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Leh Region

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Fish and Fisheries of Leh Region: An Exploratory Survey

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Dr. P.C. Mahanta
Director,
DCFR, Bhimtal, Uttarakhand (India)

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Foreword

Coldwater fisheries resources comprise of lakes, reservoirs, rivers and streams. In spite of various constraints the sector has made significant contribution in the nation's agenda for food security. Some of the fish fauna can withstand extreme cold climate in very high altitude region, which are generally found frozen from three to six months in a year that make fish genome unique for valuable traits. Such a diversified natural resource base with wide range of climatic diversity, depending on altitudinal zones, is very much conducive to conserve and rear various fish species. The rapid overall development and ever-increasing population lead to anthropogenic activities resulted in disturbing the fragile aquatic ecosystems and fish fauna. Artificial propagation & seed production from high altitudinal fish stocks raised in the farm conditions are standardized. But the current level of aquaculture technology needs to be refined for raising commercial stocks of indigenous fish species in hills. Sustained efforts are required in the areas of nutrition, growth enhancement and genetic improvement using modern biotechnology tools. Technology developed for the culture, breeding and management of the economically viable fishes suitable for high altitude region has a positive impact on the employment generation in these regions since the technology was taken as hot cake among the farmers in some areas of the hills. There is great scope for disseminating these promising technologies in high altitude in order to upgrade the socio-economic conditions of the inhabitants. Resource assessment in the high altitudinal region is a challenge due to its kaleidoscopic topography and rough weather most of the time in the year. The institute has taken a challenge to explore the fishery resources of the Leh region through exploratory survey. The document would provide baseline information to the academicians and researchers to carry out activities in order to support the region in term of food security.

Introduction

The Himalayan wall cut across by Zojila pass seems to have been designed by nature as a sharp line of demarcation between the valley of Kashmir and the region of Ladakh comprising the districts of Leh and Kargil on the east-west boundary of the two regions. As we negotiate the pass from the Kashmir side and reaching the summit, cast our eyes on the periphery of Ladakh from this point of vantage, we are startled by the violent contrast between the lush green, forest-clad, smiling garden we have left behind and the bare, bald, sandy wilderness cut up by naked, specter-like serried mountain ranges that lie ahead. And what meets the eye as we enter the area of Ladakh by its western gateway, gives a glimpse of the predominant tone in the scene pattern of this sensitive area throughout its length and breadth. Shorn of the areas grabbed by the two aggressive neighbours, the area, of the existing Leh and Kargil districts measures about 59,000 km^2. The elevation of the region varies between 8,000 and 13,000 ft above the sea level. Leh, the headquarters of the Leh district, stands at an altitude of 11,500 ft, certainly one of the highest inhabited spots in the world. The district is ringed round and crisscrossed by high mountain walls which intercept the moisture-laden clouds striking against them from various directions and divest them of the bulk of their wealth of watery vapor as they travel inward over concentric rings. According to Cunningham the dry season of the region is due to elevation and radiation of heat from the bare soil whereas "the most striking feature in the physical aspect of Ladakh is the parallelism of its mountain ranges. Glaciers of perennial snow shimmering green and giving birth to innumerable rivulets and torrents on numerous mountain sides while the low valleys remain uncommonly dry, the rainfall in the region hardly ever exceeding in the year. The great rivers which carve deep *gorges* far below their steep banks are useless for watering the fields lying mostly in terrace-like formations one above the other on mountain slopes and it is generally the mountain torrents issuing from glaciers which arc channeled and trained to irrigate the cultivated lands.

Ladakh and its mountains were apparently under an ice-cap which extended from the North pole right down to Kashmir and which on melting formed many lakes, wetlands and streams. Most of the lakes in Ladakh are landlocked and, as a result, brackish with the exception of ***Quin-Tso.*** Similarly, the main rivers draining Ladakh are the Indus, Hunza, Shigar, Shyok, Saltro, Nubra, Zanskar, Hanle, and the Galiwan which further increase the fisheries potential.

