seed in 2008-09, 75,000 in 2007-08 and 25,000 in 2006-07. Seed was produced from May to September 2009.
2. Seed production of Common carp in 2009-10 was 15 lakh Spawn and 5 lakh fry compared to 20 lakh spawn and 7 lakh fry during 2008-09, 15 laks spawn and 5 lakh fry in 2007-08 and 10 lakh spawn and three lakh fry in 2006-07. At Champawat 5 lakh spawn from which 2 lakh fry were produced in April 2008.
3. Seed production of Snow trout was carried out and 0.05 lakh fry was produced in 2009-10.
4. About 0.15 lakh eggs of Rainbow trout were produced in 2009-10.

Target and Achievements during 2009-10		
Target		Achievements
Common carp	15 Lakh	12 lakh Spawn and 5 lakh fry
Golden mahseer	1.0 Lakh	0.72 lakh spawn and 0.65 lakh fry
Snow trout	0.2 Lakh	0.05 lakh fry
Rainbow trout	0.2 Lakh	0.15 lakh eggs

Stripping

Incubation of Egg

Rearing of Mahseer fry

Seed Transportation

Dissemination and Revenue generation through Mahseer Seed

- 20,000 seed of golden mahseer produced under this project at DCFR sold for Rs. 30,000 to M.P Matsya Mahasangh (Sah.) Maryadit, Bhopal.
- 2,000 seed were sold to Meharkoat Fish Farm, Dehradun at Rs. 2,200/-
- 32,000 seeds of Golden mahseer were released in Bhimtal Lake during NFDB sponsored training program in presence of participants and invited dignitaries

Project Title	Research & Development activities in NEH region
Personnel	B.C. Tyagi

1. Aquaculture Development through Demonstration on carp farming system

Like previous year, Composite Carp Farming technology involving three exotic Chinese Carps namely grass carp, silver carp, common carp @ 3-4 fishes/m² in a combination of 40-45%, 20-25% 35-40% and with the provision of supplementary feed @ 2-3 % of body weight of fish on daily basis and fertilization with lime and only organic fertilizers @ 9000 kg/ha was demonstrated in Arunachal Pradesh. Many more new farmers joined the programme in 2009-2010.

2. Documentation and Bioprospecting of bacterial micro flora from gastrointestinal tract of selected coldwater fishes from Arunachal Pradesh, India. (Collaborative Research Project with RG University, Itanagar)

The project is completed. During the period of study, in total forty seven bacterial samples were isolate from thirty nine samples of fishes collected from different river system of Papumpare and East Siang District of Arunachal. *Lactobacillus fermentum* was found in nine (23%) samples followed by *Bacillus subtilis* and *Aeromonas salmonicidae* in six sample each (17%). *L. lactis* was in 2 samples whereas *A.hydrophila, Asalmonicida, Chryseomonas luteola, Leuconostoc mesenteroides* were recorded in 8% samples. *Hafnia alvei, Cardiobacterium divergens, Cryptococcus neoformans* and *Vibro pelagiius* occurred in 4% samples. All the isolated bacteria showed amylolitic and proteolytic activity except *Streptococcus infantarius, Yersinia ruckeries* and *Cryptococcus neoformans Chryseomonas luteola,.*

A.hydrophila, Lactobacillus fermentum, L. *lactis and Chryseomonas luteola,* can be used as probiotics. The other bacterium saphrophytic in nature can be used as probiotics in case of coldwater fishes. The biochemical test for identification of gastrointestinal flora is already reported. The enzymatic activities of different bacterial strains are listed in Table 1.

Table-1 The enzymatic activities of different bacterial strain

Name of strain	Amylolytic activity	Proteolytic activity
Aeromonas hydrophila	1.05 ±0.14-	0.04 ±0.04
Aeromonas salmonicida	1.85± 0.15	0.20 ±0.02
Bacillus subtilis	0.65 ±0.20	0.17 ±0.09
Cardiobacterium divergens	1.85 ± 0.45	1.3 ±0.90
Hafnia alvei	1.75 ± 0.15	0.34 ± 0.13
Lactobacillus fermentum	2.25 ± 1.50	1.2 ± 0.50
Lactobacillus lactis	1.65 ± 0.20	0.56 ± 0.03
Leuconostoc mesenteroides	1.85 ± 0.35	0.67 ± 0.02
Streptococcus infantarius	No activity	No activity
Vibrio Pelagius	1.25 ± 0.30	0.87 ±0.04
Yersinia ruckeri	No activity	No activity
Vibro furnissii	2.2 ± 0.50	1.5 ± 0.50
Chryseomonas luteola,	No activity	No activity
Chryseomonas neoformans	No activity	No activity

The study is very useful for further carrying out research on identification and use of probiotics in enhancing the growth of coldwater fish species in their aquaculture system.

3. Studies on the growth performance of medium carp, pengba (*Osteobrama belangeri*) in mono and composite fish culture System in Manipur

The species is one of the medium carp endemic to the Chindwin drainage. It has high food value and is in great demand in Manipur. Due to various reasons the species has become endangered and extinct in wild. To conserve the species, it has been declared *State Fish of Manipur*, and present study was taken up in collaboration with ICAR Research Complex, Imphal to understand and develop its feeding ecology, breeding behavior and culture prospects.

A series of earthen ponds having an area of 62.5 m^3 were stocked with Indian & Chinese Major carps plus pengba @ 15000 no. /ha in different combination and ratio. The ponds were regularly fertilized with organic manure plus inorganic fertilizers at 12-day interval. Lime was applied at higher rate of 400-500 kg/ha being water acidic on every 10^{th} day. The conventional carp feed was given @ 4-5% of body weight. Water quality was monitored regularly. The water temperature, pH, dissolved oxygen and transparency ranged 13.5-28.5°C, 7.7-8.0, 5.6-6.5mg/l and 19-46 cm respectively.

Study on feeding ecology reveals that juveniles (5-10cm) were found to thrive on 58.7% of zooplankton, 25.1 of algae, 9.6% of insects, and 6.5% worms. The fishes of 10-20 cm in length contained in their food, 48.4% macrovegetation, 16.1% zooplankton, 22.5% algae, 104% insects and 2.5% worms. The gut contents of the species of above 20 cm in length had 71.1% vegetation, 4.1 zooplankton 21.8 algae, 2,2% insects and 0.24% worms. The young ones are zooplankton feeder whereas bigger fish are herbivores in feeding nature.

The growth performance of the pengba with and without Indian and Chinese carps at the stocking density of 15000no/ha was recorded, analyzed and presented in Tables 1&2.

Osteobrama belangeri

Table 1: Growth performance of *O. belangeri* in monoculture system

Species	Species ratio	Stocked weight (g)	Final weight (g)	Net weight (g)
Pengba	100	29	528	499

Table 2: Growth performance of *O.belangeri* in composite culture system

POND-1

Species	Species ratio	Stocked weight (g)	Final weight (g)	Net weight (g)
Rohu	10	23	542	519
Mrigal	10	21	626	605
Catla	10	17	574	557
Grass carp	10	9	2400	2391
Silver carp	25	6	962	956
Com.carp	15	9	550	541
Pengba	20	9	283	274

POND-2

Species	Species ratio	Stocked weight (g)	Final weight (g)	Net weight (g)
Rohu	15	23	480	457
Mrigal	15	17	630	613
Catla	6	18	574	556
Silver carp	15	5	962	957
Com. carp	15	8	484	476
Pengba	34	9	428	419

POND-3

Species	Species ratio	Stocked weight (g)	Final weight (g)	Net weight (g)
Rohu	10	21	480	459
Mrigal	15	13	630	617
Catla	15	20	597	577
Pengba	55	9	355	346

The study reveals that the medium carp, Pengba (*O. belengeri*) is promosing candidate species to be included in composite farming system. It attains marketable size within a year (>500g). The species being herbivore in feeding has competition with grass carp. Reduction in total stocking density, species combination of the cultivable carps in relation to Pengba, and judicious pond management practices, may help in its production and conservation.

4. Paddy-cum- fish culture in Manipur

Paddy-cum fish culture is quite popular in Manipur and more than 40,000 ha area is suitable for this type of culture. At present, 4-500 kg/ha is the production of common carp in paddy fields. The fish seed of carps in required quantity, lack of scientific knowledge are some major constraints. The demonstration programme was conducted for 90 days for 2 consecutive years 2008 and 2009 at 2 fields in each district of Senapati, Tamenlong, Ukhrul and Churachanderpur. Fields were prepared, fertilized, planted with rice KD-263 variety and a week after fry of Common carp were released @ 4000/ha in fields having 0.35-0.45 m water depth. No feed was used. Fishes grew 300-680 g. Less weight was recorded at higher density of 8-10000/ ha. Farmers earned profit @ 20-40 000/year/ acre.

5. Composite fish culture in manipur

Demonstration on carp farming was continued in 10 ponds in Ukhrul district of Manipur and like previous years the farmers applied the technique developed by DCFR and got a fish production @ 0.6-0.8 kg/ m^3. The success story was telecast on Doordarsan.

Project Title:	**Network Project on Fish Germplasm Exploration, Cataloguing and Conservation.**
Sub programme:	**Fish Germplasm Exploration in Middle and Upper stretches of Kosi River system in Kumaon Himalayas.**
Personnel	Ashok K. Nayak, P. C. Mahanta

- This project aims to explore the fish germplasm in middle and upper stretches of Kosi river system in Kumaon Himalayas.
- During the year under report, sampling was carried out at different stations in the stretches of Kosi River system mainly at Hawalbagh, Suyalbadi, Garampani and Ratighat.
- In the winter season, the water quality parameters like water temperature, pH, iron content, ammonia, chloride and phosphate etc. were collected and analyzed for each station.
- From these sampling data in the stretches of Kosi from Ratighat to Hawalbagh, it was calculated the water quality parameters such as water temperature ranges from 9.7 to 13.1 ^{0}C; pH from 7.3 to 8.3; ammonia from around 0.02 mg/l; chloride from 14 to 20 mg/l and phosphate from 0.47 to 0.56 mg/l.
- Regarding fish species, at Ratighat only 15 numbers of *Schizothorax richardsonii* were collected in the size of 8.0 to 16.0 cm having weight range of 4.0 to 32.6 g whereas in some stations no fish species was collected in the winter season.
- In summer season the water quality parameter ranges at the different stations are: water temperature from 24.0 to 28.0 ^{0}C; dissolve oxygen from 7.6 to 8.5 mg/l; pH from 7.5 to 7.8; chloride 4 to 6 mg/l; silicate around 1 mg/l; nitrate from 0.2 to 0.8 mg/l and phosphate from 0.2 to 0.3 mg/l.
- It was observed that during the same season in last year we collected the fish species as *Schizothorax* spp., *Barilius* spp. and *tor* spp., but this year we have only collected the *Schizothorax* spp. only.
- The GIS based fish diversity database is under preparation under the project.

Water receding in Kosi river system at Ratighat

Spatial data analysis with GPS

Project Title	Outreach Activity on Fish Feeds
Personnel	Yasmeen Basade, Debajit Sarma, Madan Mohan (upto June 2009), N.N. Pandey

Activity 1: Enhancement of larval growth and survival for production of quality seed of Himalayan mahseer

A. Culture Of Live Food Organisms- Rotifer Culture

In aquaculture great demand exists for live food organisms mainly zooplankton of suitable size for feeding the fish larvae. Rotifers are an excellent source of food for rearing fish fry. To begin the culture of the rotifers zooplankton samples were collected from the fish culture ponds of Bhimtal using plankton net (mesh size 80μ). The freshwater rotifer *Brachionus calyciflorus* was identified and isolated under binocular microscope with fine glass dropper. The isolated rotifer were maintained in a glass beaker and fed with *Chlorella vulgaris* which were raised in outdoor tanks using fertilizers (Urea: DAP: GOC::2:4:16).

1. Effect of inoculation size on rotifer population growth

Culture of rotifers was carried out in 5 l-culture vessels by feeding them with Chlorella ($2x10^6$ cells/ml) and the impact of inoculums size on growth performance was evaluated.

Growth performance

Culture of rotifers was carried out in 5 l-culture vessels by feeding them with Chlorella ($2x10^6$ cells/ml) and the impact of inoculums size on growth performance was evaluated. Freshwater rotifers were stocked at a density of 5, 10, 15, 20 and 30 ind./ml in a 5 l-culture vessel containing chlorella. The population growth of rotifers and water quality characteristics in the culture vessels was monitored daily. The maximum population density of rotifers was attained on fourth day and then after the rotifer population exhibited a declining trend. It was noted that with increase in inoculums size from 5 to 30 ind./ml the population density of rotifers increased being significantly higher for 30 ind./ml to the order of 155 ind./ml. However, the growth rate of rotifers remained similar for all the treatments in the range of 0.39-0.42. The above trial infers that to start the culture of rotifers an initial inoculums size must be about 20-30ind./ml.

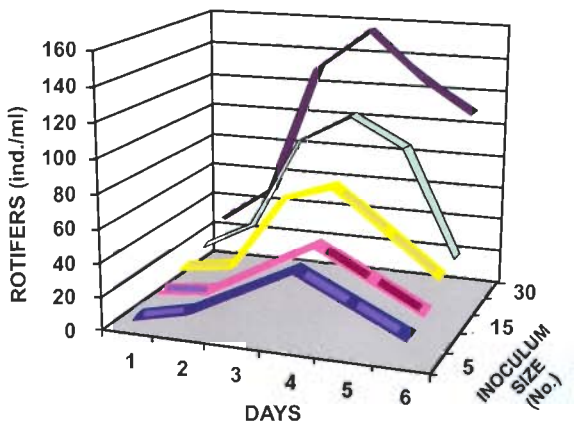


Fig. 1: Effect of initial stocking density on growth performance of freshwater rotifers

Water quality characteristics

During the rearing period the water quality characteristics in culture unit were monitored. The water quality characteristics were in the range of: water temperature 24.8-25.3°C; dissolved oxygen 3.69-4.92 mg/l; free carbon dioxide nil; pH 7.23-8.55; total alkalinity 132-146 mg/l; conductivity 402-

427 µs/cm; TDS 193.8-207mg/l; NH_4-N 0-3.94 mg/l; PO_4-P 2.0-3.0mg/l. Further, it was observed that for all the treatments with increase in population density of rotifers the dissolved oxygen level decreased; pH and total alkalinity increased; conductivity and TDS decreased; NH_4-N and PO_4-P increased. The variations in these parameters were more pronounced at higher inoculums size.

2. Effect of temperature on growth performance of freshwater rotifers

The growth performance of freshwater rotifers was investigated at three different culture temperatures (23, 26 and 29°C). Rotifers were cultured in 50L tanks and fed on *Chlorella*. To start with *Chlorella* was cultured in 50-l plastic tanks, filled up to 40 liters with ground water, using fertilizers (Urea: DAP: GOC::2:4:16). When Chlorella was in log phase of growth, *Brachinous calyciflorus* was inoculated in the Chlorella containing tanks @ 30ind./ml. The number of rotifers were counted on alternate days. The temperature, DO, pH, NH_3-N, PO_4-P, Free CO_2, total alkalinity, TDS and Conductivity were monitored in the culture system. Population growth rate (*r*) of rotifers was also calculated.

Growth performance and egg production of rotifers at different temperature

The growth performance of rotifers was studied under different temperature regimes namely, 23, 26 and 29°C. With increase in temperature the population density of rotifers increased reaching a maximum of 135±8, 258±7 and 347±10 ind./ml at 23, 26 and 29°C, respectively. The growth rate also increased from 0.188±0.01, 0.269±0.003 to 0.306±0.003 at 23, 26 and 29°C, respectively. Suggesting that a temperature of 29±1°C will be suitable for culture of freshwater rotifers. It was also observed that the number of eggs produced by

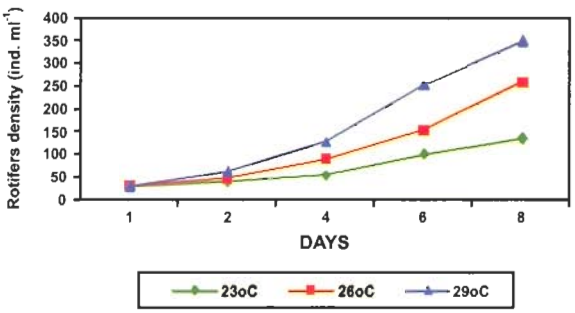


Fig. 2. Population density of rotifers at different water temperatures

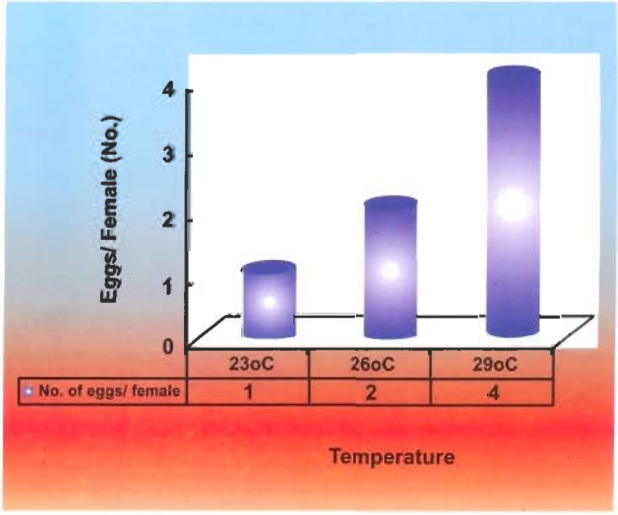


Fig. 3. Effect of temperature on egg production of rotifers

female rotifers also varied with temperature from one number per female at 23°C, two numbers per female at 26°C to four numbers per female at 29°C.

