

CYTOGENETIC AND MORPHOLOGICAL COMPARISONS BETWEEN EASTERN AND WESTERN  
PACIFIC SALVELINUS

Ted M. Cavender and Seiro Kimura

Department of Zoology, The Ohio State University, Columbus, OH, U.S.A. 43210 and Department of Fisheries, Faculty of Agriculture, Kyushu University 46-04, Fukuoka, 812 JAPAN

Character sets for use in a phylogenetic analysis of Pacific Basin Salvelinus were obtained from two sources: gross chromosome morphology with six species analyzed (S. alpinus, S. confluentus, S. fontinalis, S. leucomaenis, S. malma and S. namaycush) and cranial morphology of spawning males with eight species analyzed (the six listed above plus S. albus and S. kronocius). In addition NOR chromosomes were examined in Japanese Salvelinus (S. malma, S. m. miyabei, S. leucomaenis, S. l. pluvius and S. l. imbrius) in order to help resolve taxonomic problems within this group. Published photographs of metaphase chromosomes were used for S. albus and S. kronocius.

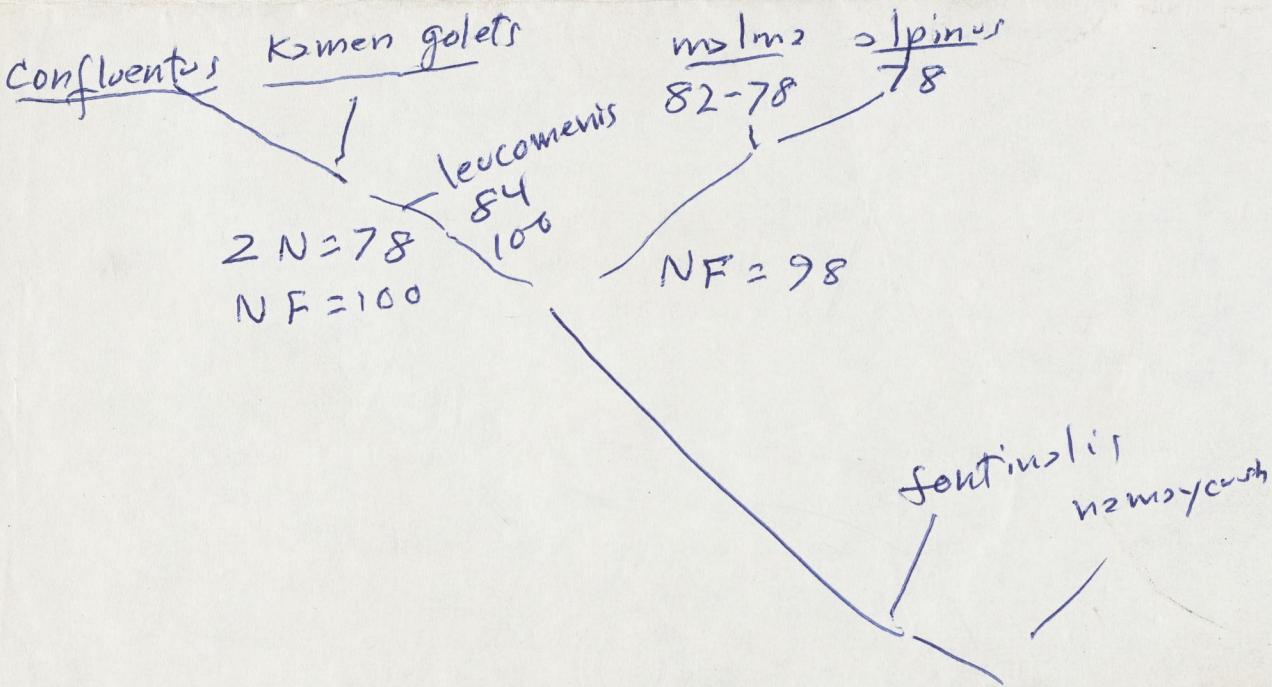
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With respect to cranial morphology, S. confluentus, S. albus, S. leucomaenis and S. namaycush share a decreased level of sexual dimorphism and head modification in large breeding males. Extreme modification, which may be plesiomorphic, was found in S. fontinalis, S. malma and S. l. pluvius.

# Karyology

— Nuclear Organizing Region NOR on chromosomes

— malma & alpinus are similar



primitive 2N = 84  
NF = 100

Mina & Alexeev — <sup>1985</sup> <sub>6</sub> <sup>7</sup> Zool. Zhurn.  
2N = 92



# INSTITUTE OF BIOLOGICAL PROBLEMS OF THE NORTH

685010 Magadan K. Marx str. 24. USSR tel: 2-01-66

Dr.E.J.Crossman

Curator

Department of Ichthyology and Herpetology

Royal Ontario Museum

100 Queen's Park

Toronto, Ontario

Canada M5S 2C6

RECEIVED

AUG 3 1988

ICHTHYOLOGY  
& HERPETOLOGY

June 24, 1988

Dear Dr.Crossman:

Thank you very much for your very useful literature on the pike, *Esox lucius* and for the information on tagging methods employed in USA and Canada. I am very interested in the problem as my colleagues and I study population biology of stone loach, salmon, and whitefish living in North-East Asia.

I received your letters dated May 3 and May 27. As for *Dallia*, I think, Dr. Andreev told inexactly my information for you. As I wrote before, Dr. A.V. Balushkin has 10 specimens of the two species, *D. pectoralis* and *D. admirabilis*, in Zoological Institute, Leningrad. It is quite possible, Dr. Balushkin will also pass you the information. As far as I know, some workers of Zoological Institute (Dr. Dorofeeva, Dr. Neelov) are going to Budapest in August, 1988. I shall ask Dr. Balushkin to make the information more exact wheather you can get *Dallia* in alive form in Budapest.

This year my coworkers will bring *D. pectoralis* from the other region of Chukotka (Achchen Lake) near Providenia Bay (Providence). This material I could bring to you myself if I have opportunity to come to Canada on an invitation. Dr. Andreev told me that you could invite me. For that I must send necessary information. My work in Canada may be as follows:

1. Research work: study of systematics and relationships of fresh water fishes in off-beringian territories (North-East Asia, Alaska,

Northern Canada); objects of study: stone loach, whitefish, grayling, Esocidae, and some Cyprinidae. Study of morphological and ecological research methods of freshwater fish; using of computers in ichthyological museums.

2. Supposed work: study of collectional material of some groups and species, study of fresh material, if possible, and osteological collections of grayling, stone loach, whitefish, and pike.

3. Places of visitation: **in Canada** - Royal Ontario Museum, National Museum of Natural Sciences; any establishment where freshwater fish tagging is carried out.

4. Meetings with colleagues: Dr. Don E. McAllister, Dr. R. J. Behnke, Dr. C. C. Lindsey, Dr. Ted M. Cavender.

5. Arrive: any time convenient for you. As for me, I would like to come in August-September, 1989.

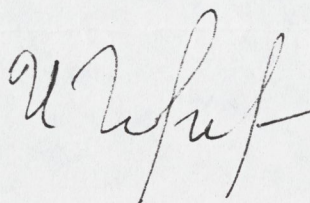
6. Stay period: 1, 5-2 months.