(*Cyprinus carpio var nudus*, *Cyprinus carpio var specularis*, and *Cyprinus carpio var communis*) were being cultured successfully in this area. However, recently field surveys were conducted by the institute and water quality parameters and dominant species of phytoplankton were recorded at existing fish farms of state Government and three locations of Indus river in order to understand the ecology of water systems in detail for developing fish as a cheap and high quality protein source of food. Attempts have also been initiated to genetically characterize species of snow trout at DNA level in order to assess the population status, genetic similarities and distances including the construction of phylogenetic tree using RAPD, mtDNA and microsatellite markers for the formulation of suitable breeding strategies for genetic improvement.

Food

The staple food of the region is the flour of parched *grim,* a specie of barley used with salted and buttered tea. Butter is an essential ingredient of the tea and is thoroughly dissolved with the tea by being vigorously chum in a wooden cylinder with a sort of pump. The flour moistened with the tea is formed into small lumps and eaten simultaneously with the sipping of tea. When going on a long journey a *Ladakhi* will take with him a bag of *grim-flour* and butter and strap these on his back. He will halt at places selected by successive caravans for encampment. These are green patches sheltered by trees with rills of clear cold water flowing by and dry cattle-dung scattered about. Here he will unpack, light a fire and make tea regaling himself with the refreshing beverage and a meal of *grim-flour.*

To economise fuel and cooking labour, *Ladakhi* convert some other eatables into flour like parched *grim* so that no elaborate process is involved in preparing them for a meal. Among these are different varieties of legumes and beans which are likewise roasted and ground into flour. The most common legume thus used is the pea and flour of which in small quantities may be mixed with *grim* flour. Sour apricots dried and powdered and dissolved in water make a tart and refreshing drink in sultry summer days when a weary march under a hot sun makes the traveler uncomfortably thirsty.

Soils

It will be evident even to the casual observer that soil changes from place to place and with it

the Trans-Himalayan zone. The characteristic of soil and water are interdependent in a fishpond. Physical, chemical, and biological properties of soil, denuded and transported from the surrounding areas and deposited in the basin shaped areas, vary from those of the cultivated soil from where it has been removed. A number of soil constituents such as colloidal clay, organic matter, nitrogen, phosphorus, potassium etc. and also trace elements are carried down with flowing water, get distributed in different proportions at various parts of the fish ponds which ultimately determines the physico-chemical and biological characteristics of the water of the fish pond.

Glaciers

A glacier is a naturally moving body of large dimensions made up of crystalline ice (neve in the upper layers) formed on the earth surface as a result of accumulation of snow. A very large number of glaciers exist in the Himalayas. A majority of these are found in the main Himalayan range while others occur on offshoot ranges. It has been found that the Himalayan Glaciers in Kashmir descend to lower elevation. The effect of aspect on the glaciations in a particular mountain slope is mainly due to differences in solar radiation received by them. South-facing slopes have a relatively less ice-cover. In the same way, areas receiving more annual precipitation in the form of snow are heavily glaciated. Himalayan glaciers are important ever-renewing sources of fresh water for the millions living in the abode of these regions and the plains of northern and eastern India. In summer, large quantities of water melt from the glaciers and flow down the rivers and streams draining the Himalayas. Fresh snow is added to the glaciers during the cold season. The total volume of ice in a glacier is calculated on the basis of area and average thickness. Thus, the total ice volume in the Himalayan has been estimated to be around 1400 cubic kms.

Weather

The Ladakh Ecological Development Group had initiated a Data Programme to evaluate and measure the Renewable Energy for the Ladakh region, under the Renewable Energy Project. Data after data collected consist of daily maximum and minimum temperature and humidity. The equipment's at each site were placed in Stevenson and the data noted twice a day. The sunshine recorder gives the daily hours of bright sunshine hours for the particular location. Thirdly, using Solar Path finder, the [illegible]

tiny veins, these rivers and streams flow through the land, cutting deep canyons and gorges.