Water quality characteristics

The water quality characteristics varied during the trial for the different treatments. When culture was carried out at 23°C the range of water quality parameters were: water temperature 23.0-24.3°C, pH 8.56-9.47, dissolved oxygen 4.52-11.27 mg/l,

free carbon dioxide nil, total alkalinity 74-82mg/l, conductivity 292-404 µs/cm, TDS 140.2-194.9 mg/l, NH_4-N 0-3.15 mg/l and PO_4-P 1.5-5.35mg/l. At 26°C the range of water quality parameters were: water temperature 26.4-26.9°C, pH 8.64-9.72, dissolved oxygen 3.94-11.89 mg/l, free carbon dioxide nil, total alkalinity 74-86mg/l, conductivity 293-414 µs/cm, TDS 142.7-199.9 mg/l, NH_4-N 0-4.12 mg/l and PO_4-P 2.5-6.17mg/l. At 29°C the range of water quality parameters were: water temperature 29.3-29.9°C, pH 9.04-9.86, dissolved oxygen 2.25-12.55 mg/l, free carbon dioxide nil, total alkalinity 76-90mg/l, conductivity 299-432 µs/cm, TDS 145.9-208.4 mg/l, NH_4-N 0-4.70 mg/l and PO_4-P 3.0-6.19 mg/l.

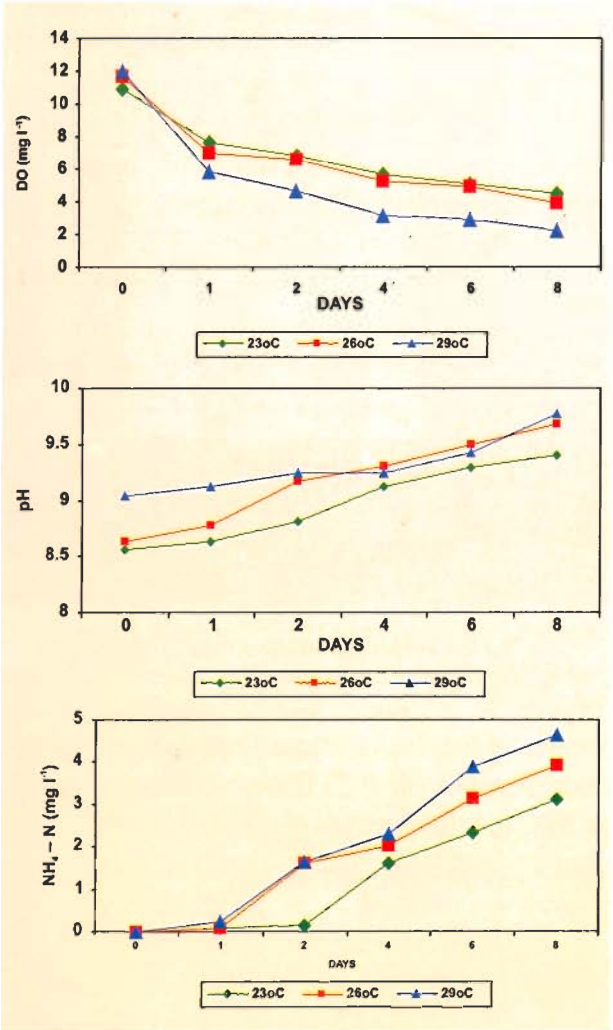


Fig. 4. Effect of temperatures on water quality characteristic of rotifer culture systems

The growth rate of freshwater rotifer and environmental changes (pH, DO, NH_4-N) in culture system at different temperatures revealed that the growth rate of rotifers significantly increased with increase in temperature. The maximum density of rotifers at 23°C was 135 ind. ml^{-1} and was significantly lower than those of rotifers at 26 and 29°C, which reached 258 and 347 ind. ml^{-1}, respectively, these values also significantly differed from each other. When the density of rotifers was highest at each temperature, the dissolved oxygen decreased to the levels of 4.52, 3.94 and 2.25 mg/l at 23, 26 and 29°C respectively. Thus, dissolved oxygen levels decreased with the progress of culture and decreased to a greater extent at higher temperature of 29°C. The pH also gradually decreased with time. NH_4-N levels increased with time and showed dramatic increase at high temperatures. NH_4-N levels at 23, 26 and 29°C were 3.12, 3.92 and 4.65 mg l^{-1}, respectively, when highest density of rotifers was attained.

B. Feeding live food organisms to Himalayan Mahseer larvae

Newly hatched golden mahseer larvae were obtained from Mahseer seed Production unit of DCFR, Bhimtal. After yolk sac absorption, the larvae (15DAH) were stocked at random in the rearing tanks each containing 40-L of water. Water was gently aerated with a single air stone. Stocking density in the rearing tank was kept at 100 larvae per tank. Initial larval total length (mean ± SEM) and average wet body weight were 12.33±0.33mm and

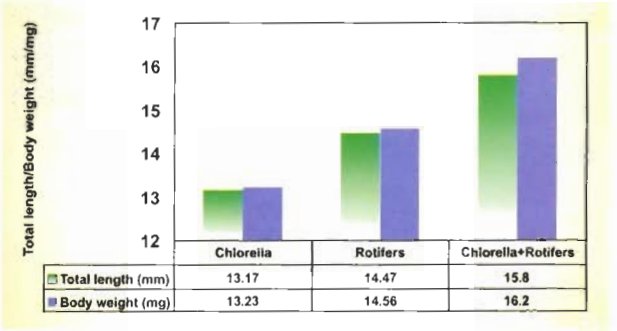


Fig. 5. Effect of different feeding regimes on growth performance of golden mahseer larvae.

12.5±0.17mg, respectively. Each day, just before feeding bottom debris was siphoned from every tank.

The experiment was performed under different feeding conditions: clear water rearing conditions with rotifers fed at a density of 10 individuals per ml, green water condition with Chlorella and green water in combination with clear water (10 rotifers ml^{-1}) up to 30DAH. There were three replicates per group. The number of fish was obtained by direct counting. Growth parameters were measured on days 15 and 30 post hatching. Fish length was measured to the nearest 0.1mm with the dissecting microscope equipped with ocular micrometer. For length measurement 20 larvae were collected randomly from each replicate. Survival of the larvae was recorded by counting the fish in the tank at the end of the experiment.

The best growth and survival was obtained in larvae fed green water and rotifer diet. The rapid loss of organic material from rotifers, which are deprived of food, is generally perceived as one of the main factors causing poor growth and high mortalities in fish larvicultures. This is probably the reason for the use of the green water by most larval culturist, which maintains the rotifers in a healthy nutritious state.

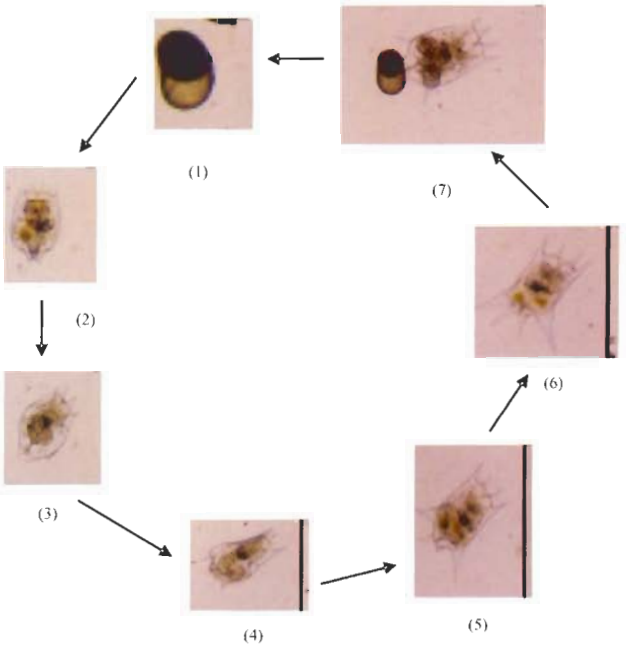


Fig. 6. Life stages of freshwater rotifer *B. calyciflorus*.

Activity 2:Development of growout feed of Chocolate Mahseer

Effect of Spirulina (*Spirulina platensis*) on Growth during growout period of Chocolate Mahseer (*Neolissocheilus hexagonolepis*)

Effect of *Spirulina platensis* on the growth and survival of Chocolate mahseer during its growout period (fry to fingerling stage) was studied for three months. Four isoproteic diets with 35% protein and different percentages of *Spirulina* (0, 3, 5 and 7%) were formulated and fed to the fishes in two equal instalments @ 5% of their body weight and performance were recorded. Highest weight gain (302) and lowest food conversion ratio (FCR 1.48) were recorded in case of 5% *Spirulina* fortified feed while, lowest weight gain (182%) and highest FCR (2.46) were recorded for control feed. The specific growth rate (SGR) was recorded highest (8.46%)

for 7% *Spirulina* containing feed and lowest (5.77%) for control feed. Comparing the cost of the formulated feeds, it was revealed from the study that 5% *Spirulina* fortified feed showed better growth performance, effective utilization of feed and maximum survival percentages.

Activity 3: Up-scaling of existing grow-out feeds and feeding practices in rainbow trout

A. Feed formulation and evaluation in respect to growth performance and survival of rainbow trout growout

Feeds were formulated with different levels of protein and lipid using the ingredients fish meal (Sterlised having >60% protein), roasted soybean flour, GOC, wheat flour, starch, fish oil, Brewer's yeast powder, linseed oil cake, dried milk and vitamin and mineral mixture.

1. Starter feed:

Starter feeds were formulated with three levels of protein (55, 50 & 45%) and two levels of lipids (14 and 16%). Trial was conducted at the Experimental fish farm, Champawat during March - May'2009 (60days). Fish (Av. Wt. 0.24g and Av. TL. 17mm) were stocked in FRP tanks (1x1x0.7m) at 1000 No./m^3 and fed with the experimental diets @ 10% of body weight 7-8 times a day. Water flow was maintained 10l/m

Above data revealed that the growth performance and nutrient utilization was better in fish fed with S3 diet having 50% protein and 14 % lipid.

2. Fingerling feed

Fingerling feeds were formulated with three levels of protein (40, 45 &50%) and three levels of lipids (14, 16 and 18%). Experiment was conducted in FRP tanks (1x1x0.7m) at the Experimental Fish Farm, Champawat during May-Sept.'2009 (120 days). Fingerlings (Av. Wt. 3.2g; Av. T.L. 78 mm) were stocked at 40 No./ m^3. Feeding was done with the experimental diets @ 5% of body weight 3-4 times a day. During the rearing period water flow rate was maintained at 2l/min.

Table 1: Growth performance and survival of rainbow trout fry fed with the experimental diets

Starter feeds	S1	S2	S3	S4	S5	S6
Protein /lipid (in %)	P55L14	P55L16	P50L14	P50L16	P45L14	P45L16
Growth performance						
Av. Initial weight (g)	0.25	0.24	0.25	0.26	0.22	0.25
Av. Final weight (g)	2.62	2.64	2.65	2.65	2.45	2.49
Av. Net wt. Gain (g)	2.37	2.40	2.40	2.39	2.23	2.24
Av. Initial length (mm)	18	17	18	18	16	17
Av. Final length (mm)	62	63	63	61	60	61
Survival (%)	72	70	78	76	80	76

Table 2: Feed utilization and carcass composition of rainbow trout fry fed with the experimental diets

Starter feeds	S1	S2	S3	S4	S5	S6
Protein /lipid (in %)	P55L14	P55L16	P50L14	P50L16	P45L14	P45L16
Feed and nutrient utilization						
FCR	2.48	2.44	2.45	2.88	3.45	3.56
Crude protein efficiency (%)	25	24	28	26	26	24
Crude lipid efficiency (%)	21	19	22	20	28	21
Carcass composition (%)						
Crude protein	18.38	17.80	18.46	17.90	17.98	17.54
Crude fat	4.132	4.336	4.104	4.398	4.134	4.245

Above data on growth performance and nutrient utilization revealed that feed F6 having 45% protein and 16 % lipid was better among all the test diets.

Table 5. Range of water quality characteristics of the rainbow trout rearing units during the study period (March- Sept.'2009)

3. Grower feed

Grow-out feeds (Floating pellets) were formulated with three levels of protein (50, 45 & 40%) and two levels of lipids (14 and 16%). Experiment is in progress in nursery raceways under outdoor condition at the Experimental Fish Farm, Champawat from Oct.'2009 and will be continue up to April'2010 (for 6 months). Advanced fingerlings of rainbow trout (Av. Wt. 76.4g; Av. T.L. 189mm) were stocked at 10 No./m3. Feeding is done with experimental diets (Floating feed) @ 3% of the body weight 3 times a day. Water flow rate is maintained at 2l/s.

Table 3. Growth performance and survival of rainbow trout fingerlings fed with the experimental diets

Fingerling feed	F1	F2	F3	F5	F6	F7	F7	F8	F9
Protein/Lipid (%)	P50 L14	P50 L16	P50 L18	P45 L14	P45 L16	P45 L18	P40 L14	P40 L16	P40 L18
Growth performance									
Av. Initial weight (g)	3.1	3.2	3.2	3.1	3.3	3.2	3.2	3.4	3.2
Av. Final weight (g)	64.2	70.9	69.2	64.0	71.1	68.0	57.4	60.1	58.0
Av. Net wt. Gain (g)	61.1	67.7	66.0	60.9	67.8	64.8	54.2	56.7	54.8
Av. Initial length (mm)	78	80	78	76	80	77	78	81	78
Av. Final length (mm)	185	188	185	183	187	186*	172	176	175
Survival (%)	82	80	84	78	84	82	68	76	66

Table 4: Feed utilization and carcass composition of rainbow trout fingerlings fed with the experimental diets

Fingerling feed	F1	F2	F3	F5	F6	F7	F7	F8	F9
Protein/Lipid (in %)	P50 L14	P50 L16	P50 L18	P45 L14	P45 L16	P45 L18	P40 L14	P40 L16	P40 L18
Feed and nutrient utilization									
FCR	3.14	2.90	3.18	2.94	2.88	3.12	3.24	3.12	3.50
CPE (%)	25	24	23	22	26	24	20	23	21
C FE (%)	26	25	22	24	28	26	27	29	24
Carcass composition (%)									
Crude protein	17.44	17.62	17.46	17.42	17.52	17.14	16.62	16.82	16.18
Crude fat	6.158	6.336	6.624	6.145	6.246	6.434	6.122	6.278	6.298

Advanced fingerlings after a rearing period of four months grew to a size of 150-171g (232-242mm) and further rearing is being continued.

Table 5. Range of water quality characteristics of the rainbow trout rearing units during the study period (March- Sept. 2009)

Month	Water temp. (^{0}C)	DO (mg/l)	Free CO_2 (mg/l)	pH
March	7.0-14.5	7.6-9.0	0.6-1.2	8.0-8.2
April	13.0-17.5	5.4-8.6	1.8-2.4	8.0-8.2
May	15.5-22.5	5.4-8.2	1.8-2.8	8.0-8.4
June	18.5-21.5	5.4-8.2	2.0-2.6	8.0-8.4
July	18.0-20.5	6.2-8.8	1.4-1.8	8.0-8.2
August	18.0-21.5	5.0-8.8	2.0-2.2	8.0-8.2
September	18.5-20.5	6.8-9.2	0.6-1.2	8.0-8.2

Table 6. Growth performance and survival of rainbow trout advanced fingerlings fed with the experimental diets (up to Feb. 2010)

Grow-out feed	G1	G2	G3	G4	G5	G6
Protein/Lipid (in %)	P50L14	P50L16	P45L14	P45L16	P40L14	P40L16
Growth performance						
Av. Initial weight (g)	75.2	74.6	68.6	76.2	72.5	74.1
Av. Initial length (mm)	192	189	186	198	190	190
Av. Final wt. (g)	164	171	162	165	150	156
Av. Final length (mm)	240	242	236	240	232	234

Rainbow trout advanced fingerlings being reared in nursery raceways at Experimental Fish Farm, Champawat

Project Title	Nutrient profiling and evaluation of fish as a dietary component
Personnel	Debajit Sarma and N. N. Pandey

Fish is an important component of human diet and more than half of India's population is fish eating. Fish is widely recognized as a health food by virtue of its richness in essential amino acids, minerals, trace elements and low fat content. Rich in PUFA, fish adds nutritional value by preventing and fighting cardiovascular ailments. Coldwater fishes like trout, mahseer may contain high PUFA compared to other warm water fishes. Under this project an attempt has been made to record the nutritional profile of the important coldwater fishes in respect to different agro climatic conditions.