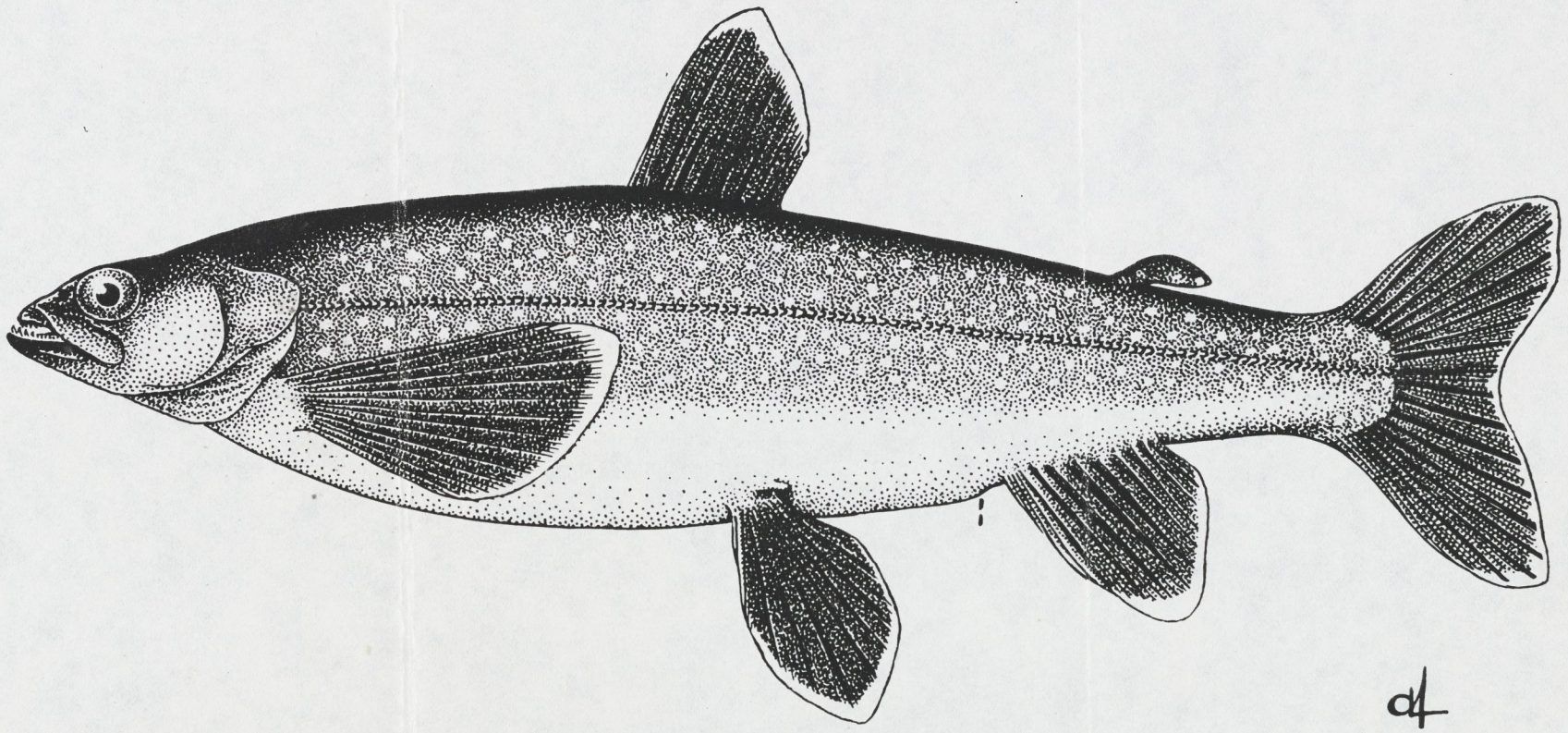
If I succeeded in coming I should be able to bring collection material you and your colleagues are interested in.

I leave Magadan for field work on June 26 and in the late September I shall be back.

I send you a holotype picture of the new genus and species of salmon from the ancient El'gigitgin Lake (Central Chukotka). I described it in the article which will be published in "Voprosi Ichtiologii" (Ichthyology), I think, in 1989. Type material is housed in Zoological Museum, Leningrad.

Sincerely yours,

 I.A. Chereshev



df

The morphological, ecological and evolution peculiarities of charrs from the El'gigitgin lake (Central Chukotka)

Igor Chereshnev and Mikhail Skopets

Institute of Biological Problems of the North, Far East Branch of the USSR Academy of Sciences, Magadan, USSR

The El'gigitgin lake is an ancient body of water (approx. 3,5 million years) situated in a crater of meteorite origin in the centre of the Chukot upland at the height of 495 m above sea-level. The climate is severe, winds of meridional direction are frequent, water temperature on the surface at the depth of 50 and more meters does not exceed +2-3°C, transparency reaches 40 m, mineralization is extremely low. That region has never undergone influence of cover glaciation and sea transgressions, so the lake meets the requirements of endemism and refugium. Findings of ancient endemic diatomic algae in the lake as well as new (probably also endemic) species and some water forms of fishes and invertebrates are indicative of the fact.

Charr ichthyocenosis of the lake includes the large charr-predator *Salvelinus boganidae* Berg, endemic benthopelagic plankton-eating charr, lake smallmouth charr *S. elgytius* Victorovsky et Glubokovsky (Victorovsky et al., 1981) as well as the specialized benthic charr plankton-eating longfin charr *Svetovidovi* which was found in 1985 and described as a new genus and species of *Salvethymus svetovidovi* Chereshnev et Skopets gen. et sp.nova.

The lake Boganid charr feeding the lake smallmouth and longfin charrs inhabits benthic layers from the coast up to the depth of 15-20 m but may do feed migration up to 100 m depth. The species lives as long as 23 years, length is 1 m, mass - 10 kg (the model sample reaches 14 kg). The lake Boganid charr grows more quickly than the other charrs in the lake. Its fecundity is very high (12,000 eggs), the reproduction takes place in autumn on shallows with gravel grounds.

The lake smallmouth charr inhabits in the day-time at the depth of 80 m; in a fine weather night it goes up to the surface and the coast following vertical zooplankton migration. Age limit is 27 years, length 24 cm, mass - 114 g. Fecundity (550 eggs on the average) and fatness are the least among charrs in the lake; spawning takes place in autumn in a brief space of time (7-10 days) on shallows.

The longfin charr inhabits at the depth of 50-105 m; at a lifting up to the surface its swim bladder swells. Age limit is 30 years or so; length - 33 cm, mass - 400 g. Fecundity is low (650 eggs on the average) but fatness is the most among the charrs. Evidently, spawning is all-the year-round. Zooplankton is its only feeding.