Wet Lands

Lying east of Kashmir, Ladakh an arid upland is barren, inhospitable plateau, often previously referred to as Little Tibet and Moon-land by some. It contains some of the remarkable wet lands areas. The high mountain lakes and bogs support the only breeding of bars headed geese *(Anser indicus)* in India (Some 250 pairs) and few breeding pairs of black-necked cranes *(Grus nigricollis)* to be found outside the peoples Republic of China. The Government of India initiated a national inventory of wetlands, entitled the All India Wetland Survey, as long ago as the late 1960s. A large number of sites have been listed. The department of Environment in the year 1980s established a wetland Working Group. Based on an analysis of the response, the Directory of Indian Wetlands was produced in the 1990 by the Ministry of Environment and Forest which are as under:

Wetlands of Ladakh

Thicksey to Shey: Description of site: From Thicksey onwards to Shey, the Indus divides into a numbers of channels which have led to the formation of several islands where small pockets of forests have developed. The road from Thicksey to Shey runs along the north bank of the Indus River.

Shey Marshes: A small, marshy tract along the Indus. Recently, a road has been constructed bisecting the marsh into two unequal parts. On the southwest side of the marsh, there is located the Shey fish farm.

Pangong Tso: Pangong Tso is a long, narrow, brackish water lake spanning the Indian/Chinese border, in a high mountain valley in the upper drainage basin of Indus river, at the east end of the Karakoram range. Only the westernmost third of the lake lies in Indian Territory. The lake is actually a chain of four interconnecting water bodies and is probably of very recent origin, having been formed by natural damming of the valley. Five rivers fed by perennial springs and snow-melt, flows in to the Indian portion of the lake; the outlet at the west and flows northwest into the Shyok River, a tributary of the Indus. There are some brackish to saline marshes near the western end, with adjacent wet meadows.

Chushul Marshes: A complex of shallow ponds, marshes, and wet meadows in a board, sandy

from the Ladakh Range to the South-West. Some streams terminate on the sandy plains in stagnant pool, which become saline as they evaporate; others carry sufficient water to *flow* into the Pangong Tso and ultimately the Indus River. Small fresh water marshes have formed where these streams coalesce or where they reach a body of standing water. Most of the ponds and marshes are frozen from November to March; they reach their maximum extent during June and July through increased melt' water run-off from the high peaks, and shrink again thereafter. The ponds average only one or *two* meters in depth.

Hanle River Marshes: A complex of fast/flowing streams, stagnant pools, saline marshes, seasonally flooded marshes, and bogs along the Hanle River above its confluence with the Indus. The Hanle River flows through a wide, sandy plain with seasonally flooded marshes and grasslands. Several small streams debouch into the river, giving rise to a complex of pools, bays, and inlets. The wetlands are frozen from November to March, and are fed by snowmelt in summer.

Tsomo-Riri: Tso Moriri is the largest (length 30 km. average width 9 km) of the high altitude trans-Himalayan lakes situated entirely within Indian Territory. The waters are alkaline. The lake had an outlet to the south, but it has contracted considerably and has become landlocked, as a result, the water is now brackish to saline. The lake is fed by spring and snow melt in two major stream systems, on entering the lake from the north, the other from the south west. Both stream systems create extensive marshes where they enter the lake. The lake has a maximum depth of 40 m, and is frozen over from October to March. Small islands near the north and south end are important for breeding waterfowl. The lake basin is bounded to the north and east by cold desert and to the south and west by mountain ranges with peaks exceeding 5500 m. A village, Korzok, inhabited by semi-nomadic tribes, is situated in a corner. Recently, a road has been constructed up to the lake.