The basic objectives of the project are, 1) to study nutrient profiling in terms of proximate composition, fatty acids, amino acids, selected vitamins and trace elements of *Tor putitora, Neolissochilus hexagonolepis, Schizothorax richardsonii, Oncorhynchus mykiss* and Common carp, 2) assessment of edible fishes, their consumption rate and pattern by different sections of fish eating population, 3) Clinico-epidemiological studies on general health profile of population to correlate the fish intake and "Low Birth Weight" of children (in collaboration with qualified physicians and /or NGOs) in the states of Uttarakhand, Assam, Meghalaya, Arunachal Pradesh, 4) Feeding trials with help of human nutritionist/experts in the field.

Fish samples were collected from Bhimtal, Champawat fish farm, Kosi River, Nandprayag, Bairangna of Uttaranchal and Patikuhal, Kangra of Himachal Pradesh. The results of the present study is showing that moisture content ranging from 70.09-83.03%, protein 14.34-22.50 %, crude fat 1.21-9.22 %, ash 0.227-2.882 %. In fish muscle, minerals like Na- 58-404(mg%), K- 609-1520 (mg%) and Ca- 209-508 (mg%) is present. Golden mahseer collected from the Kameng river has significantly higher concentration of selenium (1.56 mg/100gm), whereas, from Kosi river has significantly higher concentration of iron (1.28 mg/100 gm) and moderate estimates of manganese and zinc (0.16 and 1.19 mg/100 gm) respectively. The results also

Photographs of sample analysis at DCFR, Bhimtal and CIFA, Rahara

showed that 16 essential amino acids were present in fish muscle. The major amino acids were aspartic acid (7.606%), glutamic acid (9.631%), proline (6.684%), glycine (7.456%), leucine (7.585%), and lysine (9.411%). Levels of different amino acids were ranging from 0.482-9.631%.

Project Title **Fish Genetic Stock**

Personnel A. Barat, Prem Kumar, G.K. Sivaraman, R.S. Haldar

Sample collection

A total of 109 Mahseer (Tor putitora) samples were collected from four locations during 2009. Sampling efforts during this reporting period began in April 2009 from Arunachal Pradesh-Assam, in May 2009 from Uttarakhand and in September 2009 from Himachal Pradesh.

Details of sample collection

- Thirty-six *Tor putitora* (Mahseer) samples were collected from river Jia Bhorelli, Bhalukpong Arunachal Pradesh-Assam. The Scale, fin and muscles samples were collected from all the fish samples for DNA isolation. Individual fishes were photographed.
- Forty-three fin samples were collected from river Kosi, Ramnagar, Uttarakhand
- Ten fin samples were collected on 24-09-09 from a tributary of River Bias (near Jogindernagar), Himachal Pradesh.
- Twenty fin samples of the same species were collected from river Sutlej,near Bhakara, Himachal Pradesh on 25-09-09 .

Achievements

- All the individual fishes were digitized for Truss morphometric study. Length and weight of each individual were measured. Scales were collected from three different locations of body parts i.e., dorsal, lateral and ventral of each individual.
- Genomic DNA was isolated from preserved fin and muscle tissues using standard phenol-chloroform extraction protocol.
- Quantitative and qualitative estimation of the genomic DNA was carried out by UV -VIS spectrophotometer at 260 & 280 nm and also using 0.8% Agarose gel electrophoresis.

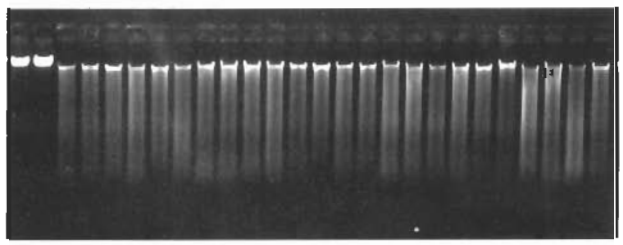


Fig: Genomic DNA

Amplification of Cytochrome b gene

Initially, a set of primers for cytochrome b with an expected product length of about 307 bp were used for PCR amplification of 25ng genomic DNA

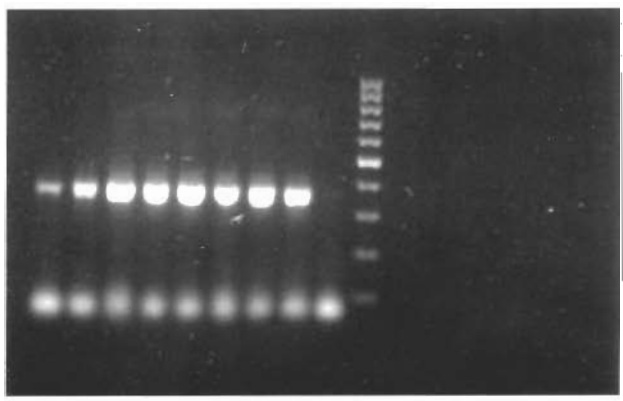


Fig. Amplification of Cytochrome b (307 bp)

isolated from three different populations of Kosi River (near Manan), Bhimtal lake and Punn river, near Palampur, Himachal Pradesh. The PCR products were column purified and sequenced commercially.

Cytochrome b (307 bp) gene sequence

Cytochrome b gene of *Tor putitora* (Manan):

TCTTTTTTGGGATCCTTTTAGGGT
TATGCTTAATCACTCAAATCCTAACCGGAC
TATTCCTAGCCATGCACTACACCTCAAA
CATCTCAACTGCATTCTCATCAGTAAC
CCACATCTGCCGAGACGTAAACTATGG
ATGACTAATCCGCAATATTCATGCTAACGG
AGCATCATTCTTTTTTATCTGCATTTATAT
GCACATTGCCCGAGGCCTATACTATGG
ATCCTACCTGTACAAAGAAACCTGAAA
CATCGGAGTAGTCCTTCTACTACTGGTCATA
ATAACAGCTTT CGTCGGCTATGTTCTC
CCATGAGGACAAATA TTATTTCTGAGGG
GTTAAAATATAAAAAG

Cytochrome b gene of *Tor putitora* (Bhimtal)

CCTTCTTATGAGATCC
TTTTTAGGGTTATGCTTA
ATCACTCAAATC CTAACCGG
ACTATTCCTAGCCATG CAC
TACACCTCAAACATCTC
AACTGCATTCTCATCAGT
AACCCACATCTGCCGAG
ACGTAAACT ATGGATGACT
AATCCGCAATATTCATGC
TAACGGAGCA TCATTCTTT
TTTATCTGCATTTATAT
GCACATTGCCCGAGGCCTA
TACTATGGATCCTACCTG TA
CAAAAAAACCTGAAACAT
CGGAGTATTCCTTCTACTA
CTGGTCATAATAACAGCTT
TCGTCGGCTATGTTCTCCCATGAG
GACAAATA TCATTCTGAGGGGCTGCATT
TAAATAG

Cytochrome b gene of *Tor putitora* (Himachal Pradesh):

CGTTGTTGGGGGATCCCTTTTTTAG
TGTTTAGGCTTAATCACTCAAATCCTAAC
CGGACTATTCCTAGCCATGCACTCCCC
CTCAAACATCTCAACTGCTTTCTCATC
AGTAACCCACATCTGCCGAGACGTAA
ACTATGGATGACTAATCCGCAATATT
CATGCTAACGGAGCATCTTTCTTTTT
TATCTGCATTTATATGCACATTGCCC
GAGGCCTATACTATGGATCCTACCTGAAC
AAAAAAACCTGAAACATCGGAGTATTCC
TTCTACTACTGGTCATAATAACAGCTTTC
GTCGGCTATGTTCTCCC

ATGAGGACAAATATCATTCTGAGGGG
CTGAAATAAAAAG

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CLUSTAL 2.0.12 multiple sequence alignment

Bhimtal     TCTCTTTTGGAAA----CCCTTTTAGGTTTATGCTTAATCACTCAAATCCTAACCGGACT 56
Himachal    TCCCTTTTTGAAGAATCCCTTTTTAGGGTTATGCTTAATCACTCAAATCCTAACCGGACT 60
Manan       CCCTTTTTTGGGA---TCCTTTTTAGGGTTATGCTTAATCACTCAAATCCTAACCGGACT 57
             *  **** *       ** ******* ********************************

Bhimtal     ATTCCTAGCCATGCACTACACCTCAAACATCTCAACTGCATTCTCATCAGTAACCCACAT 116
Himachal    ATTCCTAGCCATGCACTACACCTCAAACATCTCAACTGCATTCTCATCAGTAACCCACAT 120
Manan       ATTCCTAGCCATGCACTACACCTCAAACATCTCAACTGCATTCTCATCAGTAACCCACAT 117
            ************************************************************

Bhimtal     CTGCCGAGACGTAAACTATGGATGACTAATCCGCAATATTCATGCTAACGGAGCATCATT 176
Himachal    CTGCCGAGACGTAAACTATGGATGACTAATCCGCAATATTCATGCTAACGGAGCATCATT 180
Manan       CTGCCGAGACGTAAACTATGGATGACTAATCCGCAATATTCATGCTAACGGAGCATCTTT 177
            ************************************************************ **

Bhimtal     CTTTTTTATCTGCATTTATATGCACATTGCCCGAGGCCTATACTATGGATCCTACCTGTA 236
Himachal    CTTTTTTATCTGCTTTTATATGCACATTGCCCGAGGCCTATACTATGGATCCTACCTGTA 240
Manan       CTTTTTTATCTGCTTTTATATGCACATTGCCCGAGGCCTATACTATGGATCCTACCTGTA 237
            ************ ************************************************

Bhimtal     CAAAAAAACCTGAAACATCGGAGTATTCCTTCTACTACTGGTCATAATAACAGCTTTCGT 296
Himachal    CAAAAAAACCTGAAACATCGGAGTATTCCTTCTACTACTGGTCATAATAACAGCTTTCGT 300
Manan       CAAAAAAACCTGAAACATCGGAGTATTCCTTCTACTACGGGTCATAATAACAGCTTTCGT 297
            ************************************ ********************

Bhimtal     CGGCTATGTTCTCCCATGAGGACAAATATCATTCTGAGGGGCTGCAATTAATTG-- 350
Himachal    CGGCTATGTTCTCCCATGAGGACAAATATCATTCTGAGGGGCTGCATTTAATAGTG 356
Manan       CGGCTATGTTCTCCCATGAGGACAAATATCATTCGGAGGGGCTGCAATTAAAAAA- 352
            ********************************** ********** ****
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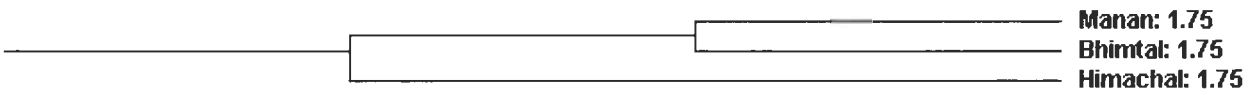
Two clusters were found among three populations:



The above sequences were obtained through direct sequencing of purified PCR products using Cyto b gene primers (F'-AAAAGCTTCCA TCCAACATCTC AGCATGATGAAA and R'-AAACTGCAGCCCCTCAGAATGATATTTG TCCTCA), the expected product length 307 bp. Amplification profile was 95°C for 5min as initial denaturation, followed by 35 cycles comprising 94°C for 30 sec, 54°C for 30 sec (ann. temp.) and 72°C for 1 min and 72°C for 10 min as final extension. The expected product size excised from 1.2% Agarose gel and purified by Qiagen gel extraction kit. Six PCR products of each populations (e.g., Manan, Bhimtal and Himachal Pradesh) were sequenced (Ocimum Biosolution, Hyderabad). The above sequences were analysed using NCBI BLAST and confirmed the respective gene. Another set of primers for Cyt b was designed to achieve larger product (1140bp) consisting F'-TGACTTGA AAAACCACCGTTG and R'-CTCCGATCTC CGGATTACAAGAC.

Mitochondrial gene, cytochrome b (cyt b) about 1140 bp size has been successfully amplified at 94°C for 30sec, 57°C for 1min and 72°C for 1 min 30 sec from four populations i.e. Bhalukpong (Jiabhoreli), Jogindernagar (River Beas), Bhakara (River Sutlej) and Ramnagar (River Kosi).

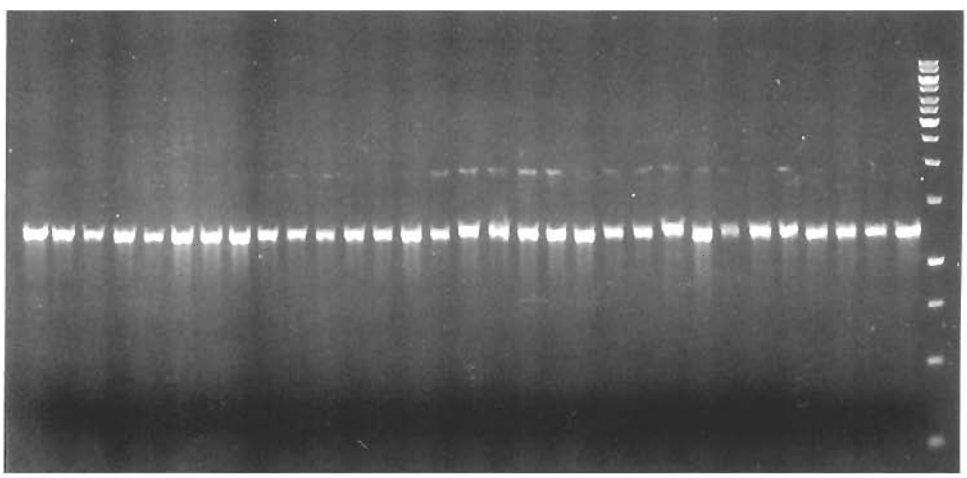


Fig. Cytochrome b (1140 bp)

OUTREACH ACTIVITIES WITH FIVE HILL STATES

Project Title	**Sustainable utilization of mountain fishery resources – A partnership mode**
Personnel	Madan Mohan, K.D. Joshi, D. Sarma, N.N. Pandey, Prem Kumar, A.K. Nayak, R.S. Haldar, A. Barat

During the year the Directorate organized a review workshop at Bhimtal on 26-27th October 2009 to evaluate the progress made in the last year and finalized the proposed work component and budgetary allocations for the year 2009-10. The major activities under the project during the period were inventorization of a upland river in Kashmir, study on biotic structure of a rivulet in Himachal Pradesh, selection of study site in Uttarakhand, conducted limnological studies in some rivers in Sikkim, reared rainbow trout juveniles to develop brood stock at Sergoun hatchery in Arunachal Pradesh.

An overall view of the opportunities, challenges, major constraints faced in the region, brief account of the progress made by the partners during 2008-09 and future work programmes was presented during the review workshop conducted at Bhimtal. It was also highlighted the integrated sport fishery based entrepreneurship model and emphasized the need for its replication in the hill region in the Outreach Workshop.

Himachal Pradesh

Director CIFT and Director DCFR constituted the following team to visit Kullu valley and submit a proposal which the Director of Fisheries, Himachal Pradesh can use for preparing a proposal in the format for submission to a suitable funding agency.

1. Dr. M.K. Mukundan, Principal Scientist & Head, QA&M Division, CIFT, Cochin
2. Dr. T.K. Srinivasa Gopal, Principal Scientist & Head, FP Division, CIFT, Cochin.
3. Dr. Madan Mohan, Principal Scientist, DCFR, Bhimtal

Meeting at private farm site

Meeting at Trout Farm site, Patlikuhal, Govt. of H.P.

Visit of Dr. S. Ayyappan at Trout Fish Firm, Patlikuhal

Meeting with Dr. S. Ayyappan at Patlikuhal

4. Dr. A Barat, Sr. Scientist, DCFR, Bhimtal
5. Dr. Prem Kumar, Sr. Scientist, DCFR, Bhimtal

The above team of experts visited the trout farms and hatchery under the Fisheries Directorate, HP as well as some private farms in Kullu valley on 27th May of 2009. The team assessed the production capacity, possible daily harvest as on today and after 5 years. The team also discussed and evaluated the major infra structure deficiencies for further development of trout farming in the Himalayan Region.

The following officials from Department of Fisheries, HP attended the discussion.