Nature of morphological features in the lake Boganiid and lake smallmouth charrs does not exceed the limits of the *Salvelinus* genus. On the contrary, the longfin charr possesses obvious specialized and unique features that singles out it of *Salvelinus* s.l. In particular, it has maximum gill raker number (44-63, 53 on the average) and minimum number of predorsalia (9-11); strongly reduced orbitosphenoideum (more frequently lacks) and basisphenoideum; there are no supraorbitalia, some tabularia; pelvic axillary process is reduced up to disappearing; usually there are no teeth on vomer (seldom there are 1-2).; commissura coronalia is torn in the centre. At the same time, in spite of zooplankton nature of feeding the longfin charr has a small mouth, protruded low mandible and strong fang-like teeth on jawbone, lingual and palatine bones. That species has no breeding colour. Supposed that the longfin charr is the most ancient form close to charr ancestors remained in the lake since the tertiary time.

It is assumed to single out the charrs into a separate tribe *Salvelini* with genera: *Salvelinus* Richardson 1836, *Bione* Dekay 1842, *Cristivomer* Gill et Jordan 1878, *Salvethymus* Chereshev et Skopets 1989. Museum material is housed in Zoological Institute, Leningrad.

SYNTHESIS OF INFORMATION  
FOR A PHYLOGENETIC INTERPRETATION OF SALVELINUS

Robert J. Behnke

Colorado State University  
Fort Collins, Colorado

Since my 1980 and 1984 papers on charr systematics, considerable new information has been compiled, particularly from the areas of karyology and biochemical genetics. In view of the latest information, I have modified my former concepts of relationships in the subgenus Salvelinus.

It is now apparent that organismal (morphological) and molecular evolution may proceed at very different rates, particularly among sympatric populations selected for different niches. Problems associated with a best interpretation of available information concern decisions on primitive vs. derived character states and convergent evolution. Ongoing studies of mitochondrial and ribosomal DNA and chromosomal banding, particularly of nuclear organizing regions, imply that much greater resolution and refinement for phylogenetic analysis will be possible.

Some controversial aspects of Salvelinus systematics, such as species criteria, are not amenable to resolution by quantification. A realm for qualitative speculation will always remain for future symposia.



Some Notes on the Taxonomical Status of Salvelinus leucomaenis Complex  
Found in Japan.

Seirô Kimura

Department of Fisheries, Faculty of Agriculture, Kyushu University 46-04, Fukuoka, 812, Japan

For a phylogenetic analysis between Salvelinus leucomaenis complex and S. malma complex, living samples of Salvelinus malma, S. m. miyabei, S. leucomaenis, S. l. pluvius, S. l. japonicus and S. l. imbrius were collected from Hokkaido and Honshu Isls. in their spawning season. Meristic counts and sexual dimorphism including nuptial color were compared with each other. Using fully mature adults, inseminations were done artificially. Additionally, the charr eggs were dug out from their spawning redds in the streams. These eggs of each were hatched out in the tray and the specimens of alevin and fry were preserved in 70 % ethanol.

It was very difficult to distinguish each species or subspecies only by meristic characters, however, S. m. miyabei was characterized by having more gill-rakers than others. Also, S. l. imbrius and S. l. japonicus, occurred in <sup>(the)</sup> southwestern Honshu, indicated tendencies to have fewer vertebrae, gill-rakers, longitudinal scales and pyloric caeca than other members of the same complex and S. malma complex. Arrangement of the vomerine and parafine teeth in the roof of mouth were visible like "M"-shape in Japanese Salvelinus. In S. leucomaenis complex, there were narrow spaces between head of vomer and parafine, whereas such spaces scarcely found in S. malma complex. The latter had basibranchial teeth. l

Sexual dimorphism were observed mainly in shapes and length of the head, jaws and snout. Males of S. malma complex showed significant sexual characters comparing with those of the other, especially S. m. miyabei had well developed kype.

With respect to alevin and fry of the charrs, parr marks appeared just after the yolk substances of them were completely consumed in S. leucomaenis complex, but at earlier stage in S. malma complex as were seen in Hucho, Salmo and most of Oncorhynchus in Japan.

CYTOGENETIC AND MORPHOLOGICAL COMPARISONS BETWEEN EASTERN AND WESTERN  
PACIFIC SALVELINUS

Ted M. Cavender and Seirō<sup>^</sup> Kimura

Department of Zoology, The Ohio State University, Columbus, OH, U.S.A. 43210 and Department of Fisheries, Faculty of Agriculture, Kyushu University 46-04, Fukuoka, 812 JAPAN

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COLOR VARIATION OF SPOTS IN SALVELINUS LEUCOMAENIS

IN NORTHERN HONSHU, JAPAN

Kazuya Nagasawa

Hokkaido Fisheries Experimental Station,  
Yoichi, Hokkaido 046, Japan

The variation in color of spots was examined using a standard color system for white-spotted charr, Salvelinus leucomaenis, from several streams of Aomori Prefecture, northern Honshu, where this species is generally believed to have no colored spots on sides. Spots were mostly white, but were often colored orange, light orange, dull orange, pale orange, pale yellow orange, pink, yellowish white, dull yellow, or light reddish yellow. Colored spots occurred between parr marks when they existed in small numbers, but were scattered on sides, chiefly below the lateral line, with an increase in number. Although there was no apparent seasonal variation in color, males during the spawning season had more densely colored spots than those in other seasons dis. No colored spots were found in 0-group charr. A marked difference in percent occurrence of charrs with colored spots was also noted between streams.

36k

Royal Ontario  
Museum

100 Queen's Park  
Toronto, Ontario  
Canada M5S 2C6  
Cables: ROMA Toronto

  
ROM

586-5759

416:

02 September 1988

Dr. R. Behnke  
Dept. of Fish & Wildlife  
Colorado State University  
Ft. Collins, Colorado  
80523

Dear Dr. Behnke:

Please see the attached correspondence from and to Dr. Chereshev in Magadan.

I have been corresponding with him in regard to a joint activity - to test the validity of, or genetic difference between, Dallia pectoralis, D. admirabilis Chereshev, and D. delicatissima Smitt.

The Dr. Andreev mentioned is an ornithologist from Magadan who visited ROM and conveyed, in a cryptic way, Dr. Chereshev's wish to visit. My instructions to Dr. Andreev included the requirement that Chereshev inform me at the outset regarding his ability to pay some portion of the costs. This was either not conveyed to Chereshev, or was ignored by him.

My comments concerning Cas Lindsey's response were editorialized. There is bad blood between Cas & Chereshev and Cas wants nothing to do with him. Chereshev apparently offered things at a meeting of the Pacific Science Congress in Khabarovsk several years ago. Cas supplied his side of the exchange but Chereshev apparently never followed through. Cas does not want to host Chereshev in Vancouver, and, I think will be aggravated with me if Wilimovsky does as a result of my statement to Chereshev. I have not written Wilimovsky as he was not one of those named by Chereshev.