Tsokar Basin: In a very remote and sparsely populated area, the TsoKar Basin is a land locked basin of a former large freshwater lake (now in a state of desiccation) has contracted into two principal water bodies: Startsapuk Tso a brackish lake of about 300 ha in the south, and Tsokar itself, a hyper saline lake of 2200 ha. Startsapuk Tso, freeze from October to March, is fed by perennial springs and snow melts and becomes almost fresh during the mid summer period of maximum run-off; it reaches its maximum depth of 2-3 m in July and August and

4	*Nemacheilus arafi*	Loach
5	*Namacheilus fascimaculatus*	Loach
6	*Nemacheilus montanus*	Loach
7	*Ptychobarbus conirostris*	Indus Trout
8	*Salmo qairdneri gairdneri*	Rainbow Trout
9	*Schiopygopsis stolczkae*	Kinnaur Snowtrout
10	*Schizothoraichthys labiatus*	Kunar Snowtrout
11	*Schizothorax richardsonis*	Alwan Snowtrout
12	Snow Loach	Snow Loach
13	*Triplophvsa choprai*	Snow Loach
14	*Triplophysa gracilis*	Snow Loach
15	*Triplophvsa griffithi*	Snow Loach
16	*Triplophysa ladacensis*	Snow Loach
17	*Triplophysa microps*	Snow Loach
18	*Triplophvsa tenuicauda*	Snow Loach

Infrastructure

1. State Fisheries Department:

There is office of Deputy Director of Fisheries at Leh with sufficient staff. The office is headed by Mr. Tundup Dorji (DDF). The office is having following farm establishments.

Shey Fish Farm of Leh District (Seen)

A small fish farm with a total area of 1 ha and water area of 0.5 ha situated in the marshes/wetland of Shey village, consisting of five ponds has been established at Shey. The farm is located at an altitude of 11500 ft above mean sea level. This farm is not only utilized for rearing exotic fish species but has played an important role in developing the fisheries in Ladakh. Apart from it has also served as an acclimatization station for the fish seeds being brought in from Kashmir Valley before it is supplied further for stocking purpose. Experimental breeding of the exotic fish species like Rainbow trout and carps had been

Trout Fish Farm at Sindhu Ghat

The farm is located near Sindhu Ghat and the farm is made in the channel about 10' wide and 1000' long and the channel is covered with the thick mesh wire. They are intercepted with the help of nets that make number of small ponds. The ponds were stoked with Rainbow trout and growing well to 80-100 gms in 6 months. It is learnt that the stock never get any disease.

Trout Fish Farm, Nubra

Situated in the valley of Diskit, Nubra this farm is one of its kinds in Leh district where for the first time Trout Raceways were developed to rear rainbow trout brought in from Kashmir. Apart from the 06 raceways a hut was also constructed at the site for the proper watch and ward of the farm. The first batch of live Trout fish seeds brought in from Srinagar has been successfully reared under local condition and is ready for sale. There are six raceways of 26'X9'8" size.

2. Field Research Laboratory (FRL), DRDO under Ministry of Defence

Field Research Laboratory (FRL), DRDO is having following laboratory facility can be availed for different research purposes:

- Biotechnology
- Microbiology
- Processing and Post harvest

In addition to these there are three good sizes cemented tanks can be used for demonstration purposes.

The team visited the ponds and necessary modifications were conveyed to the scientists for developing as the demonstration ponds.

Culture Fisheries

Fish culture is spread all over the world. Methods are diversified and system differs according to the species cultivated, the aims (fish for consumption or repopulation) and the techniques and methods employed. The important distinction between different types of fish cultivation

trout fishes and common carp. The two varieties of trout's cultured are the Rainbow trout (*Oncorhynchus mykiss*) *and* Brown Trout's (*Salmo trutta fario*). Among the common carp are the Leather Carp (Cyprinus carpio var nudus), Mirror carp *(Cyprinus carpio var specularis)*, and Scale Carp *(Cyprinus carpio var communis)*. The common carp are the sturdiest fish for culture practices. The entire tree varieties stated above have been found to thrive well even at high altitude. The common carp (Scale Carp), is found to be a fast growing fish and is widely cultured in fresh water ponds. The department, which had brought live trout seed from Kashmir Valley are thriving well in the waters of Ladakh.