Shri B.D. Sharma, Director of Fisheries (Govt. of Himachal Pradesh)

Shri R.P. Dogra, Dy. Director of Fisheries (Govt. of Himachal Pradesh)

In the second meeting over this issue headed by Dr. S. Ayyappan, the DDG (Fisheries), ICAR, during 30-31 July 2009 the following scientists attended the meeting at Patlikuhal.

- Dr. K. Gopakumar, Ex DDG, Fisheries
- Dr. T.K. Srinivasa Gopal, Principal Scientist & Head, FP Division, CIFT, Cochin.
- Dr. C.N. Ravishankar, Sr. Scientist, CIFT, Cochin
- Dr. K.D. Joshi, Principal Scientist, DCFR, Bhimtal
- Dr. Prem Kumar, Sr. Scientist, DCFR, Bhimtal

In the discussion with the Fisheries department and farm owners it became clear that the farmers are facing a problem of slump in the prices of farmed trout. Currently the price of trout on an average is Rs.200/ Kg at farm site in HP. Any increase in trout production will be leading to reduction in price, simply because there is no easy availability of ice, packing materials, suitable insulated transport facilities, cold/ chilled storage etc. There is also no fish processing facility of any sort within a radius of 1000 kms. Under this situation even though several entrepreneurs are ready to take up trout farming, the present tempo of farming will face serious setbacks if the authorities failed to provide a facility for processing and marketing the increased quantity of farmed trout. In fact to avoid price reduction the farmers are resorting to stunting the growth of trout by restricting feed so as to enable delayed harvest.

The installed capacity of the proposed trout processing plant will be 1.5 tons per day, out of which 1 Ton for Individually Quick Frozen whole gutted trout for Export and 500 Kg. for chilled whole gutted trout for domestic market.

The detailed proposal on setting up a processing plant at Patlikuhal has been prepared and handover to State Fisheries Department, HP for submitting to National Fisheries Development Board (NFDB).

Uttarakhand

- Successful rearing of rainbow trout fingerlings, development of broodstock and breeding of rainbow trout were done.
- Health management issues were taken up and samples were collected for the disease diagnosis.
- Brood stock of Rainbow trout/ brown trout – 570nos. (size-700gm.-1000gm), Yearlings - 3100 (size-110-350gm) are maintained at state fish farm.
- Successful breeding of Rainbow trout/ brown trout were completed and produced 2,20000 eyed ova and 150,000 fry with 84% fertilization, 86% hatching. (Incubation period 61 days) at water temperature 4-11°C. It was 20 % higher than the previous (2008-09) year with better breeding performance of the brooder

Jammu & Kashmir

- The outreach partner, Faculty of Fisheries, SKUAST, Srinagar has conducted survey work of the different natural water bodies in the Jammu and Kashmir State mainly at Akhnoor (Chenab River), Tawi River, Ravi River, Ujj River, Lidder River.
- Different physico chemical parameters were measured for all the surveyed sites.
- In order to assess the fisheries resources, the satellite images of IRS LISS III for the current year were procured form the NRSC, Hyderabad.

Sikkim

- During the period under report, few places of river belt namely Melli Tista, Bardang-Tista, Sigtham Rani Khola were surveyed. Water samples from fishing location and sample of fishes were collected from fisherman. The identification of different available fish species and their physical parameter is done in the laboratory.
- The environmental temperature in the river bank ranged between 22 0C to 29 0C and the water temperature observed at the fishing location is 17 -19 0C. Water is alkaline in nature and pH value ranged from 7.7 to 8.1. The alkalinity of water equivalent to calcium carbonate is 6 to 8 mg/l. Dissolved oxygen measured in the river water was 5.76 to 10.94 mg/l. The free carbon dioxide ranged between 0.8 to 1.76 mg/l. The average total dissolved solid (TDS) value observed is 47.15 ppm. *Neolissocheilus hexagonolepis* is the predominant species followed by *Schizothorax richardsonii* were recorded during the survey.
- Under the work schedule of one of this Institute's Consultancy contract with the LANCO Energy Private Limited, Mazitar, Sikkim the suitable site has been finalized for establishment of mahseer hatchery after proper survey of the site jointly by Directorate Scientists and the LANCO Officials. After the finalization of the site, the lay

Activities at Shergaon Trout farm, Arunachal Pradesh

Activities at Nuranang Trout farm, Arunachal Pradesh

out design and budget estimate for construction of mahseer hatchery have been made for the proposed hatchery for seed production of Himalayan mahseer, *Tor putitora* (Ham.) under Teesta stage- VI Hydro Electric Project, Sikkim.

Arunachal Pradesh

- Modification of trout hatchery at Shergaon and Nuranang has been done. Breeding and rearing of Brown Trout has been carried out during 2008-2010 successfully. 20,000 seeds were produced in the farm. Hatchery produced seeds were reared in the farm and also ranched in the high altitudinal lakes and rivers of Arunachal Pradesh.
- 10,000 nos. of rainbow trout eyed ova were transported from J&K to Arunachal Pradesh and reared at Shergaon trout farm. The survival percentage of hatching and rearing was quite good under the agro climatic conditions of the farm.
- The exploratory survey on commercially important species as well as indigenous species of coldwater regions inhabiting in high altitudinal lakes and rivers of Arunachal Pradesh were carried out for bio-ecological studies and conservation.

Sampling at Shella Lake, Arunachal Pradesh

Project Title	**Enhancement of livelihood security through sustainable farming systems and related farm enterprises in North-West Himalaya** (An ICAR-NAIP Project under Component-3 "Sustainable Rural Livelihood Security")
Presonnel	Prem Kumar

The following Polytanks were stocked with Silver carp, Grass carp and common carp during March-April 2009 with a density of 3 fingerlings per cubic meter as 20% Silver carp, 40% Grass carp and 40% common carp.

Cluster	No of Tank	Total Volume (cubic m)
Dharauj	8	900
Mudyani	2	300

During one year following growth range of fish was observed:

Species	Length (mm)	Weight (gm)	Average Weight (gm)
Silver Carp	275-350	200-360	298
Grass carp	185-340	160-800	363
Common Carp	140-255	145-255	211

On an average about 691 gm per cubic meter growth was observed and a 67 % survival rate was observed.

Water Quality Parameters

Cluster	Water temp (°C)	pH	DO (ppm)	FCO_2 (ppm)	Alkalinity
Dharauj	6-28	7.5-8.5	6.0-10.4	0-2	46-74
Mudyani	7-30	7.4-7.7	7.0-11.0	0-2	36-54
Makot	12-32	7.7-8.5	4.0-7.6	2-4	48-76

Monitoring water quality parameter

Periodical sampling in polytank

Fish Sampling

Target

- Five new Polytanks in Dharauj and one tank in Mudyani with total volume of 465 m^3 are constructed in this quarter would be stocked with suitable fish fingerlings as they are ready with water filling.
- Sampling on water quality and growth will be carried out.
- Locally available feed ingredients will be assessed for feeding.

Project Title	**NAIP- Bioprospecting of genes and allele mining for abiotic stress tolerance**
Personnel	A. Barat, G.K. Sivaraman (upto 25th March, 2010)

The targeted objectives under this project were, 1) Generation of genomic resource base to facilitate gene prospecting and allele mining, 2) Prospecting for new genes and alleles for abiotic stress tolerance.

Under the first objective, we surveyed several rivers, streams and lakes of high, mid and low altitude Himalayas in the states of Himachal Pradesh, Jammu & Kashmir, Sikkim and Uttarakhand and collected live individuals for sampling of different tissues. Some live samples of snow trouts, rainbow and brown trouts are also under observation and monitoring in our farm at Champawat.

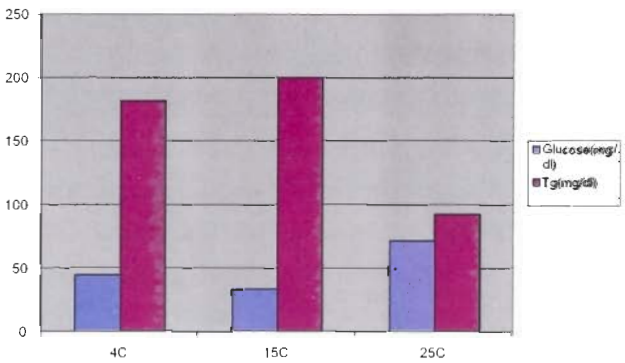
We also tried to study the effect of different temperatures (4-26°C) induced at laboratory environment using some physiological parameters like glucose and triglyceride *Schizothorax richardsonii*.

The experiment was designed in glass aquarium with 20 liter fresh water. Each tank occupied by 10 juvenile fishes of *Schizothorax richardsonii* of different size (5 cm to 15 cm). One tank was maintained in cold temperature 4 - 5°C by adding ice flakes, second tank was maintained in ambient seasonal (February) temperature 13 - 15°C and third tank was maintained from 25 - 26°C by a heat thermostat. Fishes were allowed to acclimatize to their respective temperature from 8 February 2010 to 11 February 2010 under proper aeration. Fishes were fed with adapted feed and dissolved oxygen; pH was checked once in a day. During the experiment, activities of fishes in different tanks were also observed through operculam movement per minute and feed uptake was also recorded in each day. Blood sampling was carried out after 96 hrs by anaesthetizing each fish using MS222 from caudal blood vessel using heparinized 1 ml syringe. 500µl of blood could be collected, centrifuged at 4000 rpm for 10 minute. Plasma was transferred to 1 ml eppondroff tube and stored at -80°C until analysis. Triglyceride was estimated using TG Kit (Autospan) at the wavelength of 520nm. and glucose level was estimated following OT sugar Kit (JN Mitra Corporation) at 770nm wavelength using colorimetric detection.

Challenge test for temperature tolerance

After analysis the triglyceride level at temperature 4 - 5°C, 13 - 15°C and 25 - 26 ° C were 181.8 mg/dl, 199.9 mg/dl and 92.35 mg/dl respectively. The glucose level at temperature 4 - 5°C, 13 - 15°C and 25 - 26°C is 44.4, 33.3 and 71.5 respectively. In general stress causes a relative hyperglycemia of variable extent and duration. Blood glucose levels

are often cites as being a sensitive physiological indicator of stress in fish. In the present study it was also observed the higher glucose level at 25-26°C than 4-5°C. The lowest was observed at 13-15°C. It was observed that the level of triglyceride and glycerol was inversely proportional to each other. Due to stress the level of Glucose falls whereas level of triglycerides rises. In this preliminary short-term experiment we observed that the species under study were more comfortable at 13-15°C. They were under severe stress (though it was not lethal) at 25-26°C and little stress at 4-5°C, which was also evident through the operculam movement, which was found to be highest in the fishes at 25-26°C than at 13-15°C and 4-5°C. It would be very early to conclude now that there is some cold adaptation in *Schizothorax richardsonii* because the experiment is underway using some more physiological parameters with both short term and acute stress condition.



Variation of Glucose and Triglycerides in stress condition

Under second objective, a partial amplification of uncharacterized Cold stress protein gene in the liver of *Schizothorax richardsonii* (Indian snow trout) was tried to isolate and characterize AFP gene from available known genes of winter flounder, rainbow smelt, Atlantic herring and Ocean eelpout.

Proteins interacting with the biological information molecules DNA and RNA play important cellular roles in all organisms. One widespread super family of proteins implicated in such function(s) is cold stress proteins (CSP). Cold environments on Earth are actually much more common than hot ones. The oceans, which make up over one half the Earth's surfaces, maintain an average temperature of about 2°C and vast landmasses are intermittently cold and in some cases permanently cold or even frozen. However, cold temperatures are no barriers to aquatic life, as various trout fishes flourish in cold environments. *Schizothorax richardsonii* (snow trout) species prefer thermal regime between the snowmelt waters of the Himalayas and slopes of Western Ghats in the high altitude of above 1500m. The thermal regime provides hope for an identification of cold stress protein genes in *Schizothorax richardsonii*.

Sample Collection

Liver, Fin, Brain, Heart, Spleen, Kidney, Intestine, muscles samples from live Snow trout (*Schizothorax richardsonii)*, rainbow trout (*Oncorhynchus mykiss*) and brown trout (***Salmo trutta***) were collected in RNAlater Solution (Ambion) from different locations (Jogindernagar and Patlikulh, Himachal Pradesh), Alaknanda river and Kosi River (Uttarakhand) in varying temperature. The tissue samples were brought in RNAlater solution and stored at -80 àC.

RNA extraction

The sequential steps followed are listed below: For RNA Isolation, about 100 mg of the sample were weighed, sterilized with DEPC treated water three times to remove dust and other contaminants. They were then transferred to mortar and pestle with the

help of spatula and homogenized in 1 ml of ice-cold Trizol reagent (Ambion). Proper grinding was done because it would have affected the quality of RNA isolated. The resulting homogenates was transferred to a 2ml eppendorf's using broad mouth pipette tips and were incubated for 5 min at room temperature to permit complete dissociation of nucleoprotein complexes. After incubation, the samples were centrifuged at 12,000 rpm for 10 min at 4°C. The supernatant was removed with the help of pipette tip and transferred to 2 ml eppendorf's tubes. After transfer of supernatant, 0.2ml of chloroform per ml of Trizol reagent was added in each tube and the samples were mixed by vigorous vortexing. The samples were then incubated at room temperature for 15 min and then centrifuged at 12,000 rpm for 15 min at 4°C. Three layers were formed out of which the upper colorless aqueous layer containing RNA was removed and transferred to a 2ml eppendorf's containing 500 µl Isopropanal per ml of Trizol reagent for RNA precipitation. The samples were incubated at room temperature for 10 min. and then centrifuged at 12,000 rpm for 10 min at 4°C. The supernatant was discarded and the RNA pellet was given a washing with 1ml of 75% ethanol per ml of Trizol reagent at least three times with gentle tapping. The samples were then centrifuged at 12,000 rpm for 5 min at 4°C to concentrate the pellet. Ethanol was discarded and the tubes were kept at room temperature for drying. On complete drying 100 µl DEPC treated water was added to dissolve the RNA.

RNA Quantification

The Spectrophotometer (Thermoscientific England) was first calibrated to zero absorbance using 1 ml DEPC treated water. The equipment exhibited zero absorbance. Then the different samples were analysed for RNA quantification.

First Strand cDNA Synthesis by Reverse Transcriptase PCR

The cDNA was synthesized by using High-Capacity cDNA Reverse Transcription Kit (Applied Biosystem, USA). Master Mix was prepared for RT-PCR reactions. The reaction components were added to PCR tubes kept on ice. The master mix was dispensed into thin walled 0.2 ml PCR tubes at 20µl volume per tube. After dispensing the master mix, 10 µl RNA (100 ng / µl) from each sample was dispensed. The final reaction volume had 1X RT PCR buffer 100mM dNTP, and 2 µl of RT random primers, 1 µl l of Multiscribe Reverse transcriptase and 100 ng/ ul of RNA per PCR reaction. PCR tubes were placed inside the thermal cycler (Eppendorf, Germany) with heat lid technology and the PCR machine was run at the following parameters, 25°C for 10 min; 37°C for 2 hrs, and 85°C for 5 min.

PCR amplification

Initially few sets of primers specific for different types of AFP were designed from NCBI GENBANK. All the related sequences of Winter flounder, Rainbow smelt, Atlantic herring and Ocean eelpout were downloaded and aligned using CLUSTLW. Some 14 primer sets were designed using PRIMERBLAST, NCBI and DNASTAR. The synthesis of primers was obtained from OPERON, Genetix Biotech Asia Pvt. Ltd, India. Among 14 primer sets, one primer set CT-04 F-R produced specific amplicons.

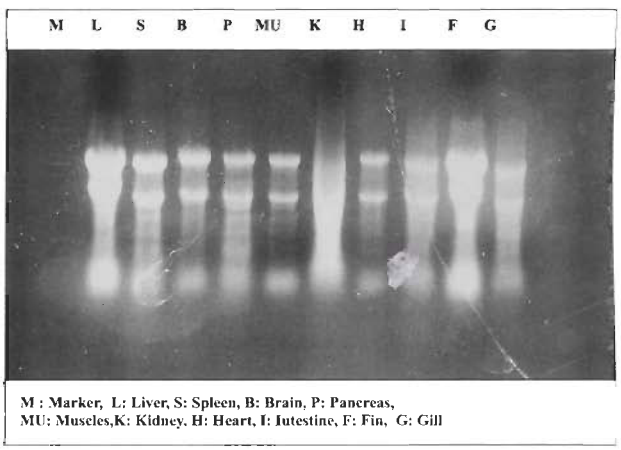
Master Mix was prepared for PCR reactions with CT - 04 primer (CT-04 F- ATG AAG TCA GTT GTT TTA ACT GGT TTG CTG, CT-04 R- TTG ACA TAC GGA CAG ACT TGG GTT TGT

GAC) and accordingly different PCR components were taken. The reaction components were added to PCR tubes kept on ice. The master mix was dispensed into thin walled 0.2 ml PCR tubes at 20ul volume per tube. After dispensing the master mix, 2µl cDNA from each sample was dispensed. The final reaction volume had 1X PCR buffer, 200 mM dNTP, and 25 picomoles of primer 1U of Taq DNA polymerase and 2 µl of cDNA per PCR reaction. PCR tubes were placed inside the thermal cycler (Eppendorf, USA) with heat lid technology and the PCR machine was run at the following parameters. 95°C for 4 min; 30 cycles at 95°C for 1 min, 60°C for 1 min, and 72°C for 3 min; and a final extension at 72°C for 7 min. PCR products were subjected to agarose gel (1.2% [w/v]) electrophoresis in 1X TBE buffer, along with DNA markers (Banglore Genie, India) as size markers. DNA was stained with Ethidium Bromide and photographed under UV light.