I'm not sure how much money, if any, I might be able to find. ROM is tightly strapped and my research grants are small. As you see from my letter I hope not to be here at his most favoured time. In fact, I hope to be in northeast China in the Heilung Jiang (= Amur) River system studying Esox reicherti. I have tried for years through Chereshev and others in the U.S.S.R. to get there via the U.S.S.R. It is as if I had never mentioned the idea. Private anglers get there from the D.D.R. in order to angle for the same species.

...2

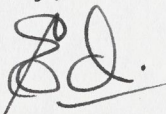
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Dr. Behnke

02 September 1988

I spoke to East Block scientists about Cherehnev's new char (see fig. attached). No critical comments were made but the elevation of eyebrows spoke volumes. Cherehnev did not send me a prepublication copy of the ms. It would have been in Russian anyway.

Sincerely,

A handwritten signature in dark ink, appearing to be 'E.J.C.', written in a cursive style with a horizontal line underneath.

Dr. E. J. Crossman  
Curator  
Department of Ichthyology & Herpetology

EJC/cr

416:

01 September 1988

Dr. I. A. Chereshev  
Institute of Biological  
Problems of North Far  
East Science Centre  
Academy of Sciences of  
the U.S.S.R.  
24 Karl Marx Street  
685000 Magadan  
U.S.S.R.

Dear Dr. Chereshev:

I have returned from Budapest after receiving from Dr. Dorofeyeva the sad news that the Dallia had died in Leningrad. It was tragic since I had received a letter from Dr. Balushkin immediately before leaving for Budapest and that letter indicated that several of each species were still alive then. I wrote immediately to Balushkin saying I hoped all those that had died had been fixed in formalin since they would serve morphological and reference purposes here.

Obviously the better way for the next lot will be for them to be transferred by air to Canada immediately after their arrival in Leningrad. The Leningrad stop need be only long enough to recharge the bags with clean water and new oxygen.

We are suffering from the problem of language in our communications through a third person. What I said to Dr. Andreev concerning your visit to North America was that I would investigate possibilities after I had received details of what you intended to accomplish, and the degree to which you would be able to pay your expenses. I took the opportunity to speak to Dr. Lindsey on your behalf in Budapest. He is now retired from the University of British Columbia and did not seem to feel he was able to promote your visit to the University of B.C. You could write to Dr. Norman Wilimovsky, Department of Zoology, University of British Columbia, 2075 Wesbrook Mall, Vancouver, British Columbia, Canada, V6T 1W5. Dr. Wilimovsky, I believe, is more intimately connected with the reference collection of fishes than is Dr. Lindsey. Dr. Alex Peden of the Royal British Columbia Museum, Parliament Buildings, Victoria, British Columbia, Canada V8V 1X4 is the appropriate curator for the other large systematic collection, and centre of activity, in B.C.

...2

Dr. Chereshev

01 September 1988

Dr. Behnke's address in Colorado and Dr. Cavender's in Ohio you must know. If not, I'll let you know and I will send it. Since you are away from Magadan I will write and tell Drs. Cavender, Behnke, and McAllister of your interest in coming.

When I write them I shall have to suggest that I know nothing of your financial situation for this trip. Am I to assume from your use of the word "invitation" that you are expecting your expenses to be paid by your hosts? If that is true your major host will have to be one of the U.S. agencies with Canadian agencies possibly paying for your travel from a U.S. city to a Canadian city. This museum is for the next three years in the most rigorous financial constraints of my experience.

With the five institutions in the U.S. and Canada you mention you will not be long in any one, so accommodation costs might be reduced by some means.

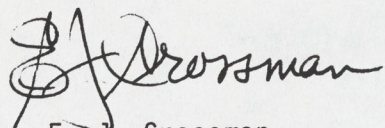
You will hear more from me later, or independently from the other scientists, in regard to your opportunity to come.

In regard to your chosen timing, I hope not to be here in August 1989. If everything works out I shall be in China collecting and studying Chinese fishes.

Thank you for the information on the new char named for Dr. Svetovidov.

Do you, by any chance, have an English language version of the Balushkin - Chereshev paper in the 1982 (Vol. 114) issue of Proc. Zool. Inst. Acad. Sci. U.S.S.R.? Since that paper was not in Voprosy Iktiologica I have never seen an English language version. I had always considered the 1980 joint paper as the original description of D. admirabilis. I have an English copy of that (J. Ichth. 20(6):25-30, 1980) with its unfortunate spelling error in the name. I always wondered why you refer to the new species with a single authority when the new species appeared in a co-authored paper.

Sincerely,



Dr. E. J. Crossman  
Curator  
Department of Ichthyology & Herpetology

EJC/cr

cc: Dr. Balushkin  
Zoological Institute, Leningrad



**Ichthyology & Herpetology**

**Royal Ontario  
Museum**

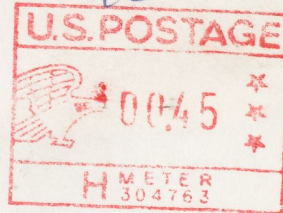
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Toronto, Ontario  
Canada M5S 2C6

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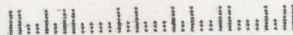
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**TNT Mailfast**

P.O. Box 466  
So. San Francisco, CA 94083



Dr. R. Behnke  
Dept. of Fish & Wildlife  
Colorado State University  
Ft. Collins, Colorado  
80523



75 ROM  
1971-1976 A YEAR OF CELEBRATION

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## Notice to Participants

Enclosed is a tentative program of the International Symposium on charr and Masu Salmon to be held at Sapporo, October 3-10, 1988. We are making the final program of the Symposium. Because so many papers will be presented at the Symposium, it is difficult to arrange the program with 30 minute presentations including 10-minute discussion, as was originally planned. Instead, each speaker will be scheduled for a 20 minute presentation, including a dicussion period. After each section 20-30 minutes will be devoted to general discussion.

In reviewing this tentative program each participant may confirm the title of the presentation, correct any mistake, and send us any comments on the program. The deadline for this confirmation is August 25, 1988. The FAX number of the Organizing Committee at the Faculty of Fisheries, Hokkaido University, Hakodate is 81-138-43-5015.

### Manuscript

As all participants know we intend to publish the proceedings as a sigle hard covered volume as soon as possible after the completion of the Syposium. Itis hoped that a copy of the manuscript of the paper presented at the Symposium be forwarded to the following member of Editorial Committee.

Dr. Koji Maekawa  
Dept. of Anatomy  
School of Dentistry  
Hokkaido University  
N 13, W 17, Sapporo 060  
Japan

All accepted papers will be refereed prior to acceptance for the published proceedings. We ask you to not fail to bring a copy of your manuscript with you at your presentation. Manuscripts must be type written in clearly legible type on one side of each page, double spaced on typewritten papers (A 4). Ms should not exceed 30 typewritten pages including Table and Figures. Papers should be written in English.

The manuscript should be presented in the following order: title, Author's name(s), institution with adress, abstract, text ending acknowledgement(s) in a separate paragraph, and literature cited. Citations of literature should have author(s), year, title, name of Journal, volume, and inclusive pages, arranged alphabetically and chronologically. In the text, the references should be cited by name and year.