Molecular Analyses of Schizothorax spp.

Different tissue samples collected at Shey Fish Farm in Ethanol and were carried to Institute at Bhimtal for DNA isolation and PCR analysis. RAPD profiles were analyzed using 10 mer random primers comparing with *Schizothorax* sp. available in Kumaon Hill region. Distinct species-specific RAPD-PCR profiles were observed between Leh and Kumaon individuals. Work in progress to develop species-specific diagnostic marker for proper characterization of this species.

Conclusion:

High altitude, land have been used for procuring food, energy and minerals. The majority of dependents on fish as means of livelihood are now facing problems to meet their both ends owing to sharp decline in fish catch in the upland areas. Keeping in view the squeezing land and burgeoning human ratio, mountain fish resource base is of great relevance and development of such areas becomes matter of national concern, which needs different technological approach and support services.

Such regions have to be tapped for increased fish production for national basket and rural development in hills.

It is only after recognition of details that a possibility of generating global prescriptions for wise management practices would emerge.

It requires effort and time to analyze various activities in the uplands that are coordinated under diverse technological, social and cultural backgrounds.

exploratory survey was conducted during December 2007. This was the time when climate was extremely cold and most of the water bodies were partially frozen.

There is a need of further survey in order to develop the suitable model of fisheries in the region.

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3. Dr. Mahesh Rangnekar, Scientist, DIHAR (DRDO), Leh
4. Mr. Tondup Dorji, Deputy Director of Fisheries, Ladakh