Results

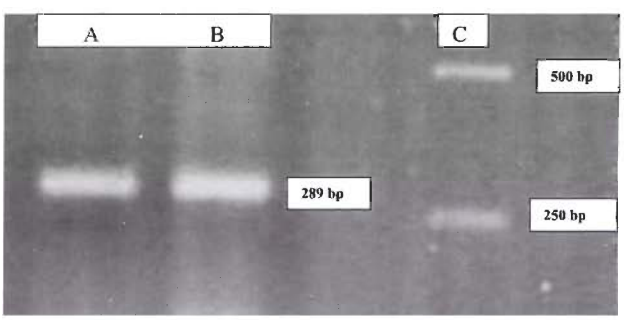
The quantity and quality of DNA was assessed by agarose gel electrophoresis (1.2%) to ensure the good quality of RNA for cDNA synthesis. The extracted RNA was of high quality with 260/280-absorbance ratio between 1.8 and 2. The RNA bands did not show any smearing or contamination. For the PCR amplification CT-04 primer were used and it generates the 289bp amplicon by amplifying the template cDNA with *Taq* polymerase. The amplified products were then separated on 1.2% Agarose gel stained with ethidium bromide and documented using gel documentation System.

First strand cDNA of liver, spleen, brain and fin tissues of three species *Schizothorax richardsonii, Oncorhynchus mykiss* and *Salmo trutta* were served as the template DNA for the above purpose. But in the present study, amplification of target fragment size observed only in liver cDNA of *Schizothorax richardsonii*. The cloning and sequencing of the above PCR product is in process.



M : Marker, L: Liver, S: Spleen, B: Brain, P: Pancreas,
MU: Muscles,K: Kidney, H: Heart, I: Intestine, F: Fin, G: Gill

RNA isolated from different tissues of *Schizothorax richardsonii* by using the Trizol reagent method



Amplified fragment of Uncharacterized cold stress gene with CT-04 Primer in *Schizothorax richardsonii* liver
A - Sample collected from Alaknanda River
B - Sample collected from Jogindernagar (Himachal Pradesh)
C- 1 Kb Size ladder

EXTERNALLY FUNDED PROJECTS:

Project Title	**Development and characterization of microsatellite markers in Indian Snow trout, *Schizothorax richardsonii*. (DBT Funded Project).**
Personnel	A. Barat, G.K. Sivaraman (upto 26th February 2010)

The Indian Snow Trout, (*Schizothorax richardsonii*), is a very important coldwater and sport fish found in North East Himalayan region. But there is less information of genetic variability within and among populations at the DNA level. The extent and distribution of genetic variation within a species are of fundamental importance to its evolutionary potential and to determining its chances of increasing population size. Microsatellite or simple sequence repeat (SSR) markers are ideal for genetic diversity and mapping studies because of their abundance, high polymorphism content, co dominance, easy detection and transferability across studies. High frequency of occurrence and uniformity of distribution within most eukaryotic genomes and high levels of variation have developed a growing appreciation of their use in genome mapping, paternity, and forensics. Therefore, it is very much required to develop some microsatellite marker in this species.

In view of the above the following objectives were approved in the project and initiated during the year 2008:

- Identification and isolation of microsatellite loci in *Schizothorax richardsonii*.
- Characterization of highly polymorphic microsatellite marker.

In continuation to earlier year, we achieved around 3000 clones under a partial genomic library of 300-600 bp RE digested DNA fragment. The clones were lifted in grid plate (Fig.1) and two replica of the plate were made for colony hybridization (Fig.2).For hybridization a nylon membrane (Biodyne-PAL Sciences) was placed on to the colonies and lifted after few seconds. The membrane was crosslinked using UV light source in a Crosslinker (Genei, India) for immobilizing DNA on the membrane filter and processed using prehybridization solution and hybridized with CA, GA, GT and CT dinucleotide probes following the DIG labeling kit (Roche, Germany). Positive clones in the form of color detection were identified. We also used colony PCR with three primers (both forward and reverse vector primers M13 and one dinucleotide repeat primer) to screen microsatellite-containing inserts. The PCR products were resolved through 1% Agarose gel in TBE buffer. The clones which produce a smear on the Agarose gel are considered containing respective repeat motif. Plasmid DNA of around 500 clones that showed both smear in gels and DIG labeled color were isolated using Plasmid DNA isolation Kit (Nucleospin-Machery-Nagel) and sequenced using ABI Big-Dye version 3.1 terminators. So far 14 sequences were aligned using MegaAlign (DNASTAR) softwere. 14 sets of loci specific primers designed from those sequences using Primerselect (DNASTAR) and PrimerBlast (NCBI). Submitted 2 sequences containing microsatellite markers in NCBI (Locus-SR 01 Accession No FN568061 Locus-SR 02 Accession No FN568062).

Fig.1. Colonies lifted in a Grid Plate

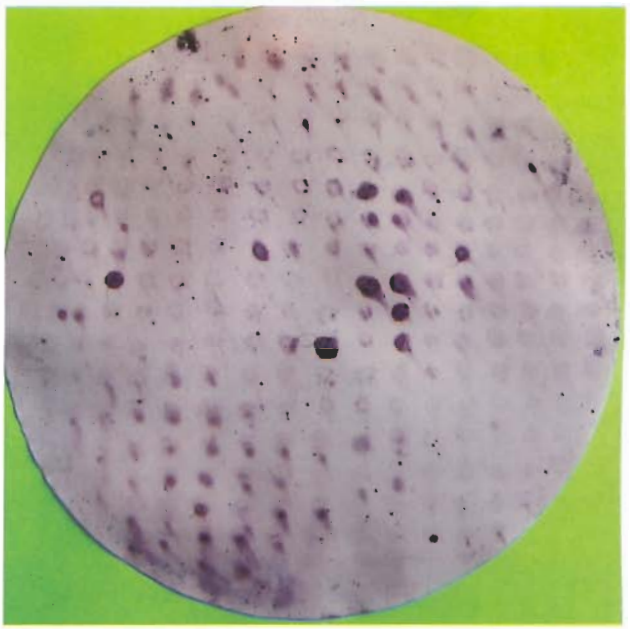


Fig.2. Colony Hybridization

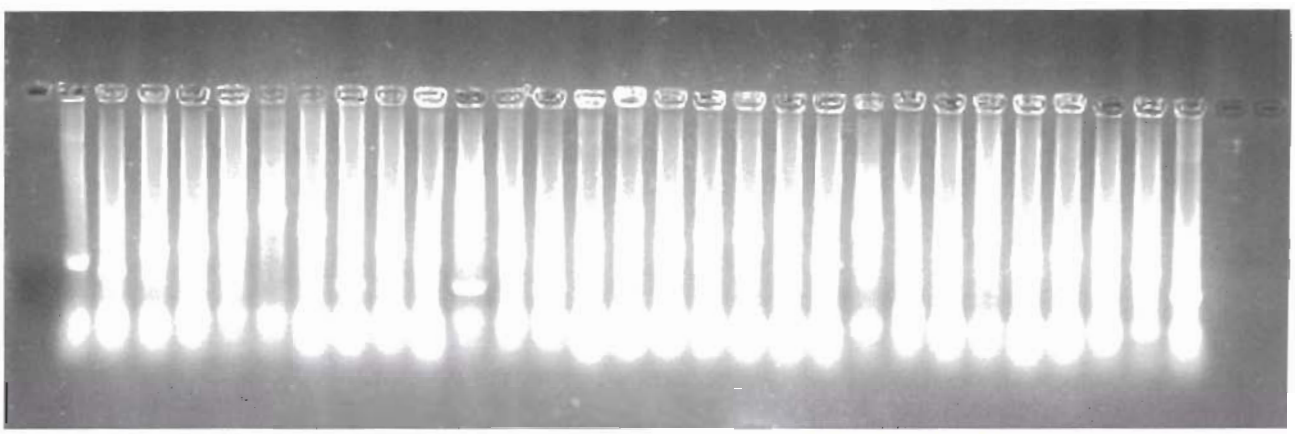


Fig.3. Colony PCR using M13 forward, reverse and dinucleotide probe.

Project Title	**Genome- Scale mining of *Schizothorax richardsonii* fish species for formulation of selective breeding programme (DST Funded Project)**
Personnel	G.K. Sivaraman (upto 25th March, 2010), Shahnawaz Ali (26th March, 2010 onwards), A. Barat.

The project was received and initiated during April 2009. The different sizes of Indian snow trout, *Schizothorax richardsonii* were collected from different areas viz., river Kosi (Ratighat), Gola (Ranibagh) and Chirapani stream (Champawat). The fin samples (n= 30) were collected from these

samples in 75% ethanol, processed and stored at –20°C for DNA isolation for studying the genetic relationship among the different parental stock. The mtDNA sequences of Cyprinidae family mainly of *Cyprinius caprio* were retrieved from NCBI database online. The data were compared with all the possible mitochondrial genome sequence of the Cyprinids as well as the more related fish species in order to determine the highly conserved gene sequence for valid estimation of genetic relatedness among the *Schizothorax* species from different region. The exon sequences with optimum length will be extracted from the mtDNA databases and compared within genome sequence to generate a set of single copy mtDNA gene exons and between genome sequences to orthologus exons should amplify in *Schizothorax* species. MtDNA with highly conserved protein coding genes are less prone to homoplasy, ease of designing universal primers and easy to align for analysis. The optimal length of forward and reverse primers of having the nucleotide length of 17-23 mer size as well lengthy primers for amplification of the complete gene(s) viz., 12S and 16SrRNAs, Cyt b, ND3, ND4, CO III, CO II, ATPase 6 and ATPase 8 were designed by using DNASTAR and Primer3 softwares.

Fish sample collection using cast net at Chirapani streams

Fish sample collection at River Kosi near Garampani

Collected fish sample

Measurement of total length and bodyweight

Collection of fin sample for DNA isolation

The mature broodstocks were selected for breeding and was successfully bred during the month of October, 2009. More than 2000 fry were produced and are rearing successfully at flow through hatchery system.

Project Title	**Studies on the diversity and phylogeny of Bagrid catfishes of the genus *Mystus scopoli* of northeast India using classical and RAPD techniques (Postdoctoral fellowship-DBT)**
Personnel	A. Darshan Singh (PDF), P.C. Mahanta (Supervisor)

Objective:

- To study the biodiversity of *Mystus* in northeast India.
- To establish correct identity and resolving taxonomic conflict and describing new taxa and catalogue them.
- To study anatomy of fishes with special reference to bone.
- Analysis using RAPD technique.
- Establishing phylogenetic relationships among them.

Methodology:

Taxonomic studies: For Identification of *Mystus* species followed Darshan et al. (2010). For osteological study clearing and staining of bones followed Hollister (1934). Methods for counting gill rakers and vertebrae followed, respectively, Roberts (1992) and Roberts (1994). Vertebrae count for rare and type specimens were taken from radiograph. Terminology of bones and body colour spots followed Mo (1991) and Grant (2008).

RAPD analysis: Tissue sampling: About 100 mg of fresh muscle tissue or fins were collected in 95% ethanol. After removing the tissue, specimens were preserved in 10% formalin by giving the same labelled given in the tissue sample for rechecking in laboratory

to avoid misidentification. Genomic DNA was extracted from ethanol fixed fin tissue, using the phenol-chloroform extraction protocol (Sambrook et al., 1989), resuspended in TE buffer (10 mM Tris-Cl, 0.1 mM EDTA, pH 8.0), and the concentration was determined through serial dilutions on 0.7% agarose gel in 0.5 X TAE (1X=40 mM Tris acetate, 1 mM EDTA) and also by taking Optical densities at 260 nm and 280 nm to calculate quantity and purity.

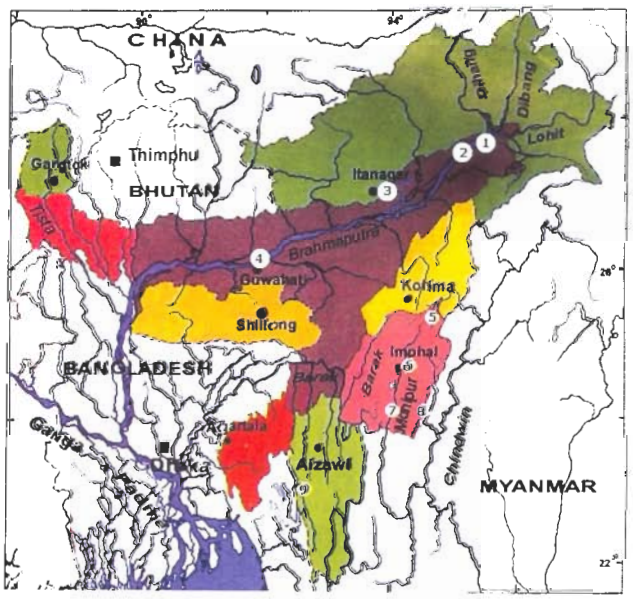
RAPD-PCR reactions was carried out in sterile PCR tubes in a reaction volume of 25 ml containing: (a) Template DNA (50 ng), (b) 2.5 ml of 10x buffer, (c) 1.5ml of $MgCl_2$ (25mM), (d) 2 mM dNTPs mix (100 mM), (e) 5 pmoles of Random primer (Operon series), (f) 0 .5 U *Taq* DNA polymerase and (f) Autoclaved Milli-Q water, using a Eppendorf Mastercycler gradient. The reaction conditions were denaturation at 94 °C for 4 min., followed by 35 cycles of 94 °C for 1 min. and 36 °C for 1 min., elongation at 72 °C for 2 min., with a final elongation at 72 °C for 7 min. One negative control (absence of template DNA) was included for each set of amplifications. Amplified product was separated on 1.2% agarose gel (SRL) by submarine gel electrophoresis in 1X TBE buffer (Tris-borate EDTA; 89.0 mM Tris, 2.0 mM EDTA, 89.0 mMboric acid), pH 8.0, f or 2 hours at constant voltage of 70 V. Size of the bands were estimated by 1 kb ladder which run in every gel. Visualization of Amplified products was performed under UV Transilluminator. Photography of result has made by Gel- Doc apparatus. Study of Genetic distance and dendrogram will analyse using the software TFPGA (Tools for population genetics analysis).

Brief report of progress of work (July, 2009-March 2010)

During the first year of the project, collection, morphometric analysis, identification and DNA isolation (for RAPD analysis) of 10 species of *Mystus* collected from two totally different basins i.e. Chindwin and Ganga-Brahmaputra were carried out.

PLACES VISITED FOR FISH COLLECTION (number in parenthesis indicate location in the map)

- ASSAM (Brahmaputra drainage): Tinsukia (1), Dibrugarh (2), Guwahati (4).
- MIZORAM (Barak basin): Karnaphuli River (9).
- MANIPUR (Chindwin basin): Chatrikhong River, Momo & Wanze stream Challou River (5); Maklang River, Lokchao River (8); Iril River and Nambul River (6) and Manipur River (7).
- ARUNACHAL PRADESH: Dikrong River (3)



Northeast India drainage map (redrawned from Vishwanath et al., 2007) showing fish collection sites 1 to 9.

List of *Mystus* species collected from Northeast India with drainages.

SL.	Species	Drainages
1	*M. carcio*	Brahmaputra
2	*M. bleekeri*	Brahmaputra
3	*Mystus cavasius*	Brahmaputra
4	*Mystus sp.*1 (in process of publication)	Brahmaputra
5	*Mystus tengara*	Brahmaputra
6	*Mystus debrugarensis*	Brahmaputra
7	*Mystus sp.* 2 (in press for publication)	Chindwin
8	*Mystus falcarius*	Chindwin
9	*Mystus rufescens*	Chindwin
10	*Mystus pulcher*	Chindwin

Diagnostic characters of 10 species of *Mystus* collected from Northeast India

1. *Mystus carcio* (Hamilton)

Diagnosis. *Mystus carcio* differs from other known striped *Mystus* species by its small size, reaching upto 47.9 mm SL; posterior fontanel width about one-fifth of head width, extending almost to the base of the occipital process; vomer interrupted in the middle; pelvic fin reaching anal-fin origin; pectoral girdle with the coracoid shield exposed ventro-laterally below pectoral fin; eyes rounded and large (25.6-30.7% HL), dorsally orientated on head; a dark-brown spot present on tympanum; and adipose-fin base shorter than or equal to dorsal-fin base.