### Hotel Accomodation

Twin-bed rooms have been reserved for all participants and accompanying persons from abroad at Hotel KKR Sapporo.



Faculty of Fisheries  
Hokkaido University  
Hakodate 041, JAPAN

April 18, 1988

Dr. R. Behnke  
Dept. Fish and Wildlife  
Colorado State University,  
Fort Collins, Co 80523,  
U.S.A.

Dear Dr. Behnke:

It is our pleasure to invite you to the International Symposium on Charr and Masu Salmon to be held at Sapporo, Japan. About a hundred scientists and specialists on charr and masu salmon have shown their interest in attending the Symposium.

It is also our pleasure to be able to offer you free accomodation and 400 US dollars as a part of your expenses during the Symposium for your services as a chairman. Enclosed is a tentative program which will be rearranged when all participants are decided.

We greatly hope that you will honor us by accepting this invitation and share the knowledge of your speciality. Your presence at the Symposium will add greatly to its success. Please let us know your plan and send us booking forms and abstract of your presentation.

Dr. R. Behnke

Page 2

Thank you very much for your consideration, and looking forward to seeing you at Sapporo.

Sincerely yours,

*Fumio Yamazaki*

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Fumio Yamazaki  
Professor,  
Secretary General  
Organizing Committee

FY/ky



Prof. F. Yamazaki

Faculty of Fisheries  
Hokkaido University  
Hakodate 041, JAPAN

BY AIR MAIL

*Chereshnev*

Dr. R. Behnke

Dept. Fish. and Wildlife  
Colorado State University  
Fort Collins Co 80523  
U.S.A.



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F. Yamazaki  
Faculty of Fisheries  
Hokkaido University  
Hakodate 041, JAPAN

BY AIR MAIL

*\$400 + free accommodations*



Dr. R. Behnke  
Dept. Fish and Wildlife  
Colorado State Univer.  
Fort Collins, Co 80523,  
U.S.A.



Mon. Oct. 3

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SYNTHESIS OF INFORMATION  
FOR A PHYLOGENETIC INTERPRETATION OF SALVELINUS

Robert J. Behnke  
Colorado State University  
Fort Collins, Colorado











Since my 1980 and 1984 papers on charr systematics, considerable new information has been compiled, particularly from the areas of karyology and biochemical genetics. In view of the latest information, I have modified my former concepts of relationships in the subgenus Salvelinus.

It is now apparent that organismal (morphological) and molecular evolution may proceed at very different rates, particularly among sympatric populations selected for different niches. Problems associated with a best interpretation of available information concern decisions on primitive vs. derived character states and convergent evolution. Ongoing studies of mitochondrial and ribosomal DNA and chromosomal banding, particularly of nuclear organizing regions, imply that much greater resolution and refinement for phylogenetic analysis will be possible.

Some controversial aspects of Salvelinus systematics, such as species criteria, are not amenable to resolution by quantification. A realm for qualitative speculation will always remain for future symposia.

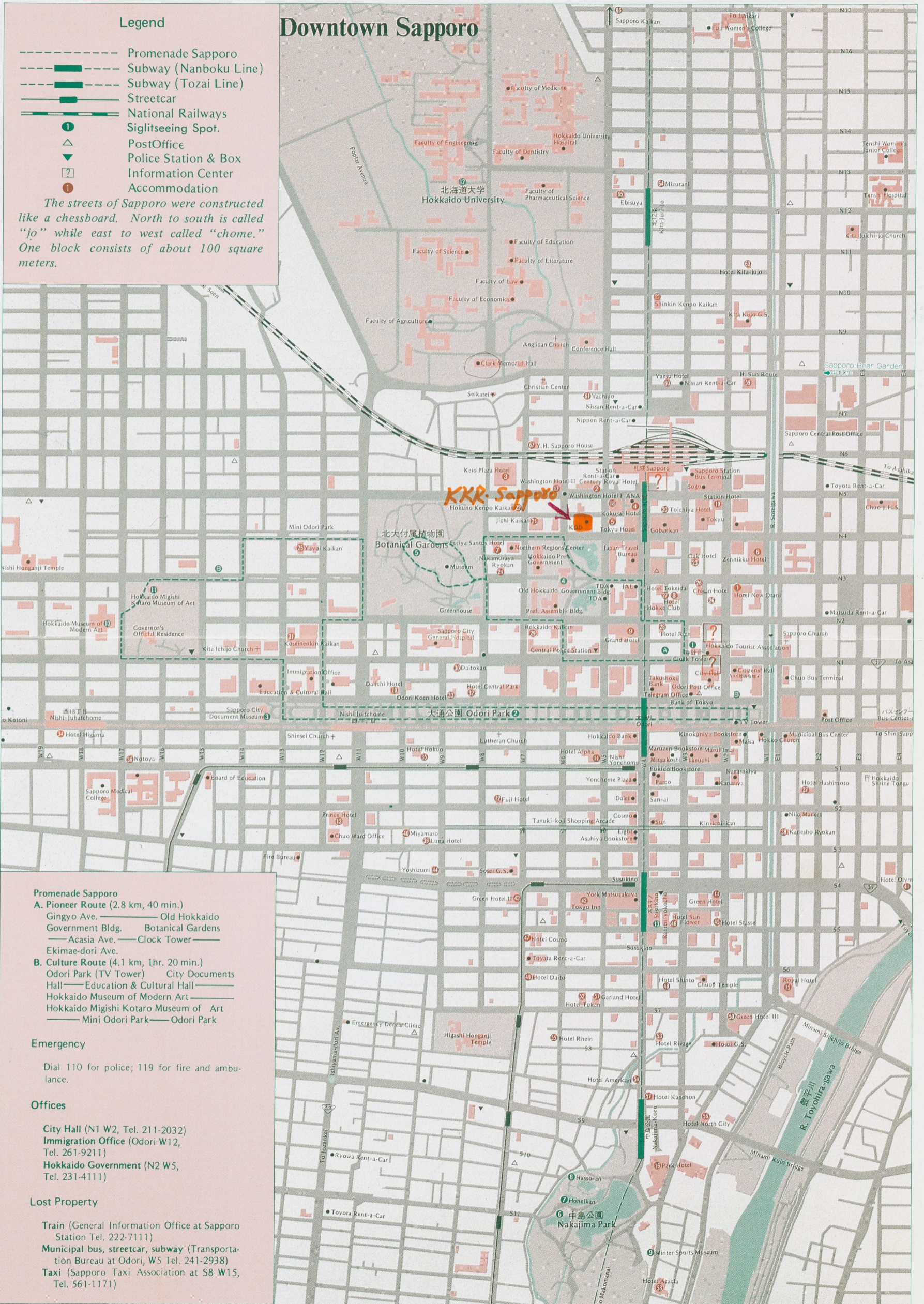
# Downtown Sapporo

## Legend

-  Promenade Sapporo
-  Subway (Nanboku Line)
-  Subway (Tozai Line)
-  Streetcar
-  National Railways
-  Sightseeing Spot.
-  Post Office
-  Police Station & Box
-  Information Center
-  Accommodation

The streets of Sapporo were constructed like a chessboard. North to south is called "jo" while east to west called "chome." One block consists of about 100 square meters.