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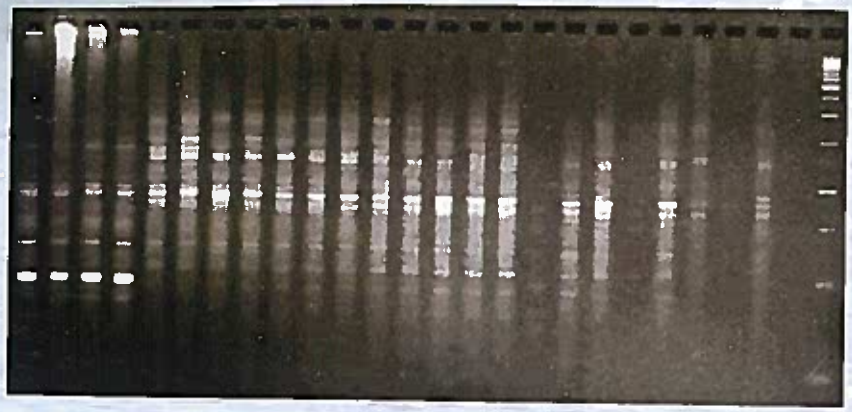
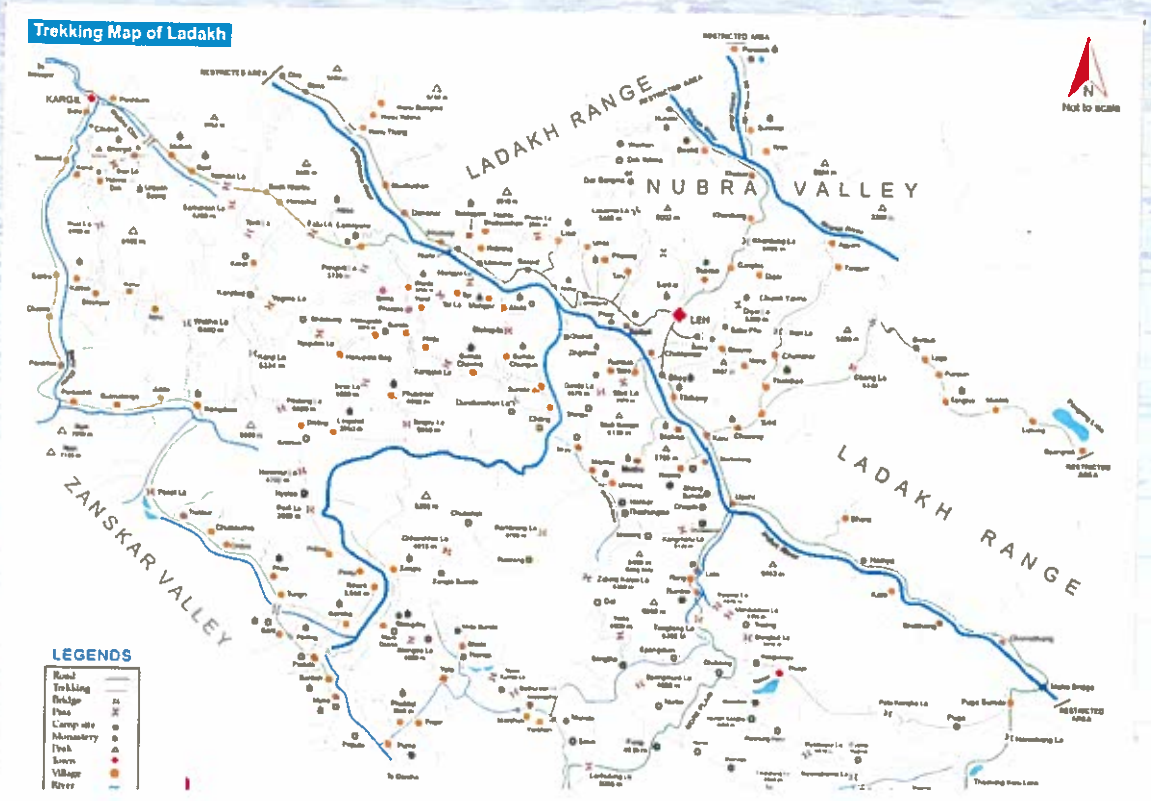
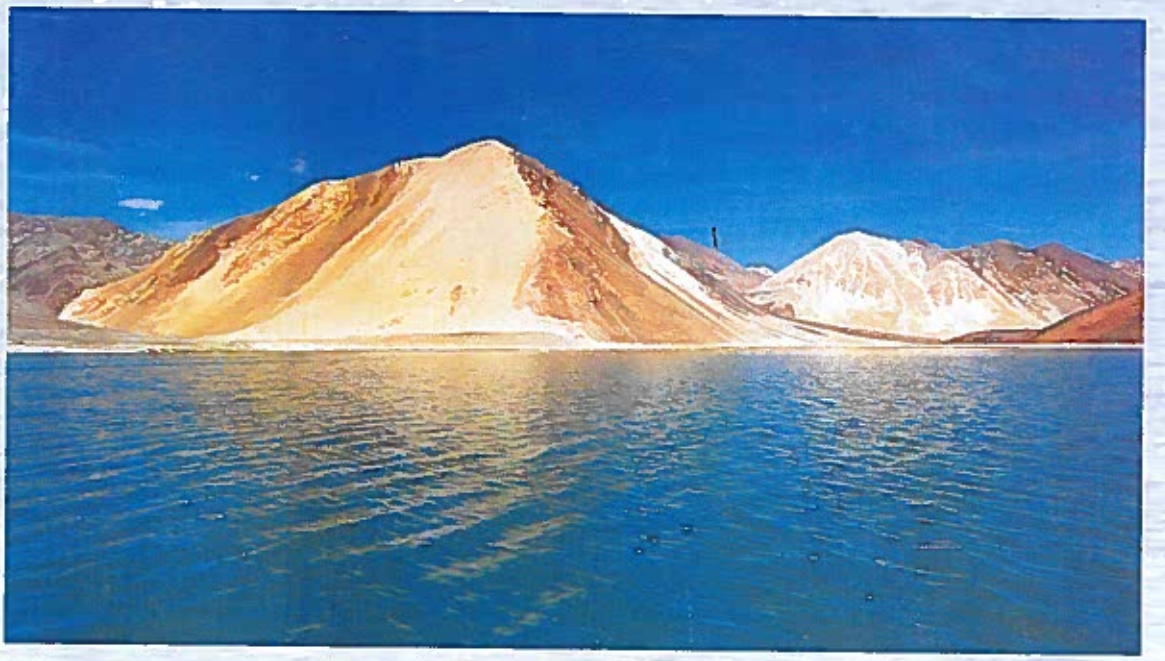