2. *Mystus bleekeri* (Day)

Diagnosis. Body with a light longitudinal band one above and another below lateral line, lower band twice as broad of upper; adipose fin base in contact with the base of last dorsal fin rays, 11-15 gill rakers on the first branchail arch and 37-40 vertebrae.

3. *Mystus cavasius* (Hamilton)

Diagnosis. *Mystus cavasius* differs from other congeners with a long-based adipose fin in having a combination of a black spot in front of the dorsal-spine base, a dark humeral mark, a body without distinct midlateral stripes, very long maxillary barbels reaching to caudal-fin base, dorsal spine short and feebly serrate, tall dorsal fin, and 13–22 gill rakers.

4. *Mystus* sp. 1 (in the process of publication)

Diagnosis. Body with a black tympanic spot and mid penduncular spot connected the two by a thin narrow black line caudal, posterior fontanel reaching base of occipital process, adipose fin base in contact with the base of last dorsal fin ray, 15 gill rakers on the first branchial arch.

5. *Mystus rufescens* (Vinciguerra)

Diagnosis. Body with a light longitudinal band one above and another below lateral line, a dark gray spot at the caudal fin base, 13-20 gill rakers on the first branchail arch and 40-42 vertebrae.

6. *Mystus dibrugarensis* (Chaudhuri)

Diagnosis. Body with a black tympanic spot and mid penduncular spot connected the two by a thin narrow black line caudal, posterior fontanel not reaching base of occipital process, 24 gill rakers on the first branchial arch.

7. *Mystus tengara* (Hamilton)

Diagnosis. *Mystus tengara* differs from its congeners by unique combination of following characters: body with a tympanic spot, four brown stripes against dull white background, 31-41 gill

rakers on first branchial arch, dorsal fin with 8-10 posterior serrations, eye rounded with diameter 16.5-19.8 % HL maxillary barbel reaching at least middle of anal fin base and may extend to the end of caudal fin.

8. *Mystus falcarius* Ng

Diagnosis. *Mystus falcarius* differs from other congeners with a long-based adipose fin in having a combination of prominent black spot in front of the dorsal-spine base with a dark humeral mark, a body without distinct midlateral stripes, very long maxillary barbels reaching to caudal-fin base, dorsal spine short and feebly serrate, first two rays of dorsal fin tall, and 22–29 rakers on the first gill arch.

9. *Mystus sp.* 2 (in press for publication)

Diagnosis: *Mystus ngasep* differs from its congeners by unique combination of following characters: body with a tympanic spot, three brown stripes against dull white background, one along the lateral line, one above it and another below, interspaces narrower. Stripes not readily visible in live specimens; median longitudinal groove on head reaching base of occipital process, adipose fin in contact with base of last dorsal fin ray, 16-19 gill rakers on first branchial arch, very slender cleithral process, pectoral spine with 9-11 serrations on the posterior edge, eye small with a diameter 16.5-19.8 % HL, pectoral-fin and anal fin branched rays respectively with 9-10 and 8-9; and short maxillary barbel (200.0-235.0 % HL).

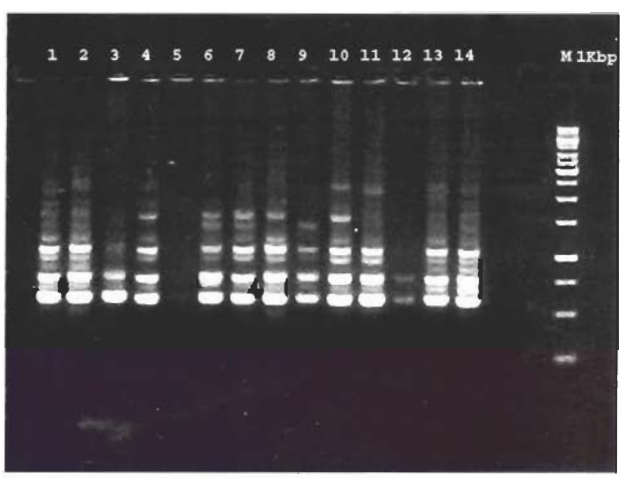
10. *Mystus pulcher* (Chaudhuri)

Diagnosis. Body with a light longitudinal band one above and another below lateral line, the two bands are almost equal in size; a dark tympanic and a mid-penduncular spot also present.

RAPD analysis

Isolation of genomic DNA: For RAPD investigation, thirty individual samples of each species were randomly selected for DNA isolation. After thorough screening of all isolated DNA samples, good quality DNA samples of high purity of 15 individuals of each species were taken for studying RAPD profiles.

Screening of Primers: In the primary analysis, 40 random primers of 10 mer from Operon Technologies (arbitrary primers from OPA and OPY series) were tested on 20 individuals (2 samples from each species). Base on the screening, four primers from OPA (OPA2, OPA5, OPA18 and OPA 20) and another six primers from OPY series (OPY4, OPY7, OPY11, OPY16, OPY17 and OPY18) are selected for RAPD profile assessment.



RAPD profile of *Mystus sp 2* (new species) using OPY4:

PAPERS UNDER PROCESS OF PUBLICATION (Under the Project)

1. *Mystus ngasep*, a new species (Teleostei: Bagridae) from the headwaters of Chindwin drainage in Manipur, India. *J. Threatened Taxa*: MS No. o2180; Revised MS sent.

INFRASTRUCTURE DEVELOPMENT

Inaugural of new building at Chhirapani, Champawat

Residential buildings, laboratory and new ponds constructed in the pocket "A" of the farm were formally inaugurated by Dr. S. Ayyappan, DDG (Fy), ICAR, New Delhi on 6th June 2009, in presence of the distinguished personalities.

Dr. S. Ayyappan, Ex-DDG (Fisheries) inaugurating the new building complex

Puja was performed during the inauguration

Dr. M.V.Gupta, World Food Laureate inaugurating the new constructed laboratory

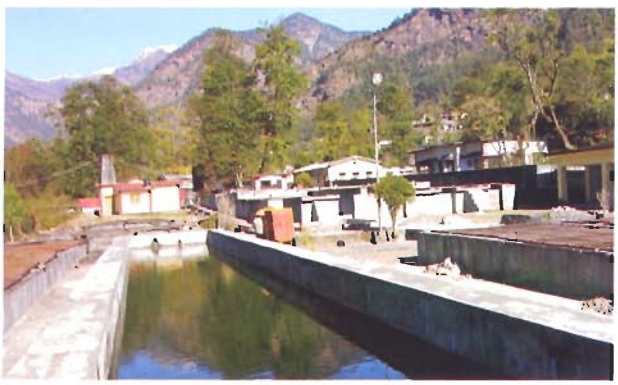
Dr. S. Ayyappan visiting the newly constructed laboratory

Internet facility created at Champawat Field Centre

FARM ACTIVITIES

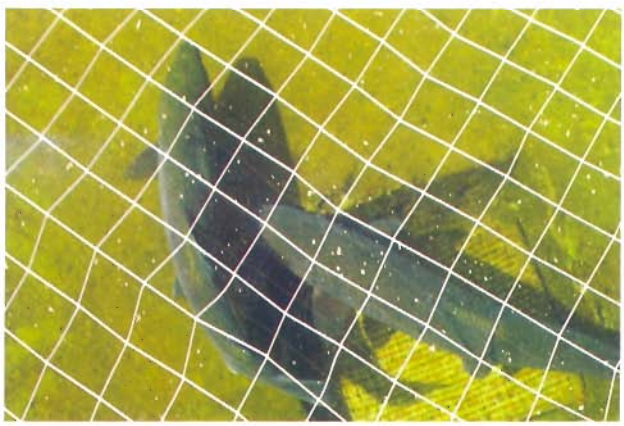
Successful breeding of Rainbow trout and brown trout at State Fish Farm, Bairangna.

- DCFR, Bhimtal is technically associated with State fisheries Department, Uttarakhand State under outreach programme on "**Sustainable utilization of Mountain fishery resources-A partnership mode.**
- A healthy Brood stock of Rainbow trout/ brown trout – 570nos. (size-700gm.-1000gm), Yearlings - 3100 (size-110-350gm) has been maintained at the Bairangna farm.
- Successful breeding of Rainbow trout/ brown trout was conducted with the technical guidance of DCFR scientists and produced 2,20000 eyed ova and 150,000 fry with 84% fertilization, 86% hatching. (Incubation period 61 days) at water temperature 4-11°C. It was 40 % higher than the previous year with better brood stock management and better breeding performance of the brooder.
- Director, DCFR visited state fish farm, Bairangna (Distt. Chamoli, Uttarakhand) on 2-6 Dec.2009 and observed healthy broodstock of rainbow trout and brown trout at the farm. He ranched farm raised healthy fingerlings of rainbow trout (20,000 nos.) in the Balkhila stream of Alaknanda.



State Fish farm, Bairangna

Ova house at trout farm, Bairangna



Healthy brooder of Rainbow trout at Bairangna

Tissue sampling of rainbow at Bairangna

Healthy brooder of Brown trout at Bairangna

Stripping of Brown trout at Bairangna

Eggs of rainbow trout at Bairangna

Fingerlings of rainbow trout at Bairangna

Successful rearing and breeding of Rainbow trout at Chhirapani Fish Farm, Champawat.

Healthy yearlings of rainbow trout have been reared at field centre, Champawat successfully.

Breeding of rainbow trout was conducted at Champawat with 71% fertilization, 72% hatching (Incubation period 54 days) at water temperature 6-14 °C.

Eyed ova of rainbow trout

Spawning of Rainbow trout

Developing yearlings at Champawat

Artificial spawning of snow trout, *Schizothorax richardsonii* (Gray) at Champawat.

Snow-trout, *Schizothorax richardsonii* (Gray) is important cold water fish species in central Himalayan region. This species is mainly inhabitant of the river streams. This species is annual breeder and the fish spawns at different elevations in different months of the year depending upon the water temperature. Study was conducted for artificial spawning by dry stripping method with wild brood stock and farm-raised stock of Kumaon region of Uttarakhand state during the period of October-December 2009.

Farm raised and wild brooders of the age of 3+ years having average body weight 175–15 gm and 62–5 gm for female & male respectively were successfully spawned during 15 sept-5oct' 09 at 16-20°C water temperature.

Collection of wild brooder of snow trout

Farm raised healthy brooder of snow trout

Mature male of snow trout

Spawning of snow trout

Developing swim up fry of snow trout

Developing Fry of snow trout

Induced breeding of farm raised Grass carp at Champawat

- Farm raised brooder of 3-4 years age were tried for induce breeding during 28 July to 31 July at water temp. 22-24°C and produced 150,000 fry.
- Average weight of brooder was 2 kg. and 1.5 kg for female and male respectively.
- At Farmers fields, growth of the cold-water farm produced seed of grass carp is better than the

Hormone dose to grass carp

Selection of grass carp brooder

Growth of grass carp (Seed of Champawat & Plain area)

seed from private hatchery of plain area due to the better acclimatization and low inbreeding depression.

Cytogenetic Characterization of Rainbow trout (*Oncorhynchus mykiss*) and Snow trout (*Schizothorax richardsonii*) of Champawat stock

- Good Metaphase spreads of the rainbow trout and Snow trout stock of Field center, Champawat were found and used for karyotyping. The data recorded on the basis of 250 metaphase spreads of specimens of both the species.
- The result shows that in Rainbow trout (***Oncorhynchus mykiss***) the diploid chromosome number was found to be 2n=60 and the Karyotype was determined for this species as 38m+6sm+16t and fundamental arm number is 208 (FN=208)
- In Snow trout (*Schizothorax richardsonii*) diploid chromosome number was found to be 2n=96 Fig. 3 and the Karyotype was determined for this species as 18m + 16sm + 12st + 50t (FN=260).

Development of starter feed and fingerling feed of rainbow trout at Field center, Champawat

Trout feed was formulated with different levels of protein and lipid using following ingredients-Fish meal (Sterlised having >60% protein), roasted soybean flour, GOC, wheat flour, Starch, fish oil, Brewer's yeast powder, Linseed oil cake, Dried Milk and Vit.& min. mixture. Starter feed was formulated with 3 levels of protein (55, 50 & 45%) and 2 levels of lipids (14 and 16%). Feed S3 having 50% protein and 14% lipid was found better in growth performance among the all 6 tested diets. Fingerling feed was formulated with 3 levels of protein (40, 45 &50%) and 2 levels of lipids (14, 16 and 18%) feed. Feed F6 having 45% protein and 16% lipid was found better among the all-9 tested diets.

Starter trout feed

Fingerlings trout feed

CONSULTANCY

Investigation of Fish Fauna in Keshang and Kerang Streams of Sutluj River falling under Integrated Kashang Hydroelectric Project in Kinnaur District of Himachal Pradesh

Prem Kumar, Shahnawaz Ali and T. M. Sharma

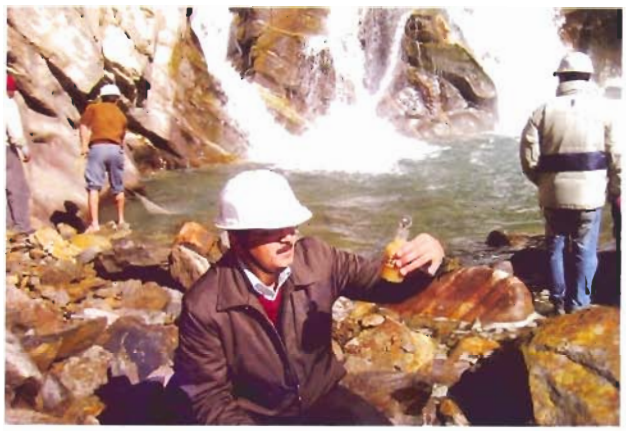
A detailed survey to assess the fish fauna in the Kashang and Kerang tributaries of river Satluj was conducted by a team of Scientists of Directorate of Coldwater Fisheries Research (DCFR), Bhimtal, Nainital during the month of November, 2009. The proposed Integrated Kashang Hydroelectric Project using waters of Kashang and Kerang streams, right bank tributaries of river Satluj is located in the Kinnaur district of Himachal Pradesh and is owned by HPPCL, Shimla. The two tributaries namely Kashang and Kerang of river Sutluj are adjacent to each other and are separated by a high altitude ridge in the area of the project.

River Sutluj: Sutluj River has its source at an elevation of 4,600 m near the Mansarovar Lake in Tibet. From the source the Sutluj flows 300 km to enter India near Shipki La in Kinnaur district. Sutluj passes through the Great Himalayan Range, cutting a deep gorge with the Kinner Kailash massif on its left. To the east of the Sutluj the valleys are narrow while in the west, they are wide and open. In the Kinnaur district, the Sutluj valley extends in northeast to southwest alignment for a length of about 140 km. The fast flow with just the right amount of water makes the Sutluj and its tributaries ideal for being tapped to generate hydroelectric power. The two tributaries of Sutluj river namely Kashang and Kerang are located in the Kinnaur district of Himachal Pradesh. The discharge characteristics of Kashang and Kerang Khads are vast with unique parameter i.e. the difference between the minimum and maximum discharge is considerable due to the orientation of their catchment whose major portion is permanent snow covers.

Table 1: Morphology of Kashang and Kerang Khads tributaries of river Sutluj

Morphology	Kashang Khad	Kerang Khad
Gradient	Very steep, almost vertical at many places	Steep throughout, except near the confluence point
River Bed	Boulders/ Pebbles	Boulders/ Pebbles/Sand
River width (Avg.)	2.0 - 2.5 m	2.5 – 3.0 m

Project Area: The project area lies in the temperate climate zone having winters from November to April and summer from May to October. The Elevation of project area falls between 1980 m (confluence point) and 2840 m (Intake point). The winter season is little extended by virtue of elevation of the area. The summer season includes the rainy season. The monsoon season starts in the middle of the June and lasts until the end of September with maximum precipitation occurring between July and August. The catchment area of Kashang Khad is around 124 km^2 while for the Kerang Khad is about 400 km^2. The



Scientist working on site

Assessing fish stock in the river

major portion of catchment area has permanent snow cover throughout the year.

Survey Methodology and Important Findings: Netting was done to ascertain the presence/ absence of fish fauna using cast net with 4 mm mesh size at different stations both in Keshang and Kerang streams. Repeated netting was done at least ten times, at each station to avoid the possibility of escape of fish, if present in the streams. Meantime the water samples were also collected for the estimation of physicochemical parameters.