## Downtown Sapporo



### Promenade Sapporo

#### A. Pioneer Route (2.8 km, 40 min.)

Gingyo Ave. — Old Hokkaido Government Bldg. — Botanical Gardens — Acasia Ave. — Clock Tower — Ekimae-dori Ave.

#### B. Culture Route (4.1 km, 1hr. 20 min.)

Odori Park (TV Tower) — City Documents Hall — Education & Cultural Hall — Hokkaido Museum of Modern Art — Hokkaido Migishi Kotaro Museum of Art — Mini Odori Park — Odori Park

### Emergency

Dial 110 for police; 119 for fire and ambulance.

### Offices

City Hall (N1 W2, Tel. 211-2032)  
 Immigration Office (Odori W12, Tel. 261-9211)  
 Hokkaido Government (N2 W5, Tel. 231-4111)

### Lost Property

Train (General Information Office at Sapporo Station Tel. 222-7111)  
 Municipal bus, streetcar, subway (Transportation Bureau at Odori, W5 Tel. 241-2938)  
 Taxi (Sapporo Taxi Association at S8 W15, Tel. 561-1171)

# Welcom to Sapporo

# TRANSPORT INFORMATION

## Tourist Information

City Hall 2F (N1 W2): 9:00 - 17:00,  
Sat. 9:00 - 13:00 Closed Sun & N.H.

Tourism Department, City of Sapporo,  
Tel 211-2376

Sapporo Tourist Association, Tel 211-3341

Hokkaido Tourist Association (N1 W2, Keizai  
Center Bldg. Tel 211-0941)

9:00 - 17:00, Sat. 9:00 - 12:30,  
Closed Sun & N.H.

J.N.R. Sapporo Station

(1F) Tourism Center (Ryoko Center),  
Tel 222-6133, 10:00 - 18:00

(1F) Nikkanren Information Center  
Tel 241-1009

(Jul. - Sep. 8:30 - 22:00, Others 9:00 - 21:00)

(B1F) Tourist Information Center,

Tel 251-0828, Jul. Aug. 8:30 - 18:00, Others  
9:00 - 17:00

Jozankei Tourist Association

Tel 598-2012 9:00 - 17:00

Japan Travel Bureau (N3 W4, Tel 241-6201),  
9:30 - 17:30, Closed Sun. & N.H.

## Airlines

Japan Air Lines (JAL) (Domestic) Tel. 231-0231  
N2 W4 (International) 231-4411

All Nippon Airways (ANA) N4 W4 231-5131

Toa Domestic Airlines (TDA) N2 W4 251-4231

Nippon Kinkyori Airlines (NKA) 781-3611

## Rent-a-car (main downtown offices)

Nissan	N7 W4, Tel. 747-2341
Nippon	N6 W3, Tel. 746-7645
Sapporo Station	N4 W4, Tel. 241-0931
Toyota	N5 E2, Tel. 281-0100
Toyota	S11 W10, Tel. 521-0100
Ryowa	S10 W10, Tel. 521-1311

## City Sightseeing Bus Tours

(As of September, 1985)

Municipal Bus (Bus leaves and returns to SAP-  
PORO BUS TERMINAL near JNR Sapporo  
Station.)  
Tel. 221-8875

A. 4/28 - 11/3 3.5 hrs. 9:00 13:10 \*14:30  
(7/25 - 8/20) 2,680 yen  
Okurayama Ski Jump - Mt. Moiwa - Hitsuji-  
gaoka Observation Hill

B. 4/28 - 10/20 3 hrs. 15 min. 8:40 13:55  
\*10:00 (7/25 - 8/20) 3,000 yen  
Hitsujigaoka Observation Hill - Mt. Moiwa -  
T.V.Tower

C. 6/1 - 10/20 3 hrs. 50 min. 8:50 13:45  
(closed on Sat., Sun. & National Holidays)  
1,960 yen  
Sapporo Beer Breweries - Yuki-jirushi Dairy  
Co. - Okurayama Ski Jump

D. 6/1 - 10/15 7.5 hrs. 9:30 (closed on Mon. and  
2nd & 3rd Wed.)  
Okurayama Ski Jump - Mt. Moiwa - Hitsuji-  
gaoka Observation Hill - Sun Piazza Aquarium  
- Historical Village of Hokkaido

E. 7/15 - 8/20 3 hrs. 18:00 2,710 yen (includ-  
ing meal)  
Mt. Moiwa

F. 11/4 - 12/19, 4/1 - 4/27 4.5 hrs. 10:30 2,710  
yen (including meal)  
Maruyama Zoo - Miyanomori Garden - Okura-  
yama Ski Jump - Salmon Museum

G. 12/20 - 3/31 4.5 hrs. 10:00 \*11:00 (2/5 - 9  
during the Sapporo Snow Festival only)  
3,540 yen (including meal)  
Mt. Moiwa - Salmon Museum - Hitsujigaoka  
Observation Hill - Nakajima Park (Winter  
Sports Museum)

Hokuto Bus (Bus leaves and returns to ZENNI-  
KKU HOTEL.) Tel. 737-4661

All year (closed Dec. 30 through Jan. 5) 3 hrs.  
18:00 4,800 yen (including meal)  
Sapporo Beer Garden - Cabaret 'Mikado'

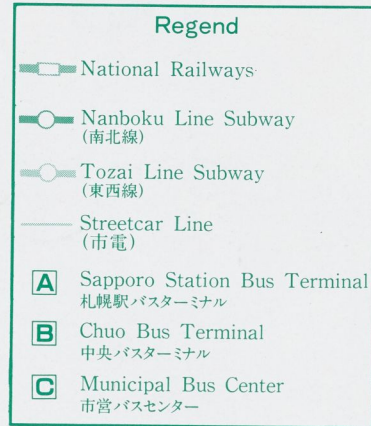
D. Shakotan (4/28 - 10/27) 9 hrs. 4,900 yen  
(including meal)  
Shakotan Seashore - Nikka Whisky Co. -  
Tenguyama Ropeway

E. Niseko Shakotan (6/9 - 10/27) 9 hrs. 8:00  
4,900 yen (including meal)  
Nakayama Pass - Niseko - Shakotan Seashore -  
Nikka Whisky Co. - Tenguyama Ropeway