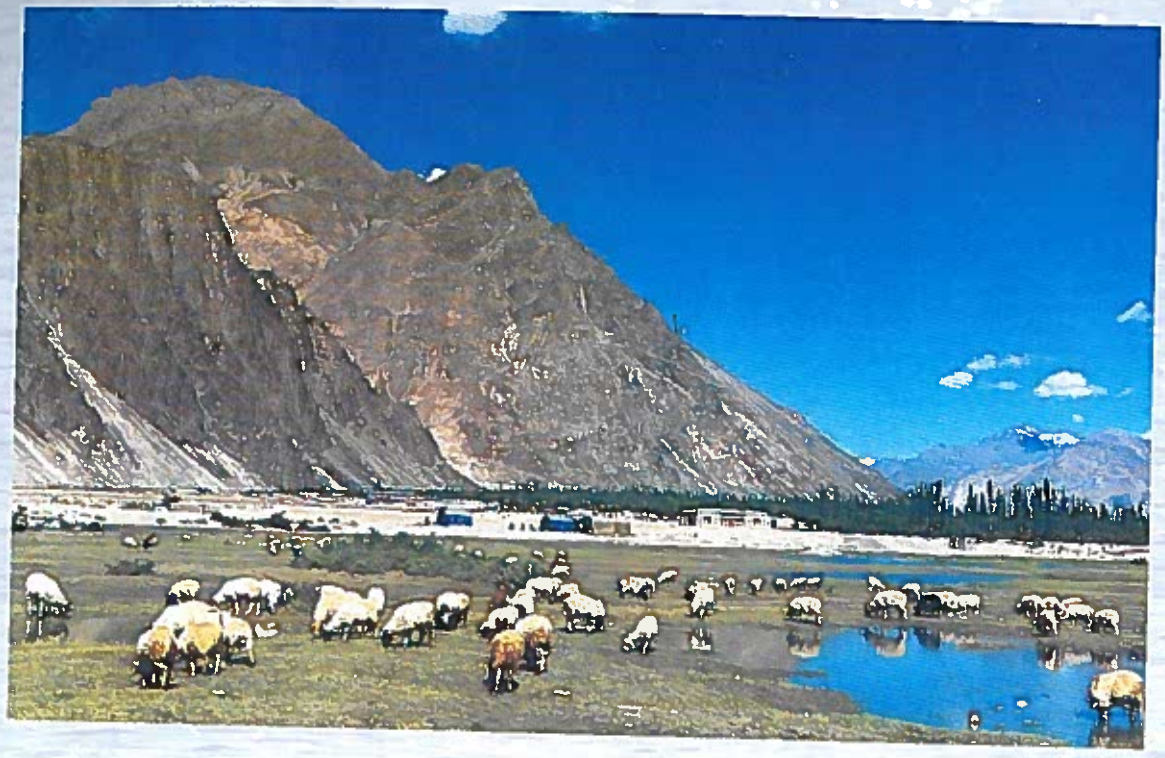
RAPD profile of *Schizothorax* from Leh and Kumaon using 10 mer Random Primer



Lakes of Ladakh region



Pengong Tso Lake



Nubra Valley

Garra gotyla gotyla

Schizothoraichthys longipinnis

Nemachielus spp.

Collection of Soil sample

Breaking ice in the Shey fish farm

Collection of water samples

Scientist with Deputy Director Fisheries, Leh

Religious Ceremony in Thickshey Gompa

Frozen Wetland near Leh

Confluence of Indus and Zhanskar rivers

Collection of tissues

Khardung La Peak