Even after the repeated fishing at different locations of the proposed project site, no fish fauna was observed in the stream of either Kashang or Kerang Khads. There is no evidence of fish fauna from intake to confluence points of the streams in the project area. The Kashang stream is very steep and flow is also very fast and turbulent throughout the year. The stream also falls from vertical height (Kashang fall) before confluence with the main Sutluj river. The vertical heights and steep elevations with turbulent flow would not allow fish to venture in the streams. The turbulent flow and gush of water perhaps prevent the ascend of fish in the stream even during the lean flow period of the year. However, the small fry of about a month old of *Botia* sp. has been observed in the isolated pools beside the main Sutluj river near Speilo, which is far away from the confluence point as well as project area.

Team of Scientist and Engineers at the water intake site of the project area

Water intake site at Keshang stream

EDUCATION AND TRAINING

ICAR sponsored short course

Ten days short course entitled "Application of molecular techniques in Coldwater Fishes" was conducted during 14-23 July 2009. Twenty-five participants from all over the country were provided hands on training with both theory and practical regarding molecular tools applicable in characterization and genetic diversity studies of coldwater species. Two guest lectures from different ICAR institutes were also arranged.

Participants in the Short Course

Practical demonstration during ICAR Short Course

Dr. S. Ali delivering lecture during ICAR Short Course

Deliberation of Guest faculty during ICAR Short Course

Dr. Yasmeen Basade delivering lecture during NFDB training

NFDB sponsored HRD training programme

A national level training program sponsored by National Fisheries Development Board, Hyderabad, Govt. of India on "Grow out technologies of important coldwater fishes in upland Himalayas was organized by DCFR during 1-7 September, 2009. The trainees included State Fisheries Officials, Research scholars and Subject matter specialists of Krishi Vigyan Kendra from all over India.

Apart from giving lecture on breeding, demonstrations on grow out technology of mahseer at the mahseer hatchery complex DCFR, Bhimtal was given. This has helped the participants to understand the minor details about seed production.

Practical demonstration to the trainees

Trainees at DCFR Hatchery

- Organised two farmers training to the selected farmers of Tehri Garhwal during 29-31 October, 2009 and 4-5 January, 2010, sponsored by *Uttaranchal Parvatiye Aajivika Sanvardhan Company*, Tehri Garhwal.

Deliberation of Guest faculty during NFDB training

Dissertation/Ph.D. thesis work

- Under the Co-supervision of Dr. A. Barat two students Ms. Girishma and Ms. Laxmi successfully completed the research work and awarded Ph.D. degree with the subjects on Genetic diversity in two different fish species using allozyme and RAPD markers, under GB Pant University of Agriculture and Technology, Pantnagar.
- Under the supervision of Dr. A. Barat, three students Ms. Kavita Tiwary from Department of Biotechnology, Uttaranchal College of Science and Technology, Dehradun, Sri Prabhakar Goyal, and Sukhdeep Singh, Dept of Biotechnology & Microbiology, G.F (P.G) College, Shahjahanpur completed the project work for B.Sc. dissertation entitled Extraction of Genomic DNA from fin tissue sample of Coldwater fish, Tor putitora.
- Under the supervision of Shri A.K. Nayak, Mr. Ravinder Singh Solank, M.Sc. student of Department of Zoology and Applied Aquaculture, Barkatullah University, Bhopal completed the dissertation work entitled Spatial database of Naukuchiatal lake, Nainital Uttarakhand.
- Under the supervision of Dr. N.N. Pandey and Dr. S.K. Srivastava, three students of M.F.Sc., Department of Applied Aquaculture and Zoology, Barkatullah University, Bhopal (Madhya Pradesh) completed M.Sc. dissertation work.
- Under the Co-supervision of Dr. Debajit Sarma one Student Ms. Tripti Tiwari from Barkatullah University, Bhopal, successfully completed M.Phil Dissertation work on Nutrient Quality Studies of Hill Stream *Labeo sp*.
- Under the Co-supervision of Dr. Debajit Sarma two Student Ms. Shabnam Kumari and Mr. Vipin Kumar from Barkatullah University, Bhopal, successfully completed M.Sc. Dissertation work on the title: Histological study of food and feeding habit of important coldwater fish species and Evaluation of Aquatic Weeds as Fish Feed Ingredients.

AWARDS & RECOGNITION

- Dr. K.D. Joshi received "Gold Medal" of the Indian Academy of Environmental Sciences, Haridwar, Uttarakhand on 26.09.2009 on the occasion of the National Seminar on " Response of eco-biological components to the phenomenon of global warming" held at Kumaun University Nainital from 26 to 27 September 2009.
- N.Okendro Singh was awarded the degree of Doctor of Philosophy in Statistics on 1st September 2009 from Kumaun University, Nainital, Uttarakhand, INDIA for the thesis entitled "Statistical Techniques On Analysis Of Water Quality And Modelling On Various Biological Characteristics Of Important Fishes Of Upland".
- Prem Kumar was awarded the degree of Doctor of Philosophy in Zoology on 9th September 2009 from M.J.P. Ruhilkhand University, Bareilly for the thesis entitled "Spatial database of fish and fisheries resources of Sarda Sagar Reservoir, Tarai Region of Uttaranchal and U.P., India".

Gold medal award to Dr. K.D. Joshi

Dr. P.C. Mahanta, Director, DCFR, Bhimtal elected as President of the Academy of Environmental Biology (AEB), Lucknow. The Annual Session of the Society was held at ICRISAT, Hyderabad during 20-21 November 2009.

Dr. B. Meena Kumari, Director, CIFT, Kochi received the 6th Dr. R. C. Dalela Oration 2009 Award from Dr. W.D. Dar, Director General, ICRISAT and Dr. P.C. Mahanta, President AEB at Hyderabad.

Winners of the Academy Awards with President, AEB and DG, ICRISAT

- DCFR received Special prize at National Expo XIII, organized by Central Calcutta science and cultural organization for youth on 2-6th September, 2009.
- DCFR received Special prize in exhibition at G.B.Pant University of Ag. & Tech. Pantnagar, during National Kisan mela on 9-12 October 2009 and also during 6-9 March 2010.

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BOOKS EDITED

- Bhuyan, RN, Ghosh D and Sarma D. 2009. Fish and Fisheries in North-East India: Geophill Publications. Guwahati. Assam.
- Mahanta, P.C., K.D. Joshi and A.K. Nayak, 2009. Souvenir of the National Workshop on Impact of Climate Changes on Coldwater Fisheries Resources: Perspectives, Framework & Priorities. Held at DCFR Bhimtal on 5th June 2009. 95pp. DCFR, Bhimtal.
- Mahanta, P.C., K.D. Joshi, Debajit Sarma, A. K. Nayak and Atul Borgohain, 2009. Souvenir cum Abstract Book of the National Symposium on Coldwater Fisheries Management: New Strategies and Approaches, held at The Eco-Camp, ABACA, Nameri National Park from 2-4th October 2009. 181 pp. DCFR, Bhimtal

BULLETINS

- Prem Kumar, N. N. Pandey, K. D. Joshi, 2009. Chhirapani Experimental Fish Farm, Champawat: Leaping forward. DCFR Bulletin No. 13: 25pp.
- Madan Mohan and Yasmeen Basade. 2008. Coldwater Fish Nutrition. Directorate of Coldwater Fisheries Research, Bhimtal, India. 60pp.
- Sarma D, Haldar R.S and Mahanta PC. 2009. Artificial Propagation and Growout of Golden Mahseer (*Tor putitora*, Ham.). DCFR Bulletin No. 14: 39 pp.
- Sarma D, Mahanta PC, Sarma D and Dutta A. 2009. Coalmines degraded ichthyofaunal diversity of Simsang river, Meghalaya (A report on climate change). D.C.F.R., Bulletin No-15: 44 pp.

Training Manual

- Mahanta, P.C., Debajit Sarma; K.D. Joshi; N.N.Pandey; A.K. Nayak and S. Ali, 2009. Grow out Technologies of Important Coldwater Fishes in upland Himalayas- NFDB Sponsored HRD Training Programme from 1-7 September 2009. DCFR, Bhimtal. 164pp.
- Barat A, Sivaraman GK, Nayak AK, Ali S. 2009. Application of molecular techniques in coldwater fishes. ICAR sponsored Short course from 14-23 July 2009. DCFR, Bhimtal. 110pp.

Films Conceived, Developed & Produced

1. Directorate of Coldwater Fisheries Research- Profile and its Role
2. Seed Production Technologies of Coldwater Fishes- Rainbow trout, Mahseer & Chinese Carps
3. Fish culture in hill Regions of India – A success Story

PARTICIPATION IN CONFERENCES/MEETINGS/SYMPOSIA/ SEMINARS/ WORKSHOPS/TRAININGS

Conferences/ Meetings / Symposia/ Seminars/ Workshops	Participants
Brainstorming session at Mandapam Regional Centre of CMFRI during 18-19 April, 2009.	Dr. P. C. Mahanta
Sensitizing meeting on "Bioprospecting of genes and allele mining for abiotic stress tolerance" under NAIP held at NASC Delhi in presence of Dr. Mangala Rai, DG, ICAR and Secretary, DARE during 5-6 May, 2009.	Dr. P.C. Mahanta Dr. A. Barat
ILDEX EXPO 2009 organized by ILDEX at Pragati Maidan, New Delhi during 1-4 July 2009.	Dr. P.C. Mahanta Dr. K.D. Joshi
National Conference of State Fisheries Ministers organized at CIFA, Bhubaneswar during 4-5 July, 2009	Dr. P. C. Mahanta
DBT task force meeting at Madras University, Chennai from 9-10 July, 2009.	Dr. A. Barat
'Indian Fish Festival' and Seminar organized by NFDB, Hyderabad during 11-13 July, 2009.	Dr. Prem Kumar Dr. S. Ali
ICAR Foundation Day and Directors meeting at NASC, New Delhi during 16-17 July, 2009.	Dr. K.D. Joshi
Workshop on PERMISNet-II at NASC Complex, organized by Indian Agricultural Statistical Research Institute, New Delhi on 22nd July, 2009.	Sh. A. K.Nayak
Meeting with DDG (Fy.) and scientists from CIFT, Kochi at Patlikuhal, H.P. to discuss the issues for setting up of a trout processing plant during 30-31 July, 2009.	Dr. K.D. Joshi Dr. Prem Kumar
Workshop on "Rehabilitation of River Tons" organized by NIE, New Delhi at Manthan Bhawan, Dehradun on 9th August 2009.	Dr. K.D. Joshi
Meeting of the chairs of the QRT and RAC organized by the SMD Fisheries, ICAR at CMFRI, Kochi during 20-21 August, 2009.	Dr. K.D. Joshi
Workshop on Procurement and Financial Management under NAIP at CSWCRTI, Dehradun during 20-21 August, 2009.	Dr. A. Barat
National Expo XIII, organized by Central Calcutta science and cultural organization for youth during 2-6 September, 2009.	Dr. N.N. Pandey
Regional Consultation Meeting for Sustainable Aquaculture Development in NEH Region organized by CIFA, Bhubaneswar at Shillong on 16th September, 2009.	Dr. P. C. Mahanta

National Symposium on Coldwater Fisheries Management: New Strategies and Approaches, held at the Eco-Camp, ABACA, Nameri National Park during 2-4 October, 2009.	Dr. P.C. Mahanta Dr. K.D. Joshi Dr. Debajit Sarma Sh. A. K. Nayak Dr. S. Ali
Project (NAIP) evaluation meeting at CIBA during 5-6 October, 2009.	Dr. A. Barat
DST Advisory meeting at Goalpara College, Goalpara on 6th October, 2009	Dr. P. C. Mahanta
Exhibition during National Kisan Mela at G.B.Pant University of Ag. & Tech. Pantnagar, during 9-12 October, 2009.	Dr. N.N. Pandey
CAC (NAIP) meeting at NASC, New Delhi during 21-22 October, 2009.	Dr. A. Barat
Kisan Mela at KVK, Jyolikot, Nainital on 6th November, 2009.	Dr. K.D. Joshi Dr. N.N. Pandey
Winter school on "**Bioinformatics and Statistical Genomics**" organized by Indian Agricultural Statistics Research Institute, Pusa Campus, New Delhi – 110 012 during 17 November – 7 December 2009.	Dr. N.O. Singh
29th Session of Academy of Environmental Biology at ICRISAT, Hyderabad 20-21 November, 2009.	Dr. P. C. Mahanta Dr. Debajit Sarma Dr. Prem Kumar
Joint International Workshop of ISPRS WG IV/1, WG VIII/1 and WG IV/3 on Geospatial Data Cyber Infrastructure and Real-time Services with special emphasis on Disaster Management, at INCOIS, Hyderabad during 25-27 November, 2009.	Sh. A.K. Nayak
Hindi Workshop at Puri, Orissa during 9-11 December, 2009.	Dr. A. Barat
Foundation Day Celebrations of NBFGR, Lucknow on 12th December 2009.	Dr. K.D. Joshi
2nd Meeting of CGPB-Sub Committee Group IX on Geoscientific investigations at Geological Survey of India, Aliganj, Lucknow on 14th December, 2009	Dr. K.D. Joshi
20th Zoological Congress and National Seminar on Bioresources and its Management for Food, Livelihood and Environmental Security and National Helminthological Congress held at CIFE, Mumbai from 29-31 December 2009	Dr. K.D. Joshi Sh. A.K.Nayak
Interaction meet of Animal scientists, Fisheries scientists and CIAE scientists organized by CIAE, Bhopal on 11-12 January, 2010	Dr. N. N. Pandey
Brainstorming Session "Bioinformatics applications in fish/shellfish genomics" at CIFA, Bhubaneswar during 12-13 January, 2010.	Dr. A. Barat
Meeting convened by DG ICAR to discuss the issues of Fisheries Division on 30th January, 2010.	Dr. P. C. Mahanta

Divisional Meeting of the Fisheries Division headed by the Secretary, DARE & DG ICAR and meeting with the NFDB officials at NASC on 30th January 2010.	Dr. K.D. Joshi
Review meeting of Ongoing Research Programmes of ICAR conveyed by Minister of State for Agriculture at Krishi Bhawan on 5th February, 2010.	Dr. P. C. Mahanta Dr. Prem Kumar Sh. A.K.Nayak
Directors' meeting and VC's conference during 15-17 February, 2010	Dr. P. C. Mahanta Dr. Prem Kumar
Consultative Group Meeting of NFDB for Northern Region held at Krishi Bhawan, New Delhi on 3rd March, 2010.	Dr. K.D. Joshi
All India Kisan Krishi Vigyan Mela at IARI, Pusa, New Delhi during 4-6 March, 2010.	Dr. K.D. Joshi
Second Annual Review Meeting of the three Outreach Programmes of the Fisheries Division, ICAR held at NASC Complex, New Delhi during 5-6 March, 2010.	Dr. Yasmeen Basade Dr. A. Barat Dr. N. N. Pandey Dr. Debajit Sarma Dr. Prem Kumar
Exhibition at G.B.Pant University of Ag. & Tech. Pantnagar, during National Kisan Mela, from 6-9 March, 2010.	Dr. S. Ali Dr. S. K. Srivastava
Workshop on "Fisheries conservation and enhancement in northern hill states "organized by NBFGR, Lucknow at H.N.B. University, Srinagar during 8-9 March, 2010.	Dr. N. N. Pandey Dr. S. K. Srivastava
Training on MDP on PME at NIRD, Hyderabad from 8-12 March, 2010.	Dr. K.D. Joshi
CSI Workshop on Cyber Security & Surveillance at Doon University, Dehradun on 10th March, 2010.	Sh. A. K. Nayak
National Workshop on Broodstock management and species diversification for sustainable aquaculture, organized by College of Fisheries, GBPUA&T Pantnagar (Uttarakhand) during 16-17 March, 2010 .	Dr. P. C. Mahanta Dr. N.N. Pandey Dr. S. K. Srivastava Dr. Prem Kumar Sh. A. K. Nayak Sh. Sumanta K. Mallik
National workshop for the Sensitization of the ARIS Incharges about the uniformity guidelines for Website at NBPGR, New Delhi on 19th March 2010.	Sh. A. K. Nayak

Dr. P.C. Mahanta, Director addressing during ILDEX 2009

DCFR stall at Assam Matsya Mohatsav 2010

MEETINGS ORGANIZED

Review workshop of the Outreach Project

Directorate of Coldwater Fisheries Research, Bhimtal organized Review Workshop of the Outreach Project "Sustainable Utilization of Mountain Fishery Resources" at Bhimtal on **26-27th October 2009**. The programme was aimed to evaluate the progress made in the last year and to finalize the proposed work component and budgetary allocations for the year 2009-10. Dr. P. C. Mahanta, Director DCFR & National Coordinator of the Project chaired the workshop. Dr. V. V. Sugunan, ADG (I. Fy) attended the workshop as representative of ICAR, New Delhi. The other participants were Mr. Tage Moda, Director Fisheries and Mr. N. Pussang, ADF, Arunachal Pradesh; Mr. P.W. Bhutia, Director Fisheries, Sikkim; Mr. B.D. Sharma, Director Fisheries, H.P.; Dr. D. N. Das, Rajiv Gandhi University, Itanagar; Dr. Atul Borgohain, Eco-tourism sector Assam; Dr. Rani Dhanze, CSKHPKV, Palampur; Prof. M. H. Balkhi, SKUAS&T, Srinagar, Dr. Prakash Nautiyal, HNB Garhwal University, Srinagar (Garhwal); Prof. R. S. Chauhan, former Director Fisheries, Uttarakhand and P.I., all Co P.I.'s, Scientists, Technical Officers and AF& AO from DCFR.