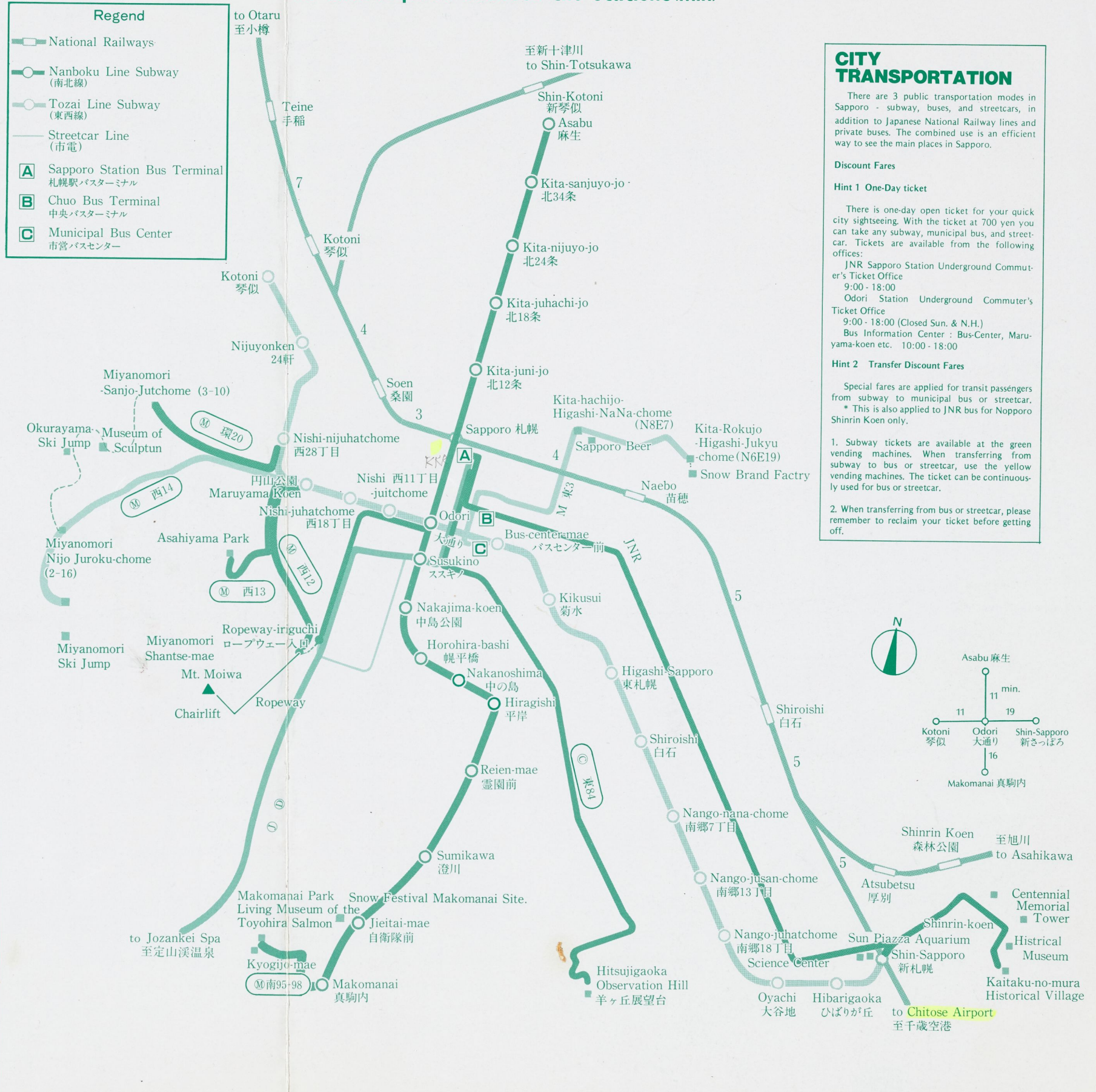
J.T.B. (Bus leaves and returns to GRAND HO-  
TEL.) Tel. 241-5851

L. Shikotsu, L. Toya, Noboribetsu Spa (6/10 -  
10/10) 8:00 7,800 yen (including meal)  
Nakayama Pass - Lake Toya - Mt. Showa Shinzan  
- Orofure Pass - Noboribetsu Spa - Shiraoi - Lake  
Shikotsu - Chitose Airport

\* Please check for other bus tours.



## The time required between the stations(min)



### CITY TRANSPORTATION

There are 3 public transportation modes in Sapporo - subway, buses, and streetcars, in addition to Japanese National Railway lines and private buses. The combined use is an efficient way to see the main places in Sapporo.

**Discount Fares**

**Hint 1 One-Day ticket**

There is one-day open ticket for your quick city sightseeing. With the ticket at 700 yen you can take any subway, municipal bus, and streetcar. Tickets are available from the following offices:

- JNR Sapporo Station Underground Commuter's Ticket Office 9:00 - 18:00
- Odori Station Underground Commuter's Ticket Office 9:00 - 18:00 (Closed Sun. & N.H.)
- Bus Information Center: Bus-Center, Maruyama-koen etc. 10:00 - 18:00

**Hint 2 Transfer Discount Fares**

Special fares are applied for transit passengers from subway to municipal bus or streetcar. \* This is also applied to JNR bus for Nopporo Shinrin Koen only.

- Subway tickets are available at the green vending machines. When transferring from subway to bus or streetcar, use the yellow vending machines. The ticket can be continuously used for bus or streetcar.
- When transferring from bus or streetcar, please remember to reclaim your ticket before getting off.

## OUTSIDE SAPPORO

Chuo Bus (Bus leaves and returns to CHUO BUS  
SAPPORO TERMINAL, etc.) Tel. 251-8141  
\*Time varies. Please check in advance.

A. Lake Shikotsu (4/28 - 10/10) 6 hrs. 45 min.  
8:50 3,800 yen (including meal)  
Hitsujigaoka Observation Hill - Lake Okotan-  
pe - Lake Shikotsu - Chitose Airport

B. Otaru (7/21 - 9/29) 7 hrs. 10:00 3,150 yen  
(including meal)  
Kitaichi Glass Shop - Tenguyama Ropeway -  
Otaru Aquarium - Hokkaido Railway Museum

C. Otaru (7/7 - 9/29) 4 hrs. 10 min. 17:15  
2,950 yen (including meal)  
Glass Studio - Tenguyama Ropeway

МОРФОЛОГИЯ ГОЛЬЦОВ ДРЕВНЕГО ОЗЕРА ЭЛЫГЫТГЫН  
(ЦЕНТРАЛЬНАЯ ЧУКОТКА).

И.А.Черешнев, М.Б.Скопец

Институт биологических проблем Севера ДВО АН СССР,  
Магадан

Озеро Элыгытгын расположено в центре Чукотского нагорья на высоте 495 м над у.м. в древнем (около 3,5 млн. лет) кратере метеоритного происхождения. Озеро почти круглое, диаметром 12 км, его наибольшая глубина 179 м, средняя - более 100 м, мелководная часть небольшая. Район озера не был затронут плейстоценовыми оледенениями. Климат очень суровый, часты сильные ветры меридионального направления. Период открытой воды 2-3 месяца. Температура воды на поверхности летом не превышает 6-7°, на глубине 105 м в июне температура была равна 2°, на 50 м в августе 2,5°; прозрачность 35 м; минерализация очень незначительная.