Dr. K.D. Joshi highlighting the progress during outreach review meeting

Dr. P.C. Mahanta, Director addressing during outreach review meeting

Discussion with the partners

IRC meeting

Institute Research Committee meeting was held on 6-7 August, 2009 under the chairmanship of Dr.

Director addressing during In-house IRC

Project discussion during IRC meeting

P.C. Mahanta, Director. The progress of each research projects was discussed in detail during the meeting. The new research projects were also presented in the meeting. The projects were finalized and the work programme for the year 2009-10 was also finalized.

Official language Hindi

Quarterly meeting of official language Hindi were conducted under the chairmanship of Director and review was done on the work going on in official language. Times to time instructions were issued to concerned sections of the Institute to carry work in Hindi.

Competition during Hindi week

Directorate has also celebrated Official Language week during September 14-20, 2009. On this occasion various types of competitions such as essay writing, translation, administrative vocabulary and official noting & drafting were also organized. All the scientists particularly from non-Hindi states were participated and prizes were distributed to successful participants.

OTHER EVENTS ORGANIZED

National Workshop on Climate change

A National Workshop on **"Impact of Climate Change on Coldwater Fisheries Resources: Perspectives, Framework & Priorities"** was organised on the occasion of World Environment Day by Directorate of Coldwater Fisheries Research, Bhimtal from 5th to 7th June, 2009. Dr. B.S. Bisht, Vice Chancellor, G.B. Pant University of Agriculture & Technology, Pantnagar inaugurated the workshop and Dr. S. Ayyappan, DDG (Fy), ICAR, New Delhi presided over the inaugural session. Dr. P.C. Mahanta, Director DCFR welcomed the delegates and highlighted the issue. A galaxy of experts including retired senior fishery officials, scientists, university professors and students attended the programme. The prominent figures among them were, Dr. S.N. Dwivedi, Ex. Director CIFE, Mumbai; Dr. M.V. Gupta, World Food Prize Winner; Dr. M.Y. Kamal, former V.C., SKUAS&T, Srinagar; Dr. P. Das, former Director NBFGR, Lucknow; Dr. S.P. Ayyar, former Director, CIFRI, Barrackpore; Dr. V.V. Sugunan, ADG (Inland Fishery), ICAR; Dr. C.S. Singh, former Dean, College of Fisheries, Pantnagar,

Lighting of ceremonial lamp by Dr. S. Ayyappan

Welcome address by Dr. P.C. Mahanta, Director

Address by Dr. S. Ayyappan

Address by Dr. B.S. Bisht, V.C, GBPUAT, Pantnagar

Dignitaries were present during the workshop

Cultural programme being organized during the eve of workshop

Releasing of publication by the dignitaries

Musical performance by school children during the eve of workshop

Felicitation of D. Bhoomaiah, (T-5, CIFE) for designing the DCFR logo

Dr. Usha Moza, ICAR, New Delhi, Prof. M.M.Goswami, Deptt. of Zoology, Gauhati University; Prof. B.D. Joshi, Deptt. of Zoology, Gurukul Kangri University, Haridwar; Prof. S.P. Biswas, Deptt. of Life Sciences, Dibrugarh University.

Dr. J.T. Gergan, former scientist Wadia Institute of Himalayan Geology, Dehradun; Dr. H.N. Dutta, former scientist National Physical Laboratory, New Delhi; Professor. B.S. Kotlia, Deptt. of Geology, Kumaun University, Nainital; Dr. W. Viswanath, Deptt. of Life Sciences, Manipur University were among the prominent speakers. They emphasized the

grim scenario of climate change, receding glaciers, change in aquatic thermal regime and their likely impacts on fisheries sectors. The possible mitigation measures were also suggested to safeguard the valuable fishery germplasm and fish-farming sector.

Farmers meet and Exhibition

The workshop held at Bhimtal was followed by a farmers meet at Experimental Fish Farm, Chhirapani, Champawat on 7th June 2009. Besides senior fishery experts, scientists, fishery officials, university professors, students, over 200 fish farmers from Champawat, Pithoragarh, Almora, Chamoli and adjacent places participated the meet. The distinguished participants witnessed the meet were - Dr. S.N. Dwivedi, Dr. M.V. Gupta, Dr. M.Y. Kamal, Dr. P. Das, Dr. S.P. Ayyar, Dr. V.V. Sugunan, Dr.

Dignitaries participating in farmer's meet at Champawat Field Centre

Dr. M.V. Gupta, World Food Laureate felicitating a progressive farmer from Kumaun

Dr. S.N. Dwivedi, Ex-Director, CIFE inaugurating the exhibition at Champawat

A view of stall at the exhibition

Dr. S. Ayyappan viewing a haul of rainbow trout at Champawat

C.S. Singh, Dr. Usha Moza, Prof. M.M.Goswami, Prof. S.P. Biswas. Dr. P.C. Mahanta, Director DCFR briefed about the progress made by fish farmers in the hills. The farmers shared their concerns and achievements with the top fishery experts. The progressive farmers contributing in the field of Chinese carp culture, trout farming, eco--tourism and fish conservation in the region were felicitated in the meet.

The participants evinced keen interest in the various exhibits displayed in an exhibition also organized at the farm campus in this occasion.

National Symposium on Coldwater Fisheries Management: New Strategies & Approaches

The Directorate of Coldwater Fisheries Research, Bhimtal, Uttarakhand organized a "National Symposium on Coldwater Fisheries Management: New Strategies and Approaches" during 2-4th October 2009 at Eco-camp, Assam Bhoreli Angling and Conservation Association, Potasali, Nameri National Park, Tezpur, Assam by focusing on management of available coldwater fisheries resources, biodiversity and conservation,

Lighting of lamp during the inaugural session of symposium

Welcome address by Dr. P. C. Mahanta

Keynote address by Dr. V.V. Sugunan ADG (I.Fy.), ICAR, New Delhi

AQUA-FAIR exhibition

aquaculture practices and nutrition, sport fisheries and eco-tourism, application of genetics and biotechnological tools in aquaculture management.

Mr. George Richmond, President, ABACA, Assam graced the auspicious occasion for being

Address by Dr. Dilip Kumar, Director, CIFE, Mumbai

Address by Dr. A.E. Eknath Director, CIFA, Bhubaneswar

conducting the symposium at ABACA. As a Chief Guest. Dr. V.V Sugunan, ADG (I.Fy.), ICAR delivered the keynote address by giving emphasis on strategies for development of coldwater fisheries

Dr. S A. H. Abidi, former Member, ASRB
Chairing a session

Felicitation to progressive farmers, of N-E
by Dr. M.Y.Kamal, Former V.C.SKAU&T

Felicitation to progressive farmers of N-E by
Dr. S.N. Dwivedi, former DG, MPCST

Felicitation to Dr. T.K. Shrestha, Tribhuban University,
Kathmandu, Nepal

in upland Himalayas. Mr. B.B. Hagjar, IAS, Commissioner of Forest, Assam, Dr. Dilip Kumar,

Group photographs of Progressive Farmers of N-E India

Inauguration of Mahseer hatchery

Director, CIFE, Mumbai and Dr. A.E. Eknath, Director, CIFA also addressed the gathering. A Souvenir cum Abstract Book was released by the Chief Guest during the inaugural session. A bulletin on "Coalmines Degraded Ichthyofaunal Diversity of Simsang River, Meghalaya" authored by Dr. Debajit Sarma, Dr. P. C. Mahanta, Dr. Dandadhar Sarma and Prof. Amalesh Dutta was also released on this occasion. An exhibition "AQUA-FAIR" was also inaugurated by Dr. S.A.H. Abidi, Ex. Member, ASRB, New Delhi.

The premier fisheries Institutes / Industries / Govt. Deptts. / NGO had participated in this exhibition. A mahseer hatchery was inaugurated by Dr. P.V. Dehadrai, former DDG (Fy.) at the premises of Ecocamp in collaboration with ABACA, Nameri, Assam. The setting up this hatchery would help in seed production and conserving the Mahseer stock in the NE States.

Independence and Republic Day Celebration

Institute celebrated Independence and Republic Days on 15th August and 26th January with full devotion. On this occasion, Dr. P.C. Mahanta, Director hoisted the national flag and addressed the gathering of the staff members. He emphasized to work in cohesion for achieving the goals of the institute and to contribute for the development of coldwater sector of the country.

Republic Day Celebration

Discussion with AEB members at DCFR, Bhimtal

PERSONNEL

List of staff (As on March 31, 2010)

Research Management

Dr. P.C. Mahanta, Director

Scientific

1.	Dr. Madan Mohan, Principal Scientist	Fish & Fishery Sciences (upto 11 July, 2009)
2.	Dr. B.C. Tyagi, Principal Scientist	Fish & Fishery Sciences
3.	Dr. K.D. Joshi, Principal Scientist	Fish & Fishery Sciences
4.	Dr. Yasmeen Basade, Senior Scientist	Fish & Fishery Sciences
5.	Dr. Amit Pande, Senior Scientist	Biotechnology (Animal Science)
6.	Dr. Ashoktaru Barat, Senior Scientist	Fish Genetics & Breeding
7.	Dr. Debajit Sarma, Senior Scientist	Fish & Fishery Sciences
8.	Dr. Nityanand Pandey, Senior Scientist	Aquaculture
9.	Dr. S.K. Srivastava, Senior Scientist	Fish & Fishery Sciences
10.	Dr. Prem Kumar, Senior Scientist	Fish & Fishery Sciences
11.	Sh. Ashok Kumar Nayak, Scientist (S.S.)	Computer Application in Agriculture
12.	Dr. N. Okendro Singh, Scientist	Agricultural Statistics
13.	Dr. G.K. Shivaraman, Scientist	Animal Genetics & Breeding (upto 26 February, 2010)
14.	Sh. Sumanta Kumar Mallik, Scientist	Aquaculture
15.	Dr. Shahnawaz Ali, Scientist	Aquaculture
16.	Dr. Neetu Shahi, Scientist	Animal Biotechnology (from 29 August, 2009)

Technical

1.	Sh. R.S. Haldar	Technical Officer, T-6
2.	Sh. A.K. Joshi, T-5	Hindi Translator
3.	Sh. Baldev Singh	T-4
4.	Sh. Santosh Kumar	T-4
5.	Sh. Ravinder Kumar	T-1-3
6.	Sh. Vijoy Kumar Singh	T-3
7.	Sh. Amit Kumar Saxena	T-3
8.	Sh. Hansa Dutt	T-2
9.	Sh. Gopal	T-2
10.	Sh. T.M. Sharma	T-2

11. Sh. R.K. Arya	T-2
12. Sh. Bhagwan Singh, Driver	T-2 (Supperanuated 31 March, 2010)
13. Sh. Manoj Kumar Yadav, Driver	T-1
14. Sh. Partha Das	T-1

Administrative

1. Sh. Harish Ram	Asst. Admin. Officer
2. Sh. B.C. Pandey	Asst. Fin. & Acc. Officer
3. Smt. Susheela Tewari	Stenographer
4. Smt. Khilawati Rawat	Assistant
5. Sh. P.C. Tewari	UDC
6. Sh. J.C. Bhandari	UDC
7. Sh. Pratap Singh	LDC
8. Smt. Munni Bhakt	LDC
9. Sh. Hayat Singh Chauhan	LDC
10. Sh. Hansa Singh Bhandari	LDC

Supporting

1. Sh. Sant Ram	SSG4 (Supperanuated on 30 April, 2009)
2. Sh. Ravinder Kumar	SSG4
3. Sh. Om Raj	SSG3
4. Sh. Sundar Lal	SSG3
5. Sh. Dharam Singh	SSG3
6. Sh. Prakash Akela	SSG2
7. Sh. Pooran Chandra	SSG2
8. Sh. Manoj Kumar	SSG2
9. Sh. Kuldeep Kumar	SSG2
10. Sh. Bhola Dutt Mouni	SSG2
11. Sh. Chander Shekhar	SSG1
12. Smt Basanti Devi	SSG1
13. Sh. Mangla Prasad	SSG1
14. Sh. Sushil Kumar	SSG1

Dr. Madan Mohan, Principal Scientists from this Directorate has joined as Assistant Director General (Marine Fisheries) at ICAR Headquarter

Farewell to Sh. Sant Ram, SSG-IV on his superanuation

Farewell to Sh. Bhagwan Singh, T-2 on his superanuation

MEMBERS OF THE MANAGEMENT COMMITTEE

Dr.P.C. Mahanta Director, DCFR, Bhimtal	Chairman
Dr.V.V. Sugunan, Asstt. Director General (I.Fy.), ICAR, KAB II, New Delhi	Member
Dr. A.K. Srivastava, Principal Scientist, Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora, Uttarakhand	Member
Dr.A.K. Sahu, Principal Scientist, Central Institute of Freshwater Aquaculture, Bhubaneswar, Orissa	Member
Dr.S.A. Ali, Principal Scientist, Central Institute of Brackishwater Aquaculture, Chennai	Member
Dr.M.K. Das, Principal Scientist, Central Inland Fisheries Research Institute, Barrackpore, West Bengal	Member
Shri Harish Ram, AAO, DCFR, Bhimtal	Member Secretary

MEMBERS OF THE RAC

Dr. S.P. Ayyar Former Director, CIFRI, Barrockpore	Chairman
Dr.V.V. Sugunan, Asstt. Director General (I.Fy.), ICAR, KAB II, New Delhi	Member

Dr. P.C. Mahanta DCFR, Bhimtal	Director
Prof. R.K. Sinha, Dept. of Zoology, Patna University	Member
Prof. W. Vishwanath Dept. of Life Sciences	Member
Prof. P. Nautiyal Dept. of Zoology, H.N.B. Garhwal University	Member
Prof. Manju Lata Bisht Head, Dept. of Zoology, Kumaun University	Member
Dr. A. Barat DCFR, Bhimtal	Member Secretary

DISTINGUISHED VISITORS

- Dr. S. Ayyappan, Ex. Deputy Director General (Fy.), Indian Council of Agricultural Research, Krishi Anusandhan Bhawan-II, New Delhi
- Shri T. Nand Kumar, IAS Secretary DAC, Govt. of India, New Delhi
- Dr. B.S. Bisht, Vice Chancellor, G.B. Pant University of Agriculture & Technology, Pantnagar, U.S. Nagar
- Dr. M. Mahadevappa, Former Chairman, Agricultural Scientist Recruitment Board, New Delhi

Visit of Shri K.C. Singh Baba, Hon'ble MP, Nainital

Dr. M. Mahadevappa, Former Chairman, ASRB addressing scientists

Dr. C.D. Mayee, Chairman, ASRB addressing DCFR scientists

Visit of Dr. M.J. Modayil, Member, ASRB to Genetics Lab.

- Dr. Mohan Joseph Modayil, Member, Agricultural Scientist Recruitment Board, New Delhi.
- Prof. S.V.S. Rana, Pro-Vice Chancellor, CCS University, Meerut.
- Dr. K.K. Vass, Former, Director CIFRI, Barrackpore
- Shri Vinod Phonia, IFS, Secretary, Horticulture, A.H., Fisheries & Dairy Development, Government of Uttarakhand, Dehradun
- Shri K.C. Singh Baba, MP, Nainital

Visit of Dr K.M. Bujarbaruah, DDG (AS), ICAR

Visit of Deputy Secretary (P), ICAR

- Dr. V.V. Sugunan, Asst. Director General (I. Fy.), Indian Council of Agricultural Research, Krishi Anusandhan Bhawan-II, New Delhi
- Dr. Madan Mohan, Asst. Director General (M. Fy.), Indian Council of Agricultural Research, Krishi Anusandhan Bhawan-II, New Delhi
- Dr. C.D. Mayee, Chairman, Agricultural Scientist Recruitment Board, New Delhi
- Dr. K.M. Bujarbaruah, Deputy Director General (Animal Science), Indian Council of Agricultural Research, Krishi Bhawan, New Delhi
- Mr. J. Ravi, Deputy Secretary (Per), Indian Council of Agricultural Research, Krishi Bhawan, New Delhi
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