Ранее было обнаружено обитание в озере боганидской палии *Salvelinus boganidae* Berg и описан новый для науки эндемичный голец - малоротая палия *S. elgyticus* Viktorovsky et Glubokovsky (Викторовский и др., 1981). Нами в 1985 г. в озере добыт ещё один весьма своеобразный глубоководный голец, несомненно эндемичный и заслуживающий выделения в особый таксон. Морфологические особенности гольцов озера следующие:

1. Боганидская палия. D III-V 8-12, A III-V 7-9, P I 12-14, V II 8(9); r.br. (слева) 10-12(13); sp.br. 25-31(среднее 27,5), из них на нижней части жаберной дуги 15-19(16,4), на верхней 10-13(II,2), крайне буторковидные; Pс 42-69(51,2); vert. 62-67(64,6), из них туловищных 33-37(35,5), хвостовых 27-31(29,2); L.1 II7-134(125,9); пятен ниже L.1 16-49(31,0). Рыло очень длинное, голова крупная, тело вальковатое, хвостовой стебель низкий. Крюк и выемка на концах челюстей заметны лишь у зрелых самцов; челюсти равной длины или верхняя чуть длиннее; верхне-челюстная кость сильно изогнута выпуклостью кверху. Хвостовой плавник выемчатый, у небольших рыб его лопасти заострены, у крупных - округлые. Серебристая окраска тела отсутствует; спина и бока тела серые, брюхо белое. На теле крупные (все больше зрачка, некоторые - глаза), неправильной формы

и округлые белые или розовые пятна. Ротовая полость обычно белая, иногда с серым калотом. По краю лучей хвостового плавника широкая коричневая (у незрелых) или красная (у нерестующих) кайма. Брачный наряд особенно яркий у крупных самцов.

2. Малоротая палия. D III-V 7-10, A III-V 6-9, P I II-14 V II 7-9; r.br. слева 9-13(II,5), справа 10-14(II,4); sp.br. 44-53(47,1), из них нижних 26-33(29,1), верхних 16-20(17,9), тычинки тонкие, длинные, буторковидных нет; Pс 25-46(33,1); vert. 59-64(62,0), туловищных 31-35(32,7), хвостовых 27-31(29,2); L.1 I05-I25(II6,5); пятен ниже L.1 8-39(17,1). Рыло заостренное, глаза очень большие, голова маленькая, тело прогонистое, вальковатое. Челюсти равной длины или верхняя чуть выщелась, крюк и выемки на них нет; верхне-челюстная кость прямая, не заходит за середину глаза. Хвостовой плавник сильно выемчатый с острыми концами. Плавательный пузырь яркий розовый. Чешуя легко спадает. Фон тела и плавников серый, у зрелых рыб почти черный с металлическим отливом. Пятна на теле округлые и неправильной формы, величиной больше зрачка, желтые или оранжевые - такого же цвета концы парных и анального плавников, наружные лучи брюшных и анального плавников белые. Ротовая полость белая с мелкими черными крапинами. Брачные изменения в пропорциях тела и окраске отсутствуют.

3. Глубоководный голец. D III-V 7-9, A III-V 7-9, P I 12-14, V II 7-9, r.br. слева 9-12(10,2), справа 8-11(9,4); sp.br. 44-63(54,1), нижних 27-38(32,3), верхних 17-27(21,8). тычинки тонкие, очень длинные, буторковидных нет; Pс 50-70(57,8); vert. 55-58(56,3), туловищных 28-31(28,9), хвостовых 26-29(27,4); L.1 I05-II9(III,1); пятен выше L.1 53-96(73,0). Рыло очень короткое, сильно горбатое, глаза большие; тело высокое, уплощенное с боков. Крюк и выемка на челюстях нет, нижняя челюсть выдается вперед, особенно сильно у зрелых самцов. Предчелюстные кости лежат впереди рыла; верхне-челюстная кость прямая, широкая, обычно достигает середины глаза (у крупных - заднего края глаза). На челюстях, изыщлой и небольшой костях мощные клыковидные зубы; на сошнике зубов обычно нет, редко бывает 1-2 маленьких зуба. Парные и непарные плавники очень длинные (у самцов брюшные заходят за 1-5 лучи анального); хвостовой широкий, с округлыми лопастями. Голова и туловище сверху и с боков темно-серые или черные (зрелые рыбы) с брон-

## サケ科イワナ属3種の染色体における仁形成部位\*

上田高嘉\*

(1986年10月6日受理)

N-banding karyotypes of 3 species in the genus *Salvelinus* (Japanese char; *S. leucomaenis*, dolly varden; *S. malma malma*, Miyabe's char; *S. m. miyabei*, brook trout; *S. fontinalis*) were described in comparison with routine Giemsa karyotypes. Both of *S. leucomaenis* and *S. malma* had two chromosomes with intense N-bands. The long arms of the chromosomes with intense N-bands in *S. leucomaenis* from the Tone River were longer than those from the Miya River. In *S. m. miyabei*, the short arms of the chromosomes with intense N-bands had two forms (long and small), and the difference in the appearance of intense N-bands of them was enormous. In *S. fontinalis*, the intense N-bands were observed in four pairs of the chromosomes, but each cell had the different number of chromosomes with intense N-bands.

魚類の染色体は、標本作製技術および分染技術の発展によって、その詳細が明らかにされようとしている。仁形成部位に関する研究は N-バンド法により特異的に染め分ける方法で進展している。染色体における仁形成部位は、Goodpasture and Bloom (1975)<sup>1)</sup> による簡便で再現性の高い銀染色法の確立以来、哺乳類を中心に多くの種で研究されるようになった。種分化や系統進化を論ずる上でも重要なマーカーとして注目され、Yosida (1979)<sup>2)</sup> は *Rattus* 属の種分化に仁形成部位の分化が深く関係することを説いている。魚類においても種分化との関連を中心に興味深い知見が得られている (Kligerman and Bloom 1977<sup>3)</sup>, Howell and Black 1979<sup>4)</sup>, Kornifield *et al.*, 1979<sup>5)</sup>, Ojima and Yamano 1980<sup>6)</sup>, Foresti *et al.*, 1981<sup>7)</sup>, Uwa and Ojima 1981<sup>8)</sup>, Uwa and Iwata 1981<sup>9)</sup>, Uwa *et al.*, 1981<sup>10)</sup>, 1982<sup>11)</sup>, 1983<sup>12)</sup>, Gold 1984<sup>13)</sup>, Kitayama and Ojima 1984<sup>14)</sup>, Takai and Ojima 1984<sup>15)</sup>, Ueda *et al.* 1985<sup>16)</sup>)。サケ科魚類ではビワマス *Oncorhynchus masou* の報告があるにすぎないが、個体間の N-バンドの多型が観察されている (Ueda *et al.* 1985)<sup>16)</sup>。

本論ではサケ科イワナ属3種、イワナ *Salvelinus leucomaenis*, オショロコマ *S. malma malma*, ミヤベイワナ *S. m. miyabei* およびカワマス *S. fontinalis* の通常ギムザ染色および N-バンド染色による核型を比較検討し、細胞遺伝学的に考察した。

\* The Nucleolus Organizer Regions in the Chromosomes of Three Species in the Genus *Salvelinus* (Salmonidae).

\*\* Takayoshi Ueda

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*Solvetymus acetabulosus*